PRETREATMENT 101

CONTINUING EDUCATION
PROFESSIONAL DEVELOPMENT COURSE

Technical Learning College

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Hyperlink to the Glossary and Appendix
http://www.abctlc.com/downloads/PDF/WWTGlossary.pdf

State Approval Listing Link, check to see if your State accepts or has pre-approved this course. Not all States are listed. Not all courses are listed. Do not solely trust our list for it may be outdated. It is your sole responsibility to ensure this course is accepted for credit. No refunds.

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Course Editor

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Contributing Editors

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Dr. Pete Greer S.M.E., Retired biology instructor, chemistry and biological review.

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Some States and many employers require the final exam to be proctored.

Do not solely depend on TLC's Approval list for it may be outdated.

Most of our students prefer to do the assignment in Word and e-mail or fax the assignment back to us. We also teach this course in a conventional hands-on class. Call us and schedule a class today.

Responsibility

This course contains EPA's federal rule requirements. Please be aware that each state implements wastewater regulations that may be more stringent than EPA's regulations.

Check with your state environmental agency for more information. You are solely responsible in ensuring that you abide with your jurisdiction or agency's rules and regulations.

Important Information about this Manual

This manual has been prepared to help students gain or increase awareness of the Environmental Protection Agency's Rules and Regulation relating to Title 40 Code of Federal Regulations, Part 403, "*General Pretreatment Regulations for Existing and New Sources of Pollution*," and other applicable State and Federal laws, including but not limited to, the Clean Water Act, Industrial pretreatment 40 CFR. This course will cover the fundamentals and basic requirements of the federal rule concerning the national pretreatment rule, POTW, wastewater sampling and reporting information.

The scope of the material is quite large, requiring a major effort to bring it under control. Employee health and safety, as well as that of the public, depends upon careful application of federal and state regulations and safe working procedures. This manual will cover federal laws, regulations, required procedures and work rules relating to general pretreatment and wastewater sampling. It should be noted, however, that the federal and state regulations are an ongoing process and subject to change over time. For this reason, a list of resources is provided to assist in obtaining the most up-to-date information on various subjects and regulations

This manual is an educational document for employees who are involved with water quality and pollution control. It is not designed to meet the full requirements of the United States Environmental Protection Agency (EPA) or the Department of Labor-Occupational Safety and Health Administration (OSHA), or your State pretreatment rules and regulations.

This course manual will provide general guidance and should not be used as a basis for developing general pretreatment, enforcement, reporting or wastewater sampling plans. This document is not a detailed pretreatment, pollution control, pollution prevention, wastewater treatment textbook or a comprehensive source book on water/wastewater rules and regulations.

Technical Learning College or Technical Learning Consultants, Inc. makes no warranty, guarantee or representation as to the absolute correctness or appropriateness of the information in this manual and assumes no responsibility in connection with the implementation of this information. It cannot be assumed that this manual contains all measures and concepts required for specific conditions or circumstances.

This document should be used for education and is not considered a legal document. Individuals who are responsible for pretreatment programs and/or water/wastewater sampling and the health and safety of workers at hazardous waste sites should obtain and comply with the most recent federal, state, and local regulations relevant to these sites and are urged to consult with OSHA, the EPA and other appropriate federal, state and local agencies.

In this photo, the Lab Tech is waiting for the Sampler to return with samples. You can see the small refrigerator with a lock on it. Samplers will normally release the samples to the Chemist, but if the Chemist is out of the office, or after work hours, you will place the samples in the refrigerator and lock it. Write on your chain-of-custody report that you placed the samples in the locked refrigerator.

Chain-of-Custody (COC)

A record of each person involved in the possession of a sample from the person who collects the sample to the person who analyzes the sample in the laboratory.

PRETREATMENT

The term **"pretreatment"** means the treatment of wastewater by commercial and industrial facilities to remove harmful pollutants before being discharged to a sewer system under the control of a publicly owned treatment works (POTWs). "Pretreatment" is also defined in **Title 40 Code of Federal Regulations (40 CFR) Subsection 403.**

Technical Learning College

Technical Learning College's Scope and Function

Welcome to the Program,

Technical Learning College (TLC) offers affordable continuing education for today's working professionals who need to maintain licenses or certifications. TLC holds several different governmental agency approvals for granting of continuing education credit.

TLC's delivery method of continuing education can include traditional types of classroom lectures and distance-based courses or independent study. TLC's distance based or independent study courses are offered in a print - based distance educational format. We will beat any other training competitor's price for the same CEU material or classroom training.

Our courses are designed to be flexible and for you to finish the material at your convenience. Students can also receive course materials through the mail. The CEU course or e-manual will contain all your lessons, activities and instruction to obtain the assignments. All of TLC's CEU courses allow students to submit assignments using e-mail or fax, or by postal mail. (See the course description for more information.)

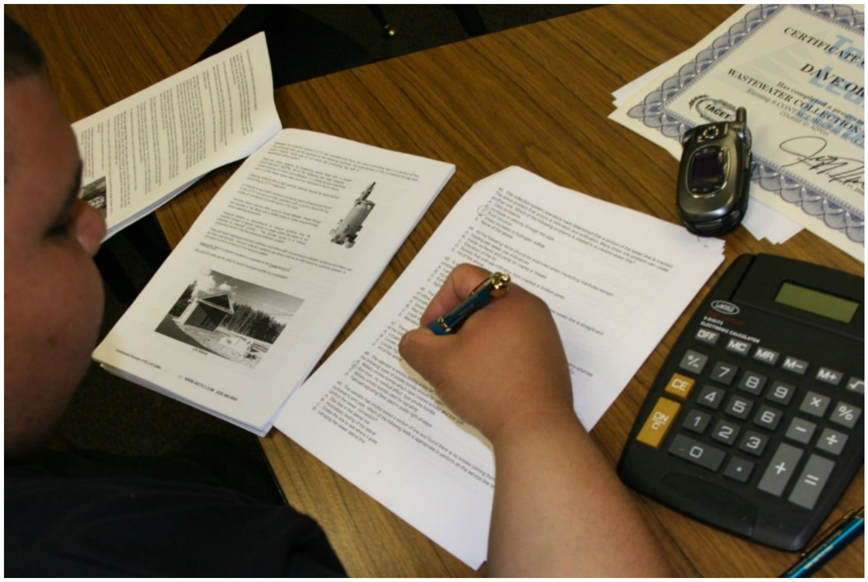
Students have direct contact with their instructor—primarily by e-mail or telephone. TLC's CEU courses may use such technologies as the World Wide Web, e-mail, CD-ROMs, videotapes and hard copies. (See the course description.) Make sure you have access to the necessary equipment before enrolling; i.e., printer, Microsoft Word and/or Adobe Acrobat Reader. Some courses may require proctored closed-book exams, depending upon your state or employer requirements.

Flexible Learning
At TLC, there are no scheduled online sessions or passwords you need contend with, nor are you required to participate in learning teams or groups designed for the "typical" younger campus based student. You will work at your own pace, completing assignments in time frames that work best for you. TLC's method of flexible individualized instruction is designed to provide each student the guidance and support needed for successful course completion.

Course Structure
TLC's online courses combine the best of online delivery and traditional university textbooks. You can easily find the course syllabus, course content, assignments, and the post-exam (Assignment). This student-friendly course design allows you the most flexibility in choosing when and where you will study.

Classroom of One
TLC offers you the best of both worlds. You learn on your own terms, on your own time, but you are never on your own. Once enrolled, you will be assigned a personal Student Service Representative who works with you on an individualized basis throughout your program of study. Course specific faculty members (S.M.E.) are assigned at the beginning of each course providing the academic support you need to successfully complete each course. Please call or email us for assistance.

Satisfaction Guaranteed
We have many years of experience, dealing with thousands of students. We assure you, our customer satisfaction is second to none. This is one reason we have taught more than 20,000 students.



We welcome you to do the electronic version of the assignment and submit the answer key and registration to us either by fax or e-mail. If you need this assignment graded and a certificate of completion within a 48-hour turn around, prepare to pay an additional rush charge of $50.

Contact Numbers
Fax (928) 468-0675
Email Info@tlch2o.com
Telephone (866) 557-1746

CEU Course Description

PRETREATMENT 101 CEU TRAINING COURSE

Intended Audience
Stormwater Inspectors, Wastewater Treatment Operators, Pretreatment and Industrial Waste Inspectors--the target audience for this course is the person interested in working in the stormwater/pretreatment field. This course was designed for the pretreatment inspector or for the wastewater treatment/wastewater collection operator who performs various pretreatment related job duties. This course is also for operators wishing to maintain CEUs for certification license, wanting to learn how to do the job safely and effectively, and/or to meet education needs for promotion. This CEU Course will review the Environmental Protection Agency's Rules and Regulation relating to Title 40 Code of Federal Regulations, Part 403, "*General Pretreatment Regulations for Existing and New Sources of Pollution*," and other applicable State and Federal laws, including but not limited to, the Clean Water Act and the Industrial Pretreatment 40 CFR. This course will cover the fundamentals and basic requirements of the Federal rule concerning the National Pretreatment Rule, POTW, wastewater sampling and reporting information.

Final Examination for Credit
Opportunity to pass the final comprehensive examination is limited to three attempts per course enrollment.

Course Procedures for Registration and Support
All of Technical Learning College's distance learning courses have complete registration and support services offered. Delivery of services will include, e-mail, web site, telephone, fax and mail support. TLC will attempt immediate and prompt service.

When a student registers for a distance or correspondence course, he/she is assigned a start date and an end date. It is the student's responsibility to note dates for assignments and keep up with the course work. If a student falls behind, he/she must contact TLC and request an end date extension in order to complete the course. It is the prerogative of TLC to decide whether to grant the request. All students will be tracked by a unique number assigned to the student.

Instructions for Written Assignments
The Pretreatment 101 CEU Training course uses a multiple-choice style answer key.

Feedback Mechanism (Examination Procedures)
Each student will receive a feedback form as part of his or her study packet. You will find this form in the rear of the course or lesson.

Security and Integrity
All students are required to do their own work. All lesson sheets and final exams are not returned to the student to discourage sharing of answers. Any fraud or deceit and the student will forfeit all fees and the appropriate agency will be notified.

Grading Criteria
TLC will offer the student either pass/fail or a standard letter grading assignment. If TLC is not notified, you will only receive a pass/fail notice.

Required Texts
The Pretreatment 101 CEU Training course comes complete with the Environmental Protection Agency's Rules and Regulation relating to Title 40 Code of Federal Regulations, Part 403, "General Pretreatment Regulations for Existing and New Sources of Pollution," and other applicable State and Federal laws, including but not limited to, the Clean Water Act and Industrial Pretreatment 40 CFR.

This course will cover the fundamentals and basic requirements of the federal rule concerning pretreatment, POTW, SIU responsibilities, wastewater sampling and reporting information.

Recordkeeping and Reporting Practices
TLC will keep all student records for a minimum of seven years. It is the student's responsibility to give the completion certificate and any other forms to the appropriate agencies. TLC will not release any records to any other party.

ADA Compliance
TLC will make reasonable accommodations for persons with documented disabilities. Students should notify TLC and their instructors of any special needs. Course content may vary from this outline to meet the needs of this particular group.

Mission Statement
Our only product is educational service. Our goal is to provide you with the best possible education service possible. TLC will attempt to make your learning experience an enjoyable opportunity.

Educational Mission
The educational mission of TLC is:
To provide TLC students with comprehensive and ongoing training in the theory and skills needed for the environmental education field,

To provide TLC students with opportunities to apply and understand the theory and skills needed for operator certification,

To provide opportunities for TLC students to learn and practice environmental educational skills with members of the community for the purpose of sharing diverse perspectives and experience,

To provide a forum in which students can exchange experiences and ideas related to environmental education,

To provide a forum for the collection and dissemination of current information related to environmental education, and to maintain an environment that nurtures academic and personal growth.

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Topic Legend

This CEU course covers several educational topics/functions/purposes of conventional pretreatment and/or wastewater collections and wastewater treatment. The topics listed below are to assist in determining which educational area is covered in a specific topic area:

CO: Having to do with the wastewater collections system. Could be regular or emergency work. This is O&M training for collection operators.

CRAO: The regulatory and compliance component. May be a requirement of the NPDES or discharge permit, compliance, non-compliance, process control and local limits. All of the compliance and regulatory related tasks require A/S facilities to be sampled/monitored throughout the process including sampling dried sludge. This along with the EPA information is to satisfy the regulatory portion of your operator training.

DISINFECTION: This area covers plant or effluent disinfection procedures. O&M training for many operators.

LAB: Having to do with wastewater sampling and or analysis. Could be considered Lab training for Lab personnel or samplers.

M/O: The biological component. The microorganisms that are WWT or A/S specific. Also covers wastewater microorganism laboratory identification, sampling and process control. Laboratory training for many operators.

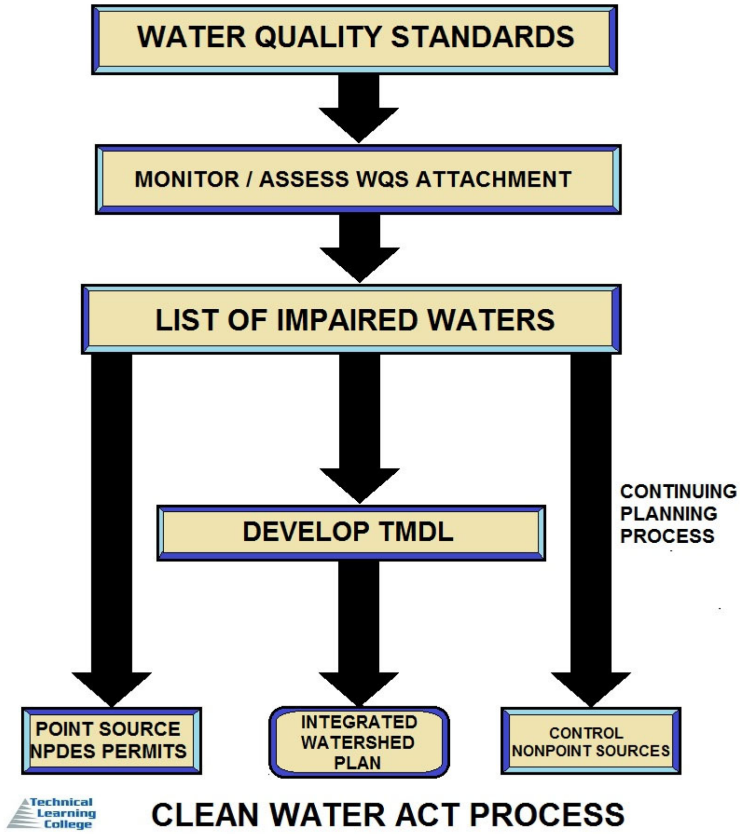
O&M: This area is for normal operation and/or maintenance of the plant or sewer collection system. O&M training for many operators.

SAFETY: This area is describing process safety procedures. Safety or general training for many operators.

TECHNICAL: The mechanical or physical treatment process/component. O&M training for many operators.

WQ: Having to do with water quality or pollutants. May be a requirement of your NPDES or discharge permit. This along with the EPA information is to satisfy the regulatory portion of your operator training.

Hyperlink to the Glossary and Appendix
http://www.abctlc.com/downloads/PDF/WWTGlossary.pdf



Sewage and Pollution

Sewage contains nutrients of every type; phosphorus, nitrogen, sodium, potassium, iron, calcium and compounds such as fats, sugars (carbohydrates) and proteins. Microorganisms use these substances as a “food” source for energy, for the synthesis of cell components and to maintain life processes.

Microorganism Introduction

Many types of microorganisms (microbes) can be found in wastewater treatment systems. However, the types of organisms that will dominate, will be the ones that are best suited to the “environment” or conditions in the system.

Wastewater treatment systems are designed to foster an “environment” that suits a certain type of microorganism. These microorganisms not only remove organic wastes from the water, but they also “settle out” as solid material for easy removal. Wastewater treatment operators are required to maintain the right conditions in the treatment system for the right type of microorganisms.

While there are many different microbes (viruses, bacteria and protozoans) used in sewage treatment, there are three well-known microbes that play an instrumental role in keeping sewage clean. Each of these types of bacteria help the treatment process in a unique way to ensure there is little to no impact on the surrounding environment.

Preface *(Credit USEPA)*

The industrial boom in the United States during the 1950s and 60s brought with it a level of pollution never before seen in this country. Scenes of dying fish, burning rivers, and thick black smog engulfing major metropolitan areas were images and stories repeated regularly on the evening news. In December of 1970, the President of the United States created the U.S. Environmental Protection Agency (EPA) through an executive order in response to these critical environmental problems.

In 1972, Congress passed the Clean Water Act (CWA) to restore and maintain the integrity of the nation's waters. Although prior legislation had been enacted to address water pollution, those previous efforts were developed with other goals in mind. For example, the 1899 Rivers and Harbors Act protected navigational interests while the 1948 Water Pollution Control Act and the 1956 Federal Water Pollution Control Act merely provided limited funding for State and local governments to address water pollution concerns on their own.

The CWA required the elimination of the discharge of pollutants into the nation's waters and the achievement of fishable and swimmable water quality levels. The EPA's National Pollutant Discharge Elimination System (NPDES) Permitting Program represents one of the key components established to accomplish this feat.

The NPDES program requires that all point source discharges to waters of the U.S. (i.e., *"direct discharges*") must be permitted. To address *"indirect discharges*" from industries to Publicly Owned Treatment Works (POTWs), the EPA, through CWA authorities, established the National Pretreatment Program as a component of the NPDES Permitting Program. The National Pretreatment Program requires industrial and commercial dischargers to treat or control pollutants in their wastewater prior to discharge to POTWs.

In 1986, more than one-third of all toxic pollutants entered the nation's waters from publicly owned treatment works (POTWs) through industrial discharges to public sewers. Certain industrial discharges, such as slug loads, can interfere with the operation of POTWs, leading to the discharge of untreated or inadequately treated wastewater into rivers, lakes, etc. Some pollutants are not compatible with biological wastewater treatment at POTWs and may pass through the treatment plant untreated.

This "pass through" of pollutants impacts the surrounding environment, occasionally causing fish kills or other detrimental alterations of the receiving waters. Even when POTWs have the capability to remove toxic pollutants from wastewater, these toxins can end up in the POTW's sewage sludge, which in many places is land applied to animal feed crops, parks, or golf courses as fertilizer or soil conditioner.

The National Pretreatment Program is unique in that the General Pretreatment Regulations require all large POTWs (i.e., those designed to treat flows of more than 5 million gallons per day) and smaller POTWs with significant industrial discharges to establish local pretreatment programs.

These local programs must enforce all national pretreatment standards and requirements in addition to any more stringent local requirements necessary to protect site-specific conditions at the POTW.

More than 1,600 POTWs have developed and are implementing local pretreatment programs designed to control discharges from approximately 23,000 significant industrial users. Since 1983, the Pretreatment Program has made great strides in reducing the discharge of toxic pollutants to sewer systems and to waters of the U.S. In the eyes of many, the Pretreatment Program, implemented as a partnership between the EPA, States, and POTWs, is a notable success story in reducing impacts to human health and the environment. These strides can be attributed to the efforts of many Federal, State, local, and industrial representatives who have been involved with developing and implementing the various aspects of the Pretreatment Program.

The EPA has supported the Pretreatment Program through development of numerous guidance manuals. The EPA has released more than 30 manuals that provide guidance to the EPA, States, POTWs, and industry on various pretreatment program requirements and policy determinations. Through the EPA's guidance, the Pretreatment Program has maintained national consistency in interpretation of the regulations. Nevertheless, turnover in pretreatment program staff has diluted historical knowledge, leaving new staff and other interested parties unaware of existing materials.

The intent of this correspondence course, *Pretreatment 101*, is to:
(1) provide a reference for anyone interested in understanding the basics of pretreatment program requirements, *and*
(2) provide a roadmap to additional and more detailed guidance materials for those trying to implement specific elements of the Pretreatment Program.

While the Pretreatment Program has demonstrated significant reductions in pollutants discharged to POTWs, Congress' goals of zero discharge of toxic pollutants and fishable/swimmable water quality have not been realized. The EPA is currently working to establish more cost-effective and common sense approaches to environmental protection (e.g., using watershed, streamlining, and reinvention concepts), creating new responsibilities for all those involved in the National Pretreatment Program. Many current challenges remain, while many new ones likely lie ahead.

This course is intended to provide an understanding of the basic concepts that drive the Program, the current status of the Program and program guidance, and an insight into what the future holds for all those involved with implementing the Pretreatment Program.

Two lab techs examine various samples, including QA/QC and Trip Blanks to ensure both sample integrity and lab equipment/sample equipment quality.

List of Pretreatment Acronyms used in this Course

Acronym	Full Phrase
AA	Approval Authority
AO	Administrative Order
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Pollutant Control Technology
BMP	Best Management Practices
BMR	Baseline Monitoring Report
BOD5	5-day Biochemical Oxygen Demand Test
BPJ	Best Professional Judgment
BPT	Best Practicable Control Technology Currently Available
CA	Control Authority
CFR	Code of Federal Regulations
CIU	Categorical Industrial User
CSO	Combined Sewer Overflow
CWA	Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended by Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, Pub. L. 97-117, and Pub. L. 100-4, 33 U.S.C. 1251 et seq.
CWF	Combined Wastestream Formula
CWT	Centralized Waste Treater
DMR	Discharge Monitoring Report
DSE	Domestic Sewage Exclusion
DSS	Domestic Sewage Study
ELG	Effluent Limitations Guideline
EPA	Environmental Protection Agency
EPCRA	Emergency Preparedness and Community Right to Know Act
ERP	Enforcement Response Plan
FOG	Fats, Oils and Grease
FDF	Fundamentally Different Factors
FR	Federal Register
FWA	Flow Weighted Average
GPD	Gallons per Day
HABS	Harmful Algae Blooms
IU	Industrial User
LEL	Lower Explosive Limit
MAHL	Maximum Allowable Headworks Loading
MAIL	Maximum Allowable Industrial Loading
MGD	Million Gallons per Day
MPN	Most Probable Number
MSDS	Material Safety Data Sheet –Replaced By SDS, Safety Data Sheet
NAICS	North American Industry Classification System (replaces SIC 1998)
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council

NSPS	New Source Performance Standard
O&G	Oil and Grease
O&M	Operations and Maintenance
OCPSF	Organic Chemicals, Plastics, and Synthetic Fibers
P2	Pollution Prevention
PCA	Federal Water Pollution Control Act
PCI	Pretreatment Compliance Inspection
PCS	Permit Compliance System
PIRT	Pretreatment Implementation Review Task Force
POTW	Publicly Owned Treatment Works
PSES	Pretreatment Standards for Existing Sources
PSNS	Pretreatment Standards for New Sources
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
SIC	Standard Industrial Classification
SIU	Significant Industrial User
SPCC	Spill Prevention Control and Countermeasures
SNC	Significant Noncompliance
SSO	Sanitary Sewer Overflow
SUO	Sewer Use Ordinance
TCLP	Toxicity Characteristic Leaching Procedure
TIE	Toxicity Identification Evaluation
TOMP	Toxic Organic Management Program
TRE	Toxicity Reduction Evaluation
TRI	Toxic Release Inventory
TSS	Total Suspended Solids
TTO	Total Toxic Organics
USC	United States Code
UST	Underground Storage Tank
WET	Whole Effluent Toxicity
WWTP	Wastewater Treatment Plant
µ	Micron

PRETREATMENT OBJECTIVES

The **Pretreatment Program** is to control the pollutants discharged into sewer systems and to **reduce the amount of pollutants released into the environment**. Most POTWs are designed to treat sanitary (domestic) wastes from households, but not to treat toxic pollutants from industrial or commercial facilities. The toxic pollutants from industrial and commercial facilities may cause serious problems at POTWs. These problems may be prevented by recycling, waste minimization, chemical substitution, pretreatment, or other best management practices to reduce or eliminate the pollutants from commercial or industrial facilities.

Technical Learning College

Glossary of Compliance Terms *(Credit USEPA)*

This glossary includes a collection of terms used in this course and an explanation of each term. *As a pretreatment inspector, you will need knowledge and understanding of EPA terms.*

Act or "the Act" *[40 CFR §403.3(b)]*
The Federal Water Pollution Control Act, also known as the Clean Water Act, as amended, 33 USC 1251*et.seq.*

Approval Authority *[40 CFR §403.3(c)]*
The Director in an NPDES State with an approved State Pretreatment Program and the appropriate EPA Regional Administrator in a non-NPDES State or State without an approved pretreatment program.

Approved POTW Pretreatment Program or Program *[40 CFR §403.3(d)]*
A program administered by a POTW that meets the criteria established in 40 CFR Part 403 and which has been approved by a Regional Administrator or State Director.

Approved State Pretreatment Program
A program administered by a State that meets the criteria established in 40 CFR §403.10 and which has been approved by a Regional Administrator

Approved/Authorized State
A State with an NPDES permit program approved pursuant to section 402(b) of the Act and an approved State Pretreatment Program.

Baseline Monitoring Report (BMR) *[paraphrased from 40 CFR §403.12(b)]*
A report submitted by categorical industrial users (CIUs) within 180 days after the effective date of an applicable categorical standard, or at least 90 days prior to commencement of discharge for new sources, which contains specific facility information, including flow and pollutant concentration data. For existing sources, the report must also certify as to the compliance status of the facility with respect to the categorical standards.

Best Available Technology Economically Achievable (BAT)
A level of technology based on the best existing control and treatment measures that are economically achievable within the given industrial category or subcategory.

Best Management Practices (BMPs)
Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the U.S. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Best Practicable Control Technology Currently Available (BPT)
A level of technology represented by the average of the best existing wastewater treatment performance levels within an industrial category or subcategory.

Best Professional Judgment (BPJ)
The method used by a permit writer to develop technology-based limitations on a case-by-case basis using all reasonably available and relevant data.

Blowdown
The discharge of water with high concentrations of accumulated solids from boilers to prevent plugging of the boiler tubes and/or steam lines. In cooling towers, blowdown is discharged to reduce the concentration of dissolved salts in the recirculating cooling water.

Bypass *[40 CFR §403.17(a)]*
The intentional diversion of wastestreams from any portion of an Industrial User's treatment facility.

Categorical Industrial User (CIU)
An industrial user subject to National categorical pretreatment standards.

Categorical Pretreatment Standards *[40 CFR § 403.6 and 40 CFR Parts 405-471*]
Limitations on pollutant discharges to POTWs promulgated by the EPA in accordance with Section 307 of the Clean Water Act, that apply to specific process wastewater discharges of particular industrial categories.

Chain of Custody (COC)
A record of each person involved in the possession of a sample from the person who collects the sample to the person who analyzes the sample in the laboratory.

Chronic
A stimulus that lingers or continues for a relatively long period of time, often one-tenth of the life span or more. Chronic should be considered a relative term depending on the life span of an organism. The measurement of chronic effect can be reduced growth, reduced reproduction, etc., in addition to lethality.

Clean Water Act (CWA)
The common name for the Federal Water Pollution Control Act. Public law 92-500; 33 U.S.C. 1251 et seq.; legislation which provides statutory authority for both NPDES and Pretreatment Programs.

Code of Federal Regulations (CFR)
A codification of Federal rules published annually by the Office of the Federal Register National Archives and Records Administration. Title 40 of the CFR contains the regulations for *Protection of the Environmen*t.

Combined Sewer Overflow (CSO)
A discharge of untreated wastewater from a combined sewer system at a point prior to the headworks of a publicly owned treatment works. CSOs generally occur during wet weather (rainfall or snowfall). During periods of wet weather, these systems become overloaded, bypass treatment works, and discharge directly to receiving waters.

Combined Wastestream Formula (CWF) *[paraphrased from 40 CFR §403.6(e)]*
Procedure for calculating alternative discharge limits at industrial facilities where a regulated wastestream from a categorical industrial user is combined with other wastestreams prior to treatment.

Compliance Schedule
A schedule of remedial measures included in a permit or an enforcement order, including a sequence of interim requirements (for example, actions, operations, or milestone events) that lead to compliance with the CWA and regulations.

Composite Sample
Sample composed of two or more discrete samples. The aggregate sample will reflect the average water quality covering the compositing or sample period.

Concentration-based Limit
A limit based upon the relative strength of a pollutant in a wastestream, usually expressed in mg/l.

Continuous Discharge
A discharge that occurs without interruption during the operating hours of a facility, except for infrequent shutdowns for maintenance, process changes or similar activities.

Control Authority *[paraphrased from 40 CFR § 403.12(a)]*
A POTW with an approved pretreatment program or the approval authority in the absence of a POTW pretreatment program.

Conventional Pollutants
BOD, TSS, fecal coliform, oil and grease, and pH.

Daily Maximum Limitations
The maximum allowable discharge of pollutants during a 24-hour period. Where daily maximum limitations are expressed in units of mass, the daily discharge is the total mass discharged over the course of the day. Where daily maximum limitations are expressed in terms of a concentration, the daily discharge is the arithmetic average measurement of the pollutant concentration derived from all measurements taken that day.

Detection Limit
The minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure set forth in 40 CFR Part 136, Appendix B.

Development Document
Detailed report of studies conducted by the U.S. EPA for the purpose of establishing effluent guidelines and categorical pretreatment standards.

Dilute Wastestream *[paraphrased from 40 CFR §403.6(e)(1)(i)]*
For purposes of the combined wastestream formula, the average daily flow (at least a 30-day average) from : (a) boiler blowdown streams, non-contact cooling streams, storm water streams, and demineralized backwash streams; provided, however, that where such streams contain a significant amount of a pollutant, and the combination of such streams, prior to treatment, with an industrial user's regulated process wastestream(s) will result in a substantial reduction of that pollutant, the Control Authority, upon application of the industrial user, may exercise its discretion to determine whether such stream(s) should be classified as diluted or unregulated. In its application to the Control Authority, the industrial user must provide engineering, production, sampling and analysis, and such other information so the control authority can make its determination; or (b) sanitary wastestreams where such streams are not regulated by a categorical

pretreatment standard; or (c) from any process wastestreams which were, or could have been, entirely exempted from categorical pretreatment standards pursuant to paragraph 8 of the NRDC v. Costle Consent Decree (12 ERC 1833) for one more of the following reasons (see Appendix D of 40 CFR Part 403):
a. the pollutants of concern are not detectable in the effluent from the industrial user (paragraph(8)(a)(iii));
b. the pollutants of concern are present only in trace amounts and are neither causing nor likely to cause toxic effects (paragraph (8)(a)(iii));
c. the pollutants of concern are present in amounts too small to be effectively deduced by technologies known to the Administrator (paragraph (8)(a)(iii)); or
d. the wastestream contains only pollutants which are compatible with the POTW (paragraph (8)(b)(I)).

Effluent Limitations Guideline
Any effluent limitations guidelines issued by the EPA pursuant to Section 304(b) of the CWA. These regulations are published to adopt or revise a national standard prescribing restrictions on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources, in specific industrial categories (e.g., metal finishing, metal molding and casting, etc.).

Enforcement Response Plan *[paraphrased from 40 CFR §403.8(f)(5)]*
Step-by-step enforcement procedures followed by Control Authority staff to identify, document, and respond to violations.

Existing Source
Any source of discharge, the construction or operation of which commenced prior to the publication by the EPA of proposed categorical pretreatment standards, which will be applicable to such source if the standard is thereafter promulgated in accordance with Section 307 of the Act.

Federal Water Pollution Control Act (FWPCA)
The title of Public law 92-500; 33 U.S.C. 1251 et seq., also known as the Clean Water Act (CWA), enacted October 18, 1972.

Flow Weighted Average Formula (FWA) *[paraphrased from 40 CFR §403.6(e)]*
A procedure used to calculate alternative limits where wastestreams regulated by a categorical pretreatment standard and nonregulated wastestreams combine after treatment but prior to the monitoring point.

Flow Proportional Composite Sample
Combination of individual samples proportional to the flow of the wastestream at the time of sampling.

Fundamentally Different Factors *[paraphrased from 40 CFR §403.13]*
Case-by-case variance from categorical pretreatment standards based on the factors considered by the EPA in developing the applicable category/subcategory being fundamentally different than factors relating to a specific industrial user.

General Prohibitions *[40 CFR §403.5(a)(1)]*
No user shall introduce into a POTW any pollutant(s) which cause pass through or interference.

Grab Sample
A sample which is taken from a wastestream on a one-time basis with no regard to the flow of the wastestream and without consideration of time. A single grab sample should be taken over a period of time not to exceed 15 minutes.

Indirect Discharge or Discharge *[40 CFR §403.3(g)]*
The introduction of pollutants into a POTW from any non-domestic source regulated under section 307(b), (c), or (d) of the Act.

Industrial User (IU) or User *[40 CFR §403.3(h)]*
A source of indirect discharge.

Industrial Waste Survey
The process of identifying and locating industrial users and characterizing their industrial discharge.

Inhibition Concentration
Estimate of the toxicant concentration that would cause a given percent reduction (e.g., IC25) in a nonlethal biological measurement of the test organisms, such as reproduction or growth.

Interference *[paraphrased from 40 CFR §403.3(i)]*
A discharge which, alone or in conjunction with a discharge or discharges from other sources, both: (1)inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and (2) therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with ... [applicable] statutory provisions and regulations or permits issued there under (or more stringent State or local regulations)

Local Limits *[paraphrased 40 CFR § 403.5(c)]*
Specific discharge limits developed and enforced by POTWs upon industrial or commercial facilities to implement the general and specific discharge prohibitions listed in 40 CFR §§403.5(a)(1) and (b).

Monthly Average
The arithmetic average value of all samples taken in a calendar month for an individual pollutant parameter. The monthly average may be the average of all grab samples taken in a given calendar month, or the average of all composite samples taken in a given calendar month.

National Pollutant Discharge Elimination System (NPDES)
The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing discharge permits from point sources to waters of the United States, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the CWA.

National Pretreatment Standard or Pretreatment Standard or Standard
[40 CFR §403.3(j)] Any regulation containing pollutant discharge limits promulgated by the EPA in accordance with section 307(b) and (c) of the Act, which applies to Industrial Users. This term includes prohibitive discharge limits established pursuant to §403.5.

New Source *[40 CFR §403.3(k)]*
Any building, structure, facility or installation from which there is or may be a discharge of pollutants, the construction of which commenced after the publication of proposed Pretreatment Standards under section 307(c) of the Act which will be applicable to such source if such standards are thereafter promulgated in accordance with that section *provided tha*t:
(a) The building, structure, facility or installation is constructed at a site at which no other discharge source is located; or
(b) The building, structure, facility or installation totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or
(c) The production or wastewater generating processes of the building, structure, facility, or installation are substantially independent of an existing source at the same site. In determining whether these are substantially independent, factors such as the extent to which the new facility is integrated with the existing plant, and the extent to which the new facility is engaged in the same general type of activity as the existing source, should be considered.
Construction on a site at which an existing source is located results in a modification rather than a new source if the construction does not create a new building, structure, facility, or installation meeting the criteria of paragraphs (k)(1)(ii), or (k)(1)(iii) of this section but otherwise alters, replaces, or adds to existing processor production equipment.
Construction of a new source, as defined under this paragraph has commenced if the owner or operator has:
(i) Begun, or caused to begin as part of a continuous onsite construction program:
(A) Any placement, assembly, or installation of facilities or equipment; or
(B) Significant site preparation work including clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment, or
(C) Entered into a binding contractual obligation for the purchase of facilities or equipment which are intended to be used in its operation within a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility, engineering, and design studies do not constitute a contractual obligation under this paragraph.

90-Day Final Compliance Report *[40 CFR §403.12(d)]*
A report submitted by categorical industrial users within 90 days following the date for final compliance with the standards. This report must contain flow measurement (of regulated process streams and other streams), measurement of pollutants, and a certification as to whether the categorical standards are being met.

Nonconventional Pollutants
Any pollutant that is neither a toxic pollutant nor a conventional pollutant (e.g., manganese, ammonia, etc.)

Non-Contact Cooling Water
Water used for cooling which does not come into direct contact with any raw material, intermediate product, waste product, or finished product. The only pollutant contributed from the discharge is heat.

Non-Regulated Wastestream
Unregulated and dilute wastestreams (not regulated by categorical standards).

Pass Through *[40 CFR §403.3(n)]*
A discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a

violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

Periodic Compliance Report *[paraphrased from 40 CFR §403.12(e) & (h)]*
A report on compliance status submitted by categorical industrial users and significant noncategorical industrial users to the control authority at least semiannually (once every six months).

Point Source *[40 CFR 122.2]*
Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fixture, container, rolling stock concentrated animal feeding operation vessel, or other floating craft from which pollutants are or may be discharged.

Pollutant *[40 CFR 122.2]*
Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal and agricultural waste discharged into water.

Pretreatment *[paraphrased from 40 CFR §403.3(q)]*
The reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW.

Pretreatment Requirements *[40 CFR §403.3(r)]*
Any substantive or procedural requirement related to Pretreatment, other than a National Pretreatment Standard, imposed on an Industrial User.

Pretreatment Standards for Existing Sources (PSES)
Categorical Standards and requirements applicable to industrial sources that began construction prior to the publication of the proposed pretreatment standards for that industrial category. (see individual standards at 40 CFR Parts 405-471.)

Pretreatment Standards for New Sources (PSNS)
Categorical Standards and requirements applicable to industrial sources that began construction after the publication of the proposed pretreatment standards for that industrial category. (see individual standards at 40 CFR Parts 405-471.)

Priority Pollutant
Pollutant listed by the Administrator of the EPA under Clean Water Act section 307(a). The list of the current 129 Priority Pollutants can be found in 40 CFR Part 423 Appendix A.

Process Wastewater
Any water which, during manufacturing or processing, comes into contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product.

Production-Based Standards
A discharge standard expressed in terms of pollutant mass allowed in a discharge per unit of product manufactured.

Publicly Owned Treatment Works (POTW) *[40 CFR §403.3(o)]*
A treatment works as defined by section 212 of the Act, which is owned by a State or municipality (as defined by section 502(4) of the Act). This definition includes any devices or systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes or other conveyances only if they convey wastewater to a POTW Treatment Plant.

The term also means the municipality as defined in section 502(4) of the Act, which has jurisdiction over the Indirect Discharges to and the discharges from such a treatment works.

Regulated Wastestream
For purposes of applying the combined wastestream formula, a wastestream from an industrial process that is regulated by a categorical standard.

Removal Credit *[paraphrased from 40 CFR §403.7]*
Variance from a pollutant limit specified in a categorical pretreatment standard to reflect removal by the POTW of said pollutant.

Representative Sample
A sample from a wastestream that is as nearly identical as possible in composition to that in the larger volume of wastewater being discharged and typical of the discharge from the facility on a normal operating day.

Sanitary Sewer Overflow (SSO)
Untreated or partially treated sewage overflows from a sanitary sewer collection system.

Self-Monitoring
Sampling and analyses performed by a facility to ensure compliance with a permit or other regulatory requirements.

Sewer Use Ordinance (SUO)
A legal mechanism implemented by a local government entity which sets out, among others, requirements for the discharge of pollutants into a publicly owned treatment works.

Significant Industrial User (SIU) *[paraphrased from 40 CFR §403.3(t)]*
(1) All users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR chapter I, subchapter N; and (2) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process wastestream which makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)].

Significant Noncompliance (SNC) *[40 CFR §403.8(f)(2)(vii)]*
Industrial user violations meeting one or more of the following criteria:
1) Chronic violations of wastewater discharge limits, defined here as those in which sixty-six percent or more of all of the measurements taken during a six-month period exceed (by any magnitude) the daily maximum limit or the average limit for the same pollutant parameter;

2) Technical Review Criteria (TRC) violations, defined here as those in which thirty-three percent or more of all of the measurements for each pollutants parameter taken during a six-month period equal or exceed the product of the daily maximum limit or the average limit multiplied by the applicable TRC (TRC=1.4 for BOD, TSS, fats, oil, and grease, and 1.2 for all other pollutants except pH);
3) Any other violation of a pretreatment effluent limit (daily maximum or longer-term average) that the Control Authority determines has caused, alone or in combination with other dischargers, interference or pass through (including endangering the health of POTW personnel or the general public);
4) Any discharge of a pollutant that has caused imminent endangerment to human health, welfare or to the environment or has resulted in the POTW's exercise of its emergency authority under paragraph (f)(1)(vi)(B) of this section to halt or prevent such a discharge;
5) Failure to meet, within 90 days after the schedule date, a compliance schedule milestone contained in a local control mechanism or enforcement order for starting construction, completing construction, or attaining final compliance;
6) Failure to provide, within 30 days after the due date, required reports such as baseline monitoring reports, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules;
7) Failure to accurately report noncompliance;
8) Any other violation or group of violations which the Control Authority determines will adversely affect the operation or implementation of the local pretreatment program.

Slug Discharge *[40 CFR §403.8(f)(2)(v)]*
Any discharge of a non-routine, episodic nature, including but not limited to, an accidental spill or a noncustomary batch discharge.

Specific Prohibitions *[40 CFR §403.5(b)]*
The following pollutants shall not be introduced into a POTW:
1) Pollutants which create a fire or explosion hazard in the POTW, including but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR Part 261.21;
2) Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges;
3) Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference;
4) Any pollutant, including oxygen-demanding pollutants (BOD, etc.) Released in a discharge at a flow rate and/or concentration which will cause interference with the POTW;
5) Heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40°C (104°F) unless the Approval Authority, upon request of the POTW, approves alternative temperature limits;
6) Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;
7) Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems;
8) Any trucked or hauled pollutants, except at discharge points designated by the POTW.

Standard Industrial Classification (SIC)
A system developed by the U.S. Office of Management and Budget that is used to classify various types of business entities. Effective in 1998, the SIC scheme is replaced by the North American Industry Classification System (**NAICS**), although the EPA has not yet implemented this change.

Storm Water
Rain water, snowmelt, and surface runoff and drainage.

Time Proportional Composite Sample
A sample consisting of a series of aliquots collected from a representative point in the discharge stream at equal time intervals over the entire discharge period on the sampling day.

Toxic Pollutant
Any pollutant listed as toxic under section 307(a)(1) of the CWA, or in the case of sludge use or disposal practices, any pollutant identified in regulations implementing section 405(d) of the CWA.

Toxicity Reduction Evaluation
A site-specific study conducted in a stepwise process designed to identify the causative agent(s) of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

Toxicity Test
A procedure to determine the toxicity of a chemical or an effluent using living organisms. A toxicity test measures the degree of effect on exposed test organisms of a specific chemical or effluent.

Toxicity Identification Evaluation
Set of procedures to identify the specific chemicals responsible for effluent toxicity.

Unregulated Wastestream
For purposes of applying the combined wastestream formula, a wastestream not regulated by a categorical standard nor considered a dilute wastestream.

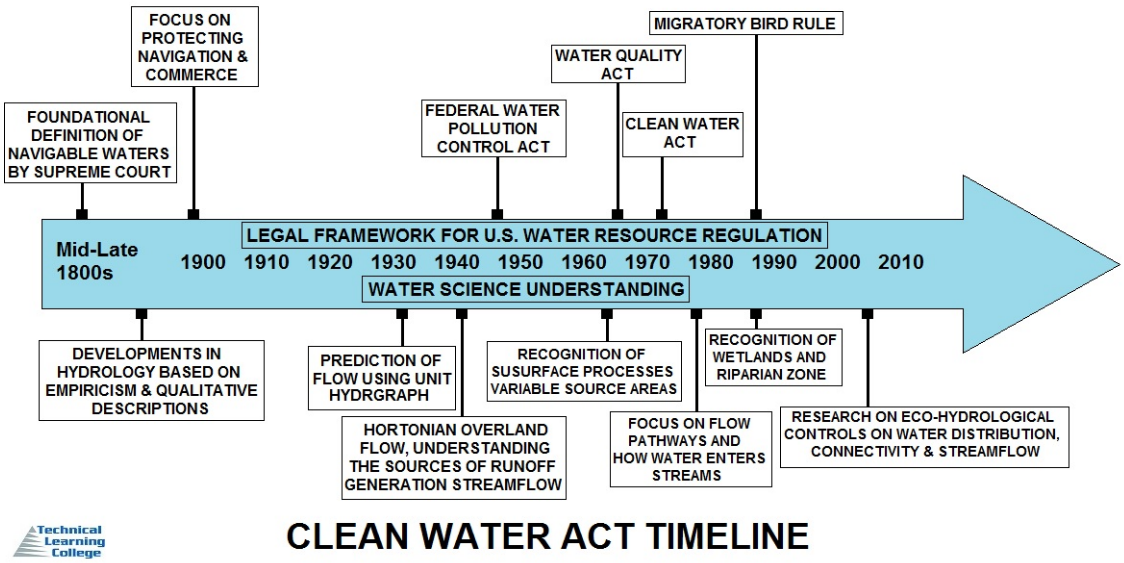
Upset *[paraphrased from 40 CFR §403.16(a)]*
An exceptional incident in which there is unintentional and temporary noncompliance with categorical Pretreatment Standards because of factors beyond the reasonable control of the Industrial User. An Upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

Water Quality Criteria
Comprised of both numeric and narrative criteria. Numeric criteria are scientifically derived ambient concentrations developed by EPA or States for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal.

Water Quality Standard
A statute or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.

Clean Water Act (CWA) Introduction *(Credit USEPA)*

33 U.S.C. s/s 1251 et seq. (1977)
The Clean Water Act (CWA), is a 1977 amendment to the Federal Water Pollution Control Act (PCA) of 1972, which set the basic structure for regulating discharges of pollutants to waters of the United States.



CLEAN WATER ACT TIMELINE

The law gave the EPA the authority to set effluent standards on an industry basis (technology-based) and continued the requirements to set water quality standards for all contaminants in surface waters. The CWA makes it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit (NPDES) is obtained under the act.

The 1977 amendments focused on toxic pollutants. In 1987, the PCA was reauthorized and again focused on toxic substances, authorized citizen suit provisions, and funded sewage treatment plants (POTW's) under the Construction Grants Program.

The CWA made provides for the delegation by the EPA of many permitting, administrative, and enforcement aspects of the law to state governments. In states with the authority to implement CWA programs, the EPA still retains oversight responsibilities.

In 1972, Congress enacted the first comprehensive national clean water legislation in response to growing public concern for serious and widespread water pollution. The CWA is the primary federal law that protects our nation's waters, including lakes, rivers, aquifers and coastal areas.

Lake Erie was dying. The Potomac River was clogged with blue-green algae blooms that were a nuisance and a threat to public health. Many of the nation's rivers were little more than open sewers and sewage frequently washed up on shore. Fish kills were a common sight. Wetlands were disappearing at a rapid rate.

Today, the quality of our waters has improved dramatically as a result of a cooperative effort by federal, state, tribal and local governments to implement the pollution control programs established in 1972 by the CWA.

The CWA's primary objective is to restore and maintain the integrity of the nation's waters. This objective translates into two fundamental national goals:

- eliminate the discharge of pollutants into the nation's waters, and
- achieve water quality levels that are fishable and swimmable.

The CWA focuses on improving the quality of the nation's waters. It provides a comprehensive framework of standards, technical tools and financial assistance to address the many causes of pollution and poor water quality. It includes municipal and industrial wastewater discharges, polluted runoff from urban and rural areas, and habitat destruction.

For example, the Clean Water Act requires major industries to meet performance standards to ensure pollution control; charges states and tribes with setting specific water quality criteria appropriate for their waters and developing pollution control programs to meet them; provides funding to states and communities to help them meet their clean water infrastructure needs; protects valuable wetlands and other aquatic habitats through a permitting process that ensures development and other activities are conducted in an environmentally sound manner. After 25 years, the CWA continues to provide a clear path for clean water and a solid foundation for an effective national water program.

In 1972
Only a third of the nation's waters were safe for fishing and swimming. Wetlands losses were estimated at about 460,000 acres annually.

Agricultural runoff resulted in the erosion of 2.25 billion tons of soil and the deposit of large amounts of phosphorus and nitrogen into many waters. Sewage treatment plants (POTW) served only 85 million people.

Today
Two-thirds of the nation's waters are safe for fishing and swimming.

The rate of annual wetlands losses is estimated at about 70,000-90,000 acres according to recent studies. The amount of soil lost due to agricultural runoff has been cut by one billion tons annually, and phosphorus and nitrogen levels in water sources are down. Modern wastewater treatment facilities serve 173 million people.

The Future
All Americans will enjoy clean water safe for fishing and swimming. We will achieve a net gain of wetlands by preventing additional losses and restoring hundreds of thousands of acres of wetlands. Soil erosion and runoff of phosphorus and nitrogen into watersheds will be minimized, helping to sustain the nation's farming economy and aquatic systems. The nation's waters will be free of effects of sewage discharges.

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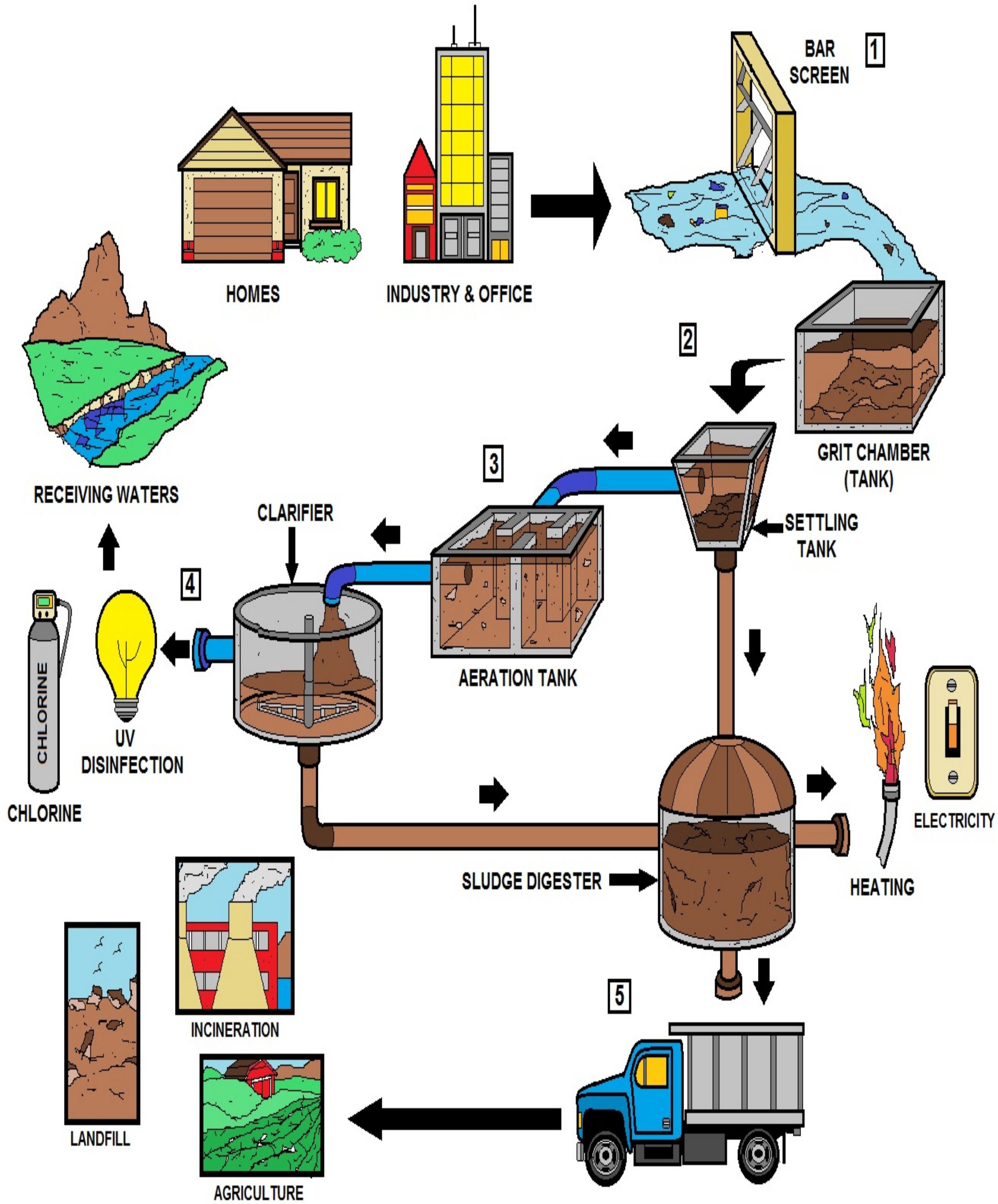
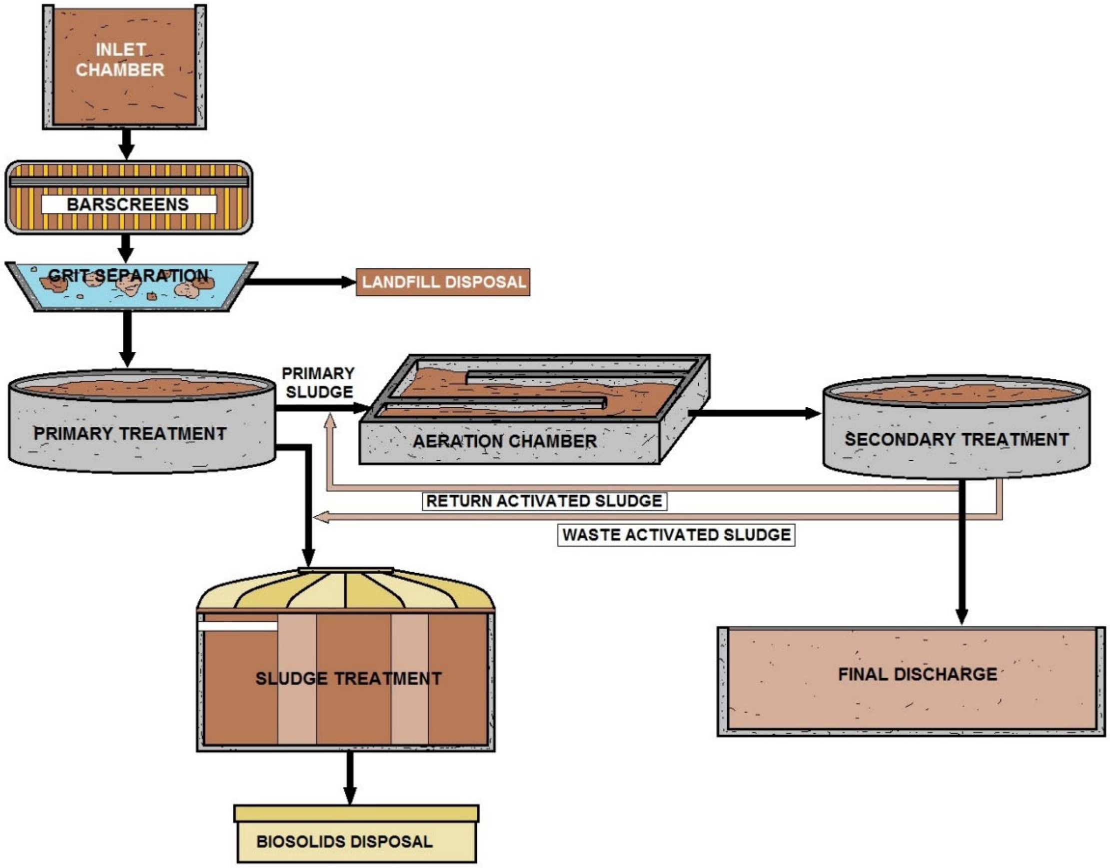


BASIC WASTEWATER TREATMENT PROCESS #1

As a pretreatment inspector, you will need knowledge of many different WWT processes and concerns in order to properly identify the problem and sometimes you will need to order the remedy, solution or correction. Generally speaking, wastewater treatment operators will make the best overall Pretreatment Inspectors because of their expert knowledge of the wastewater treatment process. However, Collection system operators also make excellent Pretreatment Inspectors.



WASTEWATER TREATMENT PLANT (SLUDGE REMOVAL BASICS)

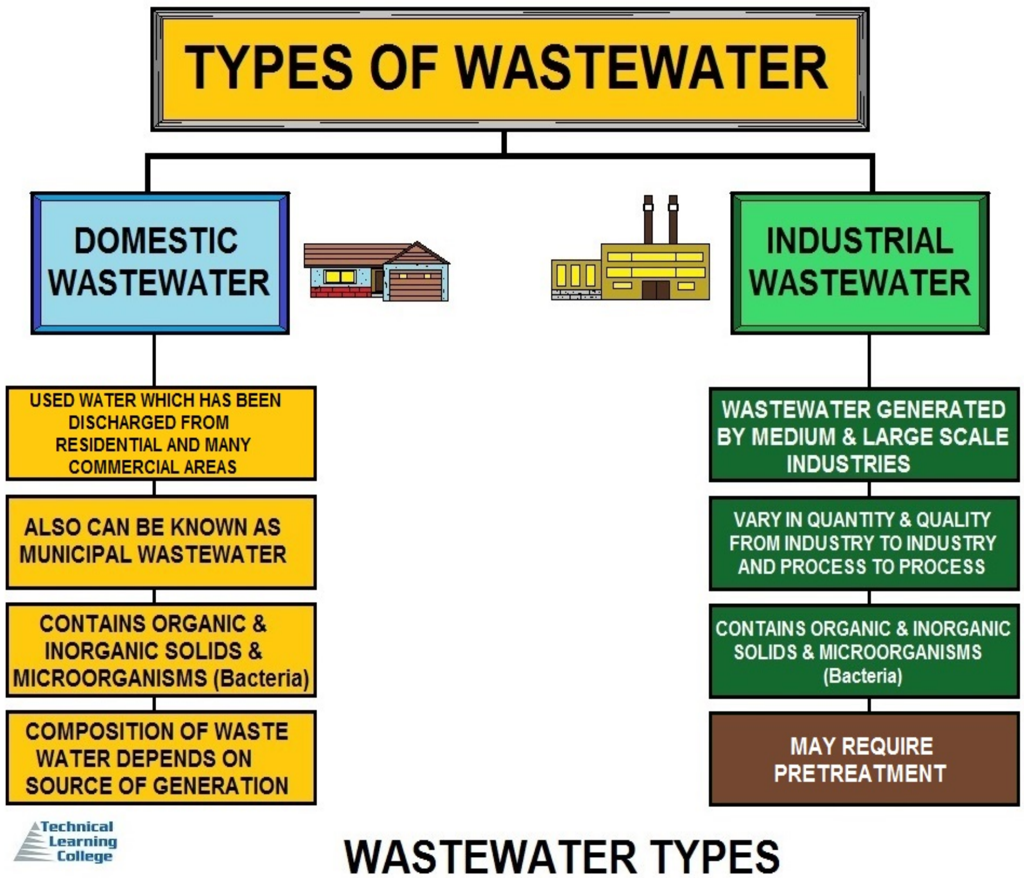
There are various options for treating sludge including stabilization, thickening, dewatering, drying, and incineration. The costs for treating sludge and removing sludge from wastewater are roughly the same. Typically a polymer chemical is used for the volume reduction process known as dewatering. Polymers are slippery chemicals, which means that there is always a risk of slipping or falling due to spills and leaks. Polymers can also be environmental stress crack agents.

Dewatering decreases sludge liquid volume as much as 90 percent. Digested sludge is put through large centrifuges that work in the same fashion as a washing machine spin cycle. The spinning centrifuge produces a force that separates the majority of the water from the sludge solid, creating a biosolid substance.

Chapter 1 – Wastewater Introduction

Section Focus: You will learn the basics of the Clean Water Act, the need for wastewater treatment and common wastewater constituents. At the end of this section, you will be able to describe the need for wastewater treatment and the composition/components of wastewater. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

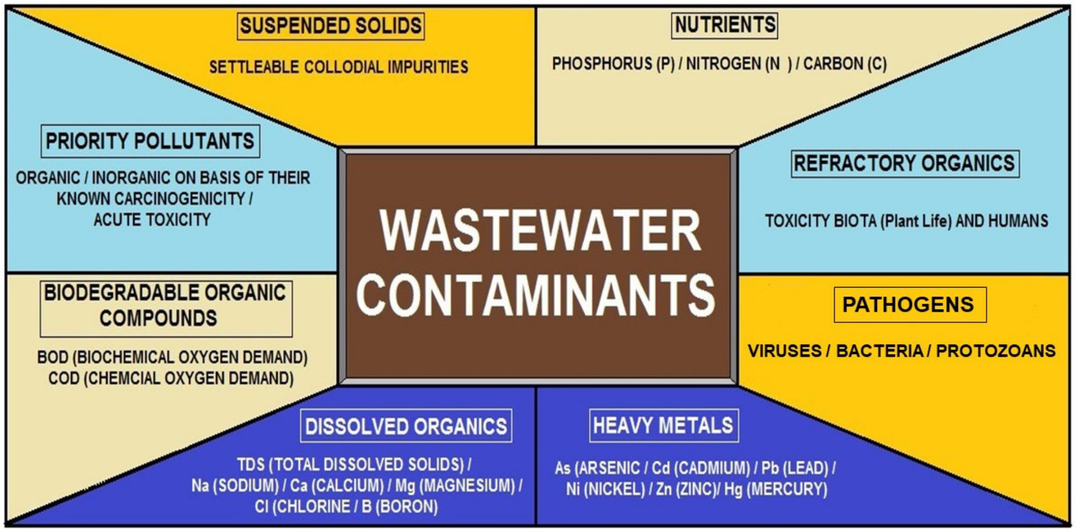
Scope/Background: Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.



The diagram above shows the difference between domestic wastewater and industrial wastewater. Not all communities have industrial waste generators and if they do, the plant generally treats a high volume of flow.

Conventional Pollutants
BOD, TSS, fecal coliform, oil and grease, and pH.

Always follow your NPDES permit for proper sampling and laboratory procedures.



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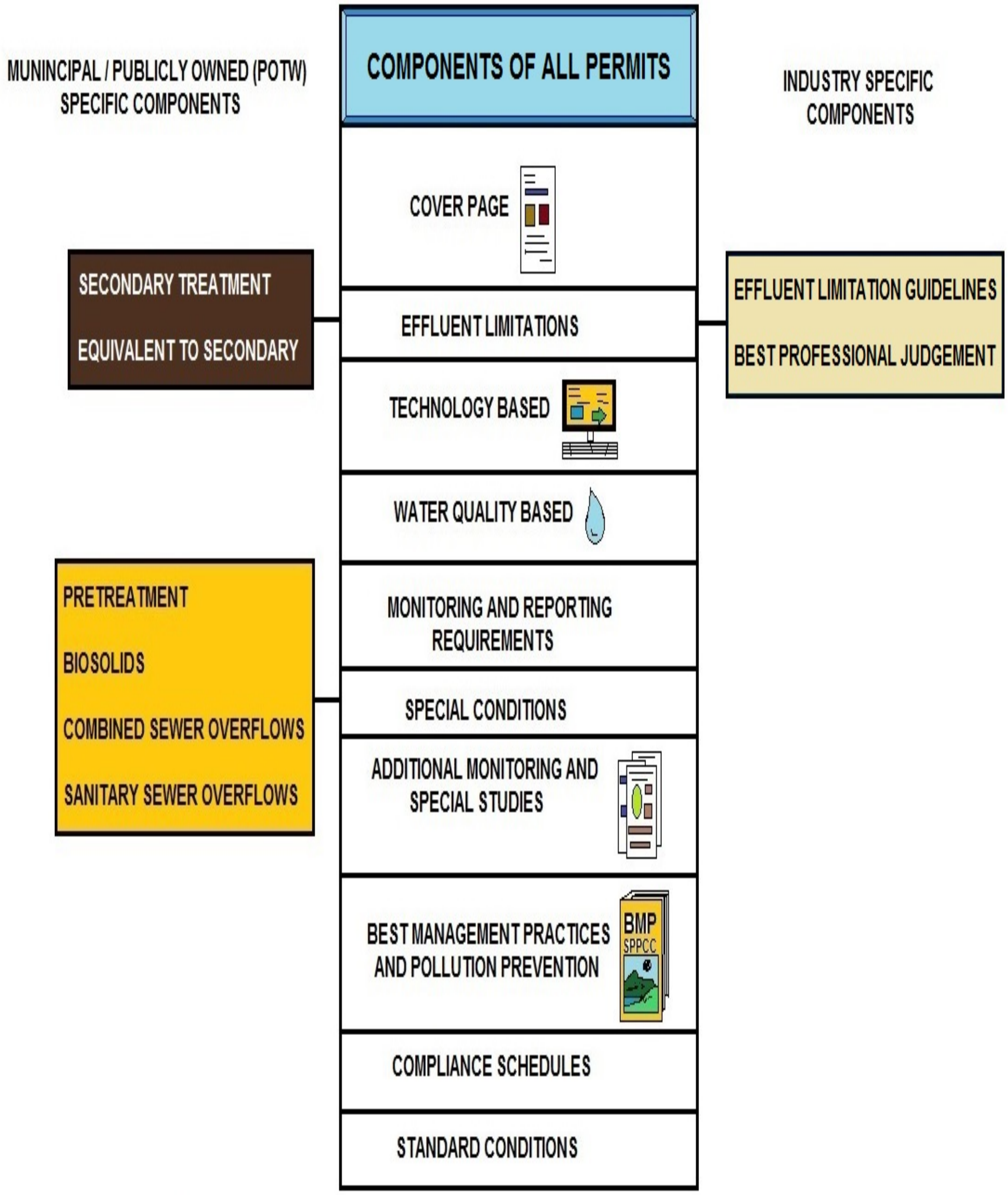
TYPES OF WASTEWATER CONTAMINANTS

Above are the common wastewater contaminants that we must deal with correctly to achieve our permit requirements. Below a pump from a lift station was damaged by rocks and clogged with flushable wipes. Whatever the label says wipes are not completely flushable.



NPDES PERMIT COMPONENTS

NPDES Permit Foreword

Once a wastewater plant is designed and built, state or federal agencies will determine the type of permit required using the information illustrated above. You will need to understand that this discharge permit is your legal standard for proper sampling, treatment and discharging. You must abide by your permit and not deviate from this requirement based on information based in this course by the course information.

Clean Water Act Secondary Treatment Standards (40 CFR § 133.102)

The following paragraphs describe the minimum level of effluent quality attainable by secondary treatment in terms of the parameters - BOD5, SS and pH. All requirements for each parameter shall be achieved except as provided for in §§ 133.103 and 133.105.

(a) *BOD*5.

(1) The 30-day average shall not exceed 30 mg/l.

(2) The 7-day average shall not exceed 45 mg/l.

(3) The 30-day average percent removal shall not be less than 85 percent.

(4) At the option of the NPDES permitting authority, in lieu of the parameter BOD5 and the levels of the effluent quality specified in paragraphs (a)(1), (a)(2) and (a)(3), the parameter CBOD5 may be substituted with the following levels of the CBOD5 effluent quality provided:

(i) The 30-day average shall not exceed 25 mg/l.

(ii) The 7-day average shall not exceed 40 mg/l.

(iii) The 30-day average percent removal shall not be less than 85 percent.

(b) *SS.* (1) The 30-day average shall not exceed 30 mg/l.

(2) The 7-day average shall not exceed 45 mg/l.

(3) The 30-day average percent removal shall not be less than 85 percent.

(c) *pH.* The effluent values for pH shall be maintained within the limits of 6.0 to 9.0 unless the publicly owned treatment works demonstrates that: (1) Inorganic chemicals are not added to the waste stream as part of the treatment process; and (2) contributions from industrial sources do not cause the pH of the effluent to be less than 6.0 or greater than 9.0.

Terms used in this part are defined as follows:

(a) *7-day average.* The arithmetic mean of pollutant parameter values for samples collected in a period of 7 consecutive days.

(b) *30-day average.* The arithmetic mean of pollutant parameter values of samples collected in a period of 30 consecutive days.

(c) *Act.* The Clean Water Act (33 U.S.C. 1251 *et seq.,* as amended).

(d) *BOD.* The five day measure of the pollutant parameter biochemical oxygen demand (BOD).

(e) *CBOD*5. The five day measure of the pollutant parameter carbonaceous biochemical oxygen demand (CBOD5).

(f) *Effluent concentrations consistently achievable through proper operation and maintenance.*

(1) For a given pollutant parameter, the 95th percentile value for the 30-day average effluent quality achieved by a treatment works in a period of at least two years, excluding values attributable to upsets, bypasses, operational errors, or other unusual conditions, and

(2) a 7-day average value equal to 1.5 times the value derived under paragraph (f)(1) of this section.

Wastewater Treatment Process Introduction

During the early days of our nation's history, people living in both the cities and the countryside used cesspools and privies to dispose of domestic wastewater. Cities began to install wastewater collection systems in the late nineteenth century because of an increasing awareness of waterborne disease and the popularity of indoor plumbing and flush toilets.

The use of sewage collection systems brought dramatic improvements to public health, further encouraging the growth of metropolitan areas. In the year 2000, approximately 208 million people in the U.S. were served by centralized collection systems.

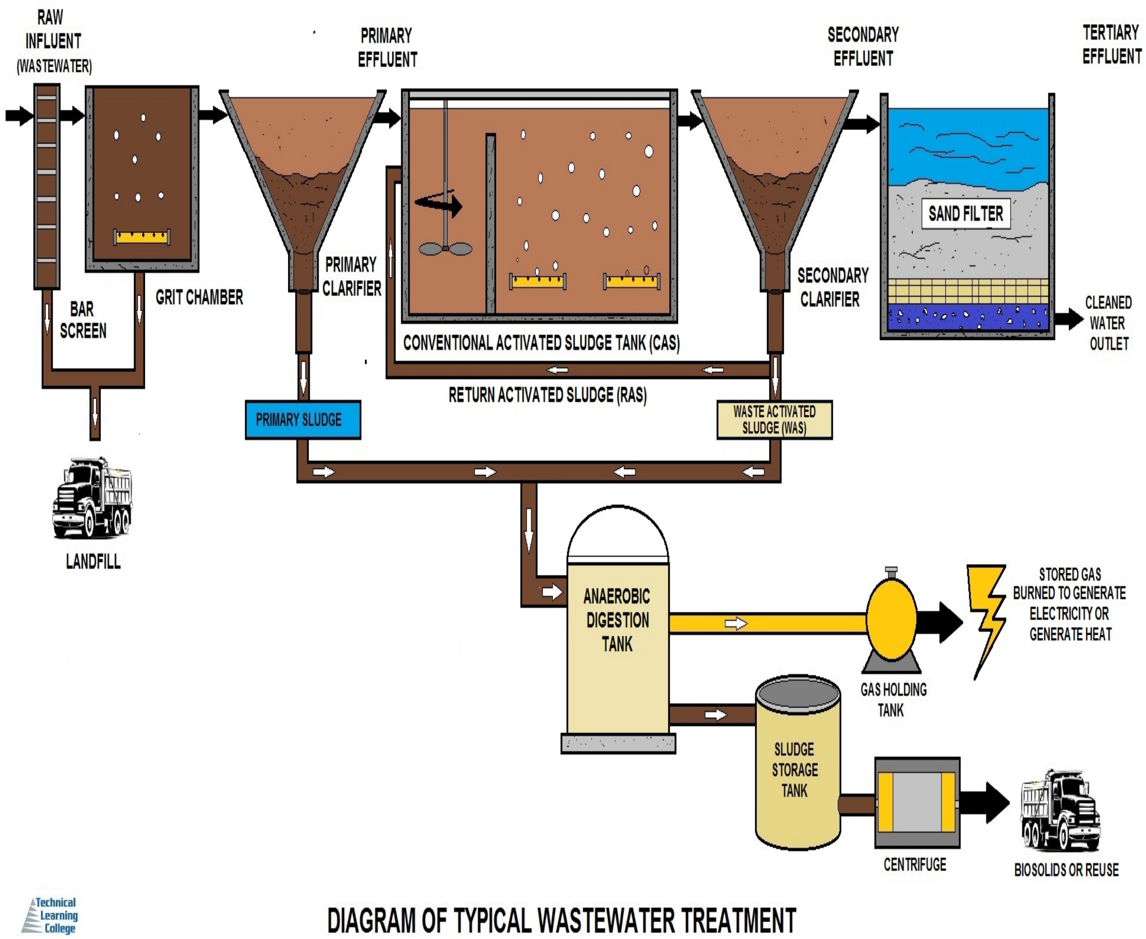


DIAGRAM OF TYPICAL WASTEWATER TREATMENT

Physical, Biological or Chemical Wastewater Treatments

There are two wastewater treatment processes namely chemical or physical treatment, and biological wastewater treatment or a mixture of the two processes. Biological waste treatment plants use biological matter and bacteria to break down waste matter. Physical waste treatment plants use chemical reactions as well as physical processes to treat wastewater. Biological treatment systems are ideal for treating wastewater from households and business premises

Primary Treatment
As sewage enters a plant for treatment, it flows through a screen, which removes large floating objects such as rags and sticks that might clog pipes or damage equipment. After sewage has been screened, it passes into a grit chamber, where cinders, sand, and small stones settle to the bottom. A grit chamber is particularly important in communities with combined sewer systems where sand or gravel may wash into sewers along with storm water. After screening is completed and grit has been removed, sewage still contains organic and inorganic matter along with other suspended solids.

These solids are minute particles that can be removed from sewage in a sedimentation tank. When the speed of the flow through one of these tanks is reduced, the suspended solids will gradually sink to the bottom, where they form a mass of solids called raw primary biosolids formerly sludge).

Biosolids are usually removed from tanks by pumping, after which it may be further treated for use as a fertilizer, or disposed of in a land fill or incinerated. Over the years, primary treatment alone has been unable to meet many communities' demands for higher water quality. To meet them, cities and industries normally treat to a secondary treatment level, and in some cases, also use advanced treatment to remove nutrients and other contaminants.

Secondary Treatment
The secondary stage of treatment removes about 85 percent of the organic matter in sewage by making use of the bacteria in it. The principal secondary treatment techniques used in secondary treatment are the trickling filter and the activated sludge process. After effluent leaves the sedimentation tank in the primary stage it flows or is pumped to a facility using one or the other of these processes. A trickling filter is simply a bed of stones from three to six feet deep through which sewage passes.

More recently, interlocking pieces of corrugated plastic or other synthetic media have also been used in trickling beds. Bacteria gather and multiply on these stones until they can consume most of the organic matter. The cleaner water trickles out through pipes for further treatment. From a trickling filter, the partially treated sewage flows to another sedimentation tank to remove excess bacteria. The trend today is towards the use of the activated sludge process instead of trickling filters.

The activated sludge process speeds up the work of the bacteria by bringing air and sludge heavily laden with bacteria into close contact with sewage. After the sewage leaves the settling tank in the primary stage, it is pumped into an aeration tank, where it is mixed with air and sludge loaded with bacteria and allowed to remain for several hours. During this time, the bacteria break down the organic matter into harmless by-products.

The sludge, now activated with additional billions of bacteria and other tiny organisms, can be used again by returning it to the aeration tank for mixing with air and new sewage. From the aeration tank, the partially treated sewage flows to another sedimentation tank for removal of excess bacteria. To complete secondary treatment, effluent from the sedimentation tank is usually disinfected with chlorine before being discharged into receiving waters. Chlorine is fed into the water to kill pathogenic bacteria, and to reduce odor.

What Exactly is in Wastewater?

Domestic wastewater is typically composed of more than 99% water and only a small portion of the 1% may include components that endanger public health or the environment. Other materials make up only a small portion of wastewater, but can be present in large enough quantities to endanger public health and the environment. Because practically anything that can be flushed down a toilet, drain, or sewer can be found in wastewater, even household sewage contains many potential pollutants. The wastewater components that should be of most concern to homeowners and communities are those that have the potential to cause disease or detrimental environmental effects.

Domestic Wastewater Quality Characteristics

Typical Composition of Untreated Domestic Wastewater -Table 1

PARAMETER	UNIT[3]	CONCENTRATED	MODERATE	DILUTED	VERY DILUTED
Biochemical oxygen demand (BOD)	g O_2/m^3				
Infinite BOD	g O_2/m^3	530	380	230	150
7-day BOD	g O_2/m^3	400	290	170	115
5-day BOD	g O_2/m^3	350	250	150	100
Dissolved BOD	g O_2/m^3	140	100	60	40
Dissolved BOD Very Easily Degradable	g O_2/m^3	70	50	30	20
After 2 hours of settling	g O_2/m^3	250	175	110	70
Total nitrogen	g N/m^3	80	50	30	20
Ammonium nitrogen[1]	g N/m^3	50	30	18	12
Nitrite nitrogen	g N/m^3	0.1	0.1	0.1	0.1
Nitrate nitrogen	g N/m^3	0.5	0.5	0.5	0.5
Organic nitrogen	g N/m^3	30	20	12	8
Kjeldahl nitrogen[2]	g N/m^3	80	50	30	20
Total phosphorus	g P/m^3	14	10	6	4
Orthophosphate	g P/m^3	10	7	4	3
Polyphosphate	g P/m^3	0	0	0	0
Organic phosphate	g P/m^3	4	3	2	1

Legend
[1] $NH_3 + NH_4^+$
[2] org-($N + NH_3$ + $NH4^+$)
[3] g/m3 = mg/L = ppm

Reference: Henze, Mogens, Paul Harremoes, Jes la Cour Jansen, and Eric Arvin, "Wastewater Treatment, Biological and Chemical Processes." Third Edition. Berlin. Springer-Verlag 2002. Specially, the data is from Table 1.7, Typical organic matter in domestic wastewater (p. 28) and Table 1.8 Typical content of nutrients in domestic wastewater (p. 29)

Typical Composition of Untreated Domestic Wastewater -Table 2

CONTAMINANTS	UNITS	LOW STRENGTH	MEDIUM STRENGTH	HIGH STRENGTH
Solids, total (TS)	mg/L	390	720	1220
Dissolved, total (TDS)	mg/L	270	500	860
Fixed	mg/L	160	300	520
Volatile	mg/L	110	200	340
Suspended solids, total (TSS)	mg/L	120	210	400
Fixed	mg/L	25	50	85
Volatile	mg/L	95	160	315
Settleable solids	mg/L	5	10	20
Biochemical Oxygen Demand				
5-d, 20°C (BOD_5 20°C)	mg/L	110	190	350
Total organic carbon	mg/L	80	140	260
Chemical oxygen demand (COD)	mg/L	250	430	800
Nitrogen (total as N)	mg/L	20	40	70
Organic	mg/L	8	15	25
Free ammonia	mg/L	12	25	45
Nitrites	mg/L	0	0	0
Nitrates	mg/L	0	0	0
Phosphorus (total as P)	mg/L	4	7	12
Organic	mg/L	1	2	4
Inorganic	mg/L	3	5	10
Chlorides	mg/L	30	50	90
Sulfate	mg/L	20	30	50
Oil and Grease	mg/L	50	90	100
Volatile organic compounds (VOCs)	mg/L	<100	100-400	>400
Total coliform	No./100 mL	10^6-10^8	10^7-10^9	10^7-10^{10}
Fecal Coliform	No./100 mL	10^3-10^5	10^4-10^6	10^5-10^8
Cryptosporidium oocysts	No./100 mL	10^{-1} – 10^0	10^{-1}-10^1	10^{-1}-10^2
Giardia lamblia cysts	No./100 mL	10^{-1}-10^1	10^{-1}-10^2	10^{-1}-10^3

Source: Metcaff & Eddy. "Wastewater Engineering Treatment and Reuse. 4th ed. Boston. McGraw –Hill, 2003 (p.186)

Conventional Wastewater Treatment Processes

Physical or Primary Treatment

Physical processes were some of the earliest methods to remove solids from wastewater, usually by passing wastewater through screens to remove debris and large solids. In addition, solids that are heavier than water will settle out from wastewater by gravity. Particles with entrapped air float to the top of water and can also be removed. These physical processes are employed in many modern wastewater treatment facilities today.

Biological or Secondary Treatment

In nature, bacteria in water consume organic matter to grow and reproduce. Aerobic bacteria near the water surface, where oxygen is present, produce carbon dioxide as a by-product. Anaerobic bacteria in or near the bottom sediments, where there is little or no oxygen, produce methane and smaller amounts of other gases as a byproduct.

In the 1920s, scientists observed that these natural processes could be contained and accelerated in systems to remove organic material from wastewater.

With the addition of oxygen to wastewater, masses of microorganisms grew and rapidly metabolized organic pollutants.

The mass of bacteria in an aeration tank came to be called “mixed liquor”. Here, floating bacteria stick to organic matter forming small clumps called “floc”. Floc is slightly denser than water so once the mixed liquor flows into a tank not being agitated by the addition of oxygen, it settles to the bottom. From here, some is returned to the head of the aeration tank to maintain the bacterial population. This is called returned activated sludge (RAS). Excess is removed (or “wasted”) from the system. This is waste activated sludge (WAS). Part of the job of a wastewater plant operator is to adjust the waste and return rates to maintain the optimum ratio of bacteria to the fluctuating amount of organic matter arriving as primary tank effluent. If there are too few bacteria, they won’t remove enough organics to meet permit requirements. If there are too many, they will not have enough to eat, and their removal efficiency will decline.

Chemical

Chemicals can be used to create changes in pollutants that increase the removal of these new forms by physical processes. Simple chemicals such as alum, lime or iron salts can be added to wastewater to cause certain pollutants, such as phosphorus, to floc or bunch together into large, heavier masses which can be removed faster through physical processes.

Over the past 30 years, the chemical industry has developed synthetic inert chemicals known as polymers to further improve the physical separation step in wastewater treatment. Polymers are often used at the later stages of treatment to improve the settling of excess microbiological growth or Biosolids (suspended solids).

Organisms
Many different types of organisms live in wastewater and some are essential contributors to treatment. A variety of bacteria, protozoa, and viruses work to break down certain carbon-based (organic) pollutants in wastewater by consuming them. Through this process, organisms turn wastes into carbon dioxide, water, and new cell growth.

Bacteria and other microorganisms are particularly plentiful in wastewater and accomplish most of the treatment. Most wastewater treatment systems are designed to rely in large part on biological processes. We will cover this area in greater detail later in the course.

Pathogens
Graywater and blackwater from typical homes contain enough pathogens to pose a risk to public health. Other likely sources in communities include hospitals, schools, farms, and food processing plants. Some illnesses from wastewater-related sources are relatively common. Gastroenteritis can result from a variety of pathogens in wastewater, and cases of illnesses caused by the parasitic protozoa Giardia lambia and Cryptosporidium are not unusual in the U.S. Other important wastewater-related diseases include hepatitis A, typhoid, polio, cholera, and dysentery. Outbreaks of these diseases can occur as a result of drinking water from wells polluted by wastewater, eating contaminated fish, or recreational activities in polluted waters. Some illnesses can be spread by animals and insects that come in contact with wastewater.

Even municipal drinking water sources are not completely immune to health risks from wastewater pathogens. Drinking water treatment efforts can become overwhelmed when water resources are heavily polluted by wastewater. For this reason, wastewater treatment is as important to public health as drinking water treatment.

The most important goal of all POTWs is to prevent the spread of human diseases caused by waterborne pathogens. Before effective wastewater treatment existed, outbreaks of diseases such as typhoid, cholera, and dysentery were common and the cause of many fatalities. Outbreaks of these and other waterborne pathogens, such as polio, hepatitis A, gastroenteritis, Giardia lamblia, and Cryptosporidium still sometimes occur when wastewater treatment systems fail to function properly.

It wasn't until the late 1850's that the link between water contamination by feces and human disease was commonly accepted. Though systems for removing sanitary sewage existed in ancient cites, it wasn't until the late 19th and early 20th century that wastewater treatment plants began being built. Humanity learned that removing organic matter from sanitary sewage also removed human pathogens.

Testing for the presence of all waterborne human pathogens is not practical. Luckily, there are "indicator organisms" such as fecal coliform and E. coli that are easy to test for and whose presence has been found to be proportional to the presence of human pathogens. Even when an indicator organism test result establishes that dangerous quantities of human pathogens are not present, NPDES permits often require POTWs to take the additional step of disinfecting their final effluent before releasing it to the environment. Common disinfection methods include the addition of liquid bleach (sodium hypochlorite), chlorine gas, peracetic acid, ozone, and/or exposure to specific UV light wavelengths. There are pros and cons to each of these methods.

Primary Environmental Wastewater Pollutant Effects

We will cover all these effects in detail later.

Effect of BOD

- Depletes dissolved oxygen from streams, lakes and oceans.
- May cause death of aerobic organisms (fish kills, etc.).
- Increases anaerobic properties of water.

Effect of TSS

- **Increases turbidity**
  - Less light - reduced photosynthesis.
  - Causes fish's gills to get plugged up.
- **Increases silting**
  - Reduces lifespan of lakes, reservoirs, etc..
  - Changes benthic (i.e., bottom) ecology.

Effects of Phosphorous and Nitrogen

- **Increases algal photosynthesis (eutrophication)**
  - Increased plant life on surface.
  - Reduces light in lower levels.
  - Decreases P and N in lower levels

Additional Effects of Nitrogen

- Organic nitrogen and ammonia are converted to nitrates in water.
- Nitrates are converted to nitrites in digestive system.
- Nitrites are assimilated into blood stream where they are converted by respired oxygen to nitrates.
- May cause suffocation (blue baby syndrome).

Effect of pH

- Organisms are very sensitive to acids and bases.
- Recommended to have near neutral conditions (6.5 - 8.5).

Effect of Pathogens

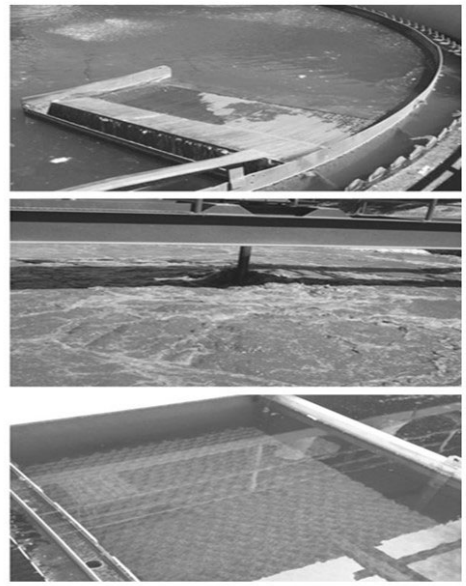
May infect:

- Humans
- Animals

PRIMARY TREATMENT
- PHYSICAL PROCESS
  - BAR SCREENS
  - GRIT CHAMBERS
  - SETTLING BASINS

SECONDARY TREATMENT
- BIOLOGICAL PROCESS
  - PONDS / LAGOONS
  - OXIDATION DITCHES
  - ACTIVATED SLUDGE

TERTIARY TREATMENT
- CHEMICAL / PHYSICAL PROCESS
  - FILTER AIDS
  - FILTRATION
  - WETLAND



CONVENTIONAL WASTEWATER TREATMENT

- PRIORITY POLLUTANTS
- PHARMACEUTICALS
- HEAVY METALS
- BIODEGRADABLE SOLIDS
- DISSOLVED INOGANICS
- NUTRIENTS
- SOLIDS
- PATHOGENS AND PARASITES

WASTEWATER TREATMENT OVERLOAD INDICATORS

Primary Wastewater Components and Constituents

Important Wastewater Characteristics

In addition to the many substances, (liquids, inorganics-solids, trash, contaminants) found in wastewater, there are other characteristics system engineers and operators use to evaluate wastewater. For example, the color, temperature, pH, odor, DO, Total Solids and turbidity of wastewater give clues about the amount and type of pollutants present and treatment necessary. We will examine these characteristics, which can affect public health and the environment, as well as the design, cost, and effectiveness of treatment.

Essential Wastewater Treatment Terms

Aerobic (AIR-O-bick) – a condition in which free or dissolved oxygen is present in the aquatic environment.

Aerobic Bacteria (Aerobes) – bacteria which will live and reproduce only in an environment containing oxygen. Oxygen combined chemically, such as in water molecules (H_2O), cannot be used for respiration by aerobes.

Anaerobic (AN-air O-bick) - a condition in which ***"free"*** or dissolved oxygen is not present in the aquatic environment.

Anaerobic Bacteria (Anaerobes) – bacteria that thrive without the presence of oxygen.

Saprophytic Bacteria – bacteria that break down complex solids to volatile acids.

Methane Fermenters – bacteria that break down the volatile acids to methane (CH_4), carbon dioxide (CO_2), and water (H_2O).

Oxidation – the addition of oxygen to an element or compound, or removal of hydrogen or an electron from an element or compound in a chemical reaction. The opposite of reduction.

Reduction – the addition of hydrogen, removal of oxygen or addition of electrons to an element or compound. Under anaerobic conditions in wastewater, elemental sulfur and/or sulfur or compounds are reduced to H_2S or sulfide ions.

Organic Matter

Organic materials are found everywhere in our environment. These materials are composed of the carbon-based chemicals that are the building blocks of most living things. Organic materials in wastewater originate from plants, animals, or synthetic organic compounds, and enter wastewater in human wastes, paper products, detergents, cosmetics, foods, and from agricultural, commercial, and industrial sources.

Organic compounds normally are some combination of carbon, hydrogen, oxygen, nitrogen, and other elements. Many organics are proteins, carbohydrates, or fats and are biodegradable, which means they can be consumed and broken down by organisms. However, even biodegradable materials can cause pollution. In fact, too much organic matter in wastewater can be devastating to receiving waters.

ORGANIC LOADING RATE

Organic loading rate is defined as the application of soluble and particulate organic matter. It is typically expressed on an area basis as pounds of BOD5 per unit area per unit time, such as pounds of BOD5 per square foot per day ($lb/ft^2/day$). The concept of using **organic loading rates** to size an infiltration surface is based on the currently allowable hydraulic loading rates and typical organic concentrations of residential septic tank effluent (STE).

Large amounts of biodegradable materials are dangerous to lakes, streams, and oceans, because organisms use dissolved oxygen in the water to break down the wastes. This can reduce or deplete the supply of oxygen in the water needed by aquatic life, possibly resulting in fish kills, odors, and overall degradation of water quality. This is called eutrophication.

The amount of oxygen organisms need to break down wastes in wastewater is referred to as the biochemical oxygen demand (BOD) and is one of the measurements used to assess overall wastewater strength. Some organic compounds are more stable than others and cannot be quickly broken down by organisms, posing an additional challenge for treatment. This is true of many synthetic organic compounds developed for agriculture and industry.

In addition, certain synthetic organics are highly toxic. Pesticides and herbicides are toxic to humans, fish, and aquatic plants and often are disposed of improperly in drains or carried in stormwater. In receiving waters, they kill or contaminate fish, making them unfit to eat. They also can damage processes in treatment plants. Benzene and toluene are two toxic organic compounds found in some solvents, pesticides, and other products. New synthetic organic compounds are being developed all the time, which can complicate treatment efforts.

Fats, Oil and Grease (FOG)
Fatty organic materials from animals, vegetables, and plastic and other components from petroleum also are not quickly broken down by bacteria and can cause pollution in receiving environments. When large amounts of FOG are discharged to receiving waters from community systems, they increase BOD and they may float to the surface and harden, causing aesthetically unpleasing conditions. They also can trap trash, plants, and other materials, causing foul odors, attracting flies and mosquitoes and other disease vectors. In some cases, too much oil and grease causes septic conditions in ponds and lakes by preventing oxygen from the atmosphere from reaching the water.

Wastewater onsite systems (septic systems) also can be harmed by too much fats, oil and grease, which can clog onsite system drainfield pipes and soils, adding to the risk of system failure. Excessive grease also adds to the septic tank’s scum layer, causing more frequent tank pumping to be required. Both possibilities can result in significant costs to homeowners.

Petroleum-based waste oils used for motors and industry are considered hazardous waste and must be collected and disposed of separately from wastewater.

FAT AND GREASE REMOVAL

In some larger plants, **fat and grease** are removed by passing the sewage through a small tank where skimmers collect the fat floating on the surface. Air blowers in the base of the tank may also be used to help recover the fat as a froth. Many plants, however, use primary clarifiers with mechanical surface skimmers for fat and grease removal.

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Volatile Fatty Acid

Volatile fatty acid **(VFA)** analysis forms an important means of assessing the effectiveness of the digestion process within a wastewater treatment plant. This new analytical technique provides wastewater treatment plant operators with a much improved means of being able to optimize the operation of the digesters in the wastewater treatment plants.

Inorganics

Inorganic minerals, metals, and compounds, such as sodium, potassium, calcium, magnesium, cadmium, copper, lead, nickel, and zinc are common in wastewater from both residential and nonresidential sources. They can originate from a variety of sources in the community including industrial and commercial sources, stormwater, and inflow and infiltration from cracked pipes and leaky manhole covers. Most inorganic substances are relatively stable, and cannot be broken down easily by organisms in wastewater.

Large amounts of many inorganic substances can contaminate soil and water. Some are toxic to animals and humans and may accumulate in the environment. For this reason, extra treatment steps are often required to remove inorganic materials from industrial wastewater sources. For example, heavy metals which are discharged with many types of industrial wastewaters are difficult to remove by conventional treatment methods. Although acute poisonings from heavy metals in drinking water are rare in the U.S., potential long-term health effects of ingesting small amounts of some inorganic substances over an extended period of time are possible.

Nutrient Introduction

Wastewater often contains large amounts of the nutrients nitrogen and phosphorus in the form of nitrate and phosphate, which promote plant growth. Organisms only require small amounts of nutrients in biological treatment, so there normally is an excess available in treated wastewater. In severe cases, excessive nutrients in receiving waters cause algae and other plants to grow quickly depleting oxygen in the water. Water deprived of oxygen, fish and other aquatic life die, emitting foul odors.

Nutrients from wastewater have also been linked to ocean "red tides" that poison fish and cause illness in humans. Nitrogen in drinking water may contribute to miscarriages and is the cause of a serious illness in infants called methemoglobinemia or "blue baby syndrome."

NUTRIENTS

Nutrients are components in foods that an organism uses to survive and grow. Macronutrients provide the bulk energy an organism's metabolic system needs to function while micronutrients provide the necessary cofactors for metabolism to be carried out. Both types of nutrients can be acquired from the environment.

Carbon, nitrogen, and phosphorus are essential to living organisms and are the chief nutrients present in natural water. Large amounts of these nutrients are also present in sewage, certain industrial wastes, and drainage from fertilized land.

Conventional secondary biological treatment processes do not remove the phosphorus and nitrogen to any substantial extent. They may convert the organic forms of these substances into mineral form, making them more usable by plant life.

When an excess of these nutrients over-stimulates the growth of water plants, the result causes unsightly conditions, interferes with boating activities and drinking water treatment processes. It causes unpleasant and disagreeable tastes and odors in drinking water. It may be linked to harmful Algae Blooms (HABS) which are similar to the recently mentioned “red tides” where the algae produces toxins dangerous to humans and animals.

The release of large amounts of nutrients, primarily phosphorus but occasionally nitrogen, causes nutrient enrichment which results in excessive growth of algae.

Uncontrolled algae growth blocks out sunlight and chokes aquatic plants and animals by depleting dissolved oxygen in the water at night. Oxygen is also depleted by the decomposition of excessive amounts of dead algae and plants. The release of nutrients in quantities that exceed the affected waterbody’s ability to assimilate them results in a condition called eutrophication or cultural enrichment.

Gases

Certain gases in wastewater can cause odors, these corrode pipes and pumps and affects treatment, or are potentially dangerous.

Hydrogen sulfide and Methane gas, for example, are byproducts of anaerobic biological treatment and is highly corrosive, flammable, smells like rotten eggs and at high concentrations, is deadly to breath. Special precautions need to be taken near septic tanks, manholes, treatment plants, and other areas where wastewater gases can collect.

Solids- Introduction

Organic and/or Inorganic Materials

Solid materials in wastewater can consist of organic and/or inorganic materials and organisms. The solids must be significantly reduced by treatment or an excessive amount of BOD will be discharged to receiving waters. Solids are removed because they provide places for microorganisms to escape disinfection. They also can clog soil absorption fields in onsite systems.

Settleable Solids

Certain substances, such as sand, grit, and denser than water organic and inorganic materials settle out from the rest of the wastewater collection system or stream during the primary treatment tanks. On the bottom of settling tanks and ponds, organic material makes up a biologically active layer of sludge that aids in treatment. During normal plant operation, only small amounts of settable solids are discharged.

Suspended Solids

Materials that resist settling may remain suspended in wastewater, especially if the wastewater is moving. Suspended solids needs to be reduced to a low level to not interfere with disinfection systems or lower the water quality of the receiving water. Suspended solids in wastewater must be treated, or they will clog soil absorption systems or reduce the effectiveness of disinfection systems.

Dissolved Solids

Small particles of certain wastewater materials can dissolve, like salt in water. Some dissolved materials are consumed by microorganisms in wastewater.

Others dissolved solids, such as heavy metals, are difficult to remove by conventional treatment. Excessive amounts of dissolved solids in wastewater can have adverse effects on the environment.

Total Suspended Solids (TSS)

Total suspended solids (TSS) is the dry-weight of suspended particles that are not dissolved, in a sample of water that can be trapped by a filter that is analyzed using a filtration apparatus.

It is a water quality parameter used to assess the quality of a specimen of any type of water or water body, ocean water for example, or wastewater after treatment in a wastewater treatment plant. It is listed as a conventional pollutant in the U.S. Clean Water Act.

Total dissolved solids is another parameter acquired through a separate analysis which is also used to determine water quality based on the total substances that are fully dissolved within the water, rather than undissolved suspended particles.

Types of Solids on Wastewater

ACRONYM	COMMON TERM	EXPLANATION
TSS	Total Suspended Solids	Solids that cannot pass through a 1.2-μm filter.
TVSS	Total Volatile Suspended Solids	Solids that cannot pass through a 1.2 - μm filter and are burned away when placed in a furnace at 550° C.
TDS	Total Dissolved Solids	Solids that are small enough to pass through a 1.2 - μm filter. The sample must be dried completely before the dissolved solids can be seen with the naked eye.
TS	Total Solids	All of the solid material in a sample. This includes both organic and inorganic solids. TS = TSS + TDS
TVS	Total Volatile Solids	All of the solids in a sample that are burned away when placed in a furnace at 550° C

Secondary Treatment Standards

SAMPLE	30-Day Average, mg/L	7 –Day Average, mg/L	Minimum Percent Removal
BOD 5	30	45	85%
CBOD 5	25	40	85%
TSS	30	45	85%
pH	Instantaneous 6.0 to 9.0 S.U.		

You must abide by your permit requirements and not deviate from them based on information presented in this course.

Hydrogen Sulfide and Ammonia Sub-Section

The gases hydrogen sulfide and ammonia can be toxic and pose asphyxiation hazards. Ammonia as a dissolved gas in wastewater also is dangerous to fish. Both gases have unpleasant odors, which can be a serious nuisance. Unless effectively contained or minimized by design and location, wastewater odors can affect the mental well-being and quality of life of residents. In some cases, odors can even lower property values and affect the local economy.

Hydrogen sulfide or H_2S problems are very common in the collection and wastewater system. There are many chemicals used to help or treat this problem. Here are a few used in the treatment of hydrogen sulfide problems: Salts of zinc, lime, hydrogen peroxide, chlorine and magnesium hydroxide. Hydrogen sulfide production in collection systems can cause a number of problems such as corrosion of the pipes, pumps, manholes, and creation of hazardous atmospheres and foul odors.

Hydrogen sulfide conditions occur in the sewer system because of the lack of oxygen.

The best method of controlling hydrogen sulfide is to eliminate its habitat or growth area by keeping sewers cleaner, this will harbor fewer slime bacteria. Here are some important statements regarding the reduction of hydrogen sulfide: Salts of zinc and iron may precipitate sulfides, lime treatments can also kill bacteria that produce hydrogen sulfide, but this creates a sludge disposal problem and chlorination is effective at reducing the bacteria which produce hydrogen sulfide.

HYDROGEN SULFIDE

Hydrogen sulfide is the chemical compound with the chemical formula $\mathbf{H_2S}$. It is a colorless gas with the characteristic foul odor of rotten eggs. It is very poisonous, corrosive, and flammable. **Hydrogen sulfide** is often produced from the microbial breakdown of organic matter in the absence of oxygen gas, such as in swamps and sewers; this process is commonly known as anaerobic digestion that is done by sulfate-reducing microorganisms.

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ODORS

Odors emitted by sewage treatment are typically an indication of an anaerobic or "septic" condition. Early stages of processing will tend to produce foul-smelling gases, with hydrogen sulfide being most common in generating complaints.

Large process plants in urban areas will often treat the odors with carbon reactors, a contact media with bio-slimes, small doses of chlorine, or circulating fluids to biologically capture and metabolize the noxious gases. Other methods of odor control exist, including addition of iron salts, hydrogen peroxide, calcium nitrate, etc. to manage hydrogen sulfide levels.

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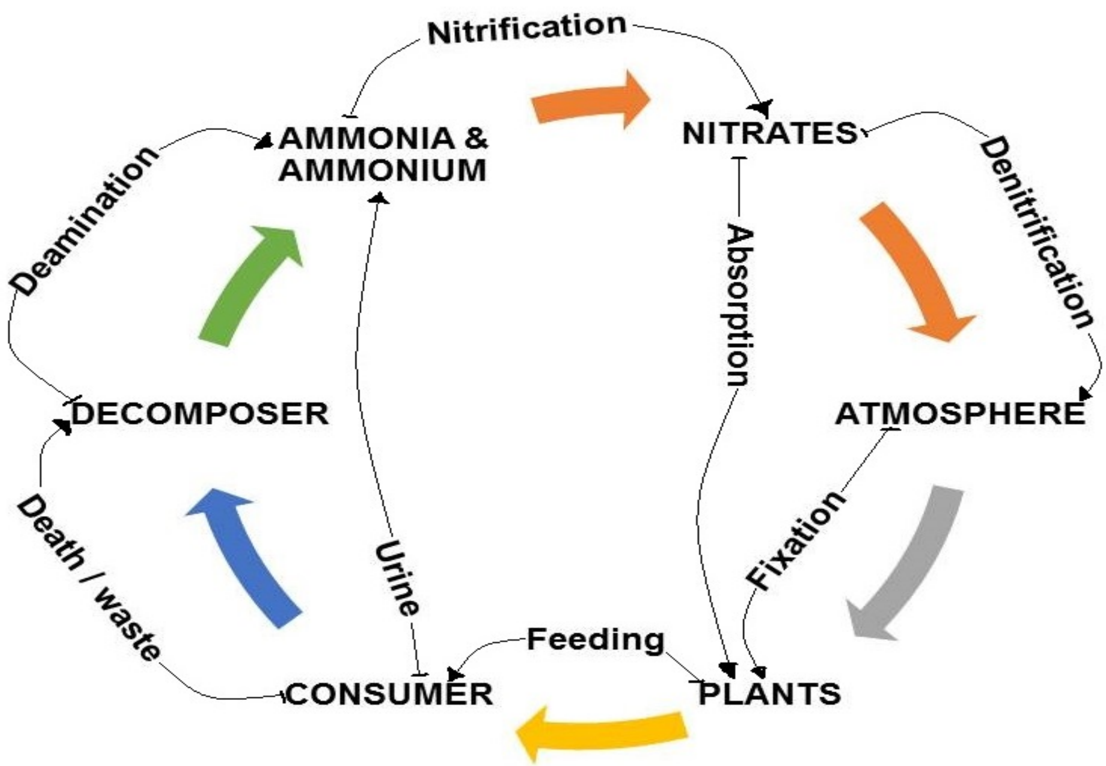
Nutrient Introduction

Influent wastewater contains the micronutrients nitrogen, potassium and phosphorus as well as trace nutrients like iron and manganese. Nitrogen is present in many compounds in wastewater influent including urea (urine), organically bound nitrogen (proteins and other compounds), and ammonia.



NITROGEN CYCLE

Organically bound nitrogen can be soluble or particulate, whereas ammonia is only present as soluble.

Phosphorus is found in particulate or dissolved forms. Phosphorus is present in proteins, urine and detergents. *Much more information on this subject in the Nutrient section.*

Biological Components Sub-Section Introduction

Biochemical Oxygen Demand or BOD Introduction
Wastewater is composed of a variety of inorganic and organic substances.

Organic substances refer to molecules that are based on carbon and include fecal matter as well as detergents, soaps, fats, greases and food particles (especially where garbage grinders are used). These large organic molecules are easily decomposed by bacteria in the POTW or septic system.

However, oxygen is required for this process of breaking large molecules into smaller molecules and eventually into carbon dioxide and water.

The amount of oxygen required for this process is known as the biochemical oxygen demand or BOD.

The five-day BOD, or BOD_5 lab test, is measured by the quantity of oxygen consumed by microorganisms or bacteria under controlled conditions during a five-day period, and is the most common measure of the amount of biodegradable organic material in, or strength of, sewage.

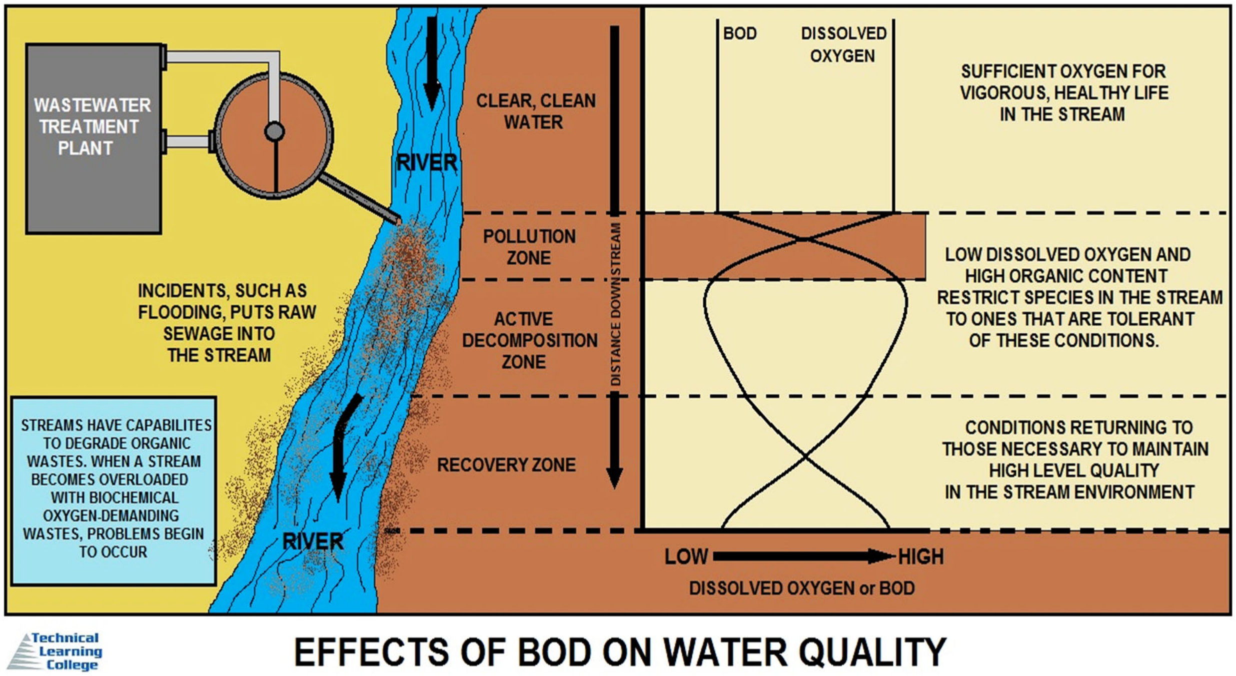
We will cover this area in detail in several different areas of this course. We will cover this area in about ten more pages and again in the Microorganism and Laboratory Sections at the end of the course.

Biochemical Oxygen Demand
Biochemical Oxygen Demand (**BOD or BOD_5**) is an indirect measure of biodegradable organic compounds in water, and is determined by measuring the dissolved oxygen decrease in a controlled water sample over a five-day period. During the five-day period, **aerobic** bacteria (oxygen-consuming) decompose organic matter in the sample and consumes dissolved oxygen in proportion to the amount of organic material that is present. Then what happens is a high BOD concentration of substance can be biologically degraded, thus consuming oxygen and possibly resulting in low dissolved oxygen in the receiving water.

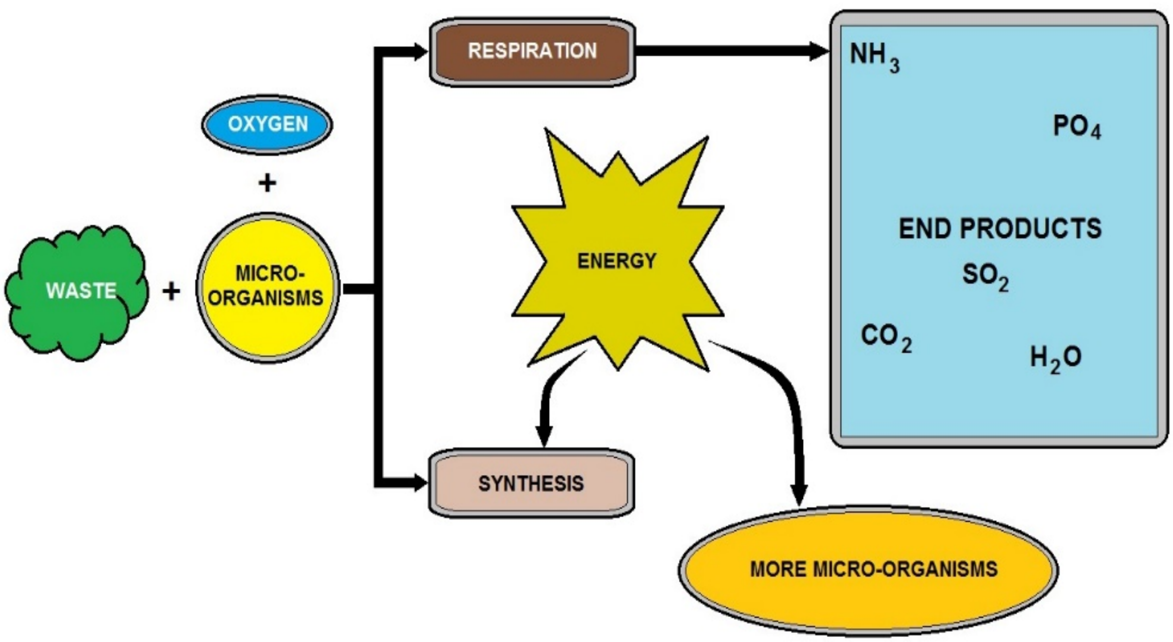
The BOD_5 test was developed for samples dominated by oxygen-demanding pollutants like sewage. While its merit as a pollution parameter continues to be debated, BOD has the advantage of a long period of record.

Organic Carbon
Most organic carbon in water occurs as partly degraded plant and animal materials, some of which are resistant to microbial degradation.

Organic carbon is important in the aquatic or estuarine food web. It is incorporated into the ecosystem by photosynthesis of green plants, then consumed as carbohydrates and other organic compounds by higher animals. In another process, formerly living tissue containing carbon is decomposed as detritus by bacteria, fungi and other microbes.



EFFECTS OF BOD ON WATER QUALITY



BASICS OF WASTEWATER MICROORGANISMS BREAKDOWN

Chemical Reaction Introduction

There are thousands of chemical reactions involved in the metabolism of a bacterium. This diagram identifies three major processes that are relevant to the biological treatment of wastewater. These are Ingestion, Respiration, Growth and division.

Total Organic Carbon (**TOC**)
TOC has a direct relationship with biological and chemical oxygen demand; high levels of TOC can result from human sources. The high oxygen demand being the main concern.

Clarification
A process to reduce the concentration of suspended matter in water. In the activated sludge treatment process, the removal of suspended solids from wastewater is usually through gravity separation in a clarifier.

Return Activated Sludge (RAS)
The settled activated sludge (biomass) that is collected in a secondary clarifier and returned to the secondary treatment process to mix with incoming wastewater. This returns a concentrated population of microorganisms back into the aeration basin.

Waste Activated Sludge (WAS)
The activated sludge (excess biomass or cell mass) removed from the secondary treatment process. For most treatment plants, this will be a small portion of the Return Activated Sludge (RAS) flow stream.

Sludge Volume Index (SVI)
A numerical expression of the settling characteristics of activated sludge in the secondary or final clarifier. SVI is expressed as the ratio of the volume in milliliters of activated sludge settled from a 1,000-mL sample in 30 minutes divided by the concentration of mixed liquor in milligrams per liter multiplied by 1,000. A good settling sludge (textbook value) is 100, but can commonly be between 80-150.

CHEMICAL OXYGEN DEMAND

Oxidizable chemicals (such as reducing chemicals) introduced into a natural water will similarly initiate chemical reactions (such as shown above). Those chemical reactions create what is measured in the laboratory as the **chemical oxygen demand (COD).**

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B.O.D.

Biochemical Oxygen Demand (**BOD**, also called **Biological Oxygen Demand**) is the amount of dissolved oxygen needed (i.e. demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. The **BOD** value is most commonly expressed in milligrams of oxygen consumed per liter of sample during 5 days of incubation at 20 °C and is often used as a surrogate of the degree of organic pollution of water.

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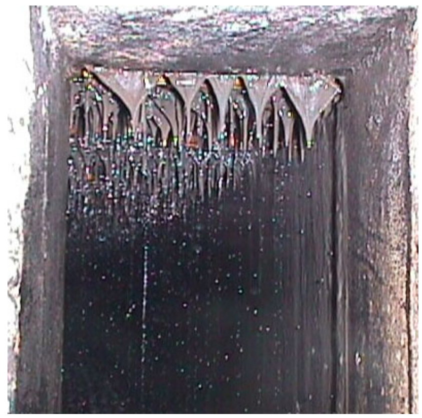
BOD and COD Reduction

Wastewater treatment plants (POTWs) are designed to reduce the BOD and COD in the effluent discharged to receiving or natural waters. The goal is to meet state and federal discharge criteria and protect the environment. It has been said that wastewater treatment plants are designed to function as "microbiology farms," where bacteria and other microorganisms are fed oxygen and organic waste. Wastewater plant operators are farmers striving to create optimum conditions for their crop of bacteria. We as pretreatment inspectors, protect this bacteria crop.

Secondary treatment of wastewater involves biological processes such as the activated sludge system in the secondary stage after preliminary screening to remove coarse particles and primary sedimentation that settles out suspended solids. These secondary treatment steps are generally considered environmental biotechnologies that harness natural self-purification processes contained in bioreactors for the biodegradation of organic matter and bioconversion of soluble nutrients in the wastewater.

Application Specific Microbiology
Each wastewater stream is unique, and so too are the community of microorganisms that process it. This "application-specific microbiology" is the preferred methodology in wastewater treatment affecting the efficiency of biological nutrient removal. The right laboratory prepared bugs are more efficient in organics removal if they have the right growth environment.

This efficiency is multiplied if microorganisms are allowed to grow as a layer of biofilm on specifically designed support media. In this way, optimized biological processing of a waste stream can occur. To reduce the start-up phase for growing a mature biofilm one can also purchase "application specific bacterial cultures" from appropriate microbiology vendors.



Draining Biofilm

Aeration is often used to refresh the wastewater flow at the influent channel.

Pollutants - Oxygen-Demanding Substances

CONVENTIONAL POLLUTANTS

POTWs are designed to treat typical household wastes and biodegradable commercial and biodegradable industrial wastes. The Clean Water Act defines the contaminants from these sources as **conventional pollutants**. **Conventional pollutants** are biological oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH.

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Dissolved oxygen is a key element in water quality that is necessary to support aquatic life. A demand is placed on the natural supply of dissolved oxygen by many pollutants in wastewater. This is called biochemical oxygen demand, or BOD, and is used to measure how well a sewage treatment plant is working. If the effluent, the treated wastewater produced by a treatment plant, has a high content of organic pollutants or ammonia, it will demand more oxygen from the receiving water and leave the water with less oxygen to support fish and other aquatic life. Organic matter and ammonia are “oxygen-demanding” substances.

Oxygen-demanding substances are contributed by domestic sewage, runoff, agricultural and industrial wastes of both plant and animal origin, such as those from food processing, paper mills, tanning, and other manufacturing processes.

These substances are usually destroyed or converted to other compounds by bacteria if there is sufficient oxygen present in the water, but the dissolved oxygen needed to sustain fish life is used up in this break down process.

Pathogens

Disinfection of wastewater and chlorination of drinking water supplies has reduced the occurrence of waterborne diseases such as typhoid fever, cholera, and dysentery, which remain problems in underdeveloped countries while they have been virtually eliminated in the infectious microorganisms, or pathogens, may be carried into surface and groundwater by sewage from cities and institutions, by certain kinds of industrial wastes, such as tanning and meat packing plants, and by the contamination of storm runoff with animal wastes from pets, livestock and wild animals, such as geese or deer.

Humans may come in contact with these pathogens either by drinking contaminated water or through swimming, fishing, or other contact activities. Modern treatment and disinfection techniques have greatly reduced the danger of waterborne disease.

Inorganic and Synthetic Organic Chemicals

A vast array of chemicals is included in this category. Examples include detergents, household cleaning aids, heavy metals, pharmaceuticals, synthetic organic pesticides and herbicides, industrial chemicals, and the wastes from their manufacture. Many of these substances are toxic to fish and other aquatic life and many are harmful to humans. Some are known to be highly poisonous at very low concentrations.

Others can cause taste and odor problems, and many are not effectively removed by conventional wastewater treatment. Heavy metals are discharged with many types of industrial wastewaters, are difficult to remove by conventional wastewater treatment.

TEMPERATURE AND GROWTH RATES

All biological and chemical reactions are affected by temperature. Microorganisms growth and reaction rates are slow at cold temperatures and much faster at warmer temperatures. Most microorganisms do best under moderate temperatures (10-25ºC). Aeration basin temperatures should be routinely measured and recorded.

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Thermal Effects
Heat reduces the capacity of water to retain oxygen. In some areas, water used for cooling is discharged to surface waters at elevated temperatures from power plants and industries.

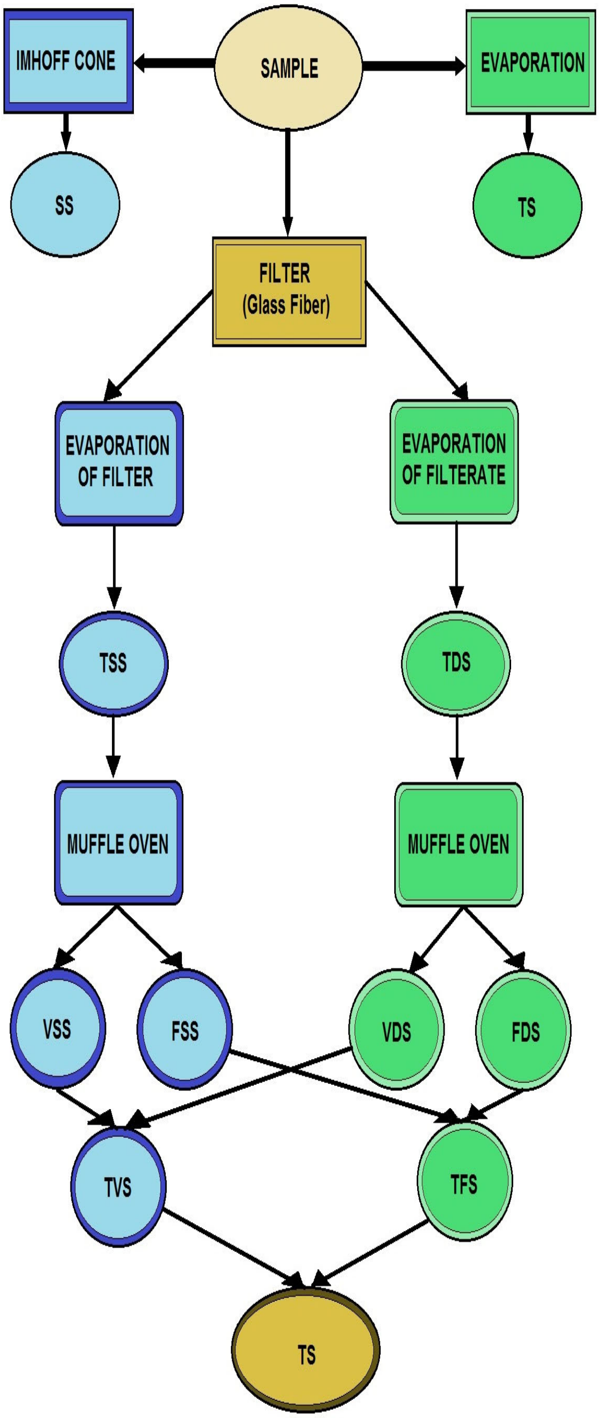
Even discharges from wastewater treatment plants and storm water retention ponds affected by summer heat can be released at temperatures above that of the receiving water, and elevate the stream temperature. Unchecked discharges of waste heat can seriously alter the ecology of a lake, stream, or estuary.

Wastewater Temperature
The maximum temperature of the wastewater entering a biological reactor should be < 95°F (35°C). It is to be understood that many wastewater treatment systems cannot maintain their wastewater at or below this temperature. Nonetheless, the literature seems to be consistent in setting 95°F as the upper limit, beyond which the operation of the biological system and solids settling in the clarifiers will begin to suffer.

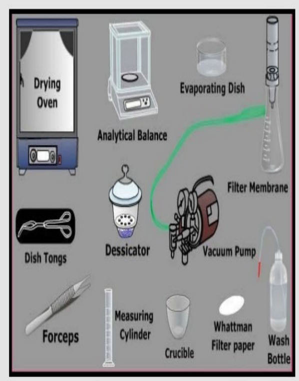
Temperatures in Celsius and Fahrenheit Chart

Reference Point	Degrees in Celsius	Degrees in Fahrenheit
Water Freeing Point Sea Level	**0**	**32**
Typical Winter Wastewater Temperature	**10**	**50**
Room Temperature *	**20**	**68**
Body Temperature (Human)	**37**	**98.6**
Boiling Point of Water at Sea Level	**100**	**212**

Because of the importance of temperature, it will be discussed in other chapters of this course.



TSS: Total Suspended Solids
SS : Settled Solids
TS : Total Solids
FSS: Fixed Suspended Solids
TDS: Total Dissolved Solids
VDS: Volatile Dissolved Solids
FDS: Fixed Dissolved Solids
TVS: Total Volatile Solids
TFS: Total Fixed Solids
VSS: Volatile Suspended Solids



EQUIPMENT USED TO MEASURE AND DETERMINE TYPES OF SOLIDS

DETERMINATION OF DIFFERENT TYPES OF SOLIDS

Key Review Notes

CHEMICAL OXYGEN DEMAND

Oxidizable chemicals (such as reducing chemicals) introduced into a natural water will similarly initiate chemical reactions (such as shown above). Those chemical reactions create what is measured in the laboratory as the **chemical oxygen demand (COD).**

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BOD TESTING CONCEPT

BOD test must create ideal growing conditions which will encourage microorganisms to effectively and efficiently utilize the digestible organic materials (waste). Running a **BOD analysis** on a sample consists of placing a portion of a sample (along with prepared dilution water) into an air-tight bottle (300 ml volume) and incubating the bottle at 20 +/- 1 deg C for (usually) 5 days.

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Chapter 1 – Wastewater Treatment Introduction Post Quiz

This is not your final assignment. You can find the final assignment online.
Hyperlink to the assignment
http://www.abctlc.com/downloads/PDF/Pretreatment%20ASSIGNMENT.pdf

Hyperlink to the Glossary and Appendix
http://www.abctlc.com/downloads/PDF/WWTGlossary.pdf

1. Ammonia is an important component of the nitrogen cycle and because it is oxidized in the environment by microorganisms (i.e., nitrification), it is a large source of available nitrogen in the environment.
True or False

2. Ammonia is a nutrient that contains nitrogen and sulfur.
True or False

3. Un-ionized ammonia refers to all forms of ammonia in water with the exception of the ammonium ion (NH_4^+). Ionized ammonia refers to the ammonium ion.
True or False

4. Indicators of low dissolved-oxygen conditions include non- turbid effluent, or dark gray or black-colored mixed liquor (often with a pleasant odor).
True or False

5. Carbon, ammonia, and copper are essential to living organisms and are the chief nutrients present in natural water.
True or False

6. The best temperatures for secondary wastewater treatment ranges from 77 to 95 degrees Fahrenheit.
True or False

7. In general, biological treatment activity accelerates in cold temperatures and slows in warm temperatures, but extreme hot or cold can stop treatment processes altogether.
True or False

8. The acidity or alkalinity of wastewater affects both treatment and the environment. True or False

9. Low pH indicates increasing acidity while a high pH indicates increasing alkalinity (a pH of 7 is low). The pH of wastewater needs to remain between 4 and 5 to protect organisms. True or False

10. Inorganic minerals, metals, and compounds, such as sodium, potassium, calcium, magnesium, cadmium, copper, lead, nickel, and zinc are not common in wastewater. True or False

11. Heavy metals which are discharged with many types of industrial wastewaters are easy to remove by conventional treatment methods. True or False

12. Although acute poisonings from heavy metals in drinking water are rare - potential long-term health effects of ingesting small amounts of some inorganic substances over an extended period of time are possible. True or False

13. The solids must be significantly reduced by treatment or they can increase BOD when discharged to receiving waters and provide places for microorganisms to escape disinfection.
True or False

14. Certain substances, such as sand, grit, and heavier organic and inorganic materials settle out from the rest of the wastewater stream during the preliminary stages of treatment. True or False

15. Large amounts of dissolved solids in wastewater cannot have adverse effects on the environment. True or False

Wastewater Treatment Introduction Post Quiz Answers
1. True, 2. False, 3. True, 4. False, 5. False, 6. True, 7. False, 8. True, 9. False, 10. False, 11. False, 12. True, 13. True, 14. True, 15. False

Chapter 2 - National Pollutant Discharge Elimination System (NPDES) Permit Program

Section Focus: You will learn the basics of the National Pollutant Discharge Elimination System (NPDES) Permit Program. At the end of this section, you will be able to describe the need for National Pollutant Discharge Elimination System (NPDES) Permit Program. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Under the CWA, EPA has implemented pollution control programs such as setting wastewater discharge standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.

A Pretreatment Inspector sampling an SIU Interceptor.
A great job promotion for any Collection System's Operator.

Pretreatment
The National Pretreatment Program is a cooperative effort of federal, state, and local regulatory environmental agencies established to protect water quality. The program is designed to reduce the level of pollutants discharged by industry and other non-domestic wastewater sources into municipal sewer systems, and thereby, reduce the amount of pollutants released into the environment through wastewater. The objective of the program is to protect the Publicly Owned Treatment Works (POTW) from pollutants that may interfere with plant operation, prevent untreated pollutants from being introduced into the POTW, and to improve opportunities for the POTW to reuse wastewater and biosolids that are generated.

The General Pretreatment Regulations require POTWS that meet certain requirements to develop local pretreatment programs to control industrial discharges into their municipal sewer systems. These programs must be approved by either EPA or the state acting as the pretreatment Approval Authority. More than 1,600 POTWs have developed Approved Pretreatment Programs. EPA has also developed national categorical pretreatment standards that apply numeric pollutant limits to industrial users in specific industrial categories. The General Pretreatment Regulations include reporting and other requirements necessary to implement these categorical standards.

National Pollutant Discharge Elimination System (NPDES) Permit Program

The Clean Water Act requires that all point source wastewater dischargers obtain and comply with an NPDES permit. NPDES permits regulate the discharges from publicly owned wastewater treatment facilities, other wastewater treatment facilities, industrial facilities, concentrated animal feeding operations, aquiculture, and other “point source” dischargers.

The NPDES program also regulates wet weather discharges such as stormwater discharges from industrial activities (e.g. factory stormwater runoff) and municipal stormwater discharges including urban storm-water runoff, combined sewer overflows, and storm sewer overflows.

NPDES permits are developed to ensure that such discharges to receiving waters are protective of human health and the environment. They establish specific discharge limits, monitoring, and reporting requirements and may also require that dischargers undertake measures to reduce or eliminate pollution released to receiving waters.

Violations of permit conditions are enforceable under the Clean Water Act. The EPA uses a variety of techniques to monitor permittee compliance status, including on-site inspections and review of data submitted by permittees. NPDES permits are issued for a term of five years (or less).

State NPDES Programs

The Clean Water Act provides that states may be authorized to operate their own NPDES programs, provided such programs meet minimum federal requirements. As of February 1998, 42 states and the United States Virgin Islands have authorized NPDES programs. Indian nations can also be authorized to operate an NPDES program, More than 200,000 sources are regulated by NPDES permits nationwide, *NPDES Watershed Permitting a NPDES Watershed Strategy* has been developed to ensure that the NPDES Program protects watersheds as effectively as possible. Chief among the NPDES program’s responsibilities is the effective implementation of EPA’s *wet-weather strategies,* including stormwater management and the control of combined sewer and sanitary sewer overflows.

Stormwater Management

Stormwater discharges from many sources are largely uncontrolled. For this reason, the mandate of the *Stormwater Program* is particularly challenging. Amendments to the Clean Water Act established a two-phased approach to address stormwater discharges. Phase 1, currently being implemented, requires permits for separate storm water systems serving large and medium-sized communities (those with over 100,000 inhabitants), and for stormwater discharges associated with industrial and construction activity involving at least five acres. To address the large number of industrial dischargers of stormwater—for populations over 100,000--EPA has developed a strategy with a tiered framework to control administrative burden while emphasizing reduction in risk to human health and ecosystems. Phase 2 will address remaining stormwater discharges. This new regulatory approach would require permits for municipalities in urban areas with populations under 100,000, and smaller construction sites.

Combined Sewer Overflows (CSO)
A combined sewer overflow (CSO) is a discharge from a sewer system that is designed to carry sanitary wastewater and stormwater in the same pipe to a sewage treatment plant. In periods of rainfall or snowmelt, a combined sewer system can discharge excess wastewater directly to rivers, lakes, and estuaries, causing health and environmental hazards because treatment plants cannot handle the extra flow.

Coal Mining
Abandoned coal mines cause many of the greatest impairments to water quality throughout the Appalachian region of the United States. The EPA, the Office of Surface Mining (OSM), the Interstate Mining Compact Commission (IMCC) and concerned states have combined their efforts to develop a proposed comprehensive watershed restoration program to help improve water quality in the areas where abandoned mines are located. These efforts are designed to clean rivers and streams polluted by coal mine drainage, while continuing to work with all affected stakeholders.
The watershed restoration program includes, among other things, efforts to provide incentives for remaining abandoned sites, use of best management practices (BMPs) to achieve limitations on various chemicals, and an increased focus on a cumulative watershed approach that relies upon total maximum daily loads (TMDLs) to achieve compliance with water quality standards (WQS).

Whole Effluent Toxicity (WET)
WET is the total toxic effect of an effluent measured by a biological toxicity test. A WET test captures the effect of all toxicants on exposed test organisms without requiring the identification of specific toxicants. WET replicates to the greatest extent possible the actual environmental exposure of aquatic life to effluent toxicants. WET tests use the same essential procedures as those used to generate water quality criteria.

WET is used in NPDES permits in two fundamental ways:
- to regulate the toxicity of a discharge
- to generate data on the toxicity of a discharge

NPDES permit limits for WET typically are expressed either as a concentration of effluent in clean water that must not result in an unacceptable WET test endpoint (such as lethality of more than half of the test organisms) or a number of toxic units (such as 3 TU) which corresponds to an effluent concentration.

WET Limits
WET limits are typically calculated to ensure that state water quality criteria for toxicity (numeric or narrative) are attained and maintained. Alternatively, WET monitoring requirements instead of WET limits are often included in NPDES to generate toxicity data for use in making future decisions about whether WET needs to be controlled at a particular discharge point.

Types of Regulated Pollutants
CONVENTIONAL POLLUTANTS are contained in the sanitary wastes or wastewater of households, businesses, and industries. These pollutants include human wastes, ground-up food from sink disposals, and laundry and bath waters.

Conventional pollutants include:

PATHOGENS are organisms which cause disease in humans.

TOXIC POLLUTANTS are a list created by the EPA of 129 pollutants that have been found to be harmful to animal or plant life by certain pathways of exposure. They are primarily grouped into organics (including pesticides, solvents, polychlorinated biphenyls (PCBS), and dioxins) and metals (including lead, silver, mercury, copper, chromium, zinc, nickel, and cadmium).

NONCONVENTIONAL POLLUTANTS are any additional substances that are not conventional or toxic that may require regulation. These include nutrients such as nitrogen and phosphorus. The term "pretreatment" refers to the requirement that non-domestic sources discharging wastewater to POTWs control their discharges, and meet limits established by the EPA, and/or your state or the local municipality (Control Authority) on the amount of pollutants allowed to be discharged. The control of the pollutants may necessitate treatment prior to discharge to the POTW (therefore the term "pretreatment").

Limits may often be met by a non-domestic source through pollution prevention techniques (product substitution, recycle and reuse of materials, more efficient production practices, improved environmental management systems, etc.), pretreatment of wastewater, or implementation of best management practices (BMPs).

The **National Pretreatment Program** is a cooperative effort of federal, state, and local regulatory environmental agencies established to protect water quality. The program is designed to reduce the level of pollutants discharged by industry and other non-domestic wastewater sources into municipal sewer systems, and thereby, reduce the amount of pollutants released into the environment from these sources.

The National Pretreatment Program was established by Congress under authority of the Federal Water Pollution Control Act of 1972 (Pub. L. 92-500) as amended by the Clean Water Act of 1977 (Pub. L. 95-217). Implementation requirements of the pretreatment portions of these laws were first codified into 40 Code of Federal Regulations (CFR) Part 403 in 1978.

Objectives of the pretreatment program:
1. Protect publicly owned treatment works (POTW) from pollutants that may cause interference with sewage treatment plant operations.
2. Prevent introducing pollutants into a POTW that could cause pass through of untreated pollutants to receiving waters.
3. Manage pollutant discharges into a POTW to improve opportunities for reuse of POTW wastewater and residuals (biosolids - sewage sludge).
4. Prevent introducing pollutants into a POTW that could cause worker health or safety concerns, or that could pose a potential endangerment to the public or to the environment.

Publically Owned Treatment Works (POTWS)

Publicly owned treatment works (POTWs) collect wastewater from homes, commercial buildings, and industrial facilities and transport it via a series of pipes, known as a collection system, to the treatment plant. Here, the POTW removes harmful organisms and other contaminants from the sewage so it can be discharged safely into the receiving stream. Generally, POTWs are designed to treat domestic and commercial sewage only. Simply defined, the typical POTW treatment process consists of primary and secondary treatment, along with some form of solids handling.

Many POTWs also receive wastewater from industrial (non-domestic) users. The General Pretreatment Regulations establish responsibilities of Federal, State, and local government, industry and the public to implement Pretreatment Standards to control pollutants from the industrial users which may pass through or interfere with POTW treatment processes or which may contaminate sewage sludge.

Preliminary treatment is designed to remove large solids (e.g., rags and debris) and smaller inorganic grit. Typical primary treatment operations include screening and settling. Secondary treatment removes organic contaminants using microorganisms to consume biodegradable organics.

Odor control facility at a modern wastewater treatment plant--the photo on the right is of an enclosed *"headworks"* to help contain odors.

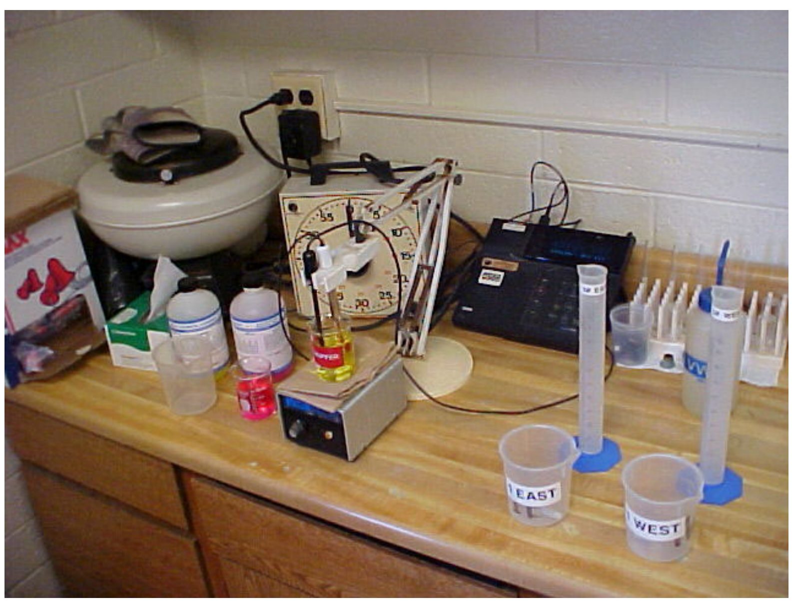
There are two general types of secondary treatment systems, those using suspended growth and those using attached (or fixed) growth. Examples of suspended growth systems are: activated sludge, sequential batch reactors, and oxidation ditches. Examples of fixed growth systems are trickling filters, membrane bioreactors, rotating biological contactors, moving bed biofilms, and constructed wetlands.

Activated sludge, trickling filters, and rotating biological contactors are examples of common secondary treatment operations. Depending on effluent discharge requirements, POTWs may perform other "*advanced treatment*" operations such as nitrification (to convert ammonia and nitrite to the less toxic nitrate), denitrification (to convert nitrate to molecular nitrogen).

Aerated Wastewater – Activated Sludge

Conventional Pollutants *Figure 1*

- Biochemical Oxygen Demand (BOD)
- Total Suspended Solids (TSS)
- Fecal Coliform
- pH
- Oil and Grease (O&G)



A small wastewater treatment plant operator's lab with a centrifuge, timer, pH meter, standard buffer solutions and settling beakers.

Physical-Chemical Treatment

Physical-chemical treatment (to remove dissolved metals and organics), and disinfection (to kill any remaining pathogens). After treatment is complete, effluent is discharged to the receiving stream, typically a creek, river, lake, estuary or ocean. Some POTWs may apply treated effluent directly to golf courses, parkland, or croplands.

Both primary and secondary treatment processes generate waste solids, known as sewage sludge or biosolids. Sludges from the treatment process may be used productively (i.e., as fertilizer or soil conditioner), disposed of in a landfill or incinerated in a dedicated sewage sludge incinerator with the ash also disposed of in a landfill.

POTWs are designed to treat typical household wastes and biodegradable commercial and biodegradable industrial wastes. The Clean Water Act (CWA) and the EPA define the contaminants from these sources as conventional pollutants.

Conventional pollutants are identified in Figure 1 above and include those specific pollutants that are expected to be present in domestic discharges to POTWs.

Commercial and industrial facilities may, however, discharge toxic pollutants that the treatment plant is neither designed for nor able to remove.

Discharge to POTW *(Credit to USEPA)*

As noted above, POTWs are not designed to treat toxics in industrial waste. As such, these discharges, from both industrial and commercial sources, can cause serious problems. The undesirable outcomes of these discharges can be prevented using treatment techniques or management practices to reduce or eliminate the discharge of these contaminants. The act of treating wastewater prior to discharge to a POTW is commonly referred to as “pretreatment.”

The National Pretreatment Program, published in Title 40 Code of Federal Regulations (CFR) Part 403, provides the regulatory basis to require non-domestic dischargers to comply with pretreatment standards (effluent limitations) to ensure that the goals of the CWA are attained.

As noted in 40CFR §403.2, the objectives of the National Pretreatment Program are to:

a. Prevent the introduction of pollutants into POTWs which will interfere with the operation of a POTW, including interference with its use or disposal of municipal sludge;

b. Prevent the introduction of pollutants into POTWs which will pass through the treatment works or otherwise be incompatible with such works; and

c. Improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges.

The two key terms used in the EPA’s objectives for the National Pretreatment Program, “*interference*” and “*pass through*,” are defined below.

Definitions
Interference - a discharge which, alone or in conjunction with a discharge or discharges from other sources, both (1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal, and (2) therefore is a cause of a violation of any NPDES permit requirement or of the prevention of sewage sludge use or disposal in compliance with any applicable requirements.

Pass Through - a discharge which exits the POTW into waters of the U.S. in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any NPDES permit requirement.

Toxic pollutants may pass through the treatment plant into the receiving stream, posing serious threats to aquatic life, to human recreation, and to consumption of fish and shellfish from these waters.

Pass through can make waters unswimmable or unfishable in direct contrast to the goals of the CWA. Or, these discharges can interfere with the biological activity of the treatment plant causing sewage to pass through the treatment plant untreated or inadequately treated.

Problems Associated With Toxic Discharges ***Figure 3***

Air pollution can occur from volatilization of toxic chemicals in the POTW collection system or treatment plant, or through incineration of sewage sludge.

Corrosion of collection system and treatment plant from acidic discharges or discharges containing elevated levels of sulfate (forming toxic and corrosive hydrogen sulfide).

Groundwater pollution can occur from leaks in the collection system or pollutants leached from contaminated sewage sludge, land applied biosolids.

National Pretreatment Program - Introduction

The National Pretreatment Program identifies specific requirements that apply to all IUs, additional requirements that apply to all SIUs, and certain requirements that only apply to CIUs.

The objectives of the National Pretreatment Program are achieved by applying and enforcing three types of discharge standards:

- **prohibited discharge standards**
- **categorical Pretreatment standards**
- **local limits**

Prohibited Discharge Standards *(Credit USEPA)*

Prohibited discharge standards are somewhat general, national standards are applicable to all industrial users to a POTW, regardless of whether or not the POTW has an approved pretreatment program or the industrial user has been issued a permit.

These standards are designed to protect against pass through and interference, protect the POTW collection system, and to promote worker safety and beneficial biosolids use. These standards are listed in 40 CFR 403.5

For Final Regulations pertaining to the Pretreatment Program, refer to 40 CFR Part 403 general pretreatment regulations (Located in the rear of this course).

Categorical Pretreatment Standards

Categorical Pretreatment Standards are limitations on pollutant discharges to publicly owned treatment works (POTWs), promulgated by the EPA in accordance with Section 307 of the Clean Water Act that apply to specific process wastewaters of particular industrial categories.

These are national, technology-based standards that apply regardless of whether or not the POTW has an approved pretreatment program or the industrial user has been issued a permit. Such industries are called Categorical Industrial Users. The standards applicable to industrial discharges to a POTW collection system are designated in the Effluent Guidelines & Limitations [Parts 405-471] by the terms "Pretreatment Standards for Existing Sources" (or "PSES") and "Pretreatment Standards for New Sources" (or "PSNS").

Note: The Effluent Guidelines & Limitations designated by the terms "Best Practicable Control Technology Currently Available (BPT)", "Best Available Technology Economically Achievable (BAT)", "Best Conventional Pollutant Control Technology (BCT)", and "New Source Performance Standards (NSPS)" apply to industries that discharge process wastewater to waters of the U.S. and should have a National Pollutant Discharge Elimination System (NPDES) Permit.

Regulations for all Effluent Guidelines and Standards are located at: http://www.epa.gov/

Additional information on ongoing Categorical Standards Projects and recently published rules is located at: http://www.epa.gov/

Conventional Pollutants (Credit USEPA)
BOD, TSS, fecal coliform, oil and grease, and pH

In the above photo, sampling equipment being air dried after being washed. You as a Sampler will spend up to 1-2 hours a day preparing your sample bottles. This may include washing your sample tools, bottles and other equipment.

Some bottles will need to be washed in a three or four step process. Hydrochloric and other acids are used for the cleaning of glass bottles. The Pickle jar or large jar is often re-used and washed on a daily basis.

Sometimes, Pretreatment Inspectors and Stormwater Inspectors will often work in pairs. Usually one Inspector will spend a lot of time setting up automatic samplers and programming flow meters, while the other Inspector will calibrate pH meters and related laboratory equipment, pre-preserve sample bottles, gather ice and calibrate the safety equipment and gas meters.

Some POTWs will hire both Samplers and Inspectors and split these duties up. Other POTWs will utilize Inspectors as Samplers.

Parshall Fume and Ultrasonic Flow Meter

Notice the debris, most POTW's will write a NOV for uncleanness, the POTW's that do not write NOV's will usually not have an ordinance in place.

Debris in the bottom of a flume will lower the accuracy of the flume measurements. This could trigger the issuing of a NOV

Professor Melissa Durbin in her water quality/pollution control days as a pretreatment inspector. Since then she has taught thousands of operators the skills necessary to become an effective inspector.

Local Limits *(Credit USEPA)*

Local limits are developed to reflect specific needs and capabilities at individual POTWs and designed to protect the POTW receiving waters. Regulations at 40 CFR 403.8(f)(4) state that POTW Pretreatment Programs must develop local limits or demonstrate that they are unnecessary; 40 CFR 403.5(c) states that local limits are needed when pollutants are received that could result in pass through or interference at the POTW. Essentially, local limits translate the general prohibited discharge standards of 40 CFR 403.5 to site-specific needs.

Assistance on how to develop local limits may be found in the Guidance Manual for the Development and Implementation of Local Discharge Limitations under the Pretreatment Program.). Information related to ordering this publication from the Office of Wastewater Management is located at: http://www.epa.gov/.

The EPA Supplemental Manual on the Development And Implementation of Local Discharge Limitations Under the Pretreatment Program: Residential and Commercial Toxic Pollutant Loadings and POTW Removal published May 1, 1991 provides information related to residential and commercial sources of toxic pollutants and estimated removal efficiencies of municipal treatment processes.

Two automatic wastewater samplers, one for regulatory compliance like Local Limits and the other sampler for the wastewater plant operator to determine plant efficiency.

LOCAL LIMITS

Delegated POTWs must control SIUs individually and not impose limits on them that may allow violations of the general or specific prohibitions. The POTW generally should impose required local limits (limits imposed by POTW to prevent interference or pass-through) for all SIUs, and is required to when interference or pass-through has occurred and may reoccur. A POTW also must evaluate **local limits** if an SIU causes interference or pass-through without violating a **local limit**. In addition to required local limits, a POTW may set other local limits not required by pretreatment rules. The State can enforce required local limits, but cannot enforce the non-required limits.

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LOADING LIMITS

In the context of an NPDES permit, a loading limit determines the amount of a pollutant (in pounds per day) which can be discharged in wastewater effluent. The loading limit is generally based upon the allowable concentration of the pollutant and a design flow rate for the discharge.

The loading limit would be calculated as follows:
loading limit = Flow million gallons/day x 8.34 lbs/gallon x Concentration mg/L

Loading limits are normally not included in indirect discharge permits, with an exception being permits for food processors.

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As a pretreatment inspector, you should be memorizing these terms (see above boxes). These USEPA terms are essential for any successful pretreatment inspector to communicate with the public.

The Need for the Pretreatment Program

The average American uses roughly 100 to 200 gallons of water a day, with less than one percent of that water actually being consumed. The rest is used for activities such as washing, preparing food, watering lawns, heating and cooling, transporting wastes, and fire protection. The public is very conscious about the quality of water that comes out of their tap each day, quickly notifying authorities of changes in appearance, odor, and taste.

Americans, on average, discharge slightly less than this amount of wastewater to local sewage treatment plants daily. This wastewater (commonly referred to as "*domestic sewage*") receives much less attention than drinking water, likely the result of an "out of sight, out of mind" attitude.

Most people take it for granted that once water goes down the drain, it will be handled appropriately. In fact, this attitude has carried over to industry as well, as can be seen by reading the labels of many household products. These labels often recommend that waste or excess product be disposed of down the drain. Other toxic or hazardous products are actually designed to be disposed of down the drain (e.g., drain clog remover).

Recall the phosphate detergent problems of the late 1960s and early 70s; large doses of phosphate, found in most detergents at the time, were passing through municipal treatment plants and overloading lakes, causing large algal blooms to form and subsequently reducing available light, food and oxygen for fish and other aquatic organisms. While great strides have been taken to address the phosphate problem, it is possible that other problematic pollutants are being dumped down the drain at the expense of human health and the environment.

GENERAL PROHIBITIONS

The federal pretreatment regulations at 40 CFR Part 403.5(a)(1) includes **"general prohibitions"** for industrial users stating that no user shall introduce into a POTW any pollutant(s) which causes pass through or interference. The federal regulations also established specific prohibitions for users.

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National Pretreatment Program's Purpose
It is a cooperative effort of federal, state, and local environmental regulatory agencies established to protect water quality. The EPA authorizes the NPDES permit program to state, tribal, and territorial governments to perform permitting, administrative, and enforcement tasks for discharges to surface waters (NPDES program), EPA and authorized NPDES state pretreatment programs approve local municipalities to perform permitting, administrative, and enforcement tasks for discharges into the municipalities' publicly owned treatment works (POTWs). The national pretreatment program is a component of the NPDES program.

National Pretreatment Program’s Objectives
The national pretreatment program requires nondomestic dischargers to comply with pretreatment standards to ensure the goals of the Clean Water Act (CWA) are attained.

The objectives of the program are to:

- prevent the introduction of pollutants into a POTW that will interfere with its operation, including interference. A discharge that, alone or in conjunction with a discharge or discharges from other sources, both
  (1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use, or disposal; and
  (2) therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with ... [applicable] statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations). [paraphrased from 40 CFR 403.3(k)] with its use or disposal of municipal sludge,
- prevent the introduction of pollutants into a POTW that will pass through the treatment works or otherwise be incompatible with it, and
- improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges.

Pretreatment Standards
The National Pretreatment Program identifies specific requirements that apply to all IUs, additional requirements that apply to all SIUs, and certain requirements that only apply to CIUs. The objectives of the National Pretreatment Program are achieved by applying and enforcing three types of discharge standards:

< ***prohibited discharge standards***
< ***categorical standards***
< ***local limits***.

\
As a pretreatment inspector, you should be memorizing these terms (see above boxes). These USEPA terms are essential for any successful pretreatment inspector to communicate with the public. Most wastewater treatment operators knows these terms.

Applicability of Pretreatment Standards and Requirements

The national pretreatment program objectives are achieved by applying and enforcing three types of pretreatment standards:

- General and specific prohibitions
- Categorical pretreatment standards
- Local limits

CATEGORICAL INDUSTRIAL USER

A **categorical industrial user** is an industry or entity which is subject to categorical standards. The wastewater from an entity or industry discharging into a sewer system tributary to a POTW (industrial user - IU) may be as simple and uncomplicated as that of a coin-operated car wash or as complex as an automobile manufacturing plant or a synthetic organic chemical producer. The IUs discharging complex wastewater would likely be subject to categorical standards, which is one of the defining criteria for significant industrial users.

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All three types of standards can be enforced by EPA, the state, and local government, even though they are developed at different levels of government (i.e., federal, state, and local). Pretreatment standards and requirements can be expressed as numeric limits, narrative prohibitions, and best management practices. The most effective and practical ways to control pollutants and meet environmental quality goals. BMPs exist for forestry, agriculture, stormwater and many other sectors. (BMPs The most effective and practical ways to control pollutants and meet environmental quality goals. BMPs exist for forestry, agriculture, stormwater and many other sectors.).

IUs should be aware of the standards that apply to them. The control authority, in the case of a POTW with an approved pretreatment program, or the Approval Authority, in the case of a POTW without an approved pretreatment program. [paraphrased from 40 CFR 403.3(f)] is responsible for identifying standard(s) applicable to each IU and applying the most stringent requirements where multiple provisions exist.

The different pretreatment standards are applied to IUs, significant industrial users (SIU (1) All users subject to categorical pretreatment standards under 40 CFR 403.6 and 40 CFR chapter I, subchapter N, except those designated as NSCIUs; and (2) Any other IU that discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling, and boiler blowdown wastewater); contributes a process wastestream that makes up 5 percent or more of the average dry-weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the POTW on the basis that the IU has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement [in accordance with 40 CFR 403.8(f)(6)]. [40 CFR 403.3(v)]s), and categorical industrial users (CIUs) as follows:

	General and Specific Prohibitions	Categorical Pretreatment Standards	Local Limits
All IUs	X		May apply; depends on publicly owned treatment works (POTW) ordinance and permit provisions
SIUs	X		Generally apply; may depend on allocation method
CIUs	X	X	Generally apply; may depend on allocation method

CATEGORICAL STANDARDS

Categorical standards are technology-based limitations on pollutant discharges to POTWs, which have been promulgated by U.S. EPA in accordance with Section 307 of the Clean Water Act, and apply to specific process wastewater discharges for thirty-two (32) different industrial categories. (Categorical standards can be found in 40 CFR Parts 405-471.) Categorical standards are similar to federal effluent guidelines (FEGs), with two important distinctions:

- **categorical standards** apply to indirect discharges while FEGs apply only to direct discharges to surface waters; and
- **categorical standards** are developed with the assumption that the POTW will remove at least small amounts of a pollutant, therefore the categorical standard for the pollutant will be less stringent than the corresponding best available technology (BAT) limits for the FEG applied to a direct discharger

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Proper Sample Handling- *Example*

The proper handling of water quality samples includes wearing gloves. Gloves not only protect field personnel, but also prevent potential contamination of the sample. Always wear powderless, disposable gloves. When sampling for inorganics, wear latex gloves. Nitrile gloves are appropriate for organics.

The following sections provide a field reference for chain of custody procedures, sampling surface water and ground water, and further provides procedures for measuring field parameters and handling water-quality samples.

Use chain-of-custody (COC) procedures when coolers and containers are prepared, sealed and shipped. They will remain sealed until used in the field. When making arrangements with the laboratory, make sure you request enough containers, including those for blank and duplicate samples. Order extra sample bottles to allow for breakage or contamination in the field.

Though not all samples require low-temperature (4°C), it is routine to store all samples in a cooler with ice packs. Some samples require chemical preservations to maintain their integrity during shipment and before analysis in the laboratory. The most common preservatives are hydrochloric, nitric, sulfuric and ascorbic acids, sodium hydroxide, sodium thiosulfate, and biocides.

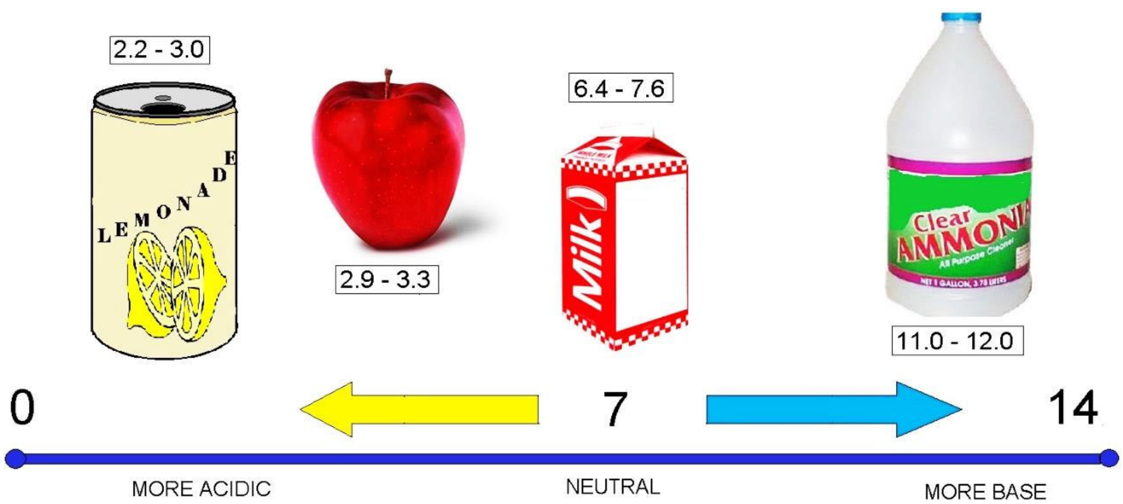
Many laboratories provide pre-preserved bottles filled with measured amounts of preservatives. Although most federal and state agencies allow the use of pre-preserved sample containers, some may require either cool temperatures or added preservatives in the field.

When the containers and preservatives are received from the laboratory, check to see that none have leaked. Be aware that many preservatives can burn eyes and skin, and must be handled carefully. Sampling bottles should be labeled with type of preservative used, type of analysis to be done and be accompanied by a Safety Data Sheet (SDS).

Make sure you can tell which containers are pre-preserved, because extra care must be taken not to overfill them when collecting samples in the field. Check with the laboratory about quality control procedures when using pre-preserved bottles. Coolers used for sample shipment must be large enough to store containers, packing materials and ice. Obtain extra coolers, if necessary. Never store coolers and containers near solvents, fuels or other sources of contamination or combustion. In warm weather, keep coolers and samples in the shade.

Field Parameters
Measure and record the field parameters of temperature, electrical conductivity, pH and dissolved oxygen in an undisturbed section of waste stream flow. Other parameters may be measured, if desired can be done in the field.

Wastewater Sample Station found at some water or wastewater treatment plants. This tap will allow the operator to obtain Grab Samples for pH, Temperature, COD, Bacterial, ORP, OUP, Organic and Inorganic field parameters. We will cover sampling and pH in greater detail.



Simple pH Scale

pH is a logarithmic scale. A pH of 6 is 10 times as acidic as a pH of 7 and a pH of 5 is ten times as acidic as a pH of 6.

NPDES Permit Information

INTERFERENCE

Interference: a discharge from an industrial user that, alone or in conjunction with other sources a) inhibits or disrupts a POTW plant, its treatment processes or operations, or its sludge processes, use, or disposal, and b) therefore causes a violation including increasing a violation's magnitude or duration of any permit or rule that controls release of pollutants from the POTW.

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PASS-THROUGH

Pass-through: a POTW has a violation of its limits caused by an industrial users discharge that **passes through** the public facility without being adequately treated. The pollutant limit violated must be a pollutant discharged by the industrial user, but it's not necessary to demonstrate impact on the POTW operation.

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Secondary Treatment Standards

SAMPLE	30-Day Average, mg/L	7 –Day Average, mg/L	Minimum Percent Removal
BOD 5	30	45	85%
CBOD 5	25	40	85%
TSS	30	45	85%

You must abide by your permit requirements and not deviate from them based on information presented in this course.

Key Review Notes

CONVENTIONAL POLLUTANTS

POTWs are designed to treat typical household wastes and biodegradable commercial and biodegradable industrial wastes. The Clean Water Act defines the contaminants from these sources as **conventional pollutants**. **Conventional pollutants** are biological oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH**.**

GENERAL PROHIBITIONS

The federal pretreatment regulations at 40 CFR Part 403.5(a)(1) includes **"general prohibitions"** for industrial users stating that no user shall introduce into a POTW any pollutant(s) which causes pass through or interference. The federal regulations also established specific prohibitions for users.

INDIRECT DISCHARGE

An **indirect discharge** is represented by an industry or business which sends wastewater to a sewer system tributary to a POTW in contrast to discharging directly into state surface waters. While **direct discharges** to surface waters are regulated under the NPDES permit program, indirect discharges are regulated as a component of the NPDES Permitting Program through the National Pretreatment Program. The National Pretreatment Program requires industrial and commercial dischargers to treat or control pollutants in their wastewater prior to discharge to POTWs.

Toxic Emissions Introduction *(Credit to USEPA)*

Toxic metals can inhibit both aerobic and anaerobic bacteria. Though many toxic metals will pass-through, some will end up in a POTW's Biosolids. This not only disrupts sludge digestion, but the contamination may also limit the available sludge disposal options.

Even where the POTW has the capability to remove these toxics, the pollutants may end up in the sewage sludge, thereby limiting sludge disposal options or escalating the cost of disposal. Incinerated contaminated sludge may release toxic emissions into the atmosphere. Toxic metals removed in primary treatment, while itself not an inhibitory process, can impact sludge digestion, a process that utilizes bacteria to stabilize sludge solids.

For example, chromium can inhibit reproduction of aerobic digestion microorganisms, thereby disrupting sludge treatment and producing sludges that must be disposed of with special treatment. Uncontaminated sludge, on the other hand, can be used as fertilizer or soil conditioner, thereby improving the productivity of our land. Many municipalities apply sewage sludge to pastureland or parkland that they could not do if the sludge were contaminated.

Tools of the Trade… Above photos***,*** the Refrigerated Automatic Sampler will have a Data programmer which will allow you to set the time to collect the sample or samples. This machine can also measure the amount of the sample.

These can also be used for the collection of composite samples. Sometimes you will see a pH probe with real-time reads sent to the Operator's Command Center. A common site on most wastewater plants and SIUs.

Care must be taken when setting up a new sampler. Programming, leveling, calibration, and power supply should be double checked to insure accurate sampling.

One big disappointment, expect sampler failures. Dead batteries, wrong sample times and over and under filling the sampler is common.

Volatile Organic Compounds (VOCs) Introduction

One more important issues that needs to be addressed before covering the essential elements of a pretreatment program is volatile organics. Volatile organics discharged to sewers can accumulate in the headspace of sewers, increasing the likelihood of explosions that can cause significant damage. Probably the most well-known impact from industrial discharges to POTWs in the U.S. is the explosion in Louisville, KY that occurred in 1981 as the result of excessive discharges of hexane into the collection system, eventually igniting and destroying more than 13 miles of sewers and causing $20 million in damage. Discharge limitations and management practices to control slug discharges have significantly reduced the likelihood of future catastrophes such as the explosion in Louisville.

Discharges of toxic organics can also result in the release of poisonous gas. This occurs most often when acidic wastes react with other wastes in the discharge. For example, cyanide and acid, both present in many electroplating operations, react to form highly toxic hydrogen cyanide gas. Similarly, sulfides from leather tanning can combine with acid to form hydrogen sulfide, another toxic gas. These can be highly dangerous to POTW collection system operators exposed to such conditions in the performance of their duties.

The National Pretreatment Program is charged with controlling the 129 Priority Pollutants from industries that discharge into sewer systems as described in the CWA (see Appendix A).

These pollutants fall into two categories; metals and organics:

- All metals, including lead, mercury, chromium, and cadmium that cannot be destroyed or broken down through treatment or environmental degradation. Toxic metals can cause various human health problems such as lead poisoning and cancer. Additionally, consumption of contaminated seafood and agricultural food crops has resulted in exposures exceeding recommended safe levels.

- Toxic organics, including solvents, pesticides, dioxins, and polychlorinated biphenyls (PCBs) can cause cancer and lead to other serious ailments, such as kidney and liver damage, anemia, and heart failure. In 1996, the EPA's Office of Science and Technology (OST) identified 2,193 water bodies with fish and wildlife advisories, up more than 25 percent from 1995.

Reductions in pollutants can ensure that industrial development vital to the economic well-being of a community is compatible with a healthy environment.

Many POTWs are responsible for ensuring that industrial and commercial facilities do not cause problems resulting from their discharges.

In 1991, the EPA estimated that 190 to 204 million pounds of metals and 30 to 108 million pounds of organics were removed each year as a result of pretreatment program requirements.

This is substantiated by many POTWs that report significant reductions in the loadings of toxics to their treatment plants that is directly attributable to implementation of the National Pretreatment Program.

Section 101 of the Clean Water Act (CWA)

To restore and maintain the chemical, physical, and biological integrity of the Nation's waters:
(1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;
(2) it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;
(3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;
(4) it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works;
(5) it is the national policy that Area wide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State;
(6) it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans; and
(7) it is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Chapter to be met through the control of both point and nonpoint sources of pollution.

Treated wastewater outfall.

Appendix A to 40 CFR, Part 423--126 Priority Pollutants

001 Acenaphthene
002 Acrolein
003 Acrylonitrile
004 Benzene
005 Benzidine
006 Carbon tetrachloride (tetrachloromethane)
007 Chlorobenzene
008 1,2,4-trichlorobenzene
009 Hexachlorobenzene
010 1,2-dichloroethane
011 1,1,1-trichloreothane
012 Hexachloroethane
013 1,1-dichloroethane
014 1,1,2-trichloroethane
015 1,1,2,2-tetrachloroethane
016 Chloroethane
018 Bis(2-chloroethyl) ether
019 2-chloroethyl vinyl ether (mixed)
020 2-chloronaphthalene
021 2,4, 6-trichlorophenol
022 Parachlorometa cresol
023 Chloroform (trichloromethane)
024 2-chlorophenol
025 1,2-dichlorobenzene
026 1,3-dichlorobenzene
027 1,4-dichlorobenzene
028 3,3-dichlorobenzidine
029 1,1-dichloroethylene
030 1,2-trans-dichloroethylene
031 2,4-dichlorophenol
032 1,2-dichloropropane
033 1,2-dichloropropylene (1,3-dichloropropene)
034 2,4-dimethylphenol
035 2,4-dinitrotoluene
036 2,6-dinitrotoluene
037 1,2-diphenylhydrazine
038 Ethylbenzene
039 Fluoranthene
040 4-chlorophenyl phenyl ether
041 4-bromophenyl phenyl ether
042 Bis(2-chloroisopropyl) ether
043 Bis(2-chloroethoxy) methane
044 Methylene chloride (dichloromethane)
045 Methyl chloride (dichloromethane)
046 Methyl bromide (bromomethane)
047 Bromoform (tribromomethane)
048 Dichlorobromomethane
051 Chlorodibromomethane
052 Hexachlorobutadiene
053 Hexachloromyclopentadiene
054 Isophorone
055 Naphthalene
056 Nitrobenzene
057 2-nitrophenol
058 4-nitrophenol
059 2,4-dinitrophenol
060 4,6-dinitro-o-cresol
061 N-nitrosodimethylamine
062 N-nitrosodiphenylamine
063 N-nitrosodi-n-propylamin
064 Pentachlorophenol
065 Phenol
066 Bis(2-ethylhexyl) phthalate
067 Butyl benzyl phthalate
068 Di-N-Butyl Phthalate
069 Di-n-octyl phthalate
070 Diethyl Phthalate
071 Dimethyl phthalate
072 1,2-benzanthracene (benzo(a) anthracene
073 Benzo(a)pyrene (3,4-benzo-pyrene)
074 3,4-Benzofluoranthene (benzo(b) fluoranthene)
075 11,12-benzofluoranthene (benzo(b) fluoranthene)
076 Chrysene
077 Acenaphthylene
078 Anthracene
079 1,12-benzoperylene (benzo(ghi) perylene)
080 Fluorene
081 Phenanthrene
082 1,2,5,6-dibenzanthracene (dibenzo(,h) anthracene)
083 Indeno (,1,2,3-cd) pyrene (2,3-o-pheynylene pyrene)
084 Pyrene
085 Tetrachloroethylene
086 Toluene
087 Trichloroethylene
088 Vinyl chloride (chloroethylene)
089 Aldrin
090 Dieldrin
091 Chlordane (technical mixture and metabolites)
092 4,4-DDT
093 4,4-DDE (p,p-DDX)
094 4,4-DDD (p,p-TDE)
095 Alpha-endosulfan
096 Beta-endosulfan
097 Endosulfan sulfate
098 Endrin
099 Endrin aldehyde
100 Heptachlor
101 Heptachlor epoxide (BHC-hexachlorocyclohexane)
102 Alpha-BHC
103 Beta-BHC
104 Gamma-BHC (lindane)
105 Delta-BHC (PCB-polychlorinated biphenyls)
106 PCB-1242 (Arochlor 1242)
107 PCB-1254 (Arochlor 1254)
108 PCB-1221 (Arochlor 1221)
109 PCB-1232 (Arochlor 1232)
110 PCB-1248 (Arochlor 1248)
111 PCB-1260 (Arochlor 1260)
112 PCB-1016 (Arochlor 1016)
113 Toxaphene
114 Antimony
115 Arsenic
116 Asbestos
117 Beryllium
118 Cadmium
119 Chromium
120 Copper
121 Cyanide, Total
122 Lead
123 Mercury
124 Nickel
125 Selenium
126 Silver
127 Thallium
126 Silver
128 Zinc
129 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD)

Summary

What is an NPDES permit?
The Clean Water Act prohibits anybody from discharging "pollutants" through a "point source" into a "water of the United States" unless they have an NPDES permit. The permit will contain limits on what you can discharge, monitoring and reporting requirements, and other provisions to ensure that the discharge does not hurt water quality or people's health. In essence, the permit translates general requirements of the Clean Water Act into specific provisions tailored to the operations of each person discharging pollutants.

Clean Water Act's National Pollutant Discharge Elimination System (NPDES)
Pollutants in industrial wastewater may compromise municipal treatment plant processes or contaminate public waters. To protect municipal treatment plants and the environment, the Pretreatment Program requires industrial dischargers to use treatment techniques and management practices to reduce or eliminate the discharge of harmful pollutants to sanitary sewers. The Pretreatment Program is a core part of the Clean Water Act's National Pollutant Discharge Elimination System (NPDES). The National Pretreatment Program's primary goal is to protect Publicly Owned Treatment Works (POTWs) and the environment from adverse impacts that might occur when pollutants are discharged into a sewage system.

What is a point source?
The term point source is also defined very broadly in the Clean Water Act because it has been through 25 years of litigation. It means any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container. It also includes vessels or other floating craft from which pollutants are or may be discharged. By law, the term "point source" also includes concentrated animal feeding operations, which are places where animals are confined and fed. By law, agricultural stormwater discharges and return flows from irrigated agriculture are not "point sources"

What is a water of the United States?
The term water of the United States" is also defined very broadly in the Clean Water Act and after 25 years of litigation. It means navigable waters, tributaries to navigable waters, interstate waters, the oceans out to 200 miles, and intrastate waters which are used: by interstate travelers for recreation or other purposes, as a source of fish or shellfish sold in interstate commerce, or for industrial purposes by industries engaged in interstate commerce.

What is a pollutant?
The term pollutant is defined very broadly in the Clean Water Act . It includes any type of industrial, municipal, and agricultural waste discharged into water. Some examples are dredged soil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste. By law, a pollutant is not sewage from vessels or discharges incidental to the normal operation of an Armed Forces vessel, or certain materials injected into an oil and gas production well.

What are the primary differences between an NPDES individual permit and an NPDES general permit?
A National Pollutant Discharge Elimination System (NPDES) individual permit is written to reflect site-specific conditions of a single discharger (or in rare instances to multiple co-permittees) based on information submitted by that discharger in a permit application and is

unique to that discharger whereas an NPDES general permit is written to cover multiple dischargers with similar operations and types of discharges based on the permit writer's professional knowledge of those types of activities and discharges. Individual permits are issued directly to an individual discharger whereas a general permit is issued to no one in particular with multiple dischargers obtaining coverage under that general permit after it is issued, consistent with the permit eligibility and authorization provisions. As such, dischargers covered under general permits know their applicable requirements before obtaining coverage under that permit. Furthermore, obtaining coverage under a general permit is typically quicker than an individual permit with coverage under a general permit often occurring immediately (depending on how the permit is written) or after a short waiting period. Coverage under an individual permit may take six months or longer.

What is the process for applying for coverage under an NPDES general permit?
National Pollutant Discharge Elimination System (NPDES) general permits do not require that Operators "apply" for coverage; rather, general permits typically rely on the submission of a document called a Notice of Intent (NOI). An NOI differs from an individual permit application in that it is submitted by Operators after the general permit is issued by the permitting authority. An NOI for a general permit is a notice to the NPDES permitting authority of an Operator's intent to be covered under a general permit, and typically contains basic information about the Operator and the planned discharge for which coverage is being requested. Some general permits, such as the EPA's Pesticide General Permit, automatically cover some Operator discharges without submission of an NOI. In these instances, Operators must comply with applicable permit requirements for their pesticide applications without submission of any paperwork to the permitting authority (or in some instances, submission of some other type of notification document).

How do Operators apply for coverage under an NPDES individual permit?
An Operator must submit a permit application to apply for coverage under a National Pollutant Discharge Elimination System (NPDES) individual permit. The application form must be submitted to the permitting authority at least180 days before the expected commencement of the discharge. NPDES permit application requirements are in Part 122, Subpart B and identified on forms developed by the EPA. NPDES-authorized states are not required to use the EPA application forms; however, any alternative form used by an NPDES-authorized state must include the federal requirements at a minimum. The EPA's application forms are available at the permit applications and forms page.

What does submittal of an NOI mean?
A Notice of Intent (NOI) for a general permit is similar to a permit application, in that it is notification to the regulatory authority of a planned discharge for which coverage under a specific National Pollutant Discharge Elimination System (NPDES) general permit is needed and contains information about the discharge and the Operator of that discharge. The NOI serves as the Operator's notice to the permitting authority that the Operator intends for the discharge to be authorized under the terms and conditions of that general permit. By signing and submitting the NOI, the Operator is certifying that the discharge meets all of the eligibility conditions specified in the general permit (e.g., that a pesticide discharge management plan has been developed if necessary) and that the Operator intends to follow the terms and conditions of the permit. A fraudulent or erroneous NOI invalidates permit coverage. An incomplete NOI delays permit coverage until such time as the NOI has been completed.

What are the Specific Pretreatment Program Goals?

- Prevent the introduction of pollutants into the POTW that will pass through the treatment works or are otherwise incompatible with treatment
- Prevent the introduction of pollutants that could interfere with POTW operations, including interference with the POTW's chosen sewage sludge use and disposal practices, as well as pollutants that could threaten worker health and safety
- Improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges

Discharges to a POTW have the potential to cause the POTW to violate its National Pollutant Discharge Elimination System (NPDES) permit if the treatment system is not able to adequately remove the pollutant contained in the discharge or the pollutant otherwise damages or disrupts operations of the POTW. Industrial discharges to POTWs have historically been a significant source of pollutants in our nation's waters. Certain industrial discharges can interfere with the operation of POTWs, leading to the discharge of untreated or inadequately treated wastewater into rivers, lakes, and such.

Some pollutants are not compatible with biological wastewater treatment at POTWs and may pass through the treatment plant untreated. This pass through of pollutants affects the surrounding environment, occasionally causing fish kills or other detrimental alterations of the receiving waters. Even when POTWs have the capability to remove toxic pollutants from wastewater, the toxics can end up in the POTW's sewage sludge, which in many places is land applied to food crops, parks, or golf courses as fertilizer or soil conditioner. The Clean Water Act (CWA or the Act) addresses this problem by requiring the U.S. Environmental Protection Agency (EPA) to promulgate federal standards for the pretreatment of wastewater discharged to a POTW [33 U.S.C. § 1317(b)(3)]. Section 307(d) of the Act prohibits discharge in violation of any pretreatment standard [33 U.S.C. § 1317(d)]. The CWA prohibits the introduction of pollutants into a POTW that might pass through or interfere with the POTW and its operations.

Discharge of a pollutant is a term specifically defined in the CWA to mean the discharge of a pollutant to navigable waters, and such discharges are generally prohibited except in compliance with the Act and a permit under section 402 of the Act. While this document uses the word discharge in its commonly understood meaning when referring to the introduction of pollutants into a POTW, such a discharge is not a CWA discharge of pollutants to navigable waters. To address indirect discharges from industries to POTWs, EPA has established the National Pretreatment Program as a component of the NPDES Permitting Program. The National Pretreatment Program requires industrial and commercial dischargers to treat or control pollutants in their wastewater before discharge to POTWs. EPA has chosen to promulgate pretreatment standards at the same time it promulgates effluent limitations guidelines for industry categories of direct dischargers under sections 301(b) and 304(b) of the Act [33 U.S.C. § 1311(b) and 1314(b)].

What are the Categorical Pretreatment Standards?

These pretreatment regulations are applicable to industrial indirect dischargers—those discharging to POTWs—and are known as categorical pretreatment standards. EPA has also developed other nationally applicable pretreatment standards (national pretreatment standards) under section 307(b) in its General Pretreatment Regulations for Existing and New Sources of Pollution (Pretreatment Regulations) at 40 CFR Part 403. Such pretreatment standards are applicable to any user of a POTW, defined as a source of an indirect discharge

[40 CFR 403.3(i)]. These national pretreatment standards include (1) a general prohibition and (2) specific prohibitions.

1. The general prohibition prohibits any user of a POTW from introducing a pollutant into the POTW that will cause pass through or interference. EPA's regulations define both pass through and interference. **Pass through** is defined as a discharge that exits the POTW into waters of the United States in quantities or concentrations that, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit.

Interference includes a discharge that, alone or in conjunction with a discharge from other sources will, among other things, prevent sewage sludge use in compliance with described regulatory provisions including section 405 of the Act [40 CFR 403.3(k)(2)]. In addition, under the Pretreatment Regulations, certain POTWs must develop and enforce local limits to implement the general and specific prohibitions of section 403.5(a)(1) and (b).

2. Local limits that are developed by a POTW in accordance with the regulations are pretreatment standards for purposes of section 307(d) of the CWA [40 CFR 403.5(d)]. See also 40 CFR 403.3(l) ("The term National Pretreatment Standard, Pretreatment Standard, or Standard ... includes any prohibitive discharge limits established pursuant to § 403.5."). Finally, states and POTWs always have the option of establishing more stringent requirements if such requirements are authorized and necessary, pursuant to their state or local law. Generally, this document describes only the National Pretreatment Program requirements established pursuant to the CWA and implementing regulations. Where state or local requirements are implemented in the same control mechanism, the control mechanism should clearly identify the applicable local or state regulation or enabling legislation. Therefore, each the pretreatment program can be a mixture of federal, state, and local standards and requirements.

What are the Specific Prohibitions?
(1) Pollutants which create a fire or explosion hazard in the POTW, including, but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR Part 261.21 (PDF).
(2) Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges.
(3) Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference.
(4) Any pollutant, including oxygen demanding pollutants (biochemical oxygen demand, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause Interference with the POTW.
(5) Heat in amounts which will inhibit biological activity in the POTW resulting in Interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40 °C (104 °F) unless the approval authority, upon request of the POTW, approves alternate temperature limits.
(6) Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through.
(7) Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems.
(8) Any trucked or hauled pollutants, except at discharge points designated by the POTW."

POTW and Pretreatment Post Quiz

1. NPDES permits are required for the discharges from_____________, other wastewater treatment facilities, industrial facilities, concentrated animal feeding operations, aquiculture, and other "point source" dischargers.

2. The NPDES program controls wet weather discharges such as stormwater discharges from industrial activities and municipal stormwater discharges including urban storm-water runoff, combined sewer overflows, and ___________________.

3. ______________ were developed to ensure that such discharges to receiving waters are protective of human health and the environment. They establish specific discharge limits, monitoring, and reporting requirements and may require that dischargers undertake measures to reduce or eliminate pollution to receiving waters.

4. Violations of permit conditions are enforceable under the______________________.

5. The EPA uses a variety of techniques to monitor permittee compliance status, including on-site inspections and review of data submitted by permittees. NPDES permits are issued for a term of _______________years (or less).

State NPDES Programs

6. NPDES Watershed Permitting a _________________was developed to ensure that the NPDES Program protects watersheds as effectively as possible.

Stormwater Management

7. __________________ from many sources are largely uncontrolled, for this reason, the mandate of the *Stormwater Program* is particularly challenging.

Combined Sewer Overflows (CSOS)

8. A combined sewer overflow is a discharge from a sewer system that is designed to carry _______________________in the same pipe to a sewage treatment plant.

9. In periods of rainfall or snowmelt, a combined sewer system can discharge ________________________ directly to rivers, lakes, and estuaries, causing health and environmental hazards because treatment plants cannot handle the extra flow.

Whole Effluent Toxicity (WET)

10. WET is the total toxic effect of an effluent measured by ___________________.

11. WET duplicates to the greatest extent possible the actual environmental exposure of aquatic life to __________________.

Pretreatment

12. The National Pretreatment Program is a joint effort of federal, state, and local regulatory environmental agencies established to protect _______________.

13. The General Pretreatment Regulations oblige POTWS that meet certain requirements to develop local pretreatment programs to control ___________________ into their municipal sewer systems. These programs must be approved by either EPA or the state acting as the pretreatment Approval Authority.

Types of Regulated Pollutants

14. _______________ are primarily grouped into organics (including pesticides, solvents, polychlorinated biphenyls (PCBS), and dioxins) and metals (including lead, silver, mercury, copper, chromium, zinc, nickel, and cadmium).

15. ________________ include human wastes, ground-up food from sink disposals, and laundry and bath waters.

Answers

1. Publicly owned wastewater treatment facilities, 2. Storm sewer overflows, 3. NPDES permit(s), 4. Clean Water Act, 5. 5, 6. NPDES Watershed Strategy, 7. Stormwater discharges, 8. Sanitary wastewater and stormwater, 9. Excess wastewater, 10. Biological toxicity test, 11. Effluent toxicants, 12. Water quality, 13. Industrial discharges, 14. Toxic Pollutants, 15. Conventional pollutants

Chapter 3- Overview of the National Pretreatment Program

Section Focus: You will learn the basics of the Clean Water Act, and the need for pretreatment program. At the end of this section, you will be able to describe the need for wastewater pretreatment and the CWA requirements. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.

Large wastewater treatment plant

The Clean Water Act

On October 18, 1972, the 92nd Congress of the United States passed the Federal Water Pollution Control Act Amendments of 1972, declaring the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's water as a National Objective. While procedures for implementing this act (more commonly referred to as the Clean Water Act (CWA)) have been re-evaluated and modified over time, the 1972 objective has remained unchanged in its long history.

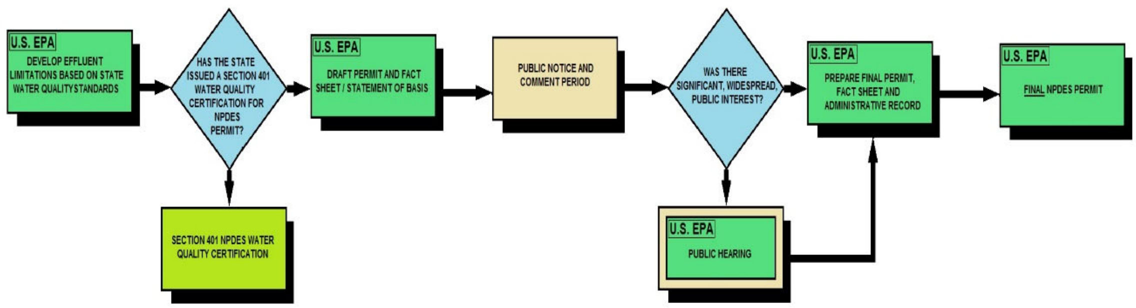
The 1972 Amendments to the CWA established a water quality regulatory approach along with the EPA-promulgated industry-specific technology-based effluent limitations. The National Pollutant Discharge Elimination System (NPDES) permit program was established under the CWA to control the discharge of pollutants from point sources and served as a vehicle to implement the industrial technology-based standards.

To implement pretreatment requirements, the EPA promulgated 40 CFR Part 128 in late 1973, establishing general prohibitions against treatment plant interference and pass through and pretreatment standards for the discharge of incompatible pollutants from specific industrial categories.

In 1975, several environmental groups filed suit against the EPA, challenging it's criteria for identifying toxic pollutants, the EPA's failure to promulgate effluent standards, and the EPA's failure to promulgate pretreatment standards for numerous industrial categories.

As a result of this litigation, the EPA promulgated the General Pretreatment Regulations at 40 CFR Part 403 on June 26, 1978, replacing the 40 CFR Part 128 requirements.

Additionally, as a result of the suit, the EPA agreed to regulate the discharge of 65 categories of pollutants (making up the 129 priority pollutants) from 21 industrial categories. The list of priority pollutants is still in effect today (the original list actually had 129 pollutants, three of which have since been removed from that list) while the list of regulated industrial categories has grown to more than 53 distinct industries.



NPDES (National Pollutant Discharge Elimination System) PERMIT PROCESS

The National Pretreatment Program is unique in that the General Pretreatment Regulations require all large POTWs (i.e., those designed to treat flows of more than 5 million gallons per day) and smaller POTWs receiving significant industrial discharges to establish local pretreatment programs. These local programs must enforce all national pretreatment standards and requirements in addition to any more stringent state and/or local requirements necessary to protect site-specific conditions at the POTW.

General Pretreatment Regulations at 40 CFR Part 403§ 403.1 Purpose and Applicability *(Credit USEPA)*

Figure 6. The General Pretreatment Regulations

§ 403.2 Objectives of general pretreatment regulations
§ 403.3 Definitions
§ 403.4 State or local law
§ 403.5 National pretreatment standards: Prohibited discharges
§ 403.6 National pretreatment standards: Categorical pretreatment standards
§ 403.7 Removal credits
§ 403.8 Pretreatment program requirements: Development and implementation by POTW
§ 403.9 POTW pretreatment programs and/or authorization to revise pretreatment standards: Submission for approval
§ 403.10 Development and submission of NPDES State pretreatment programs
§ 403.11 Approval procedures for POTW pretreatment programs and POTW granting of removal credits
§ 403.12 Reporting requirements for POTW's and industrial users
§ 403.13 Variances from categorical pretreatment standards for fundamentally different factors
§ 403.14 Confidentiality
§ 403.15 Net/Gross calculation
§ 403.16 Upset provision
§ 403.17 Bypass
§ 403.18 Modification of POTW pretreatment programs
Appendix A: Program Guidance Memorandum
Appendix B: [Reserved]
Appendix C: [Reserved]
Appendix D: Selected Industrial Subcategories Considered Dilute for Purposes of the Combined Wastestream Formula
Appendix E: Sampling Procedures
Appendix F: [Reserved]
Appendix G: Pollutants Eligible for a Removal Credit

The General Pretreatment Regulations

1. The General Pretreatment Regulations establish responsibilities of Federal, State, and local government, industry and the public to implement Pretreatment Standards to control pollutants which pass through or interfere with POTW treatment processes or which may contaminate sewage sludge. The regulations, which have been revised numerous times since originally published in 1978, consist of 18 sections and several appendices.

2. The General Pretreatment Regulations apply to all non-domestic sources which introduce pollutants into a POTW. These sources of "***indirect discharge***" are more commonly referred to as industrial users (**IUs**).

3. Since IUs can be as simple as an unmanned coin operated car wash to as complex as an automobile manufacturing plant or a synthetic organic chemical producer, EPA developed four criteria that define a Significant Industrial User (**SIU**). Many of the General Pretreatment Regulations apply to SIUs as opposed to IUs, based on the fact that control of SIUs should provide adequate protection of the POTW.

These four criteria are as follows:

- An IU that discharges an average of 25,000 gallons per day or more of process wastewater to the POTW;
- An IU that contributes a process wastestream making up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant;
- An IU designated by the Control Authority as such because of its reasonable potential to adversely affect the POTW's operation or violate any pretreatment standard or requirement; or
- An IU subject to Federal categorical pretreatment standards.

Unlike other environmental programs that rely on Federal or State governments to implement and enforce specific requirements, the Pretreatment Program places the majority of the responsibility on local municipalities. Specifically, section 403.8(a) of the General Pretreatment Regulations states that any POTW (or combination of treatment plants operated by the same authority) with a total design flow greater than 5 million gallons per day (MGD) and smaller POTWs with SIUs must establish a local pretreatment program.

As of early 2011, 1,600 POTWs are required to have local programs. While this represents only about 15 percent of the total treatment plants nationwide, these POTWs account for more than 80 percent (i.e., approximately 30 billion gallons a day) of the national wastewater flow treated by POTWs.

Control Authority

The General Pretreatment Regulations define the term “Control Authority” as a POTW that administers an approved pretreatment program since it is the entity authorized to control discharges to its system.

Section 403.10(e) provides States authority to implement POTW pretreatment programs in lieu of POTWs. Five States have elected to assume this responsibility (Vermont, Connecticut, Alabama, Mississippi, and Nebraska). In these instances, the State is defined as the Control Authority. As described above, all Control Authorities must establish a local pretreatment program to control discharges from non-domestic sources.

Approval Authority

These programs must be approved by the “Approval Authority” who is also responsible for overseeing implementation and enforcement of these programs.

As of 6/2020, a total of 47 States /Territories are authorized to implement State NPDES Permit Programs, but only 39 are authorized to be the Pretreatment Program Approval Authority. In all other States and Territories (including the 403.10(e) States), the EPA is considered to be the Approval Authority.

POTW Pretreatment Program Requirements

The actual requirement for a POTW to develop and implement a local pretreatment program is a condition of its NPDES permit. Once the Approval Authority determines that a POTW needs a pretreatment program, the POTW's NPDES permit is modified to require development of a local program and submission of the program to the Approval Authority for review and approval. Consistent with §403.8(f), POTW pretreatment programs must contain the six minimum elements.

In addition to the six specific elements, pretreatment program submissions must include:

- a statement from the City Solicitor (or the like) declaring the POTW has adequate authority to carry out program requirements;
- copies of statutes, ordinances, regulations, agreements, or other authorities the POTW relies upon to administer the pretreatment program including a statement reflecting the endorsement or approval of the bodies responsible for supervising and/or funding the program;
- a brief description and organizational chart of the organization administering the program; and
- a description of funding levels and manpower available to implement the program.

Pretreatment program submissions found to be complete proceed to the public notice process, Public Participation and POTW Reporting. Upon program approval, the Approval Authority is responsible for modifying the POTW's NPDES permit to require implementation of the approved pretreatment program. Once approved, the Approval Authority oversees POTW pretreatment program implementation via receiving annual reports and conducting periodic audits and inspections.

The National Pretreatment Program regulates IUs through three types of regulatory entities: the EPA, Approval Authorities, and Control Authorities. As noted above, Approval Authorities oversee Control Authorities while Control Authorities regulate IUs.

Using an extension pole with a sample bottle attachment to grab a sample.

Compliance Monitoring

Compliance monitoring is a cornerstone of the Environmental Protection Agency's (EPA's) program to achieve clean water. The primary goal of EPA compliance monitoring efforts, such as on-site inspections, is to ensure and document whether entities regulated under the National Pollutant Discharge Elimination System (NPDES) and pretreatment programs are complying with their Clean Water Act (CWA) obligations. EPA's NPDES inspection program identifies and documents noncompliance, supports authorized state NPDES programs, supports the enforcement process, monitors compliance with enforcement orders and decrees, establishes presence in the regulated community, deters noncompliance, supports the permitting process, and furthers the broad watershed protection and restoration goals of the NPDES program.

The purpose of this guidance is to provide inspectors with an in-depth knowledge of the NPDES inspection process. EPA inspects NPDES facilities where we directly implementation the program (e.g., in states without NPDES program authorization and in Indian country). In addition, EPA sometimes conducts inspections in states with NPDES program authorization at the request of states to complement the state's own inspection efforts and to respond to tips or complaints.

EPA regions and states communicate closely throughout the year on inspection planning and targeting to maintain a strong NPDES compliance monitoring program. Throughout this Manual, EPA has made every effort to avoid references to or identification of particular facilities. Any specific examples of noncompliance found in the Manual are offered as facts with the goal of helping inspectors be well-prepared to conduct thorough inspections that support the enforcement process. Such examples are not a statement about any one facility's compliance status or the adequacy of the authorized state's compliance monitoring program.

Routine EPA NPDES compliance inspections should be performed in a manner designed to: • Determine compliance status with regulations, permit conditions, and other program requirements.
• Verify the accuracy of information submitted by permittees.
• Verify the adequacy of sampling and monitoring conducted by the permittee.

Other purposes of compliance inspections include:
• Gathering evidence to support enforcement actions
• Obtaining information that supports the permitting process
• Assessing compliance with orders or consent decrees

Approved State NPDES Permit Program - Approved State Pretreatment Programs

Status of State Approval					
State	Authorized State NPDES Permit Program	Authorized to Regulate Federal Facilities	Authorized State Pretreatment Program	Authorized General Permits Program	Authorized Biosolids (Sludge) Program
Alabama	10/19/1979	10/19/1979	10/19/1979	06/26/1991	
Alaska	10/31/2008	10/31/2008	10/31/2008	10/31/2008	
American Samoa					
Arizona	12/05/2002	12/05/2002	12/05/2002	12/05/2002	04/01/2004
Arkansas	11/01/1986	11/01/1986	11/01/1986	11/01/1986	
California	05/14/1973	05/05/1978	09/22/1989	09/22/1989	
Colorado	03/27/1975			03/04/1982	
Connecticut	09/26/1973	01/09/1989	06/03/1981	03/10/1992	
Delaware	04/01/1974			10/23/1992	
District of Columbia					
Florida	05/01/1995	05/01/2000	05/01/1995	05/01/1995	
Georgia	06/28/1974	12/08/1980	03/12/1981	01/28/1991	
Guam					
Hawaii	11/28/1974	06/01/1979	08/12/1983	09/30/1991	
Idaho	6/5/2018[1]	7/1/2021	7/1/2018	7/1/2020[2]	7/1/2021
Illinois	10/23/1977	09/20/1979		01/04/1984	
Indiana	01/01/1975	12/09/1978		04/02/1991	
Iowa	08/10/1978	08/10/1978	06/03/1981	08/12/1992	
Johnston Atoll					
Kansas	06/28/1974	08/28/1985		11/24/1993	
Kentucky	09/30/1983	09/30/1983	09/30/1983	09/30/1983	
Louisiana	08/27/1996	08/27/1996	08/27/1996	08/27/1996	
Maine	01/12/2001	01/12/2001	01/12/2001	01/12/2001	
Maryland	09/05/1974	11/10/1987	09/30/1985	09/30/1991	
Massachusetts					
Michigan	10/17/1973	12/09/1978	06/07/1983	11/29/1993	09/28/2006[3]
Midway Island					
Minnesota	06/30/1974	12/09/1978	07/16/1979	12/15/1987	
Mississippi	05/01/1974	01/28/1983	05/13/1982	09/27/1991	
Missouri	10/30/1974	06/26/1979	06/03/1981	12/12/1985	
Montana	06/10/1974	06/23/1981		04/29/1983	
Nebraska	06/12/1974	11/02/1979	09/07/1984	07/20/1989	
Nevada	09/19/1975	08/31/1978		07/27/1992	
New Hampshire					
New Jersey	04/13/1982	04/13/1982	04/13/1982	04/13/1982	
New Mexico					
New York	10/28/1975	06/13/1980		10/15/1992	
North Carolina	10/19/1975	09/28/1984	06/14/1982	09/06/1991	

Status of State Approval

State	Authorized State NPDES Permit Program	Authorized to Regulate Federal Facilities	Authorized State Pretreatment Program	Authorized General Permits Program	Authorized Biosolids (Sludge) Program
North Dakota	06/13/1975	01/22/1990	09/16/2005	01/22/1990	
Northern Mariana Islands					
Ohio	03/11/1974	01/28/1983	07/27/1983	08/17/1992	03/16/2005[4]
Oklahoma 5	11/19/1996	11/19/1996	11/19/1996	09/11/1997	11/19/1996
Oregon	09/26/1973	03/02/1979	03/12/1981	02/23/1982	
Pennsylvania	06/30/1978	06/30/1978		08/02/1991	
Puerto Rico					
Rhode Island	09/17/1984	09/17/1984	09/17/1984	09/17/1984	
South Carolina	06/10/1975	09/26/1980	04/09/1982	09/03/1992	
South Dakota	12/30/1993	12/30/1993	12/30/1993	12/30/1993	10/22/2001
Tennessee	12/28/1977	09/30/1986	08/10/1983	04/18/1991	
Texas[6]	09/14/1998	09/14/1998	09/14/1998	09/14/1998	09/14/1998
Utah	07/07/1987	07/07/1987	07/07/1987	07/07/1987	06/14/1996
Vermont	03/11/1974		03/16/1982	08/26/1993	
Virgin Islands	06/30/1976	12/26/2007		12/26/2007	
Virginia	03/31/1975	02/09/1982	04/14/1989	04/20/1991	
Wake Island					
Washington	11/14/1973		09/30/1986	09/26/1989	
West Virginia	05/10/1982	05/10/1982	05/10/1982	05/10/1982	
Wisconsin	02/04/1974	11/26/1979	12/24/1980	12/19/1986	07/28/2000[7]
Wyoming	01/30/1975	05/18/1981		09/24/1991	

[1]Authority for Idaho's municipal permits and pretreatment transferred 7/1/2018. Authority for individual industrial permits transferred 7/1/2019. Authority for individual stormwater permits transferred 7/1/2021.

[2]Authority for Idaho's stormwater general permits transferred 7/1/2020.

[3]Michigan’s biosolids program is authorized for land application. Michigan has not sought authorization for septage management, biosolids incineration, or biosolids surface disposal, and EPA retains jurisdiction over these practices in Michigan.

[4]Ohio’s biosolids program is authorized for land application, surface disposal, and disposal in a municipal solid waste landfill. Ohio has not sought authorization for biosolids incineration or land application of domestic septage, and EPA retains jurisdiction over these management practices in Ohio.

[5]Not authorized to issue permits for activities associated with the exploration, development, or production of oil or gas or geothermal resources, including transportation of crude oil or natural gas by pipeline. EPA is the permitting authority for those activities since they are not within the jurisdictions of the approved state agencies in Oklahoma.

[6]Authorized 1/15/2021 to issue permits for activities associated with exploration, development, or production of oil or gas or geothermal resources, including transportation of crude oil or natural gas by pipeline in Texas.

[7]Wisconsin’s biosolids program is authorized for land application, surface disposal, and disposal in a municipal solid waste landfill. Wisconsin has not sought authorization for biosolids incineration or land application of domestic septage, and EPA retains jurisdiction over these management practices in Wisconsin.

Six Minimum Pretreatment Program Elements *(Credit USEPA)*

1. Legal Authority

The POTW must operate pursuant to legal authority enforceable in Federal, State or local courts, which authorizes or enables the POTW to apply and enforce any pretreatment regulations developed pursuant to the CWA. At a minimum, the legal authority must enable the POTW to:

I. deny or condition discharges to the POTW;
ii. require compliance with pretreatment standards and requirements;
iii. control IU discharges through permits, orders, or similar means;
iv. require IU compliance schedules when necessary to meet applicable pretreatment standards and/or requirements and the submission of reports to demonstrate compliance;
v. inspect and monitor IUs;
vi. obtain remedies for IU noncompliance; and
vii. comply with confidentiality requirements.

2. Procedures

The POTW must develop and implement procedures to ensure compliance with pretreatment requirements, including:

I. identify and locate all IUs subject to the pretreatment program;
ii. identify the character and volume of pollutants contributed by such users;
iii. notify users of applicable pretreatment standards and requirements;
iv. receive and analyze reports from IUs;
v. sample and analyze IU discharges and evaluate the need for IU slug control plans;
vi. investigate instances of noncompliance; and
vii. comply with public participation requirements.

3. Funding

The POTW must have sufficient resources and qualified personnel to carry out the authorities and procedures specified in its approved pretreatment program.

4. Local limits

The POTW must develop local limits or demonstrate why these limits are not necessary.

5. Enforcement Response Plan (ERP)

The POTW must develop and implement an ERP that contains detailed procedures indicating how the POTW will investigate and respond to instances of IU noncompliance.

6. List of SIUs

The POTW must prepare, update, and submit to the Approval Authority a list of all Significant Industrial Users (**SIUs**).

Pretreatment Roles and Responsibilities *(Credit USEPA)*

EPA Headquarters

< Oversees program implementation at all levels
< Develops and modifies regulations for the program
< Develops policies to clarify and further define the program
< Develops technical guidance for program implementation
< Initiates enforcement actions as appropriate

Regions

< Fulfill Approval Authority responsibilities for States without a State pretreatment program
< Oversee State program implementation
< Initiate enforcement actions as appropriate.

Approval Authorities (EPA Regions and delegated States)

< Notify POTWs of their responsibilities
< Review and approve requests for POTW pretreatment program approval or modification
< Review requests for site-specific modifications to categorical pretreatment standards
< Oversee POTW program implementation
< Provide technical guidance to POTWs
< Initiate enforcement actions, against noncompliant POTWs or industries.

Control Authorities (POTWs, States, or EPA Regions)

< Develop, implement, and maintain approved pretreatment program
< Evaluate compliance of regulated IUs
< Initiate enforcement action against industries as appropriate
< Submit reports to Approval Authorities
< Develop local limits (or demonstrate why they are not needed)
< Develop and implement enforcement response plan.

Industrial Users

< Comply with applicable pretreatment standards and reporting requirements.

What Types of Businesses are Subject to Pretreatment Regulations?

Pretreatment regulations apply to a variety of businesses discharging wastewater from industrial and commercial processes.

Certain types of industries with the potential to discharge pollutants are regulated through an industrial discharge permit system. Industries are considered Significant Industrial Users and therefore require a discharge permit if the user:

- Is subject to the Environmental Protection Agency's Categorical Pretreatment Standards. Categorical users receive increased scrutiny due to their potential to pollute. Examples of categorical users are metal finishers and pharmaceutical manufacturers.
- Is discharging an average of 25,000 gallons per day or more of process wastewater.
- Make up to 5% of the average dry weather hydraulic or organic capacity of the POTW.
- Has the potential to adversely affect the wastewater utility.

Industry-Specific Guides
Aluminum, Copper, And Nonferrous Metals Forming And Metal Powders

- Pretreatment Standards: A Guidance Manual
- Guidance Manual For Battery Manufacturing Pretreatment Standards
- Guidance Manual for Electroplating and Metal Finishing Pretreatment Standard
- Guidance Manual For Iron And Steel Manufacturing Pretreatment Standards
- Guidance Manual for Leather Tanning and Finishing Pretreatment Standards
- Guidance Manual for Pulp, Paper, Paperboard, Builders’ Paper, and
- Board Mills Pretreatment Standards

Pretreatment Standards

The National Pretreatment Program identifies specific requirements that apply to all IUs, additional requirements that apply to all SIUs, and certain requirements that only apply to CIUs. The objectives of the National Pretreatment Program are achieved by applying and enforcing three types of discharge standards:

< *prohibited discharge standards*
< *categorical standards*
< *local limits*.

Prohibited Discharge Standards *(Credit USEPA)*

All IUs, whether or not subject to any other National, State, or local pretreatment requirements, are subject to the general and specific prohibitions identified in 40 CFR §§403.5(a) and (b), respectively. General prohibitions forbid the discharge of any pollutant(s) to a POTW that cause pass through or interference.

Specific prohibitions forbid eight categories of pollutant discharges as follows:

(1) discharges containing pollutants which create a fire or explosion hazard in the POTW, including but not limited to, wastestreams with a closed cup flashpoint of less than 140°F (60°C) using the test methods specified in 40 CFR §261.21;

(2) discharges containing pollutants causing corrosive structural damage to the POTW, but in no case discharges with a pH lower than 5.0, unless the POTW is specifically designed to accommodate such discharges;

(3) discharges containing pollutants in amounts causing obstruction to the flow in the POTW resulting in interference;

(4) discharges of any pollutants released at a flow rate and/or concentration which will cause interference with the POTW;

(5) discharges of heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40°C (104°F) unless the Approval Authority, upon request of the POTW, approves alternative temperature limits;

(6) discharges of petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;

(7) discharges which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems; and

(8) discharges of trucked or hauled pollutants, except at discharge points designated by the POTW.

Compliance with the general and specific prohibitions is mandatory for all IUs, although a facility may have an affirmative defense in any action brought against it alleging a violation of the general prohibitions or of certain specific prohibitions [(3), (4), (5), (6) and (7) above] where the IU can demonstrate it did not have reason to know that its discharge, alone or in conjunction with a discharge or discharges from other sources, would cause pass through or interference, and the IU was in compliance with a technically-based local limit developed to prevent pass through or interference. These prohibited discharge standards are intended to provide general protection for POTWs. However, their lack of specific pollutant limitations creates the need for additional controls, namely categorical pretreatment standards and local limits.

Interference and Pass Through

Pass through - A discharge which exits the POTW into waters of the US in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

Interference - A discharge which, alone or in conjunction with a discharge or discharges from other sources, both (1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and (2) therefore is a cause of a violation of any requirement of the POTW's NPDES permit or of the prevention of sewage sludge use or disposal.

Categorical Pretreatment Standards *(Credit USEPA)*

Categorical pretreatment standards (i.e., categorical standards) are national, uniform, technology-based standards that apply to discharges to POTWs from specific industrial categories (i.e., indirect dischargers) and limit the discharge of specific pollutants. Categorical pretreatment standards for both existing and new sources (PSES and PSNS, respectively) are promulgated by the EPA pursuant to Section 307(b) and (c) of the CWA. Limitations developed for indirect discharges are designed to prevent the discharge of pollutants that could pass through, interfere with, or otherwise be incompatible with POTW operations.

Effluent limitations guidelines (ELGs), developed in conjunction with categorical standards, limit the discharge from facilities directly to waters of the U.S. (i.e., direct dischargers) and do not apply to indirect dischargers. ELGs include Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), and Best Available Technology Economically Achievable (BAT) limitations and New Source Performance Standards (NSPS). ELGs (i.e., BPT, BCT, BAT, and NSPS) do not apply to indirect dischargers.

The significant difference between categorical standards and effluent limitations guidelines is that categorical standards account for any pollutant removal that may be afforded through treatment at the POTW, while effluent limitations guidelines do not. Industries identified as major sources of toxic pollutants are typically targeted for effluent guideline and categorical standard development.

If limits are deemed necessary, the EPA investigates affected IUs and gathers information regarding process operations as well as treatment and management practices accounting for differences in facility size and age, equipment age, and wastewater characteristics.

Sub categorization within an industrial category is evaluated based on variability in processes employed, raw materials used, types of items produced, and characteristics of wastes generated.

Availability and cost of control technologies, non-water quality environmental impacts, available pollution prevention measures, and economic impacts are then identified prior to the EPA's presentation of findings in proposed development documents and publishing a notice of the proposed regulations in the *Federal Registe*r. After modifying the proposes rule, based upon public comments, the EPA promulgates (i.e., publishes) the standards.

Establishing Monitoring Conditions
The NPDES regulations require facilities discharging pollutants to waters of the United States to periodically evaluate compliance with the effluent limitations established in their permits and provide the results to the permitting authority. A permit writer should consider several factors when determining the specific requirements

Self-Monitoring
Sampling and analyses performed by a facility, or contracted laboratory to ensure compliance with a permit or other regulatory requirements.

to be included in the NPDES permit. Inappropriate or incomplete monitoring requirements can lead to inaccurate compliance determinations.

Factors that could affect sampling location, sampling method, and sampling frequency include the following:
- Applicability of effluent limitations guidelines and standards (effluent guidelines).
- Wastestream and process variability.
- Access to sample locations.
- Pollutants discharged.
- Effluent limitations.
- Discharge frequencies (e.g., continuous versus intermittent).
- Effect of flow or pollutant load or both on the receiving water.
- Characteristics of the pollutants discharged.
- Permittee’s compliance history.

Categorical Pretreatment Standards - Sampling

Categorical Pretreatment Standards are technology-based standards for a selected group of industries established by EPA under authority of the CWA. These standards are developed on the basis of industry-wide studies of current treatment practices for pollution control (e.g., treatment technology) and, therefore, establish national baseline pollution control requirements for the regulated industrial categories. Pretreatment Standards are generally promulgated for both existing sources and new sources. These standards could be the same or different. If an Industrial User is subject to categorical Pretreatment Standards, the permit writer must include effluent limits based on these standards in the user's permit.

In certain situations, the Control Authority may have the option to authorize a CIU to forgo sampling for a pollutant not expected to be present [40 CFR 403.12(e)(2)]. Before implementing that option, the Control Authority must have the legal authority to implement the provision (i.e., the state and local regulations include the provision and it has been submitted to and approved by the Approval Authority in accordance with 40 CFR Part 403). If the Control Authority has determined that a monitoring waiver is appropriate, the permit must still contain the applicable effluent limitations for the pollutants with waived monitoring requirements.

Furthermore, any grant of a monitoring waiver by the Control Authority must be included as a condition in the user's permit along with the requirements to submit the certification statement outlined at 40 CFR 403.12(e)(2)(v) with each user self-monitoring report. In addition, the permit must include the notification requirement that if a pollutant with waived monitoring requirements is found to be present or is expected to be present according to changes that occur in the user's operations, the user must immediately notify the Control Authority and comply with the monitoring requirements of 40 CFR 403.12(e)(1).

To include all relevant categorical Pretreatment Standards in the permit, the permit writer must be familiar with specific categorical Pretreatment Standards to which the Industrial User is subject and follow the rules below to apply categorical Pretreatment Standards.

Rules for Applying Categorical Pretreatment Standards

- Determine the proper category and subcategory for the industrial processes operated by the permittee.
- Identify all regulated, unregulated, and dilution wastestreams.
- Identify appropriate sampling locations.

Categorical standards apply directly to specific wastestream or at the end of treatment of that wastestream. When the designated sampling location described in the permit contains a categorically-regulated wastestream and one or more other wastestreams not regulated by the same categorical standard, an alternative categorical limit must be calculated.

- If effluent limits have both the daily maximum and the monthly average categorical Pretreatment Standards, both limits must be included in the permit.
- Limitations on *all* pollutants regulated by the categorical Pretreatment Standards must be included in the permit. Note, however, that some of the categorical regulations allow the use of indicator pollutants (e.g., oil and grease monitoring in lieu of TTO monitoring for dischargers subject to 40 CFR Part 467, Aluminum Forming) or allow exemptions from monitoring for certain pollutants (usually requiring periodic certification of non-use).
- Any grant of a monitoring waiver by the Control Authority must be included in the Industrial User's control mechanism.

- Upon approval of a monitoring waiver, the Industrial User's control mechanism must include the requirement for the user to submit the certification statement at 40 CFR 403.12(e)(2)(v).
- The Control Authority has the option of converting production-based categorical Pretreatment Standards to equivalent mass or equivalent concentration limits.
- The Control Authority has the option of converting categorical Pretreatment Standards that are expressed in terms of concentration to equivalent mass limits. [Note: This provision must be incorporated into the pretreatment program in accordance with 40 CFR Part 403 before implementation.]
- The Control Authority has the option of converting flow-based mass limits for facilities in the Organic Chemicals, Plastics, and Synthetic Fibers [40 CFR Part 414], Petroleum Refining [40 CFR Part 419], and Pesticide Chemicals [40 CFR Part 455] categories to concentration-based limits. [Note: This provision must be incorporated into the pretreatment program in accordance with 40 CFR Part 403 before implementation.]
- Categorical Pretreatment Standards establish the compliance date(s) by which Industrial Users covered by the standards must be in compliance. The Control Authority cannot extend these federally promulgated dates in the permit.

Several EPA documents provide guidance on how to apply categorical Pretreatment Standards. The guidance documents should be used to supplement the information provided in this section and in the Standards themselves for incorporating categorical effluent limits into permits that are based on the standards.

Industry Dischargers Responsibility
Industrial dischargers to POTWs must comply with the following:

- Prohibited Discharge Standards—The general and specific prohibited discharge standards (40 CFR 403.5) noted in Table 9-1 and any specific local limits required to implement the prohibitions.
- Appropriate Pretreatment Standards—Categorical pretreatment standards (40 CFR Parts 405–471), state requirements.
- Reporting Requirements
  —As required by 40 CFR 403.12 or 403.3, and/or by the Control Authority. The requirements provided in 40 CFR 403.12 are summarized in Table 9-1.
- POTW Requirements
  —As specified in the approved POTW's legal authority.

The categories for which the EPA has developed categorical pretreatment standards are listed in Table 9-2. IUs that meet a pretreatment standard's applicability are considered categorical IUs. Categorical pretreatment standards are national, uniform, technology-based standards that apply to dischargers to POTWs from specific industrial categories (i.e., indirect dischargers). They are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTW. Dischargers subject to categorical pretreatment standards are required to comply with those standards by a specified date, typically no more than three years after the effective date of the categorical standard. EPA develops these standards at the same time it is developing effluent limitations guidelines for specific industry categories and typically, like effluent limitations. These categorical pretreatment standards apply to the wastewaters from specific manufacturing processes. The standards apply at the point of discharge from the pretreatment unit for the regulated process, or if there is no pretreatment unit, they apply at the end of the regulated process

Rules for Production-Based Categorical Pretreatment Standards

Incorporating production-based categorical Pretreatment Standards in permits involves special considerations. The standards are expressed in terms of an allowable pollutant mass discharge per unit of production, such as pounds of pollutant per 1,000 pounds of product produced. The standards can be placed in the permit verbatim from the regulations. The permit should then require the Industrial User to submit actual production data from the date(s) on which the compliance samples were collected and to calculate the actual mass of pollutant(s) discharged, on the basis of flow and concentration, to evaluate compliance for that specific day.

Often, it might be impractical or difficult for the Control Authority to independently determine or verify compliance because the production rate and the wastestream flow and pollutant concentration must be known. The Control Authority has the option of using equivalent mass or concentration limits [40 CFR 403.6(c)].

Such limits use an industry's long-term average daily production and flow rates to derive the corresponding daily maximum and monthly average limits.

The Industrial User permit may function as the legal document for the conversion of production-based standards to equivalent mass or concentration limits. These equivalent limits are deemed Pretreatment Standards under section 307(b) of the CWA and are federally enforceable.

It is critical when converting production-based standards to equivalent mass or concentration limits that the permit writer correctly calculate the equivalent limits and document the calculations.

The applicable formulas are shown in Table.

A Permit Containing Equivalent Limits Must Clearly Specify:

(1) the applicable equivalent limits;
(2) the flow and production rates upon which the limits are based;
(3) the requirement that the Industrial User report a reasonable measure of its long-term production rate in each periodic compliance report;
(4) the requirement that the Industrial User notify the Control Authority of significant changes in long-term flow and production rates within 2 days of knowing that they will change in the next calendar month; and
(5) a provision that the Control Authority may modify the permit on the basis of such new information

Determining the appropriate production rate is one of the critical factors in deriving equivalent limits. EPA recommends using a production figure that approximates the long-term average. Data for a day, week, month, or year that are unusually high or low should not be used; 3 to 5 years of data should be reviewed to determine the appropriate long-term average.

For example, after reviewing 5 years of data, the permit writer could select the highest yearly average (provided that this value does not vary by more than 20 percent to the most recent annual average).

If a production rate varies greater than 20 percent, the Control Authority should contact the facility and determine the basis for the variation. If a facility does not have good historical data, as in the case of a new facility or a facility that has had significant operational changes, the permit writer will have to rely on the facility's future projections for production.

Detailed guidance and procedures for developing and applying equivalent limits and example problems are presented in EPA's *Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula*. EPA encourages the permit writer to use that guidance manual when developing equivalent limits.

If an Industrial User is expected to have significant fluctuations in the production (e.g., a 20 percent increase or decrease in the long-term average) during the permit period, a tiered permit could be considered. For more detailed discussion on tiered permits, see Section 6.2.6.

Rules for Applying Equivalent Mass Limits for Concentration Limits

Before establishing equivalent mass limits, the Control Authority must have the legal authority to implement such a provision (i.e., the state and local regulations include the provision and it has been submitted to and approved by the Approval Authority in accordance with 40 CFR Part 403). Note: not all states have adopted the "streamlining rule".

Where a program has been modified to do so, the Control Authority has the option of establishing equivalent mass limits for concentration limits [40 CFR 403.6(c)(5)]. For an Industrial User to be eligible for equivalent mass limits, the user must do the following:

- Employ or demonstrate that it will employ water conservation methods and technologies that substantially reduce water use during the term of its permit.
- Currently use control and treatment technologies adequate to achieve compliance with the applicable categorical Pretreatment Standards and not have used dilution as a substitute for treatment.
- Provide sufficient information to establish the facility's actual average daily flow rate for all wastestreams, on the basis of data from a continuous effluent flow monitoring device, as well as the facility's long-term average production rate. Both the actual average daily flow rate and long-term production rate must be representative of current operation conditions.
- Not have daily flow rates, production levels, or pollutant levels that vary so significantly that equivalent mass limits are not appropriate to control the discharge.
- Have consistently complied with all applicable categorical Pretreatment Standards during the period before the user's request for equivalent mass limits.

In addition, the following provisions must be included in a permit issued to an Industrial User subject to equivalent mass limits:

- Maintain and effectively operate control and treatment technologies adequate to achieve compliance with the equivalent mass limits.
- Continue to record the facility's flow rates through the use of a continuous effluent flow-monitoring device.
- Continue to record the facility's production rates and notify the Control Authority whenever production rates are expected to vary by more than 20 percent from its baseline production rates.
- Continue to employ the same or comparable water-conservation methods and technologies as those implemented to qualify for the equivalent mass limits.

If the Control Authority chooses to establish equivalent mass limits, it may retain the same equivalent mass limit in subsequent permit terms if the user's actual average daily flow rate was reduced solely as a result of implementing water-conservation methods and the actual average daily flow rate used in the original calculation of the equivalent mass limit was not based on the use of dilution as a substitute for treatment. In addition, the Control Authority must do the following:

- Calculate the equivalent mass limits by multiplying the actual daily flow rate of the regulated process(es) of the user by the concentration-based categorical Pretreatment Standards and the appropriate conversion factors.
- Reassess the equivalent mass limit and recalculate the limit as necessary to reflect changed conditions at the facility.

Rules for Applying Pollutant Not Expected to be Present

Before authorizing an Industrial User to forgo sampling of a pollutant not present, the Control Authority must ensure that it has the legal authority to implement such a provision (i.e., the state and local regulations include the provision and it has been submitted to and approved by the Approval Authority in accordance with 40 CFR Part 403). Where the program has included this provision, the Control Authority has the option to authorize a CIU to forgo sampling of a pollutant if the user can demonstrate through sampling and a technical evaluation of the facility's operations, that a given pollutant is neither present nor expected to be present in the discharge, or is present only at background levels [40 CFR 403.12(e)(2)]. This provision, however, does not supersede the certification processes and requirements established in categorical Pretreatment Standards, except as specified in the categorical Pretreatment Standard (e.g., TTO certification for metal finishing, 40 CFR Part 433).

Such an authorization is subject to the following conditions:

- The Control Authority may authorize a waiver where a pollutant is determined to be present solely because of sanitary wastewater discharged from the facility, provided that the sanitary wastewater is not regulated by an applicable categorical Pretreatment Standard and includes no process wastewater.
- The monitoring waiver is valid only for the duration of the effective period of the permit but in no case longer than 5 years. The user must submit a new request for the waiver before the waiver may be granted for each subsequent permit.

In making a demonstration that a pollutant is not present, the user must provide data from at least one sampling of the facility's process wastewater before any treatment present at the facility that is representative of all wastewater from all processes.

- The request of a monitoring waiver must be signed in accordance with 40 CFR 403.12(l) and include the certification statement in 40 CFR 403.6(a)(2)(ii).
- Non-detectable sample results may be used only as a demonstration that a pollutant is not present if the EPA-approved method from 40 CFR Part 136 with the lowest minimum detection level for that pollutant is used in the analysis.
- Any grant of the monitoring waiver by the Control Authority must be included as a condition in the user's permit. The reasons supporting the waiver and any information submitted by the user in its request for the waiver must be maintained by the Control Authority for at least 3 years after the expiration of the waiver. In addition, the following provisions must be included as permit provisions.
    - Upon approval of the monitoring waiver, the user must certify on each report with the statement below, that there has been no increase in the pollutant in its wastestream because of activities of the user:
    On the basis of my inquiry of the person or persons directly responsible for managing compliance with the Pretreatment Standard for 40 CFR _________ [specify applicable national Pretreatment Standard part(s)], I certify that, to the best of my knowledge and belief, there has been no increase in the level of _________ [list pollutant(s)] in the wastewaters because of the activities at the facility since filing the last periodic report under 40 CFR 403.12(e)(1).
    - If a waived pollutant is found to be present or is expected to be present on the basis of changes that occur in the user's operation, the user must immediately comply with the monitoring requirements of 40 CFR 403.12(e)(1) or other, more frequent monitoring requirements imposed by the Control Authority and notify the Control Authority.

Definition of New Source (40 CFR 403.3(k)) *(Credit USEPA)*

New Source is defined at 40 CFR §403.3 (k)PP (1) to mean any building, structure, facility or installation from which there is or may be a discharge of pollutants, the construction of which commenced after publication of proposed Pretreatment Standards under Section 307(c) of the Act which will be applicable to such source if Standards are thereafter promulgated in accordance with that section, *provided that:*
(i) the building, structure, facility, or installation is constructed at a site at which no other source is located; or
(ii) the building, structure, facility, or installation totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or
(iii) the production or wastewater generating processes of the building, structure, facility or installation are substantially independent of an existing source at the same site. In determining whether these are substantially independent, factors such as the extent to which the new facility is integrated with the existing plant, and the extent to which the new facility is engaged in the same general type of activity as the existing source should be considered.
(2) Construction on a site at which an existing source is located results in a modification rather than a new source if the construction does not create a new building, structure, facility, or installation meeting the criteria of paragraphs (k)(1)(ii), or (k)(1)(iii) of this section but otherwise alters, replaces, or adds to existing process or production equipment.
(3) Construction of a new source as defined under this paragraph has commenced if the owner or operator has:
(i) begun, or caused to begin as part of a continuous onsite construction program:
(A) any placement, assembly or installation of facilities or equipment, or
(B) significant site preparation work, including clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment; or
(ii) entered into a binding contractual obligation for the purchase of facilities or equipment which are intended to be used in its operation within a reasonable time.
Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility, engineering, and design studies do not constitute a contractual obligation under this paragraph.

New Source
As noted above, categorical pretreatment standards are developed both for existing (PSES) and new sources (PSNS). Facilities are classified as either PSES or PSNS based on the definition of “new source" set out in 40 CFR§403.3(k) of the General Pretreatment Regulations. Dischargers subject to PSES are required to comply with those standards by a specified date, typically no more than three years after the effective date of the categorical standard. Users subject to PSNS, however, are required to achieve compliance within the shortest feasible time, not to exceed 90 days from commencement of discharge. PSNS are often more stringent than PSES based on the opportunity for new sources to install the best available demonstrated technology and operate the most efficient production processes.

Congress established an initial list of 21 categorical industries under Section 306 of the CWA of 1972. As a result of various court decrees and settlement agreements resulting from litigation, and from the EPA's internal work plan development process, the EPA has developed effluent guidelines (for direct dischargers) and/or categorical pretreatment standards (for indirect dischargers) for 58 industrial categories.

Of these industrial categories, the EPA implements pretreatment standards for 35 categories, and either requires compliance solely with 40 CFR Part 403 General Pretreatment Regulations or does not address pretreatment standards for the remaining categories.

Plans for the EPA's expansion and modification of the list is detailed in the *Effluent Guidelines Plan,* published in the *Federal Register* biennially as required in section 304(m) of the CWA. A list of the industrial categories that have categorical standards is provided as Figure 13. Categorical pretreatment standards developed can be concentration-based or mass-based.

Concentration-based standards are expressed as milligrams of pollutant allowed per liter (mg/l) of wastewater discharged and are issued where production rates for the particular industrial category do not necessarily correlate with pollutant discharges. Mass-based standards are generally expressed on a mass per unit of production (e.g., milligrams of pollutant per kilogram of product produced, pounds of pollutant per million cubic feet of air scrubbed, etc.) and are issued where water conservation is an important component in the limitation development process.

For a few categories where reducing a facility's flow volume does not provide a significant difference in the pollutant load discharged, the EPA has established both mass and concentration-based standards. Generally, both a daily maximum limitation and a long-term average limitation (e.g., average daily values in a calendar month) are established for every regulated pollutant.

(Concentration-based limits (mg/L) to mass limits (lbs/day))

$$\left(\begin{array}{c}\text{User's Discharge Flowrate}\\ \text{In million gallons per day}\\ \text{(mgd)}\end{array}\right) \times \left(\begin{array}{c}\text{Concentration-based limit}\\ \text{In milligrams per liter}\\ \text{(mg/L)}\end{array}\right) \times \left(\begin{array}{c}\text{Conversion factor}\\ \text{8.34 lbs/gal}\end{array}\right) = \begin{array}{c}\text{Equivalent}\\ \text{mass limit,}\\ \text{lbs/day}\end{array}$$

(Mass-based limits (lbs/day) to concentration limits)

$$\frac{\left(\begin{array}{c}\text{User's Allowable Pollutant loading}\\ \text{(pounds per day (lbs/day))}\end{array}\right)}{\left(\begin{array}{c}\text{User's average daily discharge flowrates}\\ \text{(mgd)}\end{array}\right)\left(\begin{array}{c}\text{Conversion factor}\\ \text{8.34 lbs/gal}\end{array}\right)} = \begin{array}{c}\text{Equivalent concentration limit,}\\ \text{mg/L}\end{array}$$

ATTACHMENT 3-1: SUMMARY OF CATEGORICAL STANDARDS

EPA has established categorical pretreatment standards (for indirect dischargers) for 35 categories. Plans for EPA's expansion and modification of the list are detailed in the *Effluent Guidelines Plan*, published in the *Federal Register* biennially as required at CWA section 304(m). The list of the industrial categories that have categorical pretreatment standards—Pretreatment Standards for Existing Sources (PSES) and Pretreatment Standards for New Sources (PSNS)—as of March 2011 is provided below.

Summary of categorical pretreatment standards

No.	Category	40 CFR Part	Subparts	Type of standard	Overview of pretreatment standards
1	Aluminum Forming	467	A–F	PSES PSNS	Limits are production-based daily maximums and monthly averages. Subpart C prohibits discharges from certain operations.
2	Battery Manufacturing	461	A–G	PSES PSNS	Limits are production-based daily maximums and monthly averages. No discharge is allowed from any process not specifically identified in the regulations.
3	Carbon Black Manufacturing	458	A–D	PSNS	Limits are for oil and grease only (no duration specified).
4	Centralized Waste Treatment	437	A–D	PSES PSNS	Limits are concentration-based daily maximums and monthly averages.
5	Coil Coating	465	A–D	PSES PSNS	Limits are production-based daily maximums and monthly averages.
6	Concentrated Animal Feeding Operations (CAFO)	412	B	PSNS	Discharge of process wastewater is prohibited, except when there is an overflow resulting from a chronic or catastrophic rainfall event.
7	Copper Forming	468	A	PSES PSNS	Limits are production-based daily maximums and monthly averages.
8	Electrical and Electronic Components	469	A–D	PSES PSNS	Limits are concentration-based daily maximums and 30-day averages or monthly averages (varies per subpart and pollutant parameter). Certification is allowed in lieu of monitoring for certain pollutants when a management plan is approved and implemented.
9	Electroplating	413	A,B,D–H	PSES	Limits are concentration-based (or alternative mass-based equivalents) daily maximums and four-consecutive-monitoring-days averages. Two sets of limits exist, depending on whether facility is discharging more or less than 10,000 gpd of process wastewater. Certification is allowed in lieu of monitoring for certain pollutants when a management plan is approved and implemented.

No.	Category	40 CFR Part	Subparts	Type of standard	Overview of pretreatment standards
10	Fertilizer Manufacturing	418	A–G	PSNS	Limits may specify zero discharge of wastewater pollutants (Subpart A), production-based daily maximums, and 30-day averages (Subparts B–E), or may be concentration-based (Subparts F–G), with no duration of limit specified.
11	Glass Manufacturing	426	H K–M	PSNS	Limits are concentration- or production-based daily maximums and monthly averages.
12	Grain Mills	406	A	PSNS	Discharge of process wastewater is prohibited at a flow rate or mass loading rate (BOD_5 and TSS) that is excessive during periods when a POTW is receiving peak loads.
13	Ink Formulating	447	A	PSNS	Regulations specify no discharge of process wastewater pollutants to a POTW.
14	Inorganic Chemicals Manufacturing	415	A,B,F,L, AH,AJ,AL, AR,AU,BC, BL,BM,BO	PSES	Limits vary for each subpart with a majority of the limits concentration-based, daily maximums, and 30-day averages, or they may specify no discharge of wastewater pollutants.
			B–F, H, K–N,P,Q, T,V,AA, AC,AE,AH AI,AJ,AL, AN,AP,AQ AR,AU,AX BB,BC, BH, BK–BO	PSNS	
15	Iron and Steel Manufacturing	420	A–F, H–J, L	PSES PSNS	Limits are production-based daily maximums and 30-day averages.
16	Leather Tanning and Finishing	425	A–I	PSES PSNS	Limits are concentration-based daily maximums and monthly averages. In certain instances, applicability of pretreatment standards is dictated by volume of production.
17	Metal Finishing	433	A	PSES PSNS	Limits are concentration-based daily maximums and monthly averages. Certification is allowed for certain pollutants where a management plan is approved and implemented.
18	Metal Molding and Casting	464	A–D	PSES PSNS	Limits are primarily production-based daily maximums and monthly averages. Discharges from certain processes are prohibited (Subparts A–C).
19	Nonferrous Metals Forming and Metal Powders	471	A–J	PSES PSNS	Limits are production-based daily maximums and monthly averages. In some instances, the discharge of wastewater pollutants is prohibited.

No.	Category	40 CFR Part	Subparts	Type of standard	Overview of pretreatment standards
20	Nonferrous Metals Manufacturing	421	C,F–M,P, Q,V,X,Y, AA–AC	PSES	Limits are production-based daily maximums and monthly averages. PSES (Subpart F) specify no discharge from existing facilities of process wastewater pollutants to the POTW except for some stormwater events.
			A–Z, AA–AE	PSNS	Limits are production-based daily maximums and monthly averages. PSNS (Subparts D and F) specify no discharge from existing facilities of process wastewater pollutants to the POTW.
21	Oil and Gas Extraction	435	D	PSES PSNS	Regulations specify no discharge of wastes (e.g., produced water, drill cuttings) to a POTW.
22	Organic Chemicals, Plastics, and Synthetic Fibers	414	B–H, K	PSES PSNS	Limits are mass-based (concentration-based standards multiplied by process flow) daily maximums and monthly averages. Standards for metals and cyanide apply only to metal- or cyanide-bearing wastestreams.
23	Paint Formulating	446	A	PSNS	Regulations specify no discharge of process wastewater pollutants to the POTW.
24	Paving and Roofing Materials (Tars and Asphalt)	443	A–D	PSNS	Limits are for oil and grease only (no limit duration specified).
25	Pesticide Chemicals	455	A, C, E	PSES PSNS	Limits are mass-based (concentration-based standards multiplied by process flow) daily maximums and monthly averages. Subpart C specifies no discharge of process wastewater pollutants but provides for pollution-prevention alternatives. Subpart E specifies no discharge of process wastewater pollutants.
26	Petroleum Refining	419	A–E	PSES PSNS	Limits are concentration-based (or mass-based equivalent) daily maximums.
27	Pharmaceutical Manufacturing	439	A–D	PSES PSNS	Limits are concentration-based daily maximums and monthly averages. Such facilities may certify that they do not use or generate cyanide in lieu of performing monitoring to demonstrate compliance.
28	Porcelain Enameling	466	A–D	PSES PSNS	Limits are concentration-based (or alternative production-based) daily maximums and monthly averages. Subpart B prohibits discharges from certain operations.

No.	Category	40 CFR Part	Subparts	Type of standard	Overview of pretreatment standards
29	Pulp, Paper, and Paperboard	430	A–G, I–L	PSES PSNS	Limits are production-based daily maximums and monthly averages. Such facilities may certify that they do not use certain compounds in lieu of performing monitoring to demonstrate compliance. Facilities subject to Subparts B and E must also implement BMPs as identified.
30	Rubber Manufacturing	428	E–K	PSNS	Limits are concentration- or production-based daily maximums and monthly averages.
31	Soap and Detergent Manufacturing	417	O–R	PSNS	Regulations specify no discharge of process wastewater pollutants to a POTW when the wastewater chemical oxygen demand (COD)/BOD_7 ratio exceeds 10.0 and the COD concentrations exceed subcategory specific concentrations.
32	Steam Electric Power Generating	423	—	PSES PSNS	Limits are concentration-based daily maximums, or *maximums for any time*, or compliance may be demonstrated through engineering calculations.
33	Timber Products Processing	429	F–H	PSES PSNS	All PSNS (and PSES for Subpart F) prohibit the discharge of wastewater pollutants. PSES for Subparts G and H are concentration-based daily maximums (with production-based alternatives).
34	Transportation Equipment Cleaning	442	A–C	PSES PSNS	Operators subject to effluent guidelines in subparts A–B must either meet concentration-based daily maximum standards or develop a Pollutant Management Plan. Operators subject to effluent guidelines in subpart C must meet concentration-based daily maximum standards.
35	Waste Combustors	444	A	PSES PSNS	Limits are concentration-based daily maximums and monthly averages.

CWF vs. FWA

Categorical standards apply to regulated wastewaters, i.e. wastewater from an industrial process that is regulated for a particular pollutant by a categorical pretreatment standard. Therefore, demonstrating compliance with categorical pretreatment standards is intended to be based on measurements of wastestreams containing only the regulated process wastewater.

However, recognizing that isolation of regulated wastestreams from nonregulated wastestreams was not always practicable or desirable, the EPA developed the combined wastestream formula (CWF) and flow weighted average (FWA) approach for determining compliance with combined wastestreams.

Pursuant to 40 CFR §403.6(e), the CWF is applicable where a regulated wastestream combines with one or more unregulated or dilute wastestreams prior to treatment. Where nonregulated wastestreams combine with process streams after pretreatment, the more stringent approach (whether CWF or FWA) is used to adjust the limits.

The CWF and FWA approaches differ primarily in their allowances for nonregulated wastestreams. While the CWF provides a *"full credit"* (i.e., same pollutant levels as regulated wastestreams) for unregulated wastestreams yet no credit for dilute wastestreams, the FWA requires sampling and analysis of the untreated, nonregulated wastestreams to determine the credit to be granted (not to exceed that allowed for the regulated wastestreams).

Application of the CWF and FWA requires proper identification, classification, and quantification of the three wastestream types. Note: in circumstances where boiler blowdown, noncontact cooling water, stormwater, or demineralized wastestreams contain a significant amount of a regulated pollutant, and the treatment of the wastewater with the regulated wastestream results in substantial reduction of the regulated pollutant, the Control Authority can classify the wastestream as unregulated rather than as a dilute wastestream.

Proper application of the CWF or FWA will result in:

- ➢ alternative limits being established for each regulated pollutant in each regulated process;
- ➢ both daily maximum and long-term average (i.e., 4-day, 30-day, or monthly) alternative limits being calculated for each regulated pollutant;

Wastestream Types

Regulated
Wastewater from an industrial process that is regulated for a particular pollutant by a categorical pretreatment standard.

Nonregulated, Unregulated
Wastestreams from an industrial process that are not regulated for a particular pollutant by a categorical pretreatment standard and are not defined as a dilute wastestream, e.g.:

- a process wastestream for which categorical standards have been promulgated but for which the deadline for compliance has not yet been reached.

- a process wastestream that currently is not subject to categorical pretreatment standards
- a process wastestream that is not regulated for the pollutant in question but is regulated for other pollutants.

Dilute

Wastestreams which have no more than trace or non-detectable amounts of the regulated pollutant. Defined in 40 CFR § 403.6(e)(1) of the General Pretreatment Regulations, the streamlining rule, to include sanitary wastestreams, demineralized backwash streams, boiler blowdown, noncontact cooling water, storm water, and process wastestreams from certain standards based on the findings that these wastewaters contained none of the regulated pollutant or only trace amounts of it.

The EPA's *Guidance Manual for the Use of Production Based Pretreatment Standards and the Combined Wastestream Formula* should be consulted for more information on the proper application and adjustment of categorical pretreatment standards.

Although categorical standards are established based on a particular industrial category, the EPA provides several options for unique circumstances that justify adjustment of categorical standards for an individual facility:

CHECKLIST EXAMPLE FOR ASSESSMENT OF PERMANENTLY INSTALLED FLOWMETERS

<table>
<tr><td colspan="3">INSPECTOR NAME:</td><td colspan="2">DATE:</td></tr>
<tr><td colspan="3">COMPANY NAME:</td><td colspan="2">TYPE OF PRIMARY DEVICE:</td></tr>
<tr><td colspan="4">SITE CODE #</td><td>SIZE:</td></tr>
<tr><td colspan="5">ADDRESS:</td></tr>
<tr><td colspan="2">DIMENSIONS OF VAULT:</td><td colspan="3">DEPTH OF VAULT:</td></tr>
</table>

TAKE PHOTOGRAPHS

1. IS FLUME LEVEL?
2. HEIGHT MEASUREMENT FROM TOP OF FLUME TO BOTTOM OF PERMANENT TRANSDUCER:
3. HOW HIGH DOES THE LEVEL GET IN FLUME?
4. DAILY MAXIMUM FLOW (CONVERTED TO LEVEL):
5. CAN YOU SETUP OUR TRANSDUCER UNDER OR NEXT TO THEIRS, WITHOUT DISTURBING THEIRS?
6. IS THEIR PERMANENT TRANSDUCER SETUP OVER THE PROPER MEASURING POINT ON THE FLUME?
7. RECORD ANY PROBLEMS WITH THE WAY THE PERMANENT TRANSDUCER / FLOWMENTER IS SETUP:
8. COMMENTS____

____

____

Inspector's Signature:____

Permittee's Flow Measurement System

Four basic steps are involved in evaluating the permittee's flow measurement system:

- Physical inspection of the primary device
- Physical inspection of the secondary device and ancillary equipment
- Flow measurement using the primary/secondary device combination of the permittee
- Certification of the system using a calibrated, portable instrument

Facilities with a closed pipe flow measurement system present a challenge to the inspector. Have the facility personnel explain the operation of the system and how they calibrate the flow measurement system.

Check if it is calibrated yearly at a minimum. It is suggested that the facility conduct periodic monthly checks of the flow measurement system.

The inspector can do a calibration of the closed pipe flow measurement systems in the following ways:

1. If an open-channel primary device is maintained at the facility the inspector can obtain an instantaneous head reading to verify the accuracy of the closed channel flow measuring system. Flow should be within ±10 percent of the closed channel system.

2. The inspector can use a portable flow meter (usually consists of two strap-on sensors that mount on the pipe and utilize the Doppler principle) to verify the accuracy of the facility's flow measurement system by conducting side-by-side comparisons. Flow should be within ±10 percent.

3. Confirm that the calibration procedure demonstrated by the facility's calibration personnel is adequate. The following sections present procedures for inspecting the more common types of primary and secondary devices, for measuring flow using common permanent and portable systems, and for evaluating flow data.

Please note that the number of primary/secondary device combinations is limitless; therefore, it is not feasible to provide procedures for all systems. When encountering systems other than those discussed here the inspector should consult the manufacturer's manual or facility personnel for advice on how the flow-measurement system operates before preparing a written inspection procedure.

Removal Credits *(Credit USEPA)*

40 CFR §403.7 (Streamlining rule) details the conditions by which a Control Authority may demonstrate consistent removal of pollutants regulated by categorical standards at their POTW, and in so doing, may extend removal credits to industries on a pollutant-specific basis to prevent redundant treatment. Removal credits are only available for a pollutant if the pollutant is regulated by the sewage sludge use or disposal option employed by the POTW making the application request, or if the pollutant is listed in 40 CFR Part 403, Appendix G and the POTW is in compliance with the provisions included there.

Also, the availability of removal credits is not limited to Appendix G pollutants for POTWs that dispose of sewage sludge in municipal solid waste landfills. Steps for developing such a request are in the EPA's *Guidance Manual for the Preparation and Review of Removal Credit Application*s.

Fundamentally Different Factors Variance Section 301(n) of the CWA authorizes adjustments of categorical pretreatment standards for existing sources who demonstrate they have factors which are fundamentally different from the factors the EPA considered during standards development (40 CFR §403.13). Variance requests must be based solely on information and data submitted during the development of the categorical standards and the adjusted effluent limitations must neither be more nor less stringent than justified by the fundamental difference nor result in a non-water quality environmental impact markedly more adverse than the impact considered by the EPA when developing the categorical standard.

Successful requests must detail factors well outside the range considered by the EPA in establishing the standard and not merely factors deviating from the average. Further, differences must not be similar to a significant number of other facilities in the category. A facility must request a variance in writing no later than 180 days after publication of a categorical Pretreatment Standard in the Federal Register.

Net/Gross Adjustment Categorical Pretreatment Standards

Net/Gross Adjustment Categorical Pretreatment Standards can be adjusted to reflect the presence of pollutants in a CIU's intake waters (40 CFR §403.15).

To obtain a net/gross credit, the CIU must submit a formal written request to the Control Authority that demonstrates:

- Its intake water is drawn from the same body of water that the POTW discharges into (this can be waived if the Control Authority finds no environmental degradation will result);
- The pollutants present in the intake water will not be entirely removed by the treatment system operated by the CIU; and
- The pollutants in the intake water do not vary chemically or biologically from the pollutants limited by the applicable standard.

Inherent in this provision is the requirement that the CIU employ a treatment technology capable of meeting the categorical pretreatment standard(s). Net/gross adjustments should not be granted to CIUs that have no treatment. Further, credits are only granted to the extent necessary to meet the applicable standard(s), up to a maximum value equal to the influent value. A Net/Gross adjustment of Categorical Pretreatment Standards can be requested when pollutants are present in an IUS intake water.

Innovative Technology--in accordance with 307(e) of the CWA, existing CIUs choosing to install an innovative treatment system may receive approval from the Control Authority for up to a two year extension to their applicable categorical pretreatment standards compliance deadline, provided:

- The innovative treatment has a reasonable potential to result in significantly greater pollutant removal or equivalent removal at a substantially lower cost than the technologies considered by the EPA when developing the categorical standard;
- The innovative technique has the potential for industry-wide application; and
- The proposed compliance extension will not cause or contribute to the violation of the POTW's NPDES permit.

While policy has been established for universal categorical variance requests, occasionally, a Control Authority may merely need assistance to classify a CIU and/or to determine applicable categorical limitations. Provisions in the General Pretreatment Regulations allow POTWs and IUs to request an EPA category determination for a specific IU within 60 days after the effective date of the standard in question [40 CFR §403.6(a)].

Even after the formal timeframe for requesting a categorical determination, the EPA (and states) will assist POTWs and IUs with categorization issues. Such requests, however, do not affect applicable reporting requirements, including timely requests submitted under 40 CFR §403.6(a). Additionally, the EPA has addressed universal CIU questions posed by Control Authorities in various memoranda and guidance:

Research and Development (R&D) Facilities

Unless specifically addressed in the categorical regulation or associated development document, R&D facilities where there is no commercial sale of products from the facility, are not subject to categorical standards.

Should an R&D facility need pollution controls to comply with prohibited discharge standards and/or local limits, the development documents may serve as guidance on the performance of pollution control technologies.

Certification Statements

In lieu of requiring self-monitoring, some standards allow CIUs to certify that they do not use, generate or discharge a regulated pollutant [e.g. Pulp, Paper and Paperboard facilities can certify that chlorophenolic compounds are not used (40 CFR Part 430) and Pharmaceutical Manufacturing facilities can certify that cyanide is not used or generated (40 CFR Part 439)]. Facilities providing such certifications are still considered CIUs, and therefore are subject to other pretreatment standards and requirements.

Lack of specific categorical effluent limitations IUs subject to PSES or PSNS that merely require compliance with 40 CFR Part 403 are not considered CIUs. However, these users may still be classified as SIUs and are still subject to the general and specific prohibitions and any local limits.

Total Toxic Organics (TTO) *(Credit USEPA)*

Seven categorical regulations currently limit the discharge of TTO:

- **40 CFR Part 413 - Electroplating**
- **40 CFR Part 433 - Metal Finishing**
- **40 CFR Part 464 - Metal Molding and Casting**
- **40 CFR Part 465 - Coil Coating**
- **40 CFR Part 467 - Aluminum Forming**
- **40 CFR Part 468 - Copper Forming**
- **40 CFR Part 469 - Electrical and Electronic Components (Phase I and II)**

For each of these standards, TTO refers to the sum of the masses or concentrations of certain toxic organic pollutants found in the regulated discharge at a concentration greater than 0.01 milligrams per liter (mg/l).

However, the toxic organic pollutants regulated by the TTO limit are specific to each industrial category. Further, industrial categories may provide some flexibility with regard to monitoring and/or reporting requirements as follows:

40 CFR Parts 413 and 433 allow development and implementation of a Toxic Organic Management Plan (TOMP) in lieu of routine monitoring while 40 CFR Part 469 allows development and implementation of a Solvent Management Plan.

Upon approval of these plans by the Control Authority, the CIU can demonstrate compliance with TTO requirements by certifying that the facility is adhering to this Plan to prevent organics from being discharged to the POTW. A specific certification statement must be signed and provided to the Control Authority on a regular basis.

40 CFR Parts 464, 465, 467, and 468 allow an option to demonstrate compliance with an Oil and Grease limit in lieu of demonstrating compliance with a TTO limit. The option chosen by the CIU must be utilized for all reports required (i.e., BMR, 90-daycompliance report, and periodic compliance reports).

The EPA's *Guidance Manual for Implementing Total Toxic Organics (TTO) Pretreatment Standards* should be consulted for more information on TTO.

MAHL MAIL *(Credit USEPA)*

Maximum Allowable Headworks Loading Method (MAHL)
Pollutant by pollutant, treatment plant data are used to calculate removal efficiencies, before applying the most stringent criteria (i.e., water quality, sludge quality, NPDES permit, or pollutant inhibition levels) to back-calculate the MAHLs. Subtracting out contributions from domestic sources, the available industrial loading is then either evenly distributed among the IUs, or allocated on an as needed basis to those IUs discharging the pollutant above background levels.

Maximum Allowable Industrial Load (MAIL)
The MAIL is the total daily mass that a POTW can accept from all permitted IUs and ensure the POTW is protecting against pass through and interference.

Headworks' Rotating Bar screen and screening handling.

Headworks overflowing due to a blockage.

More on Local Limits *(Credit USEPA)*

Prohibited discharge standards are designed to protect against pass-through and interference generally. Categorical pretreatment standards, on the other hand, are designed to ensure that IUs implement technology-based controls to limit the discharge of pollutants. Local limits address the specific needs and concerns of a POTW and its receiving waters.

Federal regulations at 40 CFR §§403.8(f)(4) and 122.21(j)(4) require Control Authorities to evaluate the need for local limits and, if necessary, implement and enforce specific limits as part of pretreatment program activities. Local limits are developed for pollutants (e.g. metals, cyanide, BOD5 TSS, oil and grease, organics) that may cause interference, pass through, sludge contamination, and/or worker health and safety problems if discharged in excess of the receiving POTW treatment plant's capabilities and/or receiving water quality standards.

Typically, local limits are developed to regulate the discharge from all IUs, not just to CIUs, and are usually imposed at the "end-of-pipe" discharge from an IU (i.e., at the point of connection to the POTW's collection system). In evaluating the need for local limit development, it is recommended that Control Authorities:

- Conduct an industrial waste survey to identify all IUs that might be subject to the pretreatment program;
- Determine the character and volume of pollutants contributed to the POTW by these industries;
- Determine which pollutants have a reasonable potential for pass through, interference, or sludge contamination;
- Conduct a technical evaluation to determine the maximum allowable POTW treatment plant headworks (influent) loading for at least arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc;
- Identify additional pollutants of concern;
- Determine contributions from unpermitted sources to determine the maximum allowable treatment plant headworks loading from "controllable" industrial sources;
- Implement a system to ensure these loadings will not be exceeded.

Other local limit approaches available to Control Authorities include:
Collection System Approach: Pollutants found to be present which may cause fire and explosion hazards or other worker health and safety concerns, are evaluated for their propensity to volatilize and are modeled to evaluate their expected concentration in air. Comparisons are made with worker health exposure criteria and lower explosive limits. Where values are of concern, the Control Authority may set limits or require development of management practices to control undesirable discharges. The collection system approach may also consider the prohibition of pollutants with specific flashpoints to prevent discharges of ignitable wastes. The EPA's *Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors* details strategies for developing such local limits.

Industrial User Management Practice Plans
These plans typically consist of narrative local limits requiring IUs to develop management practices (e.g., chemical management practices, best management practices, and spill prevention plans) for the handling of chemicals and wastes.

The need for and suggested contents of such plans may be found in the EPA's *Control of Slug Loadings to POTWs: Guidance Manua*l, and *Spill Prevention, Control, and Countermeasure (SPCC) Information Guid*e.

Case-by-Case Discharge Limits *(Credit USEPA)*

These numeric local limits are based on best professional judgment (BPJ) and available pollution prevention and treatment technologies which are known to be economically feasible. This approach is most often used when insufficient data are available to employ the methods outlined, in local limits above.

Local Specific Prohibitions
POTW specific prohibitions may be imposed in addition to the prohibitions detailed in 40 CFR § 403.5 (a) & (b) to address hydraulic, pollutant specific, and/or aesthetic concerns; e.g.:

- Noxious or malodorous liquids, gases, or solids creating a public nuisance.
- Wastestreams which impart color and pass through the POTW treatment plant.
- Storm water, roof runoff, swimming pool drainage.
- Wastewaters containing radioactive wastes or isotopes.
- Removed substances from pretreatment of wastewater.

Regardless of the approaches taken by a Control Authority, local limits should correct existing problems, prevent potential problems, protect the receiving waters, improve sludge use options, and protect POTW personnel. Additional existing EPA guidance on the subject includes:

- *Guidance for Preventing Interference at POTWs*
- *Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program*
- *Supplemental Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program: Residential and Commercial Toxic Pollutant Loadings and POTW Removal Efficiency Estimation*
- *Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluent*s.

Additionally, many EPA Regions and States have developed local limits guidance to address regional and state issues.

LOCAL LIMITS OBSERVATION SHEET *Example*

SITE DESCRIPTION:

SITE CODE #: **DATE:**

TIME	pH	TEMP.	RES.CL_2	INITIALS
0900				
1200				
1430				
1700				
2000				
2230				
0100				
0430				

DAILY TOTAL FLOW:

PICKLE JAR IW#			
FIELD COMP IW#			
VOC's IW#			
TPH IW#			

SAMPLES COLLECTED

PARAMETER	YES	NO	PARAMETER	YES	NO
601/602 (HOW MANY)			BOD, COD, TSS		
8240 (HOW MANY)			NO_2/NO_3		
SULFIDES			METALS		
TKN			608		
AMMONIA (NH_4)			1657		
CN			625		
TPH (HOW MANY)			8270		
8140			8080		

IF NO SAMPLE COLLECTED, RECORD ON BACK AS TO WHY.

Summary of Standards

A summary of all of the pretreatment standards, including general and specific prohibitions, categorical pretreatment standards, and local limits.

	General and Specific Prohibitions	**Categorical Pretreatment Standards**	**Local Limits**
Development	Established at the Federal level	Established at the Federal level	Developed by Control Authorities
Reference	40 CFR 403.5(a) & (b)	40 CFR Parts 405-471	Requirements for development found in 40 CFR §§403.5(c) & 403.8(f)(4)
Applicability	All IUs	CIUs	Commonly all IUs or all SIUs, but depends on allocation method used when developing limits.
Purpose	Provide for general protection of the POTW. May be superseded by more stringent categorical pretreatment standards or local limits.	Minimum standards based on available treatment technology and pollution prevention measures for controlling non-conventional and toxic pollutants that may cause pass through, interference, etc. at the POTW. May be superseded by more stringent local limits.	Provide site specific protection for a POTW and its receiving waters. May be superseded by more stringent categorical standards.

All standards are considered pretreatment standards for the purpose of section 307(d) of the Clean Water Act.

A POTW is responsible for identifying standard(s) applicable to each industrial user and applying the most stringent requirements where multiple provisions exist. Compliance with imposed standards can be achieved through implementation of best management practices, development of a pollution prevention program, and/or installation of pretreatment.

Concentration - or Mass-Based Limits

The Control Authority may have the authority to establish equivalent mass limits or equivalent concentration limits for federally established concentration-based and mass-based limits, respectively. The Control Authority might also want to establish the same flexibility when applying its local limits. The permit writer needs to be familiar with how the local limits were developed, how they are meant to be implemented, and how they were adopted into the sewer use ordinance.

Local limits are generally expressed as numeric values, which are upper bounds of the amount of pollutant that may be discharged to the POTW by Industrial Users. During the local limits development process, the quantity of specific pollutants that may be accepted by the POTW is developed as a mass value (pounds per day) or otherwise known as maximum allowable industrial loadings. Then the maximum allowable industrial loading value is typically divided among all Industrial Users subject to local limit requirements and converted into a concentration-based limit. Typically, most POTWs implement their numeric limits as uniform, concentration-based local limits. (For more information regarding local limits development and implementation, see EPA's *Local Limits Development Document*, July 2004).

When to Convert Concentration-Based Local Limits to Mass Limits

There might be circumstances when applying an equivalent mass limit is more appropriate than applying a concentration limit. Before converting concentration-based local limits to mass limits, the permit writer should review how the local limits were originally established to determine the maximum allowable loading values allocated for each Industrial User. By converting concentration-based local limits to mass limits, the permit writer ensures that the maximum allowable loading allocated to that Industrial User is not exceeded and that compliance is not achieved through dilution. The following are some situations in which the permit writer should consider converting concentration-based local limits into mass limits:

Batch dischargers

- Dischargers with excessive or variable wastewater flow
- Dischargers with seasonal variations

To evaluate compliance with the equivalent mass limit, the permit writer must obtain or require the Industrial User to submit appropriate flow measurements of the wastewater discharged to the POTW.

The applicable formula is shown on following table known EPA Table 6-7

When to Convert Mass-Based Local Limits to Concentration Limits

Even though local limits are typically concentration-based limits, some POTWs have adopted mass-based local limits. If your POTW has adopted mass-based local limits, there might be situations when these limits should be converted to concentration limits. By converting mass-based local limits to concentration limits, the Control Authority can evaluate compliance with effluent requirements of local limits by simply comparing the analysis result with the numeric limit. The following are some situations in which the permit writer should consider converting mass-based local limits to concentration limits.

- Dischargers with consistent wastewater discharge flow rates
- Dischargers with consistent compliance

The applicable formula is shown on following table known EPA Table 6-7.

(Concentration-based limits (mg/L) to mass limits (lbs/day))

$$\left(\begin{array}{c}\text{User's Discharge Flowrate}\\ \text{In million gallons per day}\\ \text{(mgd)}\end{array}\right) \times \left(\begin{array}{c}\text{Concentration-based limit}\\ \text{In milligrams per liter}\\ \text{(mg/L)}\end{array}\right) \times \left(\begin{array}{c}\text{Conversion factor}\\ \text{8.34 lbs/gal}\end{array}\right) = \begin{array}{c}\text{Equivalent}\\ \text{mass limit,}\\ \text{lbs/day}\end{array}$$

(Mass-based limits (lbs/day) to concentration limits)

$$\frac{\left(\begin{array}{c}\text{User's Allowable Pollutant loading}\\ \text{(pounds per day (lbs/day))}\end{array}\right)}{\left(\begin{array}{c}\text{User's average daily discharge flowrates}\\ \text{(mgd)}\end{array}\right)\left(\begin{array}{c}\text{Conversion factor}\\ \text{8.34 lbs/gal}\end{array}\right)} = \begin{array}{c}\text{Equivalent concentration limit,}\\ \text{mg/L}\end{array}$$

NSCIU Requirements

The Control Authority, at its discretion, may establish the authority to classify some CIUs as NSCIUs. If the Control Authority has established this authority, the Control Authority should consider how it would regulate its NSCIUs. Because NSCIUs are no longer considered significant users, there is no federal requirement to control these users through a permit or any other control mechanism. The Control Authority, however, at its own discretion, can establish the authority to issue permits to these users.

Regardless of whether an Industrial User is determined to be an NSCIU, it is still a categorical discharger and, as such, is still required to comply with applicable categorical Pretreatment Standards and related reporting and notification requirements at 40 CFR 403.12(b), (c), (d), (f), (j), (l), and (p).

Furthermore, the Control Authority still must perform the same minimum oversight of an NSCIU that is required for other facilities that are not SIUs, including notifying the CIU of its status and requirements, reviewing required reports and certifications, verifying that daily regulated flow rates do not exceed 100 gpd, random sampling and inspection, and investigating noncompliance as necessary.

If the Control Authority has established the necessary authority to permit these dischargers, the permit writer should include the following:

- Applicable categorical and local effluent limitations
- Necessary reporting and notification requirements.

Zero-Discharge Requirements

The Control Authority, at its discretion, may prohibit the discharge of certain wastewaters (e.g., storm water, chlorinated swimming pool waters) into the POTW, in addition to the general federal prohibitions.

Furthermore, some categorical pretreatment standards require a facility to not discharge certain process wastewaters. For those facilities, the permit writer should evaluate whether there is a potential for the facility to actually discharge the prohibited process wastewater into the POTW. Considerations for “potential” are discussed in detail in Section 3.2 of this manual.

A Control Authority may choose to issue a permit to a facility that does not discharge (zero-discharge) or is prohibited to discharge process wastewater. There are special conditions that the Control Authority should include in the permit for this type of facility. These conditions are discussed in detail in a later topic.

Tiered Permits

The Control Authority could encounter situations in which one set of effluent limits might not be appropriate for the permit's entire period (e.g., where production rates and associated wastestream volume discharged varies). A tiered permit might be appropriate in such situations, eliminating the need for continual permit revisions. For example, an Industrial User may be issued one set of limits for the average production rate and another set that takes effect when there is a significant change in the average production rate.

Generally, a 10 to 15 percent deviation above or below the long-term average production is within the range of normal variability. Predictable changes in the long-term production higher than that range could warrant consideration of a tiered permit. Tiered permits are recommended where the long-term average production varies by 20 percent or greater. Typically, there are three situations in which tiered permits are warranted.

The first situation would involve a facility that the Control Authority knows will begin a new process or add a new process line during the term of the permit. In such a case, the permit writer could include two sets of limits—one set for the current conditions and one set for the future conditions. The permit should also clearly state the terms and conditions under which each set of limits would apply.

The second situation would involve an industry that has an annual pattern of low- and high-production rates. For example, an industry that produces Christmas items might operate at only 40–50 percent capacity from January through June, but at full capacity from July through December. In such a case, the permit writer would also develop two (or more) sets of limits for the industry.

For seasonal variations, the permit could stipulate either dates or production levels that would trigger the application of one set of limits versus another. For that type of permit, a special condition should be included in the permit that requires the Industrial User to notify the Control Authority when the scheduled production change occurs *or* if unexpected circumstances cause seasonal operations to differ from the fixed periods defined in the permit.

The third scenario would involve an industry where the demand is variable, and the permit modification process is not fast enough to respond to the need for higher or lower equivalent limits.

A permit might be written with two or three tiers that apply to ranges of production.

For example, a hypothetical battery plant has a historical average production rate that varies between 40 and 100 percent with a maximum average production rate of 2.0 x 106 lbs/day.

The plant is subject to a production-based categorical standard for pollutant X – 1 lb/million lb of product (daily maximum).

Alternate Effluent Limits Might be set as Follows:

First Tier: Basis of Calculation. 1 × 106 lbs/day Limit for Pollutant X 2.0 lbs/day (daily maximum)

Applicable Production Range: 0.8 × 106 to 1.2 × 106 lbs/day

Second Tier: Basis of Calculation. 1.4 x 106 lbs/day Limit for Pollutant X 2.8 lbs/day (daily maximum) Applicable Production Range: > 1.2 × 106 to 1.6 × 106 lbs/day

Third Tier: Basis of Calculation. 1.8 × 106 lbs/day Limit for Pollutant X 3.6 lbs/day (daily maximum)

Applicable Production Range: > 1.6 × 106 to 2.0 × 106 lbs/day

The first tier has an applicable production range that covers plus or minus 20 percent of the basis of the calculation for that tier. This can be seen by noting that the basis of calculation for the first tier is 1 × 106 lbs/day, and the threshold level that would trigger the next tier is set at 1.2 × 106 lbs/day or 20 percent higher.

Similarly, the second and third tiers have applicable production ranges of 14 percent and 11 percent, respectively. That is consistent with the general rule (mentioned earlier) that a 10 to 15 percent change in average production rate is within the range of normal variability while a 20 percent or greater change should warrant alternate limits.

The production range for each tier must be specified in the permit, and the Industrial User must be required to report the measurements or estimates of the actual production rate that prevailed during the reporting period. The anticipated production rate for the next reporting period should also be reported.

For a tiered permit, a special notification condition should be included in the permit that requires the Industrial User to notify the Control Authority within 30 days before a change in production.

A tiered permit requires an increased technical and administrative role by the Control Authority to verify compliance with effluent limits. The permit should be issued only after careful consideration and only when a substantial change in the long-term average rate of production or other changes that effect permit conditions are likely to occur.

Parshall Flumes

Parshall Flume provides both accuracy and rangeability. Dimensions and capacities are in accordance with those published in the U.S. Department of the Interior's Water Measurement Manual.

Parshall Flumes are a primary flow element for flow measurement in open channels. The big advantages of Parshall Flumes are their self-cleaning capabilities, low head loss, single-head measurement, and wide operating range.

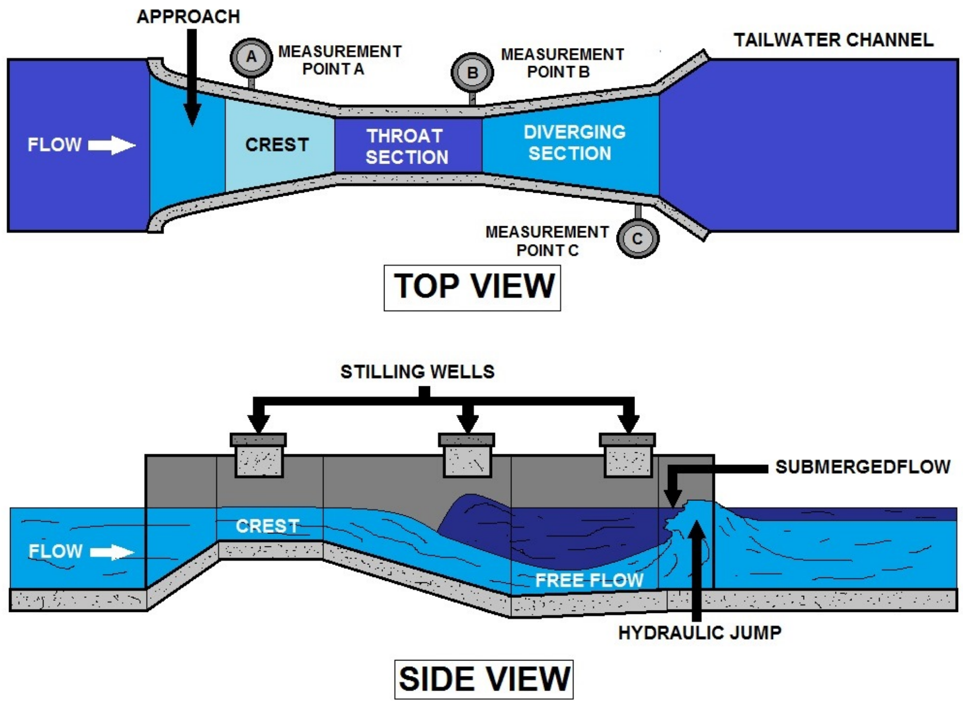
While commonly used in rectangular channels, they can also be adapted for use in circular channels. Flumes feature stiffening ribs, braces and anchor clips. Options include stilling well, staff gauge, flow sensors, adaptors, etc.

Clarification
Clarification on category-specific wastestream classifications may be provided by consulting the applicable regulation(s) and associated development documents, since wastestream types are addressed in the effluent guideline and categorical standard development process. When in doubt, the Control Authority can always require the CIU to monitor the wastestream(s) in question to quantify the presence (or lack thereof) of categorically regulated pollutants.

Reasonably accurate flow data must also be obtained for each wastestream type flowing through the monitoring point to ensure categorical pretreatment standards are adjusted accordingly.

Flow measuring device known as a *"Parshall Flume".*

Several POTW's are requiring the SIU to cover the flume inside the vault to lower the hazard of a permit required confined space. Note: The sampler suction line should be placed near the head of the flume to minimize its effect on the flow measurement



PARSHALL FLUME DIAGRAM

There are a variety of flumes used to measure water flow of a larger channel. When used to measure the flow of water in open channels, a flume is defined as a specially shaped, fixed hydraulic structure that under free-flow conditions forces flow to accelerate in such a manner that the flow rate through the flume can be characterized by a level-to-flow relationship as applied to a single head (level) measurement within the flume.

Acceleration is accomplished through a convergence of the sidewalls, a change in floor elevation, or a combination of the two.

Flow measurement flumes typically consist of a converging section, a throat section, and a diverging section. Not all sections, however, need to be present. In the case of the Cutthroat flume, the converging section directly joins the diverging section, resulting in a throat section of no length (hence the term "Cutthroat").

Other flumes omit the diverging section (Montana and HS / H / HL -flumes). Flumes offer distinct advantages over sharp-crested weirs:

- For the same control width, the head loss for a flume is about one-fourth of that needed to operate a sharp-crested weir
- The velocity of approach is part of the calibration equations for flumes
- Unauthorized altering of the dimensions of constructed flumes is difficult (and therefore unlikely)
- Most flume styles readily allow for the passage of sedimentation and floating debris – reducing the time and effort associated with maintaining a flume installation

Chapter Summary

Categorical Pretreatment Standards and local limits are distinct and complementary types of Pretreatment Standards. Promulgation of a categorical Pretreatment Standard by EPA in no way relieves a Control Authority from its obligation to evaluate the need for, and to develop, local limits to meet the general and specific prohibitions in the General Pretreatment Regulations. As mentioned earlier, categorical Pretreatment Standards are developed to achieve a degree of water pollution control for selected industries and pollutants on the basis of a national assessment of available technology and costs. Local limits are intended to prevent site-specific problems for a POTW and the environment resulting from Industrial Users.

In implementing its pretreatment program, a Control Authority is required to enforce the *applicable Pretreatment Standard* (i.e., federal, state, or local, whichever is most stringent). When the Control Authority is drafting a permit for an Industrial User subject to categorical Pretreatment Standards, the task of determining the applicable effluent limits to apply can be complicated.

Local limits are often more stringent than categorical Pretreatment Standards because they are based on local, site-specific conditions. In addition, there might be local limits for more pollutants than are regulated in the applicable categorical Pretreatment Standard. Therefore, a permit may contain a mixture of categorical Pretreatment Standards and local limits. One complicating factor is that, in contrast to the categorical Pretreatment Standards that apply to individual discharges from regulated processes (end-of-process), local limits normally apply at the point(s) of discharge to the public sewer system (end-of-pipe).

In the situation where the Industrial User's discharge to the public sewer contains *only* wastewater from a process regulated under a particular categorical standard, the end-of-process pollutant load is the same as measurement of the pollutant over the day [40 CFR 122.2]. In the situation where the Industrial User's discharge to the public sewer contains *only* wastewater from a process regulated under a particular categorical standard, the end-of-process pollutant load is the same as the end-of-pipe pollutant load. The determination of which limits apply, local or categorical, is accomplished by simply choosing the limit that is numerically more stringent if the terms of duration of the limits are the same (e.g., both limits are daily maximum limits or monthly average limits). More commonly, the industry's discharge at the point of connection contains a mixture of categorical process wastestreams and noncategorical process wastestreams.

If categorical standards are to be applied at the end-of-pipe where additional wastestreams exist, the permit writer must adjust the categorical Pretreatment Standards to end-of-pipe limits. Appendices I and J contain guidance for calculating production-based standards and using the CWF, respectively. Such adjusted limits must then be compared to the Control Authority's local limits, and the most stringent limit would be included in the permit.

In other instances, the Control Authority might find it necessary or preferable to monitor the industrial discharge at more than one location. In such a case, the permit must clearly indicate where the specific limits apply and where samples for various parameters must be collected. For example, a Control Authority might want to regulate a metal-finishing industry by requiring monitoring for local limits at the connection to the sewer system, monitoring for categorical Pretreatment Standards at the discharge from the pretreatment "system", and monitoring for cyanide on the segregated wastestream from the cyanide treatment unit.

EXAMPLE OF FACT SHEET
DOCMENTING THE DETERMINATION OF THE MOST STRINGENT DAILY MAXIMUM EFFLUENT LIMITS

Parameter	Daily PSES	Monthly PSES	Daily CWF	Monthly CWF	Local Daily Limits	Daily Final Limit	Monthly final limit**
Cadmium	0.69	0.26	0.46	0.17	0.10	0.10	0.17
Chromium (Hex)	________	________	________	________	0.10	0.10	________
Chromium (Total)	2.77	1.71	1.85	1.14	1.0	1.0	1.14
Copper	3.38	2.07	2.26	1.38	5.0	2.26	1.38
Cyanide	6.0	0.65	*	*	2.0	2.0	0.65*
Lead	0.69	0.04	0.46	0.29	0.10	0.10	0.29
Manganese	--------	---------	---------	---------	1.00	1.00	---------
Mercury	---------	---------	---------	---------	0.005	0.005	---------
Nickel	3.98	2.38	2.66	1.59	2.0	2.0	1.59
Silver	0.04	0.24	0.28	0.16	0.1	0.1	0.16
Zinc	2.61	1.48	1.74	0.99	5.0	1.74	0.99
TTO* **	2.13	---------	1.42	---------	1.0	1.0	---------

Note: All concentrations are in mg/L unless otherwise noted.

Key:
PSES = Pretreatment Standards for Existing Sources, metal finishing category (40 CFR Part 433.15 (a))

CWF = Alternative metal - finishing standards after use of the combined wastestream formula.

Local Limits = Maximum pollutant concentrations established by the Control Authority

Final Limit = Final limits based on most stringent of local, state, and federal standards

*Cyanide limits must apply to the segregated cyanide wastestream of the cyanide destruct treatment process

**The discharger required to comply with both the daily maximum and monthly average limits, if applicable.

***The pollutants regulated by the categorical TTO limit and the local TTO limit are the same.

This course contains general EPA's CWA federal rule requirements. Please be aware that each state implements wastewater/safety/environmental /building regulations that may be more stringent than EPA's regulations. Check with your state environmental agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to not be in non-compliance and do not follow this course for proper compliance.

Chapter 3- Overview of the National Pretreatment Program
Post Quiz

1. The General Pretreatment Regulations apply to all non-domestic sources that introduce pollutants into a POTW. These sources of "*indirect discharge*" are more commonly referred to as__________________________.

2. Many of the General Pretreatment Regulations apply to SIUs as opposed to IUs, because control of ___________________should provide adequate protection of the POTW.

3. An IU that contributes a process wastestream making up _________________ percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant;

4. An IU designated by the _______________________ as such because of its reasonable potential to adversely affect the POTW's operation or violate any pretreatment standard or requirement; or an IU subject to Federal categorical pretreatment standards.

Control Authority

5. The General Pretreatment Regulations define the term "_________________" as a POTW that administers an approved pretreatment program since it is the entity authorized to control discharges to its system.

6. A control authority must establish a local _____________ to control discharges from non-domestic sources.

POTW Pretreatment Program Requirements

7. The actual requirement for a POTW to develop and implement a local pretreatment program is a _______________________.

Prohibited Discharge Standards

8. General prohibitions forbid the _____________________to a POTW that cause pass through or interference.

9. Discharges containing pollutants in amounts causing _______________________to the flow in the POTW resulting in interference;

10. ________________________ released at a flow rate and/or concentration that will cause interference with the POTW.

11. Discharges of heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds ______________ unless the Approval Authority, upon request of the POTW, approves alternative temperature limits;

12. __________________ except at discharge points designated by the POTW.

Categorical Standards
13. Categorical pretreatment standards are national, uniform, technology-based standards that apply to discharges to POTWs from specific industrial categories and limit the?

Categorical Pretreatment Standards - Sampling
14. Categorical Pretreatment Standards are technology-based standards for a selected group of industries established by EPA under authority of the_______________________.

15. Categorical Pretreatment Standards are developed on the basis of industry-wide studies of current treatment practices for pollution control (e.g., treatment technology) and, therefore, establish ______________________for the regulated industrial categories.

Rules for Applying Categorical Pretreatment Standards
16. When the designated sampling location described in the permit contains a categorically-regulated wastestream and one or more other wastestreams not regulated by the same categorical standard, an _________________must be calculated.

Answers
1. Industrial users (IUs), 2. SIUs, 3. 5, 4. Control Authority, 5. Control Authority, 6. Pretreatment program, 7. Condition of its NPDES permit, 8. Discharge of any pollutant(s), 9. Obstruction, 10. Discharges of any pollutants, 11. 40°C (104°F), 12. Discharges of trucked or hauled pollutants, 13. Discharges of trucked or hauled pollutants, 14. CWA, 15. National baseline pollution control requirements, 16. Alternative categorical limit

Chapter 4 - POTW Pretreatment Program Responsibilities

Section Focus: You will learn the more about the basics of the responsibilities of a pretreatment program, the need for wastewater treatment and common wastewater constituents. At the end of this section, you will be able to describe the need for wastewater treatment and the composition/components of wastewater. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.

POTW Pretreatment Program Responsibilities

This Chapter provides an overview of the POTW pretreatment programs, highlighting each of the specific program areas that are to be addressed.

Legal Authority *(Credit USEPA)*

POTWs seeking pretreatment program approval must develop policy and procedures for program implementation and establish the legal authority to implement and enforce program requirements. The General Pretreatment Regulations do not provide Control Authorities with the legal authority to carry out their pretreatment programs; rather, the regulations set forth the minimum requirements for POTWs with pretreatment programs.

A Control Authority's legal authority actually derives from State or local law. Therefore, either State or local law must confer the minimum Federal legal authority requirements on a Control Authority. Where deficient, law must be modified to grant the minimum requirements. Even when regulatory authority provided by State law, it is generally necessary for the Control Authority to establish local regulations to legally implement and enforce pretreatment requirements. Where the Control Authority is a municipality, legal authority is detailed in a Sewer Use Ordinance (SUO), which is usually part of city or county code.

Regional Control Authorities frequently adopt similar provisions in the form of "rules and regulations." Likewise, State agencies implementing a Statewide program under 40 CFR §403.10(e) set out pretreatment requirements as State regulations, rather than as an SUO. [Local regulations cannot give the Control Authority greater authority than that provided by State law.]

The EPA's 2007 guidance, *EPA Model Pretreatment Ordinance* provides a model for POTWs that are required to develop pretreatment programs. As POTW service areas expand, new contributions may arise from "extra jurisdictional" IUs located outside of the Control Authority's legal jurisdiction. Multijurisdictional arrangements require special legal/contractual mechanisms to ensure adequate authority to implement and enforce program requirements in these other jurisdictions. Some state statutes may provide for general extraterritorial powers (i.e., a Control Authority is automatically allowed to regulate extra jurisdictional IUs contributing to their system).

However, the extent to which the authorit(ies) (i.e., to permit, inspect, enforce, monitor, etc.) is granted may be somewhat limited, thereby, restricting a Control Authority's ability to implement and enforce a program. Where obtaining authority from the State to regulate extra jurisdictional IUs is not feasible, other options may be pursued:

Districts
The creation of an independent organization (by affected municipalities or the State) which is authorized to administer and enforce an approved pretreatment program for the entire area in which it provides services is common in areas where multiple POTWs each serve various jurisdictions.

Agreements
Affected Control Authorities may opt to enter into agreements requiring each municipality to implement and enforce the approved pretreatment program covering all IUs within their jurisdiction. The Control Authority must retain the means to regulate extra jurisdictional IUs where the contributing jurisdiction's efforts are inadequate. It is essential that agreements clearly define the roles of each party.

Annexation
Where extra jurisdictional IUs lie in unincorporated areas, a Control Authority may annex or utility annex the service area.

Contracts
A Control Authority may enter into a contract with an extra jurisdictional IU, although contracts generally limit the enforcement capabilities of the Control Authority. As such, contracts should only be pursued when all other means fail. Since procedures for obtaining jurisdiction, creating sanitary districts, annexing service areas, etc. vary among states, Control Authority personnel should consult with their legal staff to thoroughly examine options allowed. This may include requesting State legislative changes if necessary. The EPA's 1994 *Multijurisdictional Pretreatment Programs - Guidance Manual* provides more information on these jurisdictional issues, including sample language for agreements and contracts.

Industrial Waste Surveys
As part of program development and maintenance, the Federal regulations [40 CFR §403.8(f)(2)(I)] require Control Authorities to identify and locate all IUs that might be subject to the pretreatment program. While the General Pretreatment Regulations do not specify how a Control Authority is to accomplish this, it is beneficial to conduct an initial in-depth survey, and then institute measures to update the list continuously.

Control Authorities must ensure that the entire service area is reviewed. This may include IUs located outside the jurisdictional boundaries of the POTW. In these instances, it may be appropriate to solicit assistance from other jurisdictions in developing the list of potential dischargers. The types of resources that may be consulted in compiling and updating the master list include:

- Water and sewer billing records
- Applications for sewer service
- Local telephone directories
- Chamber of Commerce and local business directories
- Business license records
- POTW and wastewater collection personnel and field observations
- Business associations
- Internet

Once IUs are identified, the Control Authority must classify these users to determine if pretreatment standards and requirements should apply to these facilities. Typically, the Control Authority develops and distributes an Industrial Waste Survey (IWS) questionnaire to the identified IUs. The IWS questionnaire requests information regarding IU activities and the nature of wastes discharged.

The Control Authority may opt to send a detailed IWS questionnaire initially or conduct the survey in two phases (i.e., send a screener requesting basic information to eliminate obvious facilities and then send a detailed IWS to those facilities with greater potential to be SIUs).

Key to the IWS is to identify facilities that are subject to categorical standards (i.e., CIUs) or otherwise have the potential to impact the POTW (i.e., SIUs).

A POTW's IU inventory should include the name, location, classification, applicable standards, basis for limits imposed, volume of discharge, control mechanism status, compliance dates and other special requirements for each IU.

The IWS should provide most of the information required to develop the inventory, although some supplementary information might be required from other sources, such as the permit application or monitoring data. The IU inventory must be updated as needed [40 CFR §403.8(f)(2)(I)] and provided to the Approval Authority as part of the annual report requirement (see POTW Reports section in this Chapter).

The ongoing task of maintaining a complete list of IUs requires the Control Authority to implement a system to track existing IU information and/or classification changes and new user information. Some Control Authorities may proactively opt to institute a "utility connect questionnaire" program. These types of forms are completed when a customer applies for new utility service (e.g., water, sewerage, or electricity).

Permit Compliance and Operation

In addition to the physical inspection of the plant, inspectors should also evaluate the operation and maintenance of the plant equipment and the facility's compliance with their permit requirements. When the physical inspection findings indicate that specific practices of the facility contribute to or cause problems, the inspector should detail the problems and use that information to evaluate the operation and maintenance procedures. Inspectors should interview various staff to provide a better idea of what is happening on-site. If conflicting information is received during staff interviews, make sure to clarify this information before leaving the site. If the staff does not clearly answer a question, rephrase the question and ask it later during the inspection.

The inspector should interview facility staff to:
- Gather background information.
- Determine normal operation and maintenance procedures.
- Evaluate knowledge and ability.
- Determine the number of operation, maintenance, laboratory, and other essential staff.

The inspector should also review the following records as needed:
- Operator logs
- Operations and maintenance records
- Operations and maintenance manual
- Sampling and laboratory records
- Monitoring reports

Compliance Evaluation
The inspector should bring to the inspection a few submitted Discharge Monitoring Reports (DMRs) to compare with the monitoring reports kept on-site. To evaluate compliance with permit requirements, the inspector should:
- Compare monitoring report data to the permit requirements and verify that all non-compliance has been reported, monitoring requirements have been met, and analysis is in accordance with permit requirements.
- Compare the laboratory data to reported data to ensure transcription errors have not occurred and ensure all data on the DMR is accurate.
- Evaluate laboratory analytical procedures and methods to ensure the accuracy of the effluent discharge data. • Randomly check calculations to evaluate accuracy of reported data.

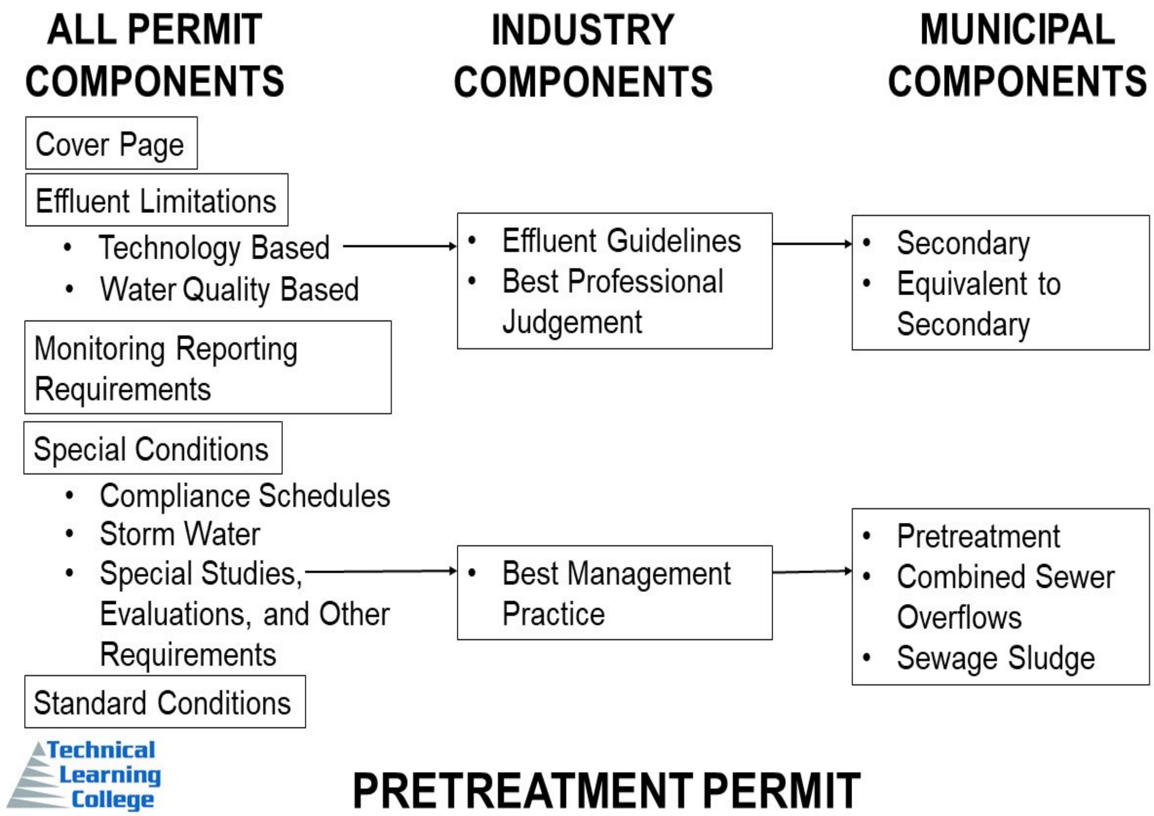
Operation Evaluation
Operating factors affecting plant performance range from qualitative factors such as the skills and aptitudes of operators (e.g., process knowledge and general aptitude), to physical deficiencies in laboratory equipment or a lack of flexibility in process equipment. The evaluation of operation functions must focus on wastewater treatment, sludge treatment/disposal, and laboratory analysis.

The evaluation should be based on the following topics:
- Policies and procedures
- Organization
- Staffing and training
- Planning
- Management controls

Although each of the preceding evaluation topics should be covered in the review of operation functions, the four areas discussed in the following paragraphs should particularly concern the inspector: Policies and Procedures Written operating procedures and standard reference texts enable the operator to achieve efficient plant operation. The operations manual prepared for the facility is the most important reference that an inspector should review when evaluating plant policies and procedures. Other reference materials relating to operations that should be available to the operator include manufacturers' literature, publications by professional organizations (e.g., the Water Environment Federation), and EPA publications.

Permit Application *(Credit USEPA)*

All industrial users that require a permit must be sampled to determine the characteristics of the wastes to be discharged into the POTW's sewer system. Prior to the issuance of a permit for existing industrial users, the POTW's Inspector or Water Quality Department/Pollution Control Division samples the user's effluent and performs the analyses required by the applicable discharge standards (i.e., Categorical standards or local limits).



For new industrial users, estimates of the wastes to be discharged into the POTW's sewer system must be submitted along with the permit application. No sampling would be performed at these new facilities, until they discharge wastes into the sewer system. Existing industrial users who are not yet permitted are required to conduct a sampling program as part of the permitting process.

Existing industrial users who are not yet permitted are required to conduct a sampling program as part of the permitting process.

Industrial Sector
Industrial sector general permitting programs are common where a real or potential POTW problem is linked to a particular pollutant discharged (e.g., collection system blockages caused by the discharge of excess oils and grease from food establishments). POTWs have authority to enforce their SUO or rules or regulations against non-SIUs without the need for any type of individual control mechanism. Control Authorities have the authority to require non-SIUs to comply with pretreatment standards and requirements contained in their local regulations and then take appropriate actions against IUs as noncompliance is identified.

Inspections
Control Authorities are required to inspect and sample all SIUs a minimum of once per year pursuant to 40 CFR §403.8(f)(2(v). The frequency with which a Control Authority actually inspects an SIU may vary depending on issues such as the variability of an SIU's effluent, the impact of their discharge on the POTW, and their compliance history. Inspection considerations will hinge upon the type of inspection performed (i.e., scheduled, unscheduled or demand).

The EPA's 2017 *Industrial User Inspection and Sampling Manual for POTWs* provides a detailed reference for inspection procedures and protocols. Scheduled inspections are useful when the Control Authority wants to gather specific information from the facility that necessitates meeting with specific SIU contacts. However, since scheduled inspections allow the facility to cleanup operations, temporarily eliminating potential violations, unscheduled inspections are preferred when assessing an IUs compliance status.

POTWs must evaluate, at least once every two years, whether each SIU needs a plan to control slug discharges (i.e., a discharge of a non-routine, episodic nature, including but not limited to an accidental spill or non-customary batch discharge). To accurately evaluate the slug potential, Control Authorities likely will have to examine the SIU during normal operating conditions. If undetected, slug discharges can have serious impacts on the POTW.

The EPA's 1991 *Control of Slug Loadings to POTWs Guidance Manual* provides a description of procedures for development, implementation, and review of slug control plans. Demand inspections are non-routine in nature and occur in response to a concern (e.g., POTW collection problems downstream from an IU, elevated enforcement actions against an IU, suspicious IU behavior, or a confidential informer complaint). Routine Control Authority inspections of SIUs typically consist of three activities; preparation, on-site assessment, and follow-up.

Permitting *(Credit USEPA)*

The General Pretreatment Regulations require all IUs be controlled through permit, order, or similar means to ensure compliance with applicable pretreatment standards and requirements. Section 403.8(f)(1)(iii)(A-E) clarifies this requirement to specify that all SIUs be issued a permit or equivalent individual control mechanism which contains, at a minimum:

- Statement of duration (not to exceed five years);
- Statement of non-transferabililty (unless outlined provisions are met);
- Effluent limitations based on applicable standards;
- Self-monitoring, sampling, reporting, notification, and record-keeping requirements;
- Statement of applicable civil and criminal penalties; and a schedule of compliance (where appropriate).

The EPA's 2012 *Industrial User Permitting Guidance Manual* details procedures for drafting IU discharge permits. SIU permits issued are site specific and tailored to the unique circumstances of the IU. Permit conditions must establish clear and explicit requirements for the permittee, to include using such terms such as "shall" and "must" in lieu of vague terms such as "recommend" or "may". The Control Authority must document its decision-making process when developing permits to ensure defensibility and enforceability. Adherence to sound, documented procedures will prevent any arbitrary and capricious claims by the permittee.

Whether developing or reissuing a permit, the permitting process consists of three phases:
Phase I - Collection and verification of information
Phase II - Data interpretation and fact sheet development
Phase III - Permit development and issuance.

Phase I
As part of Phase I, Control Authorities may review and verify information contained in the permit application, perform an inspection of the IU for confirmation of facts, tally data, and potentially sample and analyze the IU's wastestream. Knowledgeable Control Authority personnel, effective communication, and SIU cooperation are essential to the collection of complete and accurate information.

Phase II requires that the Control Authority interpret data and other information and document the permit decision-making rationale, preferably in a permit fact sheet. Although the contents of a fact sheet will vary by permittee, fact sheets should provide a justification of all permitting decisions.

Completed fact sheets should be included as part of the permit and provided to the Permittee to document the soundness of permitting decisions. For CIUs:

Components of Permit Fact Sheet

- the basis for the categorical determination(s)
- the identity and flow volume of all wastestreams generated and discharged to the POTW, and classified accordingly (i.e., regulated, unregulated, or dilution)
- data used and/or justification for estimates used to determine categorical limitations
- basis for limits imposed for categorical parameters.

For SIUs/CIUs:

- basis for limits imposed for non-categorical parameters
- rationale for compliance schedules, special plans required, special conditions, etc.
- basis for monitoring and reporting frequencies.

Inspection Considerations *(Credit USEPA)*

- Provide current data on IUs
- Confirm or determine IUs' compliance status
- Determine completeness and accuracy of the IU's performance/compliance records
- Assess the adequacy of the IU's self-monitoring and reporting requirements
- Assess the adequacy of monitoring locations and IU's sampling techniques
- Assess the adequacy of imposed limitations and pollutants of concern
- Develop rapport with IUs
- Evaluate operation and maintenance and overall performance of an IU's pretreatment system
- Assess the potential for spills and slug loadings
- Evaluate the effectiveness of slug control plan
- Reveal issues requiring action
- Identify noncompliance needing resolution
- Suggest pollution prevention opportunities
- Collect samples
- Obtain data to support enforcement actions

After all permitting decisions are made; the Control Authority must incorporate those decisions into a permit. The permit, signed by the specified Control Authority official, is provided to the Permittee for comment and after comments are addressed, a final permit is issued to the IU. While many comments may be easily addressed/resolved by the Control Authority, occasionally resolution must be obtained through a formal adjudicatory hearing process where both the Permittee and Control Authority present their case to a third party.

Non-SIUs

Many POTWs also control contributions from non-SIUs using various means, such as, where state law allows, through general permits issued to an entire industrial sector. These types of control mechanisms may not necessarily require compliance with specific pollutant limitations.

For example:

✓ Grease trap maintenance and record keeping requirements for food establishments;
✓ Maintenance and record-keeping requirements for photo processors' silver reclamation units;
✓ Best management practices for mercury recovery by hospitals and dentists.

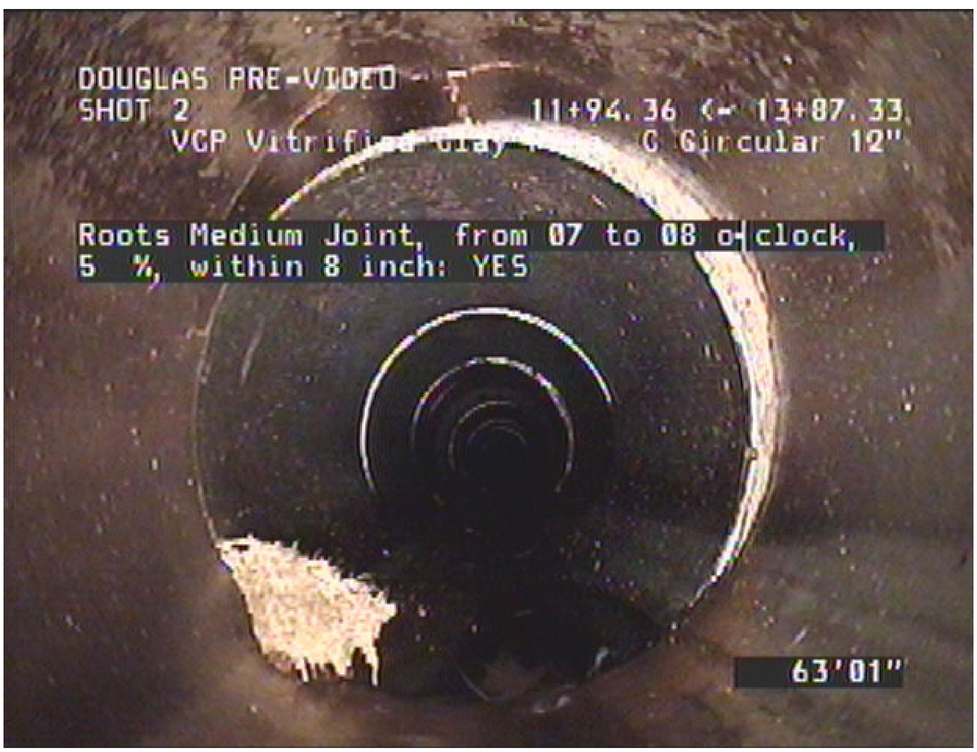
Inspection Preparation *(Credit USEPA)*

Control Authority personnel should review POTW records for the SIUs to be inspected to familiarize themselves with the facility. Information reviewed may include compliance status, compliance schedule activities, reports and plans, upcoming report and plan due dates, enforcement activities, permit applications, waste surveys, previous inspection summaries, categorical regulations, water use/billing records, and POTW collection system maps.

Control Authority personnel should also be familiar with any specific issues and concerns regarding the POTW treatment plant or collection system problems receiving the SIU's discharge.

On-site Assessment
Control Authority personnel typically discuss IU operations with IU contacts and perform a walkthrough of the facility to: update IU information regarding contacts, processes, production rates, pretreatment, and other waste management activities; review records required to be kept by the IU; visually verify the need for a slug control plan; and review pretreatment system maintenance, categorical standards applicable to processes employed, metering and sampling equipment, sampling procedures, chemicals used, processes employed, management practices, containment structures, locations of floor drains, etc. Many POTWs have developed a standard inspection questionnaire to facilitate the interview process and promote consistency during the inspection.

Follow-up
An inspection report should be prepared as soon as possible after the inspector returns to the office. Unanswered questions, required permit modifications, and/or necessary enforcement actions should be processed in a timely manner. Non-routine inspections (e.g., demand) may not encompass all the activities and steps specified above, but, like routine inspections, these activities may provide the Control Authority an opportunity to collect samples of the IU's discharge.



Facility Inspection Introduction

As mentioned earlier, EPA recommends that the permit writer conduct a facility inspection (including taking pictures) to verify application information and to gain an understanding of the Industrial User's facilities. The inspection should encompass a review of the following:

• ***Facility information***—This review will ensure that the facility information such as the facility address (physical location versus mailing location) and the location of the sampling point is correct in the permit and permit files.

• ***Production processes***—This will help the permit writer identify the following:

  – Applicable categorical Pretreatment Standards
  – Toxic or hazardous substances that might be present in raw materials, products, and by-products that have the potential to be present in the industry's discharge
  – Water uses and resulting wastewater streams
  – Existing in-process pollution controls
  – Potential for spills and leaks

From such information, the permit writer can select pollutants to be limited or require development of additional in-process controls.

• ***Sewer layout of the plant***—If a sewer plan exists, the permit writer should review the plan thoroughly to determine the course and destination of each sewer line. He or she should identify the exact source of and the point at which each wastestream enters the sewer. The permit writer should also delineate the existing monitoring point or any potential location for monitoring. Where sewer plans do not exist, he or she should perform smoke or dye testing to locate all points of discharge to the sewer system. This information will be used to determine the appropriate sampling points, to ensure that all points of discharge to the sewer system will be identified in the permit, and to evaluate the need for application of the CWF.

• ***Wastewater pretreatment facilities, including treatment performance and operation and maintenance practices***—Such information can be used to evaluate the adequacy of existing treatment, to assess the feasibility of improvements, and to evaluate performance data.

• ***Types of batch discharges that occur at the facility***—This information could affect the monitoring requirements. Cleanup operations usually result in batch discharges of clean-in-place (CIP) and washdown water. Permit writers should obtain information about cleanup times and water volumes.

• ***Raw material and product storage and loading areas, sewage sludge storage and disposal areas, hazardous waste management facilities (if applicable) including on-site disposal areas and all process areas, and the proximity of such areas to sewer discharge points***—This review will help to identify potential pollutants and potential or known problems with spills or leaks. The information is then used to determine the need for additional controls by establishing specific Industrial User BMPs (i.e., slug discharge control plans, toxic organic management plans, and good housekeeping practices).

• ***Sampling points, sampling methods, and analytical techniques***—This information is necessary to determine appropriate limits to apply at different locations, whether internal monitoring points should be established, and to evaluate the quality of both the Control Authority's and the Industrial User's sampling data.

An adequate inspection of a facility could require a full day or more to conduct. Complex plants with several treatment systems, numerous sewer connections and associated waste delivery piping, and extensive ancillary activities might require more than one day to inspect. For guidance on the performance of inspections, see the *NPDES Compliance Inspection Manual* and EPA's *Industrial User Inspection and Sampling Manual for POTWs*.

Wastewater Priority Pollutants

The concentrations of various wastewater pollutants in dissolved, colloidal, and suspended form are typically low but can vary considerably. EPA Priority Pollutants refer to a list of 129 pollutants that includes heavy metals and specific organic chemicals. They were assigned a high priority for development of water quality criteria and effluent limitation guidelines because they are frequently found in wastewater. The EPA has published analytical test methods for all of them. Priority Pollutants are a subset of "*Toxic Pollutants*" as defined in the CWA. There are hundreds of *toxic pollutants*. There is no analytical test for the group as a whole, nor is it currently practical to regulate or test for all of these compounds in wastewater.

*Each POTW w*ith an approved pretreatment program must develop local limits for arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver and zinc. The POTW must also identify all *other pollutants of concern* and evaluate the need for limits for these pollutants.

The priority pollutant scans performed periodically by POTWs with approved pretreatment programs are useful in identifying *Pollutants of concern.* Many POTWs have surcharge programs for excess *Conventional pollutants.* A POTW should set absolute upper limits for *Conventional pollutants* in its sewer use ordinance (SUO) or industrial user (IU) permits, based on total plant capacity.

Excess Nutrients
Excess nutrients can stimulate the growth of algae and other aquatic plants. When these plants die and decompose, they may reduce the amount of *Oxygen* in the water.

Nutrients can also get into wastewater from industrial discharges, common household detergents and cleaners, runoff from streets and lawns and air pollutants that fall to the ground. Treatment plants cannot remove all *nutrients* from the wastewater.

"Heavy Metals" refers to dense, *metallic elements* that generally occur at trace levels in wastewater.
Many heavy metals are toxic at low concentrations and most tend to accumulate.

Typical pesticides and herbicides include DDT, Aldrin, Chlordane, Endosulfan, Endrin, Heptachlor, and Diazinon. Surprisingly, concentrations of pesticides in urban runoff may be equal or greater than the pesticides in agricultural runoff. DDT is still present in stormwater.

PAHs spilled or released petroleum products (from oil spills or discharge of oil production brines) and combustion products that are found in urban runoff.

Polychlorinated biphenyls (PCBS) are *Organic chemicals* that formerly had widespread use in electrical transformers and hydraulic equipment. This class of chemicals is extremely persistent in the environment and has been proven to bioconcentrate in the food chain, thereby leading to environmental and human health concerns in areas such as the Great Lakes.

The Priority Pollutants are a set of *Chemical pollutants* EPA regulates, and for which EPA has published analytical test methods. *Priority Pollutant* list is more practical for testing and for regulation in that chemicals are described by their individual chemical names.

The list of toxic pollutants contains hundreds of compounds; there is no test for the group as a whole, nor is it practical to regulate or test for all of these compounds.

National Prohibited Discharges General Prohibitions

A user may not introduce into a POTW any pollutants that cause pass through or interference [40 CFR 403.5(a)(1)].

Specific Prohibitions:

The following pollutants must not be introduced into a POTW:

- Pollutants that create a fire or explosion hazard in the POTW, including, but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 262.21 [40 CFR 403.5(b)(l)]

- Pollutants that will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the POTW is specifically designed to accommodate such discharges [40 CFR 403.5 (b) (2)]

- Solid or viscous pollutants in amounts that will cause obstruction to the flow in the POTW resulting in interference [40 CFR 403.5(b)(3)]

- Any pollutant, including oxygen demanding pollutants (BOD, and the like) released in a discharge at a flow rate or pollutant concentration that will cause interference with the POTW [40 CFR 403.5(b)(4)]

- Heat in amounts that will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW exceeds 40 degrees Centigrade (104 degrees Fahrenheit) unless the Approval Authority, upon request of the POTW, approves alternate temperature limits [40 CFR 403.5(b)(5)]

- Petroleum oil, non-biodegradable cutting oil, or products of mineral oil in amounts that will cause interference or pass through [40 CFR 403.5(b)(6)]

- Pollutants that result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that could cause acute worker health and safety problems [40 CFR 403.5(b)(7)]

- Any trucked or hauled pollutants, except at discharge points designated by the POTW. [40 CFR 403.5(b)(8)]

Summary

The inspector should conduct an examination of process treatment units, sampling and flow monitoring equipment, outfalls, and the receiving stream, particularly focusing on areas of the permittee's premises where pollutants are generated, pumped, conveyed, treated, stored, or disposed of.

As the inspector becomes more knowledgeable about the facility being inspected, they should focus on areas that are likely to impact permit compliance and evaluate overall performance of the treatment facility. Inspectors should not enter confined spaces during the inspection of the facility unless they are properly training for confined space entry procedures. During the inspection, the inspector should pay attention to the operational factors listed below and carefully document all the observations:

- Influent characteristics, including:
  - Appearance (color, odor, etc.)
  - Combined sewer loads
  - Infiltration/inflow
  - Industrial contributions
  - Diurnal/seasonal loading variations
- Process control and settings
- Unit operations including supply of treatment chemicals
- Equipment design and current operating conditions
- Maintenance and operation staff
- Safety controls and equipment
- Effluent characteristics, including:
  - Appearance of discharge
  - Receiving stream appearance including any staining, deposits, or eutrophication
  - Evidence of toxicity of the discharge
- Other conditions particular to the plant

The inspector should evaluate the facility in terms of solids management, looking for evidence of excessive solids levels in clarifiers and sludge thickeners, insufficient solids wasting capabilities, the need for temporary sludge holding tanks, dewatering systems such as belt presses out of service, and sludge drying beds with excessive amounts of sludge. The Environmental Protection Agency's (EPA's) Field Manual for Performance Evaluation and Trouble Shooting at Municipal Wastewater Facilities (EPA, 1978) is a good reference for operational characteristics of plants.

Section 403.5(a) and (b) of the General Pretreatment Regulations establishes general and specific prohibitions that apply to all nondomestic users that discharge to POTWs . Local ordinances for POTWs with approved pretreatment programs must include the authority for local enforcement of those provisions. The permit writer should keep informed of developments in this area to ensure that all permits accurately incorporate all federal pretreatment requirements.

The structure and wording of a permit directly affect the Control Authority’s ability to invoke its various enforcement options successfully.

For this reason, the permit writer should follow three general rules:

- Use specific language
- Develop concise and complete discharge conditions and requirements
- Write as clearly and simply as possible (please refer to www.plainlanguage.gov for more information)

The permit writer should avoid vague, weak, or obtuse language that could undermine the permit's enforceability.

The list below shows appropriate language to use in the permit.

To Express	Use
is required to	must
Is required not to, is not allowed	must not
has discretion to, is permitted to	may
is not permitted to	may not
ought to	should
future contingency	will

The permit writer should also avoid long and confusing requirements. However, the permit writer should not be so brief as to leave out vital specifics.

A permit frequently acts as the principal notification to the Industrial User of its responsibilities for compliance. Therefore, permit requirements must be clear and simple to understand.

Chapter 4 - POTW Pretreatment Program Responsibilities Post Quiz

1. Affected Control Authorities may opt to enter into agreements requiring each municipality to implement and enforce the approved pretreatment program covering___________________.

2. Where extra jurisdictional IUs lie in______________, a Control Authority may annex or utility annex the service area.

Industrial Waste Surveys

3. As part of program development and maintenance, ____________________require Control Authorities to identify and locate all IUs that might be subject to the pretreatment program.

4. Once_______________ are identified, the Control Authority must classify these users to determine if pretreatment standards and requirements should apply to these facilities.

5. Normally, the Control Authority develops and distributes an Industrial Waste Survey (IWS) questionnaire to the identified IUs. The IWS questionnaire requests information regarding IU activities and the ______________________.

6. The Control Authority may opt to send a detailed IWS questionnaire initially or conduct the survey in two phases (i.e., send a screener requesting basic information to eliminate obvious facilities and then send a detailed IWS to those facilities with greater potential to be____________________).

7. Key to the _____________________ is to identify facilities that are subject to categorical standards (i.e., CIUs) or otherwise have the potential to impact the POTW (i.e., SIUs).

Permitting

8. The General Pretreatment Regulations require all IUs be controlled through permit, order, or similar means to ensure ______________ with applicable pretreatment standards and requirements.

9. ____________________issued are site specific and tailored to the unique circumstances of the IU.

10. ___________________must establish clear and explicit requirements for the permittee, to include using such terms such as “shall” and “must” in lieu of vague terms such as “recommend” or “may”.

11. The Control Authority must document its decision-making process when developing permits to ensure defensibility and enforceability. Adherence to sound, documented procedures will prevent any arbitrary and capricious claims by the ___________________.

Phase I

12. As part of Phase I, Control Authorities may ______________contained in the permit application, perform an inspection of the IU for confirmation of facts, tally data, and potentially sample and analyze the IU's wastestream.

13. Control Authority personnel, effective communication, and _____________ cooperation are essential to collection of complete and accurate information.

14. Completed fact sheets should be included as part of the permit and provided to the __________________ to document the soundness of permitting decisions.

15. After all permitting decisions are made; the Control Authority must incorporate those decisions into a permit. The permit, signed by__________________, is provided to the Permittee for comment and after comments are addressed, a final permit is issued to the IU.

16. While many comments may be easily addressed/resolved by the Control Authority, occasionally resolution must be obtained through a formal adjudicatory hearing process where both the Permittee and Control Authority present their case to_________________.

Non-SIUs

17. Many POTWs also control contributions from ____________________using various means, such as through general permits issued to an entire industrial sector. These types of control mechanisms may not necessarily require compliance with specific pollutant limitations.

Wastewater Priority Pollutants

18. The concentrations of various substances in __________in dissolved, colloidal or suspended form are typically low but vary considerably.

Answers

1. All IUs within their jurisdiction, 2. *Unincorporated areas, 3. The Federal regulations, 4. IUs, 5. Nature of wastes discharged, 6. SIUs, 7. IWS, 8. Compliance, 9. SIU permits, 10. Permit conditions, 11. Permittee, 12. Review and verify information, 13. SIU, 14. Permittee, 15. The specified Control Authority official, 16. A third party, 17. Non-SIUs, 18. Wastewater*

Chapter 5 - Pretreatment and Wastewater Sampling

Section Focus: You will learn the basics of the Clean Water Act's wastewater sampling requirements, the need for wastewater / pretreatment sampling procedures. At the end of this section, you will be able to describe the need for sampling composition/components of customer's wastewater. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.

An automatic programmable wastewater sampler inside a customer's vault.

Note, to minimize flow monitoring disruption, the samplers suction line should be placed near the head, not at the neck, of the flume.

The General Pretreatment Regulations require Control Authorities to monitor each SIU at least annually and each SIU to self-monitor semi-annually.

As with inspections, the Control Authority should assess site-specific issues, such as SIU effluent variability, impact of this effluent on the POTW, and the SIU's compliance history to determine appropriate sampling frequencies (i.e., if more frequent monitoring is necessary).

For more detailed information on sampling frequencies, consult the EPA's 2017 *Industrial User Inspection and Sampling Manual for POTWs*.

Parameter	Sample type	Container	Preservative	Holding time
pH	Grab	Polyethylene or Glass	N/A	analyze immediately 15 minutes
BOD	Composite	Polyethylene or Glass	chilled to 4°C	48 hours
TSS	Composite	Polyethylene or Glass	chilled to 4°C	7 days
NH 3 as N	Composite	Polyethylene or Glass	chilled to 4°C, H2 SO_4 to pH<2	28 days
Oil and Grease	Grab	Glass	chilled to 4°C, HCl or H_2SO_4 to pH<2	28 days
Cyanide, total	Grab	Polyethylene or Glass	chilled to 4°C, NaOH to a pH >12, and 0.6g of ascorbic acid if residual chlorine is present	14 days
Metals (total) excl. Cr $^{+6}$ B, and Hg	Composite	Polyethylene or Glass	HNO3 to pH<2	6 months
624 (volatiles organics)	Grab	Amber glass, w/ Teflon septum lid and zero headspace	chilled to 4°C (additional laboratory preservation required)	7 or 14 days, depending on specific organic
625 (semi-volatile organics)	Composite	Amber glass w/ Teflon lined lid	chilled to 4°C (additional laboratory preservation required)	7 days for sample prep; 40 days for extract

Pretreatment Sampling

Sampling is the most appropriate method for verifying compliance with pretreatment standards. Monitoring location(s) are designated by the Control Authority and must be such that compliance with permitted discharge limits can be determined. Where possible, the Control Authority should not designate monitoring locations that are confined spaces or difficult to access or difficult to place automated sampling equipment.

Monitoring locations should:

- be appropriate for waste stream conditions;
- be representative of the discharge;
- have no bypass capabilities; and
- allow for unrestricted access at all times.

Control Authorities should measure flow to allow for collection of flow-proportioned composite samples, which are required, unless flow-proportional sampling is not feasible. Flow-proportional composite samples are preferred over time composite samples particularly where the monitored discharge is intermittent or variable.

Desired analyses dictate the preparation protocols, equipment, and collection bottles to be used to avoid contamination of samples or loss of pollutants through improper collection. Sampling for such pollutants as pH, cyanide, oil and grease, flashpoint, and volatile organic compounds require manual collection of grab samples.

Similar to composite samples, grab samples must be representative of the monitored discharge and are to be collected from actively mixed holding tanks or flowing wastestreams. Fluctuations in flow or the nature of the discharge may require collection of and hand-composting of more than one grab sample to accurately assess compliance.

To ensure defensibility of data, Control Authorities should develop and implement standard operating procedures and policies detailing sample collection and handling protocols in accordance with 40 CFR Part 136.

Adherence to proper sample collection and handling protocols, 40 CFR Part 136 approved analytical methodologies, and record-keeping requirements [40 CFR §403.12(o)(1)] can be verified through review of field measurement records, chain of custodies, and lab reports. Field measurement records may require information regarding sample location, condition of and programmed settings for sampling equipment, wastewater meter readings, and information for such parameters as pH and temperature which require analysis in the field.

Chain of custody forms serve as a link between field personnel and the laboratory and contain information regarding sample matrix, type, and handling. Lab reports should contain the minimum information specified in 40 CFR §403.12(o)(1)(ii-iv) as well as any additional information necessary to demonstrate compliance with 40 CFR Part 136 requirements (e.g., analytical methodology, sample preparation date and time, and time of analysis).

Use of standardized forms which prompt recording of information necessary for demonstrating compliance with applicable requirements will aid in ensuring it can be used as admissible evidence in enforcement proceedings or in judicial actions.

Compliance Sampling Evaluation

Wastewater sampling/analysis is an integral part of the National Pollutant Discharge Elimination System (NPDES) Compliance Monitoring Program. NPDES permits contain specific and legally enforceable effluent limitations and monitoring requirements.

Objectives and Requirements
When evaluating the permittee sampling program, the inspector should:

- Verify that the permittee's sampling program complies with the permit.
- Verify that the permittee's sampling program complies with:

– Title 40 of the *Code of Federal Regulations* (CFR), sections 136.1 to 136.6 and Appendices A, B, and C (Guidelines for Establishing Test Procedures for the Analysis of Pollutants) for wastewater samples; and 40 CFR Part 503.

- Document potential violations to support enforcement action.

In addition, specific objectives of the sampling conducted by inspectors include the following:

- Verify compliance with effluent limitations.
- Verify accuracy of reports and program self-monitoring.
- Support enforcement action.
- Support permit development reissuance and/or revision.
- Determine the quantity and quality of effluent.

Sampling, analysis, preservation technique, sample holding time, and sample container requirements are provided under 40 CFR Part 136 as authorized by section 304(h) of the Clean Water Act (CWA). For all NPDES permittees the inspector should perform a review of sampling procedures and quality control measures the facility uses to ensure the integrity of sample data.
To evaluate sampling procedures, assess the following eight areas:

- Sample site locations
- Sample collection techniques
- Field measurements
- Sample labeling (including locations) and documentation
- Sample preservation and holding time
- Transfer of custody and shipment of samples
- Quality control
- Data handling and reporting

Types of Samples *(Credit USEPA)*

General
There are four types of routine samples that are collected by the POTW's Sampling Section: grab, time proportional composites, flow proportional composites, and hand composites. The sampling method used depends largely on the types of analyses to be run, and the nature of the wastestream being sampled. Each sampling method is described in this section.

Most POTW's will define the sampling methods which must be used by industrial users (IUs) to obtain representative samples to show compliance with their permits:
Example

(1) A grab sample is an individual sample collected in less than 15 minutes without regard for flow or time of day. pH, cyanide, oil and grease, sulfide, and volatile organics must be collected as grab samples.

(2) 24-hour flow proportional composite samples where feasible. The POTW may waive this requirement if the IU demonstrates that this method is not feasible. Samples would then be taken by means of time proportional composite sampling methods, or by hand composite where the IU can demonstrate that this will provide a representative sample of the effluent being discharged.

The volume of sample to be collected by any of these methods is dependent on the number and types of analyses that must be performed.

Grab Samples
Grab samples are individual samples collected in less than 15 minutes without regard to flow or time of day. Grab samples are normally taken manually, but can be pumped. Oil and grease samples and purgeable organics are exceptions and must be taken manually.

The collection of a grab sample is appropriate when a sample is needed to:

- Represent an effluent that does not discharge on a continuous basis.
- Provide information about instantaneous concentrations of pollutants at a specific time.
- Allow collection of a variable sample volume.
- Corroborate composite samples.
- Monitor parameters not amenable to compositing (e.g., pH, temperature, dissolved oxygen, chlorine, purgeable organics, oil and grease, coliform bacteria, and others specified by the NPDES permit, which may include phenols, sulfites, and hexavalent chromium).

Grab Sample

A sample which is taken from a water or wastestream on a one-time basis with no regard to the flow of the water or wastestream and without consideration of time. A single grab sample should be taken over a period of time not to exceed 15 minutes.

EPA Sample Identification Methods

Identify each sample accurately and completely. Use labels or tags to identify the samples that are moisture-resistant and able to withstand field conditions. If moisture-resistant labels are not available, place a piece of tape over each label to prevent water damage. Use a waterproof pen to complete the labels or tags. A numbered label or tag associated with a field sample data sheet containing detailed information on the sample is preferable to using only a label or tag for information.

The information for each sample should include the following:

- Facility name/location
- Sample site location
- Sample number
- Name of sample collector
- Date and time of collection
- Indication of grab or composite sample with appropriate time and volume information
- Identification of parameter to be analyzed
- If the sample is preserved and, if so, the preservative used

Various Composite Sampling Techniques (Credit EPA)

The four primary methods of composite sample collection are time compositing, flow proportion compositing, sequential compositing, and continuous compositing. Table 5-1 lists the advantages and disadvantages of these methods. The permit may specify which type of composite sample to use. Composite samples are collected either manually by combining multiple grab samples or by using automatic sampling equipment. Inspectors should consider variability in wastestream flow rate, parameter concentrations and the approved EPA methods when choosing compositing methods, sampling equipment (tubing and containers), and quality assurance procedures. The compositing methods are as follows:

• **Time Composite Sample**: This method requires discrete sample aliquots collected in one container at constant time intervals. This method is appropriate when the flow of the sampled stream is constant (flow rate does not vary more than ±10 percent of the average flow rate) or when flow monitoring equipment is not available.

• **Flow-Proportional Composite Sample**—in one method, a constant sample volume is collected at varying time intervals proportional to stream flow (e.g., 200 milliliters sample collected for every 5,000 gallons of flow). In the other method (which has two variations), the sample is collected by increasing the volume of each aliquot as the flow increases, while maintaining a constant time interval between the aliquots.

• **Sequential Composite Sample**—this method requires discrete samples collected in individual containers at constant time intervals or discharge increments; for example, samples collected every 15 minutes, composited into separate containers each hour. The discrete samples can then be manually flow-proportioned to form the composite sample. Alternatively, a constant sample volume is collected at constant discharge volume increments measured with a flow totalizer.

• **Continuous Composite Sample**—collect this sample continuously from the wastestream. The sample may be constant volume, or the volume may vary in proportion to the flow rate of the wastestream.

Influent Sample Collection
Document and take influent samples at points of high turbulence flow to ensure good mixing. In some instances, the most desirable location may not be accessible.

Ensure sampling points are located prior to any internal facility return lines, and sampling equipment should be placed so that it does not interfere with flow measuring devices. The preferred sampling points for raw wastewater are at the most downstream location from the collection lines, but prior to preliminary treatment:

- Waste flowing from the last process in a manufacturing operation, for an industrial user.

- Pump wet well (if turbulent).

- Upstream collection lines, tank, or distribution box following pumping from the wet well or sump.

- Flume throat.

- Aerated grit chamber.

- Upstream siphon following the comminutor (in absence of grit chamber). If it is not possible to sample at a preferred point, choose an alternative location and document the basis for choosing that location.

Table 5-1. Compositing Methods			
Method	**Advantages**	**Disadvantages**	**Comments**
Time Composite			
Constant sample volume, constant time interval between samples.	Minimal manual effort; requires no flow measurement.	May lack representativeness for highly variable flows.	Widely used in both automatic and manual sampling.
Flow-Proportional Composite			
Constant sample volume, time interval between samples proportional to stream flow.	Minimal manual effort.	Requires accurate flow measurement reading equipment; manual compositing from flowchart.	Widely used in automatic as well as manual sampling.
Constant time interval between samples, sample volume proportional to total stream flow at time of sampling.	Minimal instrumentation.	Manual compositing from flowchart in absence of prior information on the ratio of minimum to maximum flow; chance of collecting too small or too large individual discrete samples for a given composite volume.	Used in automatic samplers and widely used as manual method.
Constant time interval between samples, sample volume proportional to total stream flow since last sample.	Minimal instrumentation.	Manual compositing from flow chart in absence of prior information on the ratio of minimum to maximum flow; chance of collecting too small or too large individual discrete samples for a given composite volume.	Not widely used in automatic samplers but may be done manually.
Sequential Composite			
Series of short period composites, constant time intervals between samples.	Useful if fluctuations occur and the time history is desired.	Requires manual compositing of aliquots based on flow.	Commonly used; however, manual compositing is labor intensive.
Series of short period composites, aliquots taken at constant discharge increments.	Useful if fluctuations occur and the time history is desired.	Requires flow totalizer; requires manual compositing of aliquots based on flow.	Manual compositing is labor intensive.
Continuous Composite			
Constant sample volume.	Minimal manual effort, requires no flow measurement highly variable flows.	Requires large sample capacity; may lack representativeness for highly variable flows.	Practical but not widely used.
Sample volume proportional to stream flow.	Minimal manual effort, most representative especially for highly variable sample volume, variable pumping capacity and power.	Requires accurate flow measurement equipment, large sample volume, variable pumping capacity, and power.	Not widely used.

Effluent Sample Collection

Collect effluent samples at the location specified in the NPDES permit. Occasionally, municipal plant permits may specify sampling prior to chlorination. For these plants, monitor all parameters at the upstream location except fecal coliforms, pH, and total residual chlorine. Collect wastewater for use in bioassays at the location specified in the facility's NPDES permit. Collect samples either manually (grab or composite) or with automatic samplers (continuous or composite).

The following general guidelines apply when taking samples:

- Take samples at a location specified in the NPDES permit and/or at a location selected to yield a representative sample.
- Use the sampling method (grab, composite, continuous) specified in the permit. Some parameters that must be collected as an individual grab sample are dissolved oxygen, total residual chlorine, oil and grease, coliform bacteria, purgeable organics, sulfides, cyanide, and total phenols. • Avoid collecting large nonhomogeneous particles and objects.
- Collect the sample facing upstream to avoid contamination.
- Do not rinse sample container with sample when collecting oil and grease and microbiological samples, but fill the container directly to within 2.5 to 5 cm from the top.
- Fill the container completely if the sample is to be analyzed for purgeable organics, oxygen, ammonia, hydrogen sulfide, free chlorine, pH, hardness, sulfite, ammonium, ferrous iron, acidity, or alkalinity.
- Collect sufficient volume to allow for quality assurance testing. (see EPA's website https://www.epa.gov/cwa-methods for a listing of all approved sampling methods. Each sampling method will indicate the required sampling equipment, sampling containers and sampling volume, but additional volumes may be necessary for quality assurance testing.

The following general guidelines apply when using automatic samplers:

- Collect samples where the wastewater is well mixed. Collect the sample near the center of the flow channel at 0.4 to 0.6 depth (mid-depth).
- Obtain a sufficient volume of sample to perform all required analyses plus any additional amount for quality control. Individual portions of a composite sample should be at least 100 milliliters to minimize sampler solids bias.
- For automatic samplers that use a peristaltic pump, obtain adequate flow rates in the sampler tubing to effectively transport the suspended solids. To avoid solids bias, the velocity of the wastewater in sample tubing should be at least 2 feet per second (fps) and the tubing diameter should be at least 0.25 inch.
- Time of sample collection begins when the last aliquot is dispensed into the composite sample container.

Sample Volume

The volume of sample collected depends on the type and number of analyses needed, as reflected in the parameters to be measured. Obtain the volume of the sample sufficient for all the required analyses plus an additional amount to provide for any split samples or repeat analyses.

EPA approved sampling methods provide a guide to sample volumes required for determining the constituents in wastewater (available at https://www.epa.gov/cwa-methods).

Consult the laboratory receiving the sample for any specific volume required. EPA's Methods for Chemical Analysis of Water and Wastes (EPA, 1979a) and Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA, 1982), and the current EPA-approved edition of Standard Methods for the Examination of Water and Wastewater (American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), 2013) contain specific recommended minimum sample volumes for different pollutant parameters.

Sample Containers

The regulations at 40 CFR Part 136 describe required sample containers, sample preservation, and sample holding time. EPA approved sampling methods indicate appropriate sample containers for each analysis It is essential that the sample containers be made of chemically resistant material unaffected by the concentrations of the pollutants measured. In addition, sample containers must have a closure that will protect the sample from contamination. Collect wastewater samples for chemical analysis in plastic (polyethylene) containers. Exceptions to this general rule are oil and grease samples, pesticides, phenols, polychlorinated biphenyls (PCBs), and other organic pollutant samples.

Collect these in properly cleaned glass jars or bottles and seal. Collect bacteriological samples in properly sterilized plastic or glass containers. Collect samples that contain constituents that will oxidize when exposed to sunlight (such as iron cyanide complexes) in dark containers. Ensure sample containers are clean and uncontaminated. Check analytical procedures to determine if they specify container cleaning procedures. Use precleaned and sterilized disposable containers (e.g., polyethylene cubitainers).

If these are not used or if the analytical method does not specify procedures, use the following procedures for cleaning sample containers:

- Wash with hot water and detergent.
- Rinse with acid (e.g., nitric for metals).
- Rinse with tap water, then rinse three or more times with organic-free water.
- Rinse glass containers with an interference-free, redistilled solvent (such as acetone or methylene chloride for extractable organics.
- Dry in contaminant-free area.

EPA Sample Identification Procedures

Identify each sample accurately and completely. Use labels or tags to identify the samples that are moisture-resistant and able to withstand field conditions. If moisture-resistant labels are not available, place a piece of tape over each label to prevent water damage.

Use a waterproof pen to complete the labels or tags. A numbered label or tag associated with a field sample data sheet containing detailed information on the sample is preferable to using only a label or tag for information.

The information for each sample should include the following:

- Facility name/location
- Sample site location
- Sample number
- Name of sample collector
- Date and time of collection
- Indication of grab or composite sample with appropriate time and volume information
- Identification of parameter to be analyzed • If the sample is preserved and, if so, the preservative used

Wastewater Sample Preservation and Holding Time Introduction

In most cases, wastewater samples contain one or more unstable pollutants that require immediate (e.g., within 15 minutes) preservation and/or analysis. Provide appropriate chemical preservation before transferring samples to the laboratory. EPA approved sampling methods indicate appropriate sample preservation for each analysis (sampling methods are available at https://www.epa.gov/cwa-methods).

Procedures used to preserve samples include cooling, pH adjustment, and chemical treatment. For some parameters, such as cyanide and phenols, add preservatives to sample bottles prior to or immediately following sample collection.

For many samples, if preservatives are not appropriately used, bacteria can quickly degrade certain constituents (such as phenols and phosphorus). Other constituents may volatilize (such as volatile organics and sulfides) or may react to form different chemical species (hexavalent chromium, for example).

Proper preservation and holding times are essential to ensure sample integrity (see 40 CFR Part 136). Analysis of samples within one day ensures against error from sample deterioration. However, such prompt analysis is not feasible for composite samples in which portions may be stored for as long as 24 hours.

Where possible, provide sample preservation during compositing, usually by refrigeration to 6°C (or icing). If using an automatic sampler with ice, replace the ice as necessary to maintain low temperatures. This is a limitation of automatic samplers used during the summer when ice must be frequently replaced. Table II of 40 CFR 136.3(e) indicates maximum sample holding times. Times listed are the maximum holding times between sample collection and analysis that are allowed for the sample to be considered valid. Unless otherwise specified in the method, holding time limitations begin upon combination of the last aliquot in a sample. When use of an automatic sampler makes it impossible to preserve each aliquot, the chemical samples may be preserved by maintaining at 6°C until compositing and sample splitting is completed (40 CFR 136.3(e)).

Transfer and Custody of Samples
To ensure the validity of the permit compliance sampling data in court, written records must accurately trace the custody of each sample through all phases of the monitoring program (EPA Order 5360.1). The primary objective of this chain-of-custody is to create an accurate written record (see an example chain-of-custody form in Appendix M) that can be used to trace the possession and handling of the sample from the moment of its collection through its analysis and introduction as evidence.

The following procedures are appropriate for the transfer of custody and shipment of samples:

- Use sample seals to protect the sample's integrity from the time of collection to the time it is opened in the laboratory, including the time the sample is within an automatic sampling apparatus, thus the automatic sampler should be sealed on the outside. The seal should indicate the collector's name, the date and time of sample collection, and sample identification number. For automatic samplers, seals should indicate the sample time at which the apparatus began sampling, as the sample container is subsequently sealed in the apparatus.
- Pack samples properly to prevent breakage. Seal or lock the shipping container to readily detect any evidence of tampering. Use of tamper-proof evidence tape is recommended.
- Place samples on ice or synthetic ice substitute that will maintain sample temperature at 6°C throughout shipment.
- The responsibility for proper packaging, labeling, and transferring of possession of the sample lies with the inspector. Accompany every sample with a sample tag and a chain-of-custody record that has been completed, signed, and dated. The chain-of-custody record should include the names of sample collectors, sample identification numbers, date and time of sample collection, location of

sample collection, and names and signatures of all persons handling the sample in the field and in the laboratory.

• The originator retains a copy of the chain of custody forms. Also, the originator must retain all receipts associated with the shipment.

• EPA Inspectors with the responsibility of working with hazardous materials that are placed in commerce (transporting/shipping) must have hazardous materials training as required by the Department of Transportation (see Appendix N).

• When transferring possession of samples, the transferee must sign and record the date and time on the chain-of-custody record (use the currently approved record). In general, custody transfers are made for each sample, although samples may be transferred as a group, if desired. For each sample being transferred, the transferee should list the sample and their name on the custody record. Each person who takes custody must fill in the appropriate section of the chain-of-custody record. Both the transferee and person who takes custody of the sample(s) must sign the custody record.

• Pack and ship samples in accordance with applicable International Air Transportation Association (IATA) and/or DOT regulations.

Quality Control

Conduct control checks during the actual sample collection to determine the performance of sample collection techniques. In general, the most common monitoring errors usually are improper sampling methodology, improper preservation, inadequate mixing during compositing and splitting, and excessive sample holding time. In addition, collect and analyze the following samples to check sample collection techniques:

Blanks

Trip blank

Trip blanks are vial(s) filled at the laboratory with deionized water. The blank(s) follows the same handling and transport procedures as the samples collected during the event. The blank(s) functions as a check on sample contamination originating from sample transport, shipping and from site conditions. Note: Expose the trip blank vial(s), to the same environmental conditions (light, temperature, etc.) of the sample vial(s) but do not open until it is time for analysis.

Field blank/field reagent blank

Field blanks are similar to trip blanks except they are prepared in the field with deionized water exactly as the sample(s) that are collected. Field blanks are used to check for analytical artifacts and/or background introduced by sampling and analytical procedures.

Temperature blank.

A temperature blank is a small sample bottle filled with distilled water that is placed in each cooler prior to shipment. Upon arrival at the laboratory the temperature of the sample bottle is measured to evaluate if samples were adequately cooled during sample shipment.

Equipment/rinsate blank

Collect an equipment/rinsate blank when using an automatic sampler or other non-dedicated equipment during the sampling process. The blank is a check of the equipment cleanliness. For automatic samplers, prepare blanks prior to collecting samples, by pumping deionized organic free water (rinsate) through the sampler and collecting the discharge purge water in a sample container for analysis for the constituents of concern.

Field Duplicate

Collect a field duplicate sample simultaneously from the same source at selected stations on a random timeframe by grab samples or from two sets of field equipment installed at the site. Duplicate samples check analytical precision as well as evaluate the “representativeness” of the sample aliquot.

Split Samples
Split samples are samples that have been divided into two containers for analysis by separate laboratories. These samples provide an excellent means of identifying discrepancies in the permittee's analytical techniques and procedures. When filling split samples from a single composite jug, shake the composited sample well and half fill the EPA sample container, then shake the composite again and fill half of the permittee's container. Repeat the procedure for each parameter collected. The laboratories performing the sample analyses should also use the following control measures:

Prep/Reagent Blank
A prep/reagent blank is a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and to aid in identifying errors in the observed value that may result from the analytical steps.

Quality Control Sample
A quality control sample is an uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. Use this sample to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurements' system.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)
A matrix spike/matrix spike duplicate sample is three times the normal volume required for a specific chemical analysis to which a known quantity of analyte has been added prior to all sample preparation. The laboratory utilizes the MS/MSD samples as part of their Quality Assurance/Quality Control Program.

- Use a matrix spike to verify accuracy of the analytical procedures.
- A matrix spike duplicate is a duplicate of a matrix spike sample. It measures the precision of the analysis in terms of relative percent difference.

Table 5-2 indicates quality control procedures for field analyses and equipment. Quality control is discussed in greater detail in Chapter 7 EPA's NPDES

Collecting Procedure for Water/Wastewater Grab Samples

1. Lower dipper or mouth of the bottle into water just below surface. Note sampling time and any other relevant information to the previously applied sampling label.

2. Retrieve or move the collected sample to a clean processing area.

3. If a bottle was used to collect the sample, rinse the bottle 3 times to remove any contaminants.

4. Pour the sample into the required laboratory bottle.

5. You may need to filter the sample; this is true with some water and wastewater samples. Filtering (for ortho-P and NOx samples).

6. Bottles supplied by an independent laboratory often come pre-loaded with preservative. Otherwise, preservative can be added in the POTW's lab. Bringing bulk preservatives, often strong acids and bases, into the field is not practical.

7. Secure sample container caps tightly.

8. Place the sample containers in an iced cooler before storage.

Timed Composites
Timed samples are usually taken in instances where the intention is to characterize the wastes over a period of time without regard to flow, or where the flow is fairly constant.

Timed composite samples consist of a series of equal volume grab samples taken at regular intervals. A typical interval is 15 minutes, with a maximum sampling duration of 24 hours.

The sample volume and sampling interval need to be calculated, and calibrated, so as to not overfill the collection bottle.

Samplers are available which can hold 24 separate bottles, each of which can receive multiple samples. Samplers can also be fitted with a single composite bottle, typically having a 2.5-gallon capacity. They provide space around the bottle for ice to cool the sample.

Flow Proportional Composites
Flow proportional composite samples consist of: a series of grab samples whose volumes are equal in size, taken each time a specified amount of flow has been measured. For example, a flow measuring device sends readings to a controller which then sends a signal to the sampler every time 1,000 gallons of flow are recorded. A flow measuring device must be used in conjunction with the automatic sampler.

This sampling method is used for all sampling activities except for instances where grab samples are required or time proportional sampling is more expedient and can provide the same accuracy as flow proportional sampling (i.e., constant flow levels or level of contaminants).

Hand Compositing
When sampling a batch discharge tank, hand compositing can be done. If the tank contents are homogenous, and remain so by active mixing, a grab sample provides the same results as a flow proportional composite sample.

If one is not certain that the contents of a batch tank are homogenous, taking four or more discharge grab samples of equal volume at evenly spaced time intervals over the course of the discharge will produce a more representative sample.

For multiple batch discharges in a day, the results of the hand composites can be averaged, considering differences in the volume of the batches.

The results of one, or the proportional average of multiple batch discharges, are the equivalent of a 24-hour flow proportional sampling at a facility with a continuous discharge. The sampling data would be compared with the average daily categorical standards or local limits where applicable.

Pre-Sampling Procedures
To ensure acceptable analytical results, numerous steps must be followed before a sampling program can be initiated:

To ensure that sampling goes smoothly, a considerable amount of preparation is required.
(1) All sampling equipment shall be clean and be in good working order.
(2) Fully charge needed batteries and backups.
(3) Select approved sampling location or equivalent.
(4) Determine what analyses are needed. Be sure the method selected Is sensitive enough to provide results in the range of the permit limit.
(5) Order sample bottles if not enough are in stock.
(6) Label sample containers with available information.
(7) Pack extra sample containers and labels to replace any that break while sampling.
(8) Gather enough ice chests to hold all the samples with room for ice/ice packs.
(9) Prepare PPE and, if needed, traffic control and/or confined space entry equipment.
(10) Arrange for the additional staff required for traffic control or confined space entry.
(11) Prepare Chain of Custody forms.

Sampling Equipment Example
Most pretreatment programs have one or more dedicated vehicles. These are loaded with equipment that is routinely needed for sampling. This typically includes equipment for confined space entry (support frame, winch, harnesses, gas detector, blowers, etc.) traffic diversion (cones, reflective vests, flags, etc.), manhole cover removal, flow measurement, PPE, and, of course, sampling.

There are many types and brands of automatic composite samplers. Most use a battery for remote placement and power from an outlet when available. If more than a few grabs for pH and temperature are needed, probes linked to a local or remote data logger are used for “sampling”.

The equipment that is kept in the sampling vehicle is dependent on the types of sampling activities planned each week, while the equipment stored in the storeroom is for back-up needs and future sampling demands.

Each sampling vehicle should be equipped with at least one sampler and one flow meter more than is needed for the particular sampling period. For example, three scheduled flow proportionate sampling sites would require a vehicle to be equipped with four samplers and four flow meters.

At least one spare battery for each type of equipment taken into the field should also be placed in the sampling vehicle.

Auxiliary equipment, such as supports, harnesses, blowers, etc., to be carried in each vehicle will depend on the nature of the sampling location.

In order to keep the equipment in good working order, the equipment should be maintained, cleaned and inspected on a regular basis. Routine maintenance and cleaning procedures should be written into your standard operating procedures.

Sampling Equipment Maintenance - Example

Basic maintenance for samplers includes: periodic calibration and general equipment checking, and replacement of the internal desiccant and fuses. Routine cleaning or replacement of tubing and other parts should be done following the manufactures guidelines or according to your SOP.

Basic maintenance of the flow meters includes: periodic replacement of the internal desiccant, plotter paper, ribbon, fuses, and any broken re-roll spool assemblies. Note: Some flow meters have two tabs on the sides which are extremely thin and easily broken.

The NiCad and Gel Cell batteries need to be recharged on a regular basis. Any battery that reads less than 12.50 when checked should not be installed or left on any of the sampling equipment. At the battery charging station, areas are set aside for batteries that need to be charged and batteries already charged.

To prolong battery life, NiCad batteries should be fully discharged before recharging for a maximum of 24 hours, in accordance with the procedures described in the manufacturer's operations and maintenance manuals. Always bring a second set or back-up set of batteries with you.

It is important to note that charged NiCad batteries, if left unused for a long time, are nevertheless slowly discharging. Gel cell batteries are generally more stable. Voltage readings should be taken before the charged batteries are taken into the field to be sure that they still have a full charge.

When a sampler, flow meter, or ancillary equipment needs more specific repairs, the manufacturer representative should be contacted and arrangements made for repair or replacement of the equipment.

Compliance Sampling Evaluation

Wastewater sampling/analysis is an integral part of the National Pollutant Discharge Elimination System (NPDES) Compliance Monitoring Program. NPDES permits contain specific and legally enforceable effluent limitations and monitoring requirements.

Objectives and Requirements
When evaluating the permittee sampling program, the inspector should:

- Verify that the permittee's sampling program complies with the permit.
- Verify that the permittee's sampling program complies with:

– Title 40 of the *Code of Federal Regulations* (CFR), sections 136.1 to 136.6 and Appendices A, B, and C (Guidelines for Establishing Test Procedures for the Analysis of Pollutants) for wastewater samples; and 40 CFR Part 503.

- Document potential violations to support enforcement action.

In addition, specific objectives of the sampling conducted by inspectors include the following:

- Verify compliance with effluent limitations.
- Verify accuracy of reports and program self-monitoring.
- Support enforcement action.
- Support permit development reissuance and/or revision.
- Determine the quantity and quality of effluent.

Sampling, analysis, preservation technique, sample holding time, and sample container requirements are provided under 40 CFR Part 136 as authorized by section 304(h) of the Clean Water Act (CWA). For all NPDES permittees the inspector should perform a review of sampling procedures and quality control measures the facility uses to ensure the integrity of sample data.
To evaluate sampling procedures, assess the following eight areas:

- Sample site locations
- Sample collection techniques
- Field measurements
- Sample labeling (including locations) and documentation
- Sample preservation and holding time
- Transfer of custody and shipment of samples
- Quality control
- Data handling and reporting

Safety First

Proper safety precautions must be observed when collecting wastewater samples. Wastewater can contain microbiological disease agents (pathogens), chemical poisons (toxins), and other biological, chemical, and physical components that may cause human health problems or disturb natural aquatic ecosystems. Waterborne pathogens in the sewer collection system are different, and potentially more antibiotic resistant, than decades ago.

Wastewater operators can be exposed to wastewater pathogens and toxins through several pathways:

- respiratory exposure -face shield and masks protect from droplets and aerosols
- dermal exposure -gloves and hand hygiene protect from direct contact
- surface (fomite) exposure - barriers between skin and surfaces protect from wastewater and plant equipment contact

Always check the atmosphere of manholes before sampling or entering. Note: Resting the atmospheric monitor on an inverted manhole cover balanced over the manhole is not recommended.

Refer to Centers for Disease Control and Prevention (CDC) Guidance for Controlling Potential Risks to Workers exposed to Class B Biosolids. DHHS (NIOSH) Publication Number 2002-149. Refer to the SESD* Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

Credit U.S. EPA, Science and Ecosystem Support Division (SESD)

Procedural Precautions

The following precautions should be considered when collecting wastewater samples.

• Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.

• Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.

• If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.

• Shipped samples shall conform to all U.S. Department of Transportation (DOT) and/or International Air Transportation Association (IATA) hazardous materials shipping requirements.

• Documentation of field sampling is done in a bound logbook.

• Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.

• All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader and stored in a secure place.

Special Precautions for Wastewater Sampling

• A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.

• Sample containers for samples suspected of containing high concentrations of contaminants shall be stored separately.

• Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area. Samples of waste or highly contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background/control samples.

• If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.

• Field investigators must use new, verified certified-clean disposable or non-disposable equipment cleaned according to procedures contained in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) for collection of samples for trace metals or organic compound analyses.

Site Selection for Wastewater Sampling

Where applicable, wastewater samples should be collected at the location specified in your NPDES permit (if the source has a permit). In some instances, the sampling location specified in the permit, or the location chosen by the permittee, may not be adequate for the collection of a representative wastewater sample.

In such instances, the investigator is not limited by permit specifications and may collect a sample at a more representative location. When a conflict exists between the permittee and the regulatory agency regarding the most representative sampling location, both sites should be sampled, and the reason for the conflict should be noted in the field notes and the inspection or study report. Recommendations and reasons for a change in sampling locations should be given to the appropriate permitting authority.

Plant Influent Sampling
Influent wastewaters are preferably sampled at locations of highly turbulent flow in order to ensure good mixing; however, in many instances the most desirable location is not accessible. Preferable influent wastewater sampling locations include: 1) the upflow siphon following a comminutor (in absence of grit chamber); 2) the upflow distribution box following pumping from the main plant wet well; 3) aerated grit chamber; 4) flume throat; 5) pump wet well when the pump is operating; or 6) downstream of preliminary screening. When possible, influent samples should be collected upstream from sidestream returns.

Plant Effluent Sampling
Effluent samples should be collected at the site specified in the permit, or if no site is specified in the permit, at the most representative site downstream from all entering wastewater streams prior to discharge into the receiving waters. If a conflict exists between the permittee and inspector regarding the source being sampled or the location of the most representative site, follow the procedures and examples described in a few mores pages.

Treatment Pond and Lagoon Sampling
Generally, composite effluent wastewater samples should be collected from ponds and lagoons. Even if the ponds or lagoons have long retention times, composite sampling is necessary because ponds and lagoons have the tendency to have flow paths that short circuit, which changes the designed detention time.

Sampling Techniques and Equipment

The wastewater sampling techniques and equipment described in this document are designed to minimize effects on the chemical and physical integrity of the sample. If the procedures in these sections are followed, a representative sample of the wastewater should be obtained.

The variety of conditions at different sampling locations requires that considerable judgment be exercised regarding the methodologies and procedures for the collection of representative samples of wastewater. Each sampling location warrants attention commensurate with its complexity. There are, however, basic rules and precautions generally applicable to sample collection.
Acceptable procedures are generally those outlined in the permit or NPDES Compliance Inspection Manual. Some important considerations for obtaining a representative wastewater sample include:

- The sample should be collected where the wastewater is well mixed. Therefore, the sample should be collected near the center of the flow channel, at approximately 40 to 60 percent of the water depth, where the turbulence is at a maximum and the possibility of solids settling is minimized. Skimming the water surface or dragging the channel bottom should be avoided. However, allowances should be made for fluctuations in water depth due to flow variations.

• In sampling from wide conduits, cross-sectional sampling should be considered. Rhodamine water Tracing (WT) dye may be used as an aid in determining the most representative sampling locations.

• If manual compositing is employed, the individual sample portions must be thoroughly mixed before pouring the individual aliquots into the composite container. For manual composite sampling, the individual sample aliquots should be preserved at the time of sample collection.

Sample Handling and Preservation Requirements

1. All sample collection and preservation procedures will comply with the requirements outlined in your permit and/or 40 CFR, Part 136.3 (e), Table II, and Figure 3-1 of the US EPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASB LOQAM), most recent version.

2. Wastewater samples will typically be collected either by directly filling the sample container or by using an automatic sampler or other device.

3. During sample collection, if transferring the sample from a collection device, make sure that the device does not come in contact with the sample containers.

4. Place the sample into appropriate, labeled containers. Samples collected for VOC analysis must not have any headspace. All other sample containers must be filled with an allowance for ullage, a little air space.

5. All samples requiring preservation must be preserved as soon as practically possible, ideally immediately at the time of sample collection. If preserved VOC vials are used, these will be preserved with concentrated hydrochloric acid. The adequacy of sample preservation will be checked after the addition of the preservative for all samples, except for the samples collected for VOC analysis. If it is determined that a sample is not adequately preserved, additional preservative should be added to achieve adequate preservation.

6. All samples preserved using a pH adjustment (except VOCs) must be checked, using pH strips, to ensure that they were adequately preserved. This is done by pouring a small volume of sample over the strip. Do not place the strip in the sample. Samples requiring reduced temperature storage should be placed on ice immediately.

Common Wastewater Sample Bottles

625/608, 1657, TTO/Organics, TPH/Oil/Grease,
Thin vials-TOCs, VOCs, 601/602 and 502.2
Be careful not to get air in the VOC/SVOC bottles.

NO_2/NO_3, Fluoride, Sulfide, Metals, BOD-TDS-TSS
Wide-mouth Sludge/Metals bottle

Laboratory
123 W. Main St
Sun City, Arizona 85541

LAB I.D. NUMBER

Sampler:

DATE: PAGE **1** OF **1**

Company:
Department:
Address:
Contact:
Telephone:

Sample Identification	Date	Time	Matrix	Lab ID	Metals* See Attached	TSS	Lead/Copper	BOD/COD	Nitrate	Nitrate + Nitrite	TKN / Amonia	VOC / THM's	Semi Volital Organics (625)	Chloride		Cyanide	Floride	Surfactants (MBAS)	Tot. Coliform MPN	Fecal Coliform MPN-HPC	Organo-Phosphorus Pest. (8141)	Sulfate	EC Conductivity	Number/Containers

Project Name

Project Number

Field Measurements:

pH:

Temp:

Sample Receipt

No. Containers:

Custody Seals:

Received Intact: Yes No

Received Cold: Yes No

Temperature:

PRIORITY:

RELINQUISHED BY:

Signature: Time:

Printed Name: Date:

SAMPLED RECEIVED BY:

Signature: Time:

Printed Name: Date:

RELINQUISHED BY:

Signature: Time:

Printed Name: Date:

Company

SAMPLED RECEIVED BY:

Signature: Time:

Printed Name: Date:

Company

Wastewater Sampling Information
Required Containers, Preservation Techniques, and Holding Times
40 CFR 136.3

Table II-Required Containers, Preservation Techniques, and Holding Times

Parameter No./name	Container[1]	Preservation[2,3]	Maximum holding time[4]
Bacterial Tests:			
Coliform, total, fecal, and *E. coli*	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$[5]	8 hours.[22,23]
Fecal streptococci	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$[5]	8 hours.[22]
Enterococci	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$[5]	8 hours.[22]
Salmonella	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$[5]	8 hours.[23]
Inorganic Tests:			
Acidity	P, FP, G	Cool, ≤6 °C[18]	14 days.
Alkalinity	P, FP, G	Cool, ≤6 °C[18]	14 days.
Ammonia	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days.
Biochemical oxygen demand	P, FP, G	Cool, ≤6 °C[18]	48 hours.
Boron	P, FP, or Quartz	HNO_3 to pH<2	6 months.
Bromide	P, FP, G	None required	28 days.
Biochemical oxygen demand, carbonaceous	P, FP G	Cool, ≤6 °C[18]	48 hours.
Chemical oxygen demand	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days.
Chloride	P, FP, G	None required	28 days.
Chlorine, total residual	P, G	None required	Analyze within 15 minutes.
Color	P, FP, G	Cool, ≤6 °C[18]	48 hours.
Cyanide, total or available (or CATC) and free	P, FP, G	Cool, ≤6 °C[18], NaOH to pH>10[5,6], reducing agent if oxidizer present	14 days.
Fluoride	P	None required	28 days.
Hardness	P, FP, G	HNO_3 or H_2SO_4 to pH<2	6 months.
Hydrogen ion (pH)	P, FP, G	None required	Analyze within 15 minutes.
Kjeldahl and organic N	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days.
—Metals—:[7]			
Chromium VI	P, FP, G	Cool, ≤6 °C[18], pH = 9.3–9.7[20]	28 days.
Mercury (CVAA)	P, FP, G	HNO_3 to pH<2	28 days.
Mercury (CVAFS)	FP, G; and FP-lined cap[17]	5 mL/L 12N HCl or 5 mL/L BrCl[17]	90 days.[17]
Metals, except boron, chromium VI, and mercury	P, FP, G	HNO_3 to pH<2, or at least 24 hours prior to analysis[19]	6 months.
Nitrate	P, FP, G	Cool, ≤6 °C[18]	48 hours.
Nitrate-nitrite	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days.
Nitrite	P, FP, G	Cool, ≤6 °C[18]	48 hours.
Oil and grease	G	Cool to ≤6 °C[18], HCl or H_2SO_4 to pH<2	28 days.
Organic Carbon	P, FP, G	Cool to ≤6 °C[18], HCl, H_2SO_4, or H_3PO_4 to pH<2	28 days.
Orthophosphate	P, FP, G	Cool, ≤6 °C[18, 24]	Filter within 15 minutes; Analyze within 48 hours.
Oxygen, Dissolved Probe	G, Bottle and top	None required	Analyze within 15 minutes.
Phenols	G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days.
Phosphorous (elemental)	G	Cool, ≤6 °C[18]	48 hours.
Phosphorous, total	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days.
Residue, total	P, FP, G	Cool, ≤6 °C[18]	7 days.
Residue, Filterable	P, FP, G	Cool, ≤6 °C[18]	7 days.

Parameter No./name	Container[1]	Preservation[2,3]	Maximum holding time[4]
Residue, Nonfilterable (TSS)	P, FP, G	Cool, ≤6 °C[18]	7 days.
Residue, Settleable	P, FP, G	Cool, ≤6 °C[18]	48 hours.
Residue, Volatile	P, FP, G	Cool, ≤6 °C[18]	7 days.
Silica	P or Quartz	Cool, ≤6 °C[18]	28 days.
Specific conductance	P, FP, G	Cool, ≤6 °C[18]	28 days.
Sulfate	P, FP, G	Cool, ≤6 °C[18]	28 days.
Sulfide	P, FP, G	Cool, ≤6 °C[18], add zinc acetate plus sodium hydroxide to pH>9	7 days.
Sulfite	P, FP, G	None required	Analyze within 15 minutes.
Surfactants	P, FP, G	Cool, ≤6 °C[18]	48 hours.
Temperature	P, FP, G	None required	Analyze.
Turbidity	P, FP, G	Cool, ≤6 °C[18]	48 hours.
—Organic Tests—[8]			
Purgeable Halocarbons	G, FP-lined septum	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5]	14 days.
Adsorbable Organic Halides (AOX)	G	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5], HNO_3 to pH <2	Hold at least 3 days but not more than 6 months
Purgeable aromatic hydrocarbons	G, FP-lined septum	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5], HCl to pH 2[9]	14 days.[9]
Acrolein and Acrylonitrile	G, FP-lined septum	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5], pH to 4–5[10]	14 days.[10]
Phenols[11]	G, FP-lined cap	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction.
Benzidines[11,12]	G, FP-lined cap	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5]	7 days until extraction.[13]
Phthalate esters[11]	G, FP-lined cap	Cool, ≤6 °C[18]	7 days until extraction, 40 days after extraction.
Nitrosamines[11,14]	G, FP-lined cap	Cool, ≤6 °C[18], store in dark, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction.
PCBs[11]	G, FP-lined cap	Cool, ≤6 °C[18]	1 year until extraction, 1 year after extraction.
Nitroaromatics and isophorone[11]	G, FP-lined cap	Cool, ≤6 °C[18], store in dark, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction.
Polynuclear aromatic hydrocarbons[11]	G, FP-lined cap	Cool, ≤6 °C[18], store in dark, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction.
Haloethers[11]	G, FP-lined cap	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction.
Chlorinated hydrocarbons[11]	G, FP-lined cap	Cool, ≤6 °C[18]	7 days until extraction, 40 days after extraction.
Pesticides[11]	G, FP-lined cap	Cool, ≤6 °C[18], pH 5–9[15]	7 days until extraction, 40 days after extraction.

[1]"P" is polyethylene; "FP" is fluoropolymer (polytetrafluoroethylene (PTFE; Teflon®;), or other fluoropolymer, unless stated otherwise in this Table II; "G" is glass; "PA" is any plastic that is made of a sterilizable material (polypropylene or other autoclavable plastic); "LDPE" is low density polyethylene.

[2]Except where noted in this Table II and the method for the parameter, preserve each grab sample within 15 minutes of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), refrigerate the sample at ≤6 °C during collection unless specified otherwise in this Table II or in the method(s). For a composite sample to be split into separate aliquots for preservation and/or analysis, maintain the sample at ≤6 °C, unless specified otherwise in this Table II or in the method(s), until collection, splitting, and preservation is completed. Add the preservative to the sample container prior to sample collection when the preservative will not compromise the integrity of a grab sample, a composite sample, or an aliquot split from a composite sample; otherwise, preserve the grab sample, composite sample, or aliquot split from a composite sample within 15 minutes of collection. If a composite measurement is required but a composite sample would compromise sample integrity, individual grab samples must be collected at prescribed time intervals (e.g., 4 samples over the course of a day, at 6-hour intervals). Grab samples must be analyzed separately and the concentrations averaged. Alternatively, grab samples may be collected in the field and composited in the laboratory if the compositing procedure produces

results equivalent to results produced by arithmetic averaging of the results of analysis of individual grab samples. For examples of laboratory compositing procedures, see EPA Method 1664A (oil and grease) and the procedures at 40 CFR 141.34(f)(14)(iv) and (v) (volatile organics).

[3]When any sample is to be shipped by common carrier or sent via the U.S. Postal Service, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H2SO4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4]Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before the start of analysis and still be considered valid. Samples may be held for longer periods only if the permittee or monitoring laboratory has data on file to show that, for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under §136.3(e). For a grab sample, the holding time begins at the time of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), the holding time begins at the time of the end of collection of the composite sample. For a set of grab samples composited in the field or laboratory, the holding time begins at the time of collection of the last grab sample in the set. Some samples may not be stable for the maximum time period given in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if it knows that a shorter time is necessary to maintain sample stability. See §136.3(e) for details. The date and time of collection of an individual grab sample is the date and time at which the sample is collected. For a set of grab samples to be composited, and that are all collected on the same calendar date, the date of collection is the date on which the samples are collected. For a set of grab samples to be composited, and that are collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14–15. For a composite sample collected automatically on a given date, the date of collection is the date on which the sample is collected. For a composite sample collected automatically, and that is collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14–15.

[5]ASTM D7365-09a specifies treatment options for samples containing oxidants (e.g.,chlorine). Also, Section 9060A of Standard Methods for the Examination of Water and Wastewater (20th and 21st editions) addresses dechlorination procedures.

[6]Sampling, preservation and mitigating interferences in water samples for analysis of cyanide are described in ASTM D7365-09a. There may be interferences that are not mitigated by the analytical test methods or D7365-09a. Any technique for removal or suppression of interference may be employed, provided the laboratory demonstrates that it more accurately measures cyanide through quality control measures described in the analytical test method. Any removal or suppression technique not described in D7365-09a or the analytical test method must be documented along with supporting data.

[7]For dissolved metals, filter grab samples within 15 minutes of collection and before adding preservatives. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), filter the sample within 15 minutes after completion of collection and before adding preservatives. If it is known or suspected that dissolved sample integrity will be compromised during collection of a composite sample collected automatically over time (e.g., by interchange of a metal between dissolved and suspended forms), collect and filter grab samples to be composited (footnote 2) in place of a composite sample collected automatically.

[8]Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[9]If the sample is not adjusted to pH 2, then the sample must be analyzed within seven days of sampling.

[10]The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

[11]When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity (i.e., use all necessary preservatives and hold for the shortest time listed). When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to ≤6 °C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6–9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (regarding the requirement for thiosulfate reduction), and footnotes 12, 13 (regarding the analysis of benzidine).

[12]If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

[13]Extracts may be stored up to 30 days at < 0 °C.

[14]For the analysis of diphenylnitrosamine, add 0.008% Na2S2O3 and adjust pH to 7–10 with NaOH within 24 hours of sampling.

[15]The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na2S2O3.

[16]Place sufficient ice with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, it is necessary to immediately measure the temperature of the samples and confirm that the preservation temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature cannot be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature. Aqueous samples must not be frozen. Hand-delivered samples used on the day of collection do not need to be cooled to 0 to 6 °C prior to test initiation.

[17]Samples collected for the determination of trace level mercury (<100 ng/L) using EPA Method 1631 must be collected in tightly-capped fluoropolymer or glass bottles and preserved with BrCl or HCl solution within 48 hours of sample collection. The time to preservation may be extended to 28 days if a sample is oxidized in the sample bottle. A sample collected for dissolved trace level mercury should be filtered in the laboratory within 24 hours of the time of collection. However, if circumstances preclude overnight shipment, the sample should be filtered in a designated clean area in the field in accordance with procedures given in Method 1669. If sample integrity will not be maintained by shipment to and filtration in the laboratory, the sample must be filtered in a designated clean area in the field within the time period necessary to maintain sample integrity. A sample that has been collected for determination of total or dissolved trace level mercury must be analyzed within 90 days of sample collection.

[18]Aqueous samples must be preserved at ≤6 °C, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of "≤ °C" is used in place of the "4 °C" and "< 4 °C" sample temperature requirements listed in some methods. It is not necessary to measure the sample temperature to three significant figures (1/100th of 1 degree); rather, three significant figures are specified so that rounding down to 6 °C may not be used to meet the ≤6 °C requirement. The preservation temperature does not apply to samples that are analyzed immediately (less than 15 minutes).

[19]An aqueous sample may be collected and shipped without acid preservation. However, acid must be added at least 24 hours before analysis to dissolve any metals that adsorb to the container walls. If the sample must be analyzed within 24 hours of collection, add the acid immediately (see footnote 2). Soil and sediment samples do not need to be preserved with acid. The allowances in this footnote supersede the preservation and holding time requirements in the approved metals methods.

[20]To achieve the 28-day holding time, use the ammonium sulfate buffer solution specified in EPA Method 218.6. The allowance in this footnote supersedes preservation and holding time requirements in the approved hexavalent chromium methods, unless this supersession would compromise the measurement, in which case requirements in the method must be followed.

[21]Holding time is calculated from time of sample collection to elution for samples shipped to the laboratory in bulk and calculated from the time of sample filtration to elution for samples filtered in the field.

[22]Sample analysis should begin as soon as possible after receipt; sample incubation must be started no later than 8 hours from time of collection.

[23]For fecal coliform samples for sewage sludge (biosolids) only, the holding time is extended to 24 hours for the following sample types using either EPA Method 1680 (LTB–EC) or 1681 (A–1): Class A composted, Class B aerobically digested, and Class B anaerobically digested.

[24]The immediate filtration requirement in orthophosphate measurement is to assess the dissolved or bio-available form of orthophosphorus (*i.e.*,that which passes through a 0.45-micron filter), hence the requirement to filter the sample immediately upon collection (*i.e.*,within 15 minutes of collection).

[38 FR 28758, Oct. 16, 1973]

Wastewater Treatment Plant Sampling *(Example Procedure)*

POTW samples are collected in accordance with the National Pollutant Discharge Elimination System (NPDES) permit which sets discharge limits for certain pollutants and specifies sampling frequencies and sample types.

Depending on the POTW, laboratory personnel, operators, or a combination of these are responsible to prepare sample bottles and trip blanks, program composite samplers, and collect grab samples. It is common to collect samples for operational parameters along with permit required samples.

Plant Sampling Procedure ***(Example Procedure)***
Ideally, set up two samplers at the plant influent channel and two samplers at the plant effluent channel. Two samplers are used to provide sufficient sample quantity and to minimize the impact of a sampler failure. All sampling equipment must be prepared and cleaned as established in your POTW's SOP's procedures. Teflon hose is required. Sampling locations or sites are specified in each plant's NPDES permit.

Collect the following composite samples at both sites.

(1) **Metals Sample** - (one 2-liter plastic bottle)

Preserve with 1:1 nitric acid to a pH < 2. Store sample at 4°C.

(2) **Cyanide Sample** – (one 2-liter plastic bottle)

Collect the cyanide sample as a composite in accordance with NPDES permit. Check the sample for chlorine. If Cl_2 is present, use ascorbic acid to eliminate it. Add NaOH to a pH > 12. Store samples at 4°C.

(3) EPA Test Method 608 and 625 samples are informational samples only. These results are used for local limits data.

608 and 625 samples are collected as composite samples. From the well-mixed influent channel composite jug: Pour one 1-liter amber glass bottle of each sample (608, 625). Check samples for chlorine. At the effluent channel: Collect and pour one 4-liter amber glass bottle of each sample (608, 625). Check samples for chlorine. If Cl_2 is present in the samples, use sodium thiosulfate ($Na_2S_20_3$) to eliminate it. Store samples on ice at 4°C.

(4) **625/Phenols** are collected as a grab sample. Collect one 4-liter amber glass bottle at the effluent channel only. Check the sample for chlorine. If Cl_2 is present, use sodium thiosulfate ($Na_2S_20_3$) to eliminate it. Store sample at 4°C.

Bio-Solids Sampling *(Example Procedure)*

Bio-solids (dried sludge) samples are collected at POTWs.

Normally, bio-solid samples will be collected from the final storage area for dry sludge. The location of the dried bio-solids may vary based on the individual plants. Sampling frequency will be determined on an as needed basis and to comply with the EPA requirements.

Grab samples are useful for bio-solids. Care should be taken to avoid contamination. All samples are collected using a sterile plastic scoop in order to avoid any contamination.

The following is a list of samples to be collected:

PARAMETER	CONTAINER
Helminth Ova & Enteric Virus	1 Qt Plastic Bag (Ziploc)
Metals +	500 ml Plastic Bottle
Nitrogen (total)	4 oz Glass Bottle
TOC (Total Organic Carbon)	4 oz Glass Bottle
Fecal Coliform	500 ml Plastic Bottle

Sample Scheduling
An active file is maintained on each sampling location which contains historical data including past process discharge flow readings, water meter readings, sampling dates, and conditions of sampling site. A calendar of upcoming sampling events should be maintained.

River Sampling Activities *(Example Procedure)*
To judge the impact of a POTW's discharge to a river, it may be necessary to sample the river above and below the plant's outfall. When developing a sampling plan for river sampling, the following considerations must be observed:

(1) Sampling sites must meet the objectives of the program or study.
(2) At the sampling sites the river must be flowing freely and the sample must be as representative as possible of river flow at that site. Consideration of all safety factors must be observed.
(3) Samples must be collected midstream of the main channel at approximately two-thirds of the depth unless specific depths have been requested.
(4) All safety precautions must be observed during sampling which includes the use of harnesses, waterproof boots and other equipment.

Sewers *(Example Procedure)*
Sewer system and user rate sampling are conducted in manholes. General guidelines for selection of sampling locations include the following:

(1) Samples should be taken at points of high turbulent flow to ensure good mixing and prevent the deposition of solids.
(2) The sample location should be easily accessible and free of any major safety hazards.
(3) Sample lines should not be located where there is surface scum.

(4) If a flow study or a flow/proportional sampling event is required, make sure that the sewer pipe does not have a curve, a drop in the line or any obstructions. These would cause false flow readings.

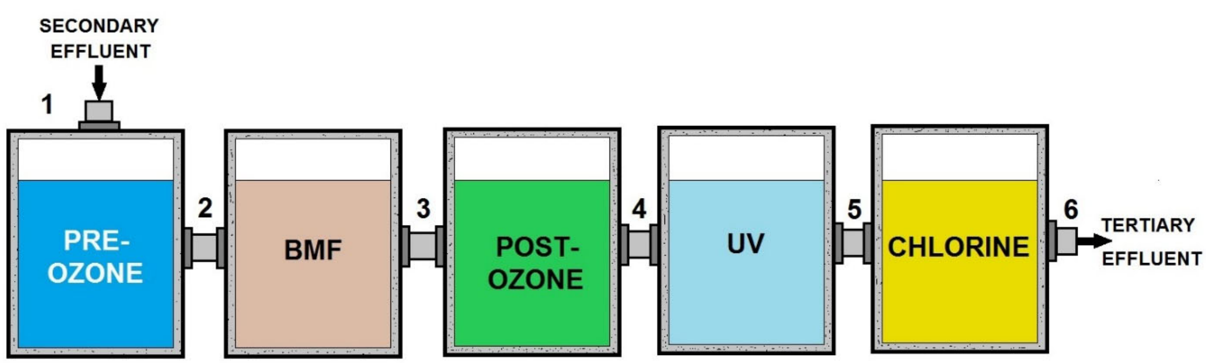
Cleaning Automatic Samplers *(Example Procedure)*
Samplers, sample jars, grab beakers, and all other equipment used in collecting samples must be cleaned between their use at each site, to avoid the possibility of cross contamination. Latex or nitrile gloves should be worn to protect against infections and chemical burns. The following steps should be taken to ensure the proper cleaning of the sampling equipment.

Follow the manufactures recommended procedures for cleaning your automatic samplers. Clean composite jugs and caps separately from the samplers, following your labs SOP.

You may also want to read an EPA Operating Procedure [https://www.epa.gov/sites/default/files/2016-01/documents/field_equipment_cleaning_and_decontamination_at_fec206_af.r3_1.pdf].

Many state environmental departments have their own cleaning procedures for field samplers.

Cleaning often includes the following steps:
(1) Disassemble the sampler into its component parts.
(2) Add laboratory soap to a bucket and immerse the parts to be cleaned. Use a bottle brush to thoroughly scrub the inside and outside of parts, focusing on areas that sample comes in contact with.
(3) Sometimes tubing (suction, peristaltic, or discharge) is so contaminated or worn that replacement is a better option than cleaning. Keep extra tubing in stock.
(4) A dilute acid is sometimes used to remove stubborn contaminants.
(5) A disinfectant is sometimes called for.
(6) Lab water is most commonly used for the final rinse before drying. Sometimes a solvent like acetone is used instead.
(7) Once dry, reassemble the sampler. Return it to your sampling vehicle or storage area. Leave the lid loose so moisture won't be trapped inside.



TERTIARY TREATMENT PROCESS SAMPLING POINTS

Selection of Sampling Site
In order to ensure the collection of valid samples, a representative sampling site must be selected. For industrial sampling, the sites are designated in the permit.

Hand Compositing

Hand compositing is a series of time proportional grab samples that are collected and composited by hand. Provided the Sample volumes are equal and are collected at even intervals, the results should be the same as if done by an automatic sampler (i.e., flow proportional composite sampling).

A specific instance where this sampling method may be used is in metal plating shops that have Batch discharges from the treatment tank.

Provided the tank contains a homogeneous mixture, a minimum of four grab samples are taken of equal amounts and at evenly spaced intervals of time during discharge, to accurately represent the entire tank. This should represent the waste characteristics of the entire batch discharge to the sewer.

One hand composite per batch discharge would be equivalent to a 24-hour composite sample taken at other types of facilities.

The sampling data would be compared with the Average daily categorical standards or local limits where applicable.

Industrial Users - Permitted/Nonpermitted Sampling *(Example Procedure)*

The sampling points within an industry vary with each industry, depending on the nature of the process and location of pretreatment facilities. Therefore, exact locations must be identified on a case by case basis. However, the following general principles apply in all cases:

(1) SUOs should give permit writers the ability to require industries to install a sampling vault at a specified location. Depending on the specific site, a special sampling vault may or may not be needed.

(2) The sampling location should be easily accessible and relatively free of safety hazards.

(3) The specific location of all sampling points should be part of any permit. It is common to include a map and/or photos to help identify sampling locations.

(4) If a sampling location can no longer provide access to a representative sample, the permit needs to be modified to identify a location that works.

(5) When sampling a categorical process or pretreatment system effluent, there should be, if possible, no discharge present other than that from the regulated process. If other wastestreams are combined with the regulated wastestream prior to the sampling location, the combined wastestream formula will need to be utilized. The sampling crew must be aware of lower limits to correctly show analysis on chain of custody.

(6) When filling out chain of custody forms, be sure to specify a test method sensitive enough to provide concentration results below the limit.

(7) If mass limitations are to be applied, some means of determining process flow must be available.

(8) The local limit sampling location needs to be after all flows (industrial and domestic) have combined and before discharge to the public sewer.

Sample Volume -Type and Analyses

Typical sample volumes are required for various analyses. Each laboratory has developed their own standard volumes for routine analyses performed on industrial waste samples. If you are not getting sample bottles from a lab, be sure to ask what volumes they require.

Typical volumes:

(1) BOD/COD/TSS (1000-2000 ml, plastic)
(2) Heavy metals (500-2000 ml, plastic)
(3) Cyanide (2000 ml, plastic)
(4) Oil and grease (1000 ml, level-one glass)

Selection and Preparation of Sample Containers

The selection of a sample container is based on the parameter to be measured and the volumetric needs of the lab. The primary variables are material, diameter of the opening, and volume. The inspector should be familiar with the type of sampling containers and preservatives that are needed.

It is essential that the sample containers be made of chemically resistant material, and do not affect the concentrations of the pollutants to be measured. In addition, sample containers should have a closure (i.e., leak proof/resistant, Teflon lined) that protects the sample from contamination and should be properly labeled before leaving the sampling site.

Sample Preservation

Wastewater usually contains one or more unstable pollutants that require immediate analysis or preservation until an analysis can be made. Sample preservation is needed for composite samples, for example, which may be stored for as long as 24 hours prior to transferring them to the laboratory. Recommended preservatives and holding times that should be used for specific pollutants are presented at the start of this Chapter.

Chain of Custody (COC)
Documentation of all pertinent data concerning the collection, preservation and transportation of samples is critical to the overall success of the Wastewater Sampling Program. If sampling is performed for the Pretreatment program, any sampling data may be used as evidence in court proceedings against a noncompliant industrial user. In this case, documentation becomes critical. The COC form is a legal document and is of major importance in a court hearing.

Specific procedures with regard to chain of custody are outlined below:

(1) The sampling crew takes a sufficient supply of prenumbered Industrial Waste Lab Reports, (custody forms) and sample containers into the field.

It is generally possible to fill out much of the form ahead of time, with the notable exceptions of the time of collection and the change in custody signatures.

a) TURN-AROUND TIME: Check box to indicate if results are needed on a rush basis or in standard turn-around time.
b) PROJECT #/NAME: The ID # or name assigned for the sampling event.
c) SITE ID #/NAME: For each sampling location.
d) DATE SAMPLED: From - Date sampling began. To - Date sample is pulled. If it is a grab sample, only the date the sample was taken will be entered with the other line crossed out.
e) COLLECTED: Date and Time. For a composite sample, the start, end, and total times are recorded.
f) MATRIX: Wastewater, DI water, etc.
g) SAMPLE TYPE: Grab or Composite (hand, flow, or time proportional).
h) SAMPLE BOTTLE: Material & Size
i) NUMBER OF CONTAINERS: Used for this sample.
j) PARAMETER: For example: Metals, Cyanide, O&G, VOC, etc. and,
k) TEST METHOD: Respectively: EPA 200.7, 4500-CN E, EPA 1664A, EPA 624, etc.
l) PRESERVATIVE: Codes for each preservative may be specified on the COC form.
m) NOTES to LAB: Includes any special notes to the lab, such as special analysis required of the sample, a letter code which is assigned to the entity being tested, the amount of flow if sample is flow proportional, grab sample pH and temperature, and/or actual sample temperature.
n) NOTES (Other): Should include the results of any field tests including pH and temperature.
o) COLLECTED BY: for the samplers initials and, if needed, the vehicle ID #.
p) RELINQUISHED BY: Signature w/Date & Time.
q) RECEIVED BY: Signature w/Date & Time.

(2) When a sample is taken the crew records the time of collection on the COC form.

Quality Assurance/Quality Control (*Example*)
Quality Assurance/Quality Control (QA/QC) measures taken by the sampling crew include equipment blanks, trip blanks, split samples and duplicate samples. Equipment blanks and trip blanks are routine QA/QC measures.

Split samples are taken for Local Limits sampling and when requested by an industry.

Split samples requested by an industry are analyzed by their lab at their expense.

Duplicate samples are run when requested by a Project Leader.

According to the EPA, the primary purpose of blanks is to trace sources of artificially introduced contamination. There are five types of blanks used to trace where contamination is introduced, three of which are used in the field and two are used the laboratory. https://www.epa.gov/sites/default/files/2015-06/documents/blanks.pdf

In addition, temperature blanks are sometimes used. Either laboratory staff or the sampling crew prepare the travel, trip, and/or temperature blanks needed for a sampling event.

Any contamination detected in the blanks would result from field exposure which could in turn affect collected samples.

Field Equipment (Rinsate) Blank Procedure *((Example Procedure)*

The purpose of Field Equipment Blanks, also known as Rinsate Blanks is to test the procedure for cleaning the sample measuring container to determine if cross contamination between sample sites has occurred. These Blanks are needed only at sites where flow-proportion samples are taken. Follow these steps when collecting a Field Equipment Blank(also see QA/QC check list example:

1. Collect Field Equipment Blank **AFTER** collecting a sample and **BEFORE** moving to the next sampling location.
2. Open a sealed bottle of High Purity Water.
3. After collecting a sample, triple rinse the sample measuring container, usually a graduated cylinder, using High Purity water.
4. Pour the High Purity Water into the sample measuring container that was just rinsed.
5. Pour the High Purity water from sample measuring device into sample bottles labeled for the Field Equipment Blanks.
6. Repeat Steps 3 through 5 until all Field Equipment Blank sample bottles have been filled.
7. Process samples using standard procedures and submit to laboratory.

An equipment blank is high purity water which has been collected in a composite sample bottle or a series of discrete bottles from an automatic sampler. Equipment blanks are used to evaluate the reliability of composite samples collected in the field. The data produced from the equipment blank indicates the performance of the sample collection system, which involves the cleaning of sampling equipment, and accessories, preservation techniques, and handling of samples. The objective is to demonstrate that the samples are not contaminated by inadequate cleaning of equipment, contaminated preservation additives or sample collection techniques, and to provide documented records on Quality Assurance Practices.

Procedures to be followed in collecting the equipment blanks are outlined below. (Also see QA/QC check list, example).

(1) The sampler is to be assembled completely in the manner determined by the parameters the crew will be sampling (i.e. if sampling for organics, Teflon suction tubing must be used at that site). The composite jar inside the sampler must always be rinsed out thoroughly with high purity water.

(2) Program the sampler to collect the proper amount of high purity water that is representative of the sample parameters that will be collected at that site. Grab samples are excluded. Pump high purity water through the strainer and intake tubing prior to filling the sampler bottle. Then, place the strainer into as many fresh, uncontaminated bottles of high purity water as needed to collect the necessary volume of sample.

(3) If the sampler is set up in the discrete mode, the crew must then transfer the collected samples into the field composite bottle and shake to mix thoroughly.

(4) Transfer the sample from the field composite bottle into its respective lab sample bottles. Test and preserve the samples as appropriate for the parameters being analyzed.

(5) Follow the chain of custody procedures outlined in SOP for turning the samples in to the laboratory. All paperwork must be completed at this time, and all bottles must be marked accordingly. Custody seals must be used. The crew must note the sampling activity in a logbook that is kept specifically for documenting preparation of equipment blanks and/or any other QA activities.

Sampling Techniques *(Example)*

General Guidelines
In general, the following guidelines should be observed in conducting sampling activities:

(1) Samples being collected must be representative of the wastestream being tested.

(2) Samples shall be collected in uncontaminated containers and preserved properly.

(3) Samples should be of sufficient volume for the required analyses.

(4) Samples should be stored in a manner which does not alter the properties of the sample prior to chain of custody transfer.

(5) Samples should be properly and completely identified by labeling them with the proper information.

(6) Sample lines should be as short as possible and the smallest practical diameter to facilitate purging, reduce lag time, and give adequate consideration to maximum transport velocity. Also, they should have sufficient strength to prevent structural failure.

(7) Sample lines should be pitched downward at least 10 percent to prevent settling or separation of solids contained by the sample.

(8) Samples should be delivered as quickly as possible to the laboratory.

Specific Techniques
Sampling techniques in addition to the above general guidelines must also recognize differences in sampling methodology, preservation, and analytical methods.

The following sections specify techniques that differ by pollutant group and discuss such factors as sampling methodology (e.g., composite, grab, etc.), type of container, preservation and holding time.

Sampling Techniques for Volatile Organics *(Example Procedure)*
Volatile organics are analyzed in accordance with EPA methods 601, 602, 603 and 624.

Due to the volatility of these compounds, only grab samples can be used. If a composite sample is needed, individual grab samples must be collected and composited in the laboratory prior to analysis.

The procedures that must be followed in taking these samples are outlined below.

NOTE: Gloves, clothing, face, and eye protection must be worn when handling volatile organics. In addition, the sampling crew must thoroughly clean those parts of the body that have been exposed to these materials.

(1) For each sampling date, the lab should also provide two additional bottles to be used as a backup in case of breakage. These sampling vials are only

good for one week. If any are unused, they must be returned to the lab for disposal.

(2) The lab will provide one sample trip blank per sampling date. This bottle is to be kept on ice until the samples are submitted to the lab. At least one day prior to sampling, go to the lab and request the sample bottles (40 ml vials) for the specific sampling site, as indicated by the sampling plan. The laboratory will arrange to have the appropriate number of sample bottles prepared, based on the number of analyses to be performed. The sampling crew should make sure that all bottles are provided for these samples by the lab technicians.

(3) Collect the sample in a clean glass beaker. Test for chlorine with the Hach test kit. If there is any chlorine residual, neutralize the chlorine with sodium thiosulfate ($Na_2S_2O_3$) and retest for chlorine. Repeat until there is no chlorine residual. Make notes on chain of custody sheet if extra amounts of sodium thiosulfate are required for neutralization.

(4) Remove the vials from the ice. There will be two empty vials for the 601 sample and two vials with HCl for the 602. The HCl will already have been measured into the vials by the lab personnel.

(5) Fill the vial so that the sample is higher than the rim. Surface tension causes this bulge to exist. This is accomplished by pouring the sample from the beaker into the vial along the side of the vial to minimize the possibility of entrapping air in the sample. Do not rinse out or overfill the vials, this will wash out the preservative in the vial.

(6) Seal the vial so that no air bubbles are entrapped in it. Remember to put the Teflon side of the cap facing down onto the vial.

(7) To be sure there are no air bubbles, turn the vial upside down and tap it against the palm of the hand. Check to see if there are air bubbles along the sides or bottom of the vial. If there are bubbles, unseal the vial, top off the vial, and reseal. Check the vial again for the presence of bubbles.

(8) All samples must be maintained at 4°C from the time of collection until the time of extraction. Custody seals must be placed on all samples, and all paper work must be filled out properly.

(9) Return the sample bottles and QA/QC bottles to the laboratory the same day the sample is collected.

Common wastewater sample bottles

Radionuclides, VOCs, (Volatile Organic Compounds), TTHMs, (Total Trihalomethanes), Nitrate, Nitrite.

Most of these sample bottles will come with the preservative already inside the bottle.

Some bottles will come with a separate preservative (acid) for the field preservation.

Slowly add the acid or other preservative to the water sample; not water to the acid or preservative.

SECONDARY TREATMENT STANDARDS

The biological treatment component for a municipal wastewater treatment plant is termed **secondary treatment**, and is usually preceded by simple settling (primary treatment). Secondary treatment standards have been established by U.S. EPA for publicly-owned treatment works (POTWs) and reflect the performance of secondary wastewater treatment plants. These technology-based regulations apply to all municipal wastewater treatment plants and represent the minimum level of effluent quality attainable by **secondary treatment**, as reflected in terms of 5-day biochemical oxygen demand (BOD5) and total suspended solids (TSS) removal.

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METHOD DETECTION LIMIT OR MDL

The **Method Detection Level (MDL)** is the basic measure of whether a pollutant or parameter has been detected. It's the minimum concentration at which we can be confident that the effluent concentration is greater than zero. The **MDL** is dependent upon the analytical method used for the pollutant. A sensitive analytical method will typically have a lower **MDL** and can provide more accurate results. In general, if the reported pollutant concentration is less than three times the magnitude of the **MDL**, the accuracy or reliability of these results is questionable, and permit decisions using data in this range should be avoided if possible.

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PRETREATMENT OBJECTIVES

The **Pretreatment Program** is to control the pollutants discharged into sewer systems and to **reduce the amount of pollutants released into the environment**. Most POTWs are designed to treat sanitary (domestic) wastes from households, but not to treat toxic pollutants from industrial or commercial facilities. The toxic pollutants from industrial and commercial facilities may cause serious problems at POTWs. These problems may be prevented by recycling, waste minimization, chemical substitution, pretreatment, or other best management practices to reduce or eliminate the pollutants from commercial or industrial facilities.

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Synthetic Organic Chemicals (SOC) Sub-Section

Common wastewater sampling bottles. SOC/VOC bottles are the smaller, thin bottles with the septum tops. Be careful not to get any air bubbles in the SOC/VOC bottles

SOC Introduction

Synthetic Organic Chemicals (SOCs) are organic (carbon based) chemicals that are less volatile than Volatile Organic Compounds (VOCs). SOCs are used as pesticides, defoliants, fuel additives and as ingredients for other organic compounds. They are all man made and do not naturally occur in the environment. Some of the more well-known SOCs are Atrazine, 2,4-D, Dioxin and Polychlorinated Biphenyls (PCBs).

SOCs most often enter the natural environment through application of pesticide (including runoff from areas where they are applied), as part of a legally discharged waste stream, improper or illegal waste disposal, accidental releases or as a byproduct of incineration. Some SOCs are very persistent in the environment, whether in soil or water.

SOCs are generally toxic and can have substantial health impacts from both acute (short-term) and chronic (long-term) exposure. Many are known carcinogens (cancer causing). EPA has set Maximum Contaminant Levels (MCL) for 30 SOCs under the Safe Drinking Water Act.

SDWA Act
The Safe Drinking Water Act requires that all water sources of all public water systems be periodically monitored for regulated SOCs. The monitoring frequency can be adjusted through a waiver if SOCs are not detected.

EPA established Maximum Contaminant Levels (MCL), Maximum Contaminant Level Goals (MCLG), monitoring requirements and best available technologies for removal for 65 chemical contaminants over a five year period as EPA gathered and analyzed occurrence and health effects data. This series of rules are known as the Chemical Phase Rules and they define regulations for three contaminant groups:

- Inorganic Chemicals (IOC),
- Synthetic Organic Chemicals (SOC), and
- Volatile Organic Chemicals (VOC).

The Chemical Phase rules provide public health protection through the reduction of chronic risks from:

- cancer;
- organ damage; and
- circulatory,
- nervous, and
- reproductive system disorders.

They also help to reduce the occurrence of Methemoglobinemia or "blue baby syndrome" from ingestion of elevated levels of nitrate or nitrite. All public water systems must monitor for Nitrate and Nitrite. Community water systems and Non-transient non-community water systems must also monitor for IOCs, SOCs, and VOCs.

This is a list of the organic chemicals—which include pesticides, industrial chemicals, and disinfection by-products—that are tested for in public water systems (those that provide water to the public), along with the maximum standard for the contaminant, and a brief description of the potential health effects associated with long-term consumption of elevated levels of the contaminants.

The federal standard for most contaminants is listed as a Maximum Contaminant Level (MCL), the lowest concentration at which that particular contaminant is believed to represent a potential health concern.

Unless otherwise noted, the MCL is expressed as parts per billion (ppb). Also, because of technological limitations or other factors, it is not possible to test for some contaminants in a reliable fashion. Instead, public water systems are required to use specific Treatment Techniques (TT) that are designed to remove these particular contaminants from the water.

In addition to the chemicals listed, monitoring is done for approximately 60 organic chemicals for which MCLs have not been established. If unacceptable levels are found of these “unregulated” contaminants—based on established state health standards and an assessment of the risks they pose—the response is the same as if an MCL has been exceeded: the public water system must notify those served by the system.

Volatile Organic Compounds (VOCs) Sub-Section

Definitions

Volatile Organic Compounds (VOCs) – "VOCs are groundwater contaminants of concern because of very large environmental releases, human toxicity, and a tendency for some compounds to persist in and migrate with groundwater to drinking-water supply well … In general, VOCs have high vapor pressures, low-to-medium water solubilities, and low molecular weights. Some VOCs may occur naturally in the environment, other compounds occur only as a result of manmade activities, and some compounds have both origins." - Zogorski and others, 2006

40 CFR 51.100(s) - Definition - Volatile organic compounds (VOC)

(s) "Volatile organic compounds (VOC)" means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

VOCs Explained

Volatile organic compounds (VOCs) are organic chemicals that have a high vapor pressure at ordinary, room-temperature conditions. Their high vapor pressure results from a low boiling point, which causes large numbers of molecules to evaporate or sublimate from the liquid or solid form of the compound and enter the surrounding air. An example is formaldehyde, with a boiling point of –19 °C (–2 °F), slowly exiting paint and getting into the air.

VOCs are numerous, varied, and ubiquitous. They include both human-made and naturally occurring chemical compounds. Most scent or odors are composed of VOC molecules. Industrial use of fossil fuels produces VOCs either directly as products (e.g., gasoline) or indirectly as byproducts (e.g., vehicle exhaust). Some VOCs are dangerous to human health or cause harm to the environment. Anthropogenic VOCs are regulated by law, especially indoors, where concentrations are the highest. Harmful VOCs are typically not acutely toxic, but instead have compounding long-term health effects. Because the concentrations are usually low and the symptoms slow to develop, research into VOCs and their effects is difficult.

Specific Sources of Select VOCs

Paints and Coatings

A major source of man-made VOCs are coatings, especially paints and protective coatings. Solvents are required to spread a protective or decorative film. Approximately 12 billion liters of paints are produced annually.

Typical paint solvents are aliphatic hydrocarbons, ethyl acetate, glycol ethers, and acetone. Motivated by cost, environmental concerns, and regulation, the paint and coating industries are increasingly shifting toward aqueous solvents.

Chlorofluorocarbons and Chlorocarbons

Chlorofluorocarbons, which are banned or highly regulated, were widely used cleaning products and refrigerants. Tetrachloroethene is used widely in dry cleaning and by industry. Industrial use of fossil fuels produces VOCs either directly as products (e.g., gasoline) or indirectly as byproducts (e.g., automobile exhaust).

Benzene

One common VOC that is a known human carcinogen is benzene, which is a chemical found in environmental tobacco smoke, stored fuels, and exhaust from cars in an attached garage. Benzene also has natural sources such as volcanoes and forest fires. It is frequently used to make other chemicals in the production of plastics, resins, and synthetic fibers.

Benzene evaporates into the air quickly and the vapor of benzene is heavier than air allowing the compound to sink into low-lying areas. Benzene has also been known to contaminate food and water and if digested can lead to vomiting, dizziness, sleepiness, rapid heartbeat, and at high levels, even death may occur.

Methylene Chloride

Methylene chloride is another VOC that is highly dangerous to human health. It can be found in adhesive removers and aerosol spray paints and the chemical has been proven to cause cancer in animals. In the human body, methylene chloride is converted to carbon monoxide and a person will suffer the same symptoms as exposure to carbon monoxide. If a product that contains methylene chloride needs to be used the best way to protect human health is to use the product outdoors. If it must be used indoors, proper ventilation is essential to keeping exposure levels down.

Perchloroethylene

Perchloroethylene is another VOC that has been linked to causing cancer in animals. It is also suspected to cause many of the breathing related symptoms of exposure to VOC's. Perchloroethylene is used mostly in dry cleaning. Studies show that people breathe in low levels of this VOC in homes where dry-cleaned clothes are stored and while wearing dry-cleaned clothing. While dry cleaners attempt to recapture perchlorothylene in the dry cleaning process to reuse it in an effort to save money, they can't recapture it all. To avoid exposure to perchlorothylene, if a strong chemical odor is coming from clothing when picked up from the dry cleaner, do not accept them and request that less of the chemical be used as well as a complete drying of the garments

MTBE

MTBE was used as an octane booster and oxygenated-additive. It was banned in the US around 2004 in order to limit further contamination of drinking water aquifers primarily from leaking underground gasoline storage tanks.

Formaldehyde

Many building materials such as paints, adhesives, wall boards, and ceiling tiles slowly emit formaldehyde, which irritates the mucous membranes and can make a person irritated and uncomfortable. Formaldehyde emissions from wood are in the range of 0.02 – 0.04 ppm. Relative humidity within an indoor environment can also affect the emissions of formaldehyde. High relative humidity and high temperatures allow more vaporization of formaldehyde from wood-materials.

Health Risks

Respiratory, allergic, or immune effects in infants or children are associated with man-made VOCs and other indoor or outdoor air pollutants. Some VOCs, such as styrene and limonene, can react with nitrogen oxides or with ozone to produce new oxidation products and secondary aerosols, which can cause sensory irritation symptoms. Unspecified VOCs are important in the creation of smog. VOCs are one category of hazardous air pollutants (HAPs) that are known or suspected to cause cancer, birth defects, and seriously impact the environment. Along with regulating air emissions, the EPA, through the Clean Water Act, regulates wastewater discharges of these, and other, pollutants from many categories of industries.

Health effects include:

Eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system. Some organics can cause cancer in animals; some are suspected or known to cause cancer in humans.

Key signs or symptoms associated with exposure to VOCs include conjunctival irritation, nose and throat discomfort, headache, allergic skin reaction, dyspnea, declines in serum cholinesterase levels, nausea, emesis, epistaxis, fatigue, dizziness.

The ability of organic chemicals to cause health effects varies greatly from those that are highly toxic, to those with no known health effects. As with other pollutants, the extent and nature of the health effect will depend on many factors including level of exposure and length of time exposed. Eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment are among the immediate symptoms that some people have experienced soon after exposure to some organics. At present, not much is known about what health effects occur from the levels of organics usually found in homes. Many organic compounds are known to cause cancer in animals; some are suspected of causing, or are known to cause, cancer in humans.

Reducing Exposure
To reduce exposure to these toxins, one should buy products that contain Low-VOC's or No VOC's. Only the quantity which will soon be needed should be purchased, eliminating stockpiling of these chemicals. Use products with VOC's in well ventilated areas. When designing homes and buildings, design teams can implement the best possible ventilation plans, call for the best mechanical systems available, and design assemblies to reduce the amount of infiltration into the building. These methods will help improve indoor air quality, but by themselves they cannot keep a building from becoming an unhealthy place to breathe.

While proper building ventilation is a key component to improving indoor air quality, it cannot do the job on its own. As stated earlier, awareness is the key component to improving air quality, when choosing building materials, furnishings, and decorations. When architects and engineers implement best practices in ventilation and mechanical systems, the owner must maintain good air quality levels thereafter.

40 CFR 51.100(s) - Definition - Volatile organic compounds (VOC)
(1) This includes any such organic compound other than the following, which have been determined to have negligible photochemical reactivity:
- methane
- ethane
- methylene chloride (dichloromethane)
- 1,1,1-trichloroethane (methyl chloroform)
- 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113)
- trichlorofluoromethane (CFC-11)
- dichlorodifluoromethane (CFC-12)
- chlorodifluoromethane (HCFC-22)
- trifluoromethane (HFC-23)
- 1,2-dichloro 1,1,2,2-tetrafluoroethane (CFC-114)
- chloropentafluoroethane (CFC-115)
- 1,1,1-trifluoro 2,2-dichloroethane (HCFC-123)
- 1,1,1,2-tetrafluoroethane (HFC-134a)
- 1,1-dichloro 1-fluoroethane (HCFC-141b)
- 1-chloro 1,1-difluoroethane (HCFC-142b)
- 2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124)
- pentafluoroethane (HFC-125)
- 1,1,2,2-tetrafluoroethane (HFC-134)
- 1,1,1-trifluoroethane (HFC-143a)
- 1,1-difluoroethane (HFC-152a)
- parachlorobenzotrifluoride (PCBTF)
- cyclic, branched, or linear completely methylated siloxanes

- acetone
- perchloroethylene (tetrachloroethylene)
- 3,3-dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca)
- 1,3-dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)
- 1,1,1,2,3,4,4,5,5,5-decafluoropentane (HFC 43-10mee)
- difluoromethane (HFC-32)
- ethylfluoride (HFC-161)
- 1,1,1,3,3,3-hexafluoropropane (HFC-236fa)
- 1,1,2,2,3-pentafluoropropane (HFC-245ca)
- 1,1,2,3,3-pentafluoropropane (HFC-245ea)
- 1,1,1,2,3-pentafluoropropane (HFC-245eb)
- 1,1,1,3,3-pentafluoropropane (HFC-245fa)
- 1,1,1,2,3,3-hexafluoropropane (HFC-236ea)
- 1,1,1,3,3-pentafluorobutane (HFC-365mfc)
- chlorofluoromethane (HCFC-31)
- 1-chloro-1-fluoroethane (HCFC-151a)
- 1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a)
- 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxy-butane ($C_4F_9OCH_3$ or HFE-7100)
- 2-(difluoromethoxymethyl)-1,1,1,2,3,3,3-heptafluoropropane ($(CF_3)_2CFCF_2OCH_3$)
- 1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane ($C_4F_9OC_2H_5$ or HFE-7200)
- 2-(ethoxydifluoromethyl)-1,1,1,2,3,3,3-heptafluoropropane ($(CF_3)_2CFCF_2OC_2H_5$)
- methyl acetate
- 1,1,1,2,2,3,3-heptafluoro-3-methoxy-propane (n-$C_3F_7OCH_3$ or HFE-7000)
- 3-ethoxy-1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-2-(trifluoromethyl) hexane (HFE-7500)
- 1,1,1,2,3,3,3-heptafluoropropane (HFC 227ea)
- methyl formate ($HCOOCH_3$)
- 1,1,1,2,2,3,4,5,5,5-decafluoro-3-methoxy-4-trifluoromethyl-pentane (HFE-7300)
- dimethyl carbonate
- propylene carbonate
- and perfluorocarbon compounds which fall into these classes:
    - (i) cyclic, branched, or linear, completely fluorinated alkanes,
    - (ii) cyclic, branched, or linear, completely fluorinated ethers with no unsaturations,
    - (iii) cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations, and
    - (iv) sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.

(2) For purposes of determining compliance with emissions limits, VOC will be measured by the test methods in the approved State implementation plan (SIP) or 40 CFR Part 60, Appendix A, as applicable. Where such a method also measures compounds with negligible photochemical reactivity, these negligibly-reactive compounds may be excluded as VOC if the amount of such compounds is accurately quantified, and such exclusion is approved by the enforcement authority.

Toxic - Heavy Metals Sub-Section

Heavy metals, also known as trace metals, are one of the most persistent pollutants in wastewater. The discharge of high amounts of heavy metals into water bodies leads to several environmental and health impacts. The exposure of humans to heavy metals can occur through a variety of routes, which include inhalation as dust or fume, vaporization and ingestion through food and drink. Some negative impacts of heavy metals to aquatic ecosystems include death of aquatic life, algal blooms, habitat destruction from sedimentation, debris, increased water flow, other short and long term toxicity from chemical contaminants.

Abundant amounts of heavy metals present in soils cause reduction in quality and quantity of food preventing plants' growth, uptake of nutrients, physiological and metabolic processes. Severe effects on animals may include reduced growth and development, cancer, organ damage, nervous system damage, and in extreme cases, death. To help mitigate the negative impacts of heavy metals on the health of humans, animals and the environment, a variety of remediation processes exists. These remediation processes are broadly classified into chemical and biological, although the latter is advocated in recent years.

Biological remediation processes (microbial remediation and phytoremediation) are indicated to be very effective in the treatment of heavy metal pollutants in wastewater. Microbial remediation is the restoration of the environment and its quality using microorganisms, such as bacteria, fungi, protozoan and algae while phytoremediation is the use of plants to degrade or accumulate toxic metals, thereby leading to a reduction in the bioavailability of the contaminant in the soil or water.

Heavy metal concentrations from industrial wastewater pollution such as zinc, copper, nickel and chrome, has sparked major environmental compliance initiatives. For this purpose, government agencies established industry compliance standards for metal-contaminated wastewater discharge into municipal sewage treatment plants, and hazardous metal waste solids into landfills.

Industrial metal pollutants that include, but are not limited to:

- Aluminum
- Antimony (a metalloid)
- Arsenic is a metalloid
- Barium
- Beryllium
- Cadmium
- Copper
- Ferric (Iron / Iron Oxide)
- Hexavalent & Trivalent Chrome
- Lead
- Mercury - mercury poisoning
- Molybdenum
- Nickel / Electroless Nickel
- Osmium
- Selenium
- Silver
- Thallium
- Vanadium
- Zinc / Zinc Phosphate

Radioactive metals:

- Actinium
- Thorium
- Uranium
- Radium
- The transuraniums, such as plutonium, americium, etc.
- Polonium
- Radioactive isotopes of metallic elements not otherwise strongly toxic, e.g. cobalt-60 and strontium-90.

Aluminum

Aluminum has no biological role and its classification into toxic metals is controversial. Significant toxic effects and accumulation to tissues have been observed in renally impaired patients. However, individuals with healthy kidneys can be exposed to large amounts of aluminum with no ill effects. Thus, aluminum is not considered dangerous to persons with normal elimination capacity.

Trace Elements with Toxicity

- Chromium as hexavalent Cr(VI)
- Nickel – nickel salts are carcinogenic
- Copper – copper toxicity
- Zinc - zinc toxicity
- Iron – iron poisoning
- Fluorine-fluoride poisoning

Non-metals

Some heavy nonmetals may be erroneously called "metals", because they have some metallic properties.

- Selenium – a nonmetal; essential element
- Tellurium

Atomic Spectrometry

Atomic spectrometry converts each metal in the water sample to a particulate emission that can then be weighed. Extrapolations are made to determine each metal concentration in each water sample taken. The complicated analysis requires preserving the sample with acid, heating the sample to convert to a particulate emission and then identifying each metal and its weight.

A simple analogy is to capture the steam from a pot of water, separate every atom in the steam, identify each atom, weigh each atom and then apply these numbers back to the original volume of water contained in the pot. The result is an accurate picture of what is in the water.

Heavy Metals in Water

High heavy metals concentrations can be naturally occurring. Every geologic formation contains a certain amount of heavy metal. Mine operations extract and process these metals in areas with the highest concentrations. Water in these areas may have high metal concentrations due to the combination of naturally occurring deposits and mine waste.

Water samples are usually taken randomly within a contaminated area and offsite to identify the source of contamination and the pathway it travels, into the drinkable groundwater system or away from potable water sources. Accurate determination of heavy metal contamination is important to identify cumulative risks to people drinking water derived from these areas.

Sampling Techniques for Heavy Metals *(Example)*

(1) Generally, all metal samples collected are to be composite samples, i.e., flow/composite, time/composite, or hand composite.

(2) For composite sampling, place the lid on the bottle and agitate the bottle to completely mix the composite sample.

(3) Transfer the required amount from the composite container to either a 500 ml or 2000 ml clean plastic bottle. Check the pH of the sample.

Note: For inductively coupled plasma (ICP) metal analysis, a 500 ml clean plastic bottle is required. For extra metals or metals by furnace, a 2000 ml clean plastic bottle is required.

(4) Add nitric acid (1:1 solution) to the sample to reduce the pH to below 2.0. Usually, 2 ml/500 ml is sufficient. Recheck the pH to be sure it is below 2.0. Make a note on the lab sheet if more than two ml of acid is required to bring the pH below 2.0.

(5) Label the sample bottle with the corresponding IW number and proper analysis code letter. Attach the custody seal to the sample, then store in the ice chest until transferred to the laboratory. Fill out the IW lab sheet with all the pertinent information, being careful to include all required parameters and the type of analysis required, e.g., ICP/furnace.

(6) When a grab sample is necessary, rinse out the receiving sample bottle with an aliquot of the wastewater flow or sample stream at least three times. Then fill the sample bottle and proceed with steps two through four described above.

(7) When a split sample is requested (i.e., one for the samplers and one for the user), the composite sample is prepared as described in item one. Providing there is sufficient sample, a portion is transferred into the bottle provided by the user.

(8) If more than one site is sampled per day, a clean composite container (i.e., two and one half-gallon glass jar), must be used at each site.

(9) If a discrete sampler is being used, at the time of collection combine all the samples that have been collected into a single clean composite bottle. Then follow the preceding steps one through four, and refer to step six if a split is requested.

Acid/Base/Neutral Extractable Organics and Pesticides

Acid extractable organics are analyzed in accordance with EPA methods 604 and 625. Base/neutral extractable organics are analyzed in accordance with EPA method 625, or individual methods for various groups of compounds including EPA methods 605, 606, 607, 609, 611, and 612. Pesticides are analyzed in accordance with EPA method 608.

The procedures that must be followed in taking these samples are outlined below.

(1) Samples must be collected in certified clean one-gallon amber glass bottles with Teflon lids.

(2) No travel blanks or QA/QC bottles are required with the samples.

(3) Grab samples must be collected in amber glass bottles. They do not have to be completely filled, but must be a minimum of 1/3 to 1/2 full. Bottles should not be prewashed with samples prior to filling.

(4) For composite sampling, glass composite bottles must be used and precleaned. Teflon tubing must be used for the suction piping. The pump tubing must be medium grade silicone rubber.

(5) The composite bottle in the sampler must be kept refrigerated (putting ice in the sampler) at 4°C. If amber glass is not used (i.e. 2 1/2-gallon clear composite sampler bottle), the sample must be protected from the light during collection and compositing. The compositing must be done in the field (i.e. when discrete sampling has been used).

(6) All samples must be iced at 4°C from the time of collection until extraction.

(7) The sample should be checked for the presence of chlorine using field test kits that provide results in accordance with EPA methods 330.4 and 330.5. If chlorine is determined to be present, 80 mg of sodium thiosulfate should be added to each bottle. The sample must be retested for chlorine. This procedure must be repeated until there is no residual of chlorine shown. The amount of sodium thiosulfate added must be noted on the chain of custody if in excess of 80 mg.

(8) All necessary paperwork must be completed at sampling site. All bottles must be properly labeled, and have custody seals.

Cyanide *(Procedure Example)*

To assure that the sample can be analyzed for cyanide, no chlorine can be present in the sample. Procedures for taking cyanide samples are as follows:

(1) This sample is normally a grab sample. The cyanide sample is a composite sample when collected as part of Priority Pollutants or Plant Sampling at the POTW.

(a) In the sampling file, check the industries' wastewater discharge permit and locate all cyanide (CN) sampling sites. If the sampling sites are located in a confined space, follow Confined Space procedures before collecting the sample or samples.

(b) Collect 2000 ml (maximum), 1000 ml (minimum), of CN sample into a plastic bottle.

NOTE: 2000 ml is the standard, but for batch dischargers 1000 ml is adequate.

(c) Test the cyanide sample for pH and temperature with the pH meter. Record the results on the custody sheet (Industrial Waste (IW) lab sheet).

(d) Test for chlorine with a Total Chlorine Test Kit (the instructions are located in the kit)

(e) If chlorine is present in the CN sample, neutralize it with Ascorbic Acid ($C_6H_8O_6$). For ascorbic acid neutralization, add $C_6H_8O_6$, a few crystals at a time, until five mls of sample in the test tube produces no color. Then add an additional 0.06 g of $C_6H_8O_6$ for each liter of sample volume.

(f) Once all Cl_2 has been neutralized, preserve the sample with Sodium Hydroxide (NaOH) and raise the pH to >12. Verify the >12 pH with a pH meter or pH test strips.

(g) Mark on the side of the CN sample bottle the COC sheet number (using a water proof marker), and place a corresponding custody seal across the sample bottle tightened cap. Place a Cyanide label on the bottle if cyanide is suspected of being present in the sample.

(h) Cool and store the CN sample at 4°C and transport it to the laboratory.

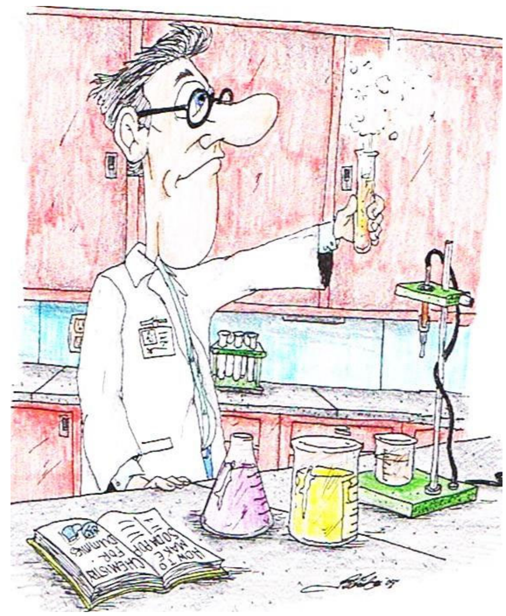
Total Sulfides *(Example)*

(1) The Total Sulfide sample is collected as a grab sample only. Use a clean 500 ml plastic bottle to collect the sample. This sample may be pumped into the sample container or collected directly from the discharge side of the sampling device.

(2) Preserve the sample with 1 ml of 2N Zinc Acetate ($C_4H_6O_4Zn$) and then add Sodium Hydroxide (NaOH) to raise the pH > 9.

(3) Label and seal the sample with a custody seal. Cool to 4°C.

Oil and Grease/TPH *(Procedure Example)*



EPA Method 1664A
Extraction of Oil and Grease from Water Samples Using Solid-Phase Extraction (SPE) Disk Configuration

Oil and Grease Disc Configuration Method
Acidify each 1L sample to pH < 2 using 6 M of HCl.

Place required number of samples (1–6) in the sample vial rack. Insert sample lines into each sample bottle.

Collection
Label the collection vials (1–6) and place these into the collection rack. Position the solvent bottles on the left side of the Dionex AutoTrace instrument.

Solvents
Add methanol to solvent bottle

1. Water (pH 2) to solvent bottle
2. Hexane/THF (1:1) to solvent bottle
3. Hexane to solvent bottle
4. And water to solvent bottle
5. Place these solvent bottles to the left side of the Dionex AutoTrace instrument and insert the solvent lines into the corresponding bottle (up to five different solvents can be used with the Dionex AutoTrace instrument). SPE Media Insert SPE disks onto the Dionex AutoTrace instrument (see Dionex (now part of Thermo Scientific) AutoTrace 280 Operation Manual for details1) and secure the disk into place using the disk holder. The green LED will be illuminated when the disk is locking into place.

METHOD 413.1 (Oil and Grease). Is no longer a valid procedure.

BOD/COD/SS *(Example)*

(1) 24-hour composite sampling is always used for this test. Agitate the bottle to completely mix the composite sample. Do not allow the solids to settle out before you pour off the sample.

(2) When more than one sample is being taken from a composite bottle, the BOD/COD/SS is taken first. The lab needs 1000 ml if the sample is cloudy or has solids. If the sample is clear, you must collect 2000 ml. Transfer the appropriate volume to the sample bottle.

(3) Take the pH/temperature of the sample with either pH paper and a thermometer, or the pH meter carried on the sampling trucks.

(4) Label the sample bottle and place a custody seal over the lid. Store at 4°C.

(5) Should split samples be requested, they are only supplied when it is sure there is enough sample for POTW's requirements. Users must provide their own sample containers and allow POTW's staff to pour off samples.

More on these samples in the Laboratory Analysis Chapter located in the rear of this course.

Virus Sampling *(Procedure Example)*

Viruses are microbiological organisms which can cause infectious diseases. Wastewater recharge and sewage disposal into the environment may contribute to the occurrence of viruses in surface water and groundwater. Viruses are the most mobile and infectious of the waterborne pathogens. Large volumes of water must be filtered to detect viruses. This involves passing the water samples through a cartridge filter by use of a gasoline driven pump.

(1) **Equipment Needed**
Most of the equipment required for virus sampling is available on the sampling trucks. However, some equipment is virus sampling specific. The needed equipment is as follows:

(a) Gasoline/oil powered water pump
(b) Hoses - intake (supplied with pump) and discharge (garden type, with female connectors at both ends)
(c) Two 55-gallon plastic containers
(d) Filter apparatus
(e) Cartridge filters
(f) Sodium thiosulfate (two 500 gram bottles/site)
(g) Gasoline can with gas/oil mixture
(h) Hach total chlorine test kit
(i) Large plastic Zip-lock bags (supplied with cartridges)
(j) Chain of custody sheets
(k) Thermometer
(l) Water-proof marker
(m) Latex gloves
(n) Liquid bleach
(o) Cooler with blue ice
(p) pH meter

(2) **Sampling Procedure**
Check the pump for gas/oil prior to starting (do not fill while it is running). Make sure the gas/oil mixture is correct by checking the mixing instructions on the side of the two-cycle pump oil can. Latex gloves should be worn for protection, and to prevent contamination of the filters.

Connect the hoses and filter housing (with no filter) to the pump, and run the effluent through it for one to two minutes to flush the system. Next, pump effluent into the two 55-gallon drums and rinse them out. (Note: If disinfection was not possible after the last sampling, then 50-100 gallons of effluent should be pumped through the entire equipment set up prior to placing the filter in the housing.)

Pump effluent almost to the top (just above the handles) of both containers. While the drums are filling, check the water in the drums for chlorine using a Hach test kit and record the results and the temperature on the custody sheet. If chlorine is present and needs to be eliminated, add 500 grams of sodium thiosulfate to each container to eliminate it. After visual observation has determined that all the sodium thiosulfate has dissolved, retest to make sure there is a <0.1 ppm chlorine residual. If chlorine was removed, take the hose from the channel, allow it to drain, and reprime the pump with the dechlorinated water.

Pump this water through the system to flush it, and adjust the flow to fill a one-gallon jug in about 15-20 seconds. Don't waste too much water, as the flow can be adjusted after the filter is inserted. Install the filter into the blue holder, being very careful not to touch it with your hands (wear clean latex gloves).

There are two black washers that go with the filter, one on the bottom and the other on the top. Make sure these are aligned with the filter housing to prevent leaking. Screw the holder and filter onto the apparatus.

Refuel the pump, restart it, and adjust the water flow so that it is close to 15-20 seconds per gallon. Make sure the housing doesn't leak.

Try to keep this amount of flow, since too great a flow will cause pass-through in the filter. Pump the water from both containers until they are empty. Stop the pump, remove the filter (wear clean latex gloves), and place it in its original zip-lock bag. The washers do not need to go with the filter, but if they fall into the bag it is better to leave them than take the chance of contaminating the filter trying to remove them.

Fill in the information area on the zip-lock bag with a marker, indicating the plant being sampled and the date, and put it in the cooler with the blue ice provided. The blue ice keeps the temperature at 4°C to prevent significant die-off of the viruses.

While at the site, or later at the plant, mix a half-gallon of bleach to 10 gallons of clean water. Pump it through the flow system and the containers. Rinse everything with fresh water and drain it so it is ready for the next time.

Let the pump cool before storing it. Store the gas/oil mixture in the warehouse flammable storage cabinet.

Parasitology Sampling
Parasitology sampling utilizes the same equipment and techniques as in the virus sampling described above. However, a different type of filter, which is provided by the Lab, is used.

Chapter 5 - Pretreatment and Wastewater Sampling Post Quiz

True or False

1. Grab samples indicate the condition of the wastewater at that specific time and always represent the normal conditions. True or False

2. Grab samples are required when the sample characteristics change rapidly. For instance, grab samples are required for tests such as temperature, pH, D.O. (dissolved oxygen), and bacteriological analysis. True or False

3. An unweighted composite collects a different sample volume at a constant time interval. True or False

4. A composite sample consists of several grab samples collected from the same spot over a specific period of time and merged into a single sample. True or False

5. A flow meter is connected to the composite sampler and the sampler is programed to draw at a specific /volume flow. As the flow increases so does the number of samples. True or False

6. A grab sample is more arduous, complicated and usually more inconvenient than a simple composite sample. True or False

7. An automatic sampler has the capability to be programmed to draw an unknown volume of sample every few minutes and deposit the sample into one of a series of bottles that are preserved or refrigerated. At the end of the sampling period, the operator can retrieve the bottles, bring them back to the lab and create a grab sample. True or False

8. Where applicable, wastewater samples should be collected at the location specified in the NPDES permit (if the source has a permit). True or False

9. In some instances, the sampling location specified in the permit, or a location chosen by the permittee, may be adequate for the collection of a representative wastewater sample. True or False

10. When a conflict exists between the permittee and the regulatory agency regarding the most representative sampling location, both sites should be sampled, and the reason for the conflict should be noted in the field notes and the inspection or study report. True or False

11. Influent wastewaters are preferably sampled at locations of low turbulence where the most desirable location is accessible. True or False

12. When possible, influent samples should be collected upstream from sidestream returns. True or False

13. Composite effluent wastewater samples should never be collected from ponds and lagoons. True or False

14. Even if a pond or lagoon has a long retention time, composite sampling is necessary because ponds and lagoons have the tendency to have flow paths that short circuit (don't mix), which changes the designed detention time. True or False

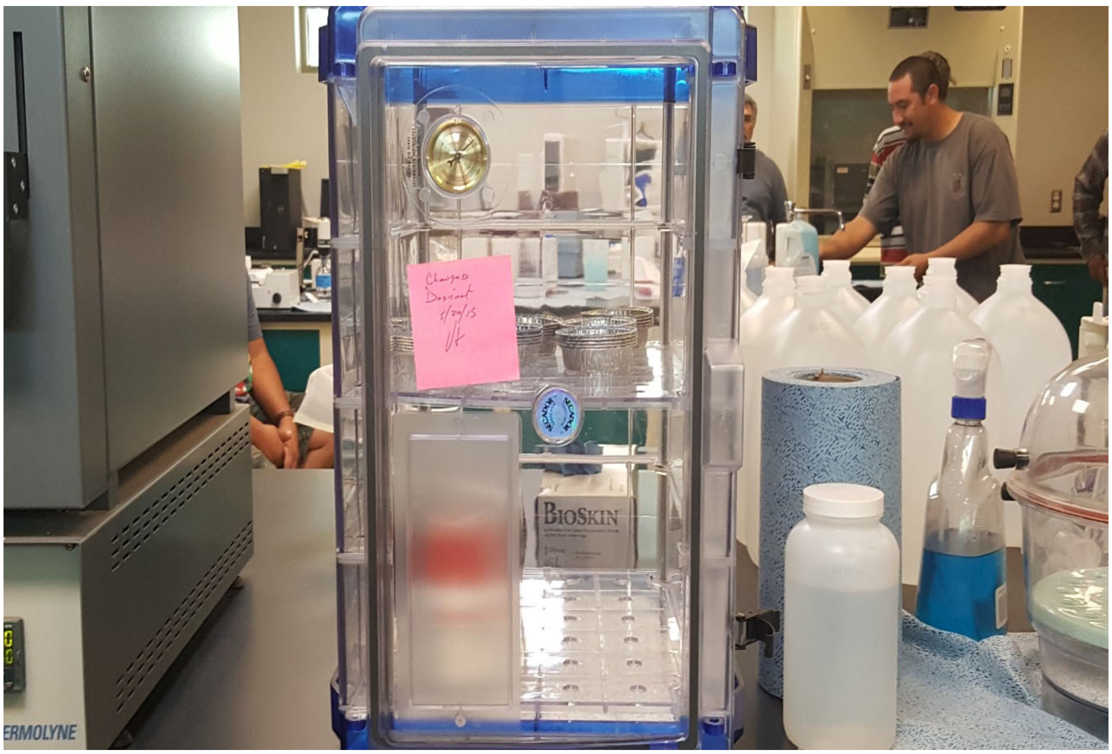
15. Effluent samples do not be collected at the site specified in the permit, or if no site is specified in the permit, at the most representative site upstream from all entering wastewater streams prior to discharge into the receiving waters.
True or False

Wastewater Sampling Section
1. False, 2. True, 3. False, 4. True, 5. True, 6. False, 7. False, 8. True, 9. False, 10. True, 11. False, 12. True, 13. False, 14. True, 15. False

Chapter 6- Laboratory Analysis / Process Control Section

Section Focus: You will learn the basics of the wastewater laboratory analysis and process control procedures. At the end of this section, you will be able to describe general laboratory analysis procedures. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Wastewater quality indicators are laboratory analysis methodologies to assess suitability of wastewater for disposal or re-use. Analysis selected and desired test results vary with the intended use or discharge location. Analysis measure physical, chemical, and biological characteristics of the wastewater. The program is important in preventing harm to the environment and to abide with regulations.



Laboratory Tests and Analysis
Wastewater treatment operators run laboratory tests and analysis to monitor the treatment plant operation. These analyses are for testing the process control and indicate how well a particular process is working. Operators will analyze the results and if needed, will make operational adjustments.

In a typical wastewater treatment plant, there are several locations to sample. As wastewater flows through the treatment plant, including the collection system, its characteristics frequently change. By taking samples at different locations throughout the process, the operator has a better understanding of how to treat the flow.

Laboratory duties include some of the following:

- Collect and preserve samples
- Prepare samples for analysis
- Analyze samples and interpret results
- Operate and maintain equipment and instruments
- Handle chemicals and wastes (PPE)
- Quality assurance/quality control (Engineering and Administrative controls)
- Manage laboratory
- Laboratory safety

Quality Assurance (QA)/Quality Control (QC)

Quality Assurance (QA)/Quality Control (QC) is a program designed by the laboratory that specifies the methods and procedures required to produce measurement-based, technically valid, legally defensible and known quality information.

The QA/QC activities are designed to evaluate precision and accuracy of the sample collection and analysis and to ensure that any problems that may occur are quickly identified and rectified.

The QA/QC Program has two components:

1. Quality Assurance (QA) - describes the overall measures that a laboratory uses to ensure the quality of its operations. It is designed to evaluate the precision and accuracy of the sample collection, laboratory analysis and potential sources of contamination encountered during sample collection and delivery to the laboratory.

2. Quality Control (QC) – is part of the overall QA. It consists of operational techniques and activities that are used to fulfil requirements for quality.

Objectives and Requirements

U.S. EPA Interim Revised NPDES Inspection Manual | 2017

The analytical laboratory provides both qualitative and quantitative information for determining the extent of permittee compliance with permit discharge requirements. To be valuable or useful, the data must be representative and accurately describe the characteristics and concentrations of constituents in the samples submitted to the laboratory. The objectives of laboratory Quality Assurance (QA) are to monitor and document the accuracy and precision of the results reported and to meet reliability requirements. QA refers to a total program for ensuring the reliability of data by utilizing administrative and technical procedures and policies regarding personnel, resources, and facilities.

QA is required for all functions bearing on environmental measurements and includes activities such as project/study definition; sample collection and tracking; laboratory analysis; data validation, analysis, reduction, and reporting; documentation; and data storage systems. Thus, the QA program is designed to evaluate and maintain the desired quality of data. Quality Control (QC), a function of QA, is the routine application of procedures for controlling the accuracy and precision of the measurement process and includes the proper calibration of instruments and the use of the appropriate analytical procedures.

The regulations at Title 40 of the *Code of Federal Regulations* (CFR), section 122.41(e) (conditions applicable to all permits), requires adequate laboratory and process controls, including appropriate QA/QC procedures. Each permittee's laboratory must have a QA/QC program. The laboratory must document the QA/QC program in a written QA/QC manual and the laboratory should make it available to all personnel responsible for sample analyses. The manual must clearly identify the individuals involved in the QA program and document their responsibilities. The laboratory's standard operating procedures must meet user requirements in terms of specificity, completeness, precision, accuracy, representativeness, and comparability of the required testing procedures. The laboratory should devote approximately 10 to 20 percent of their resources to their QA/QC program.

Guidance in this chapter is broad-based and may not be applicable to every laboratory. This chapter includes a Laboratory Quality Assurance Checklist for the inspector's use at the end of the chapter. For detailed information concerning laboratory QA/QC, refer to Environmental Protection Agency's (EPA's) *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA, 1979) and EPA's *National Pollutant Discharge Elimination System (NPDES) Compliance Monitoring Inspector Training Module: Laboratory Analysis* (EPA, 1990). If a more detailed assessment of a laboratory is required, personnel with more extensive knowledge of the methodologies should perform the inspection.

Sample Handling Procedures

Evaluation of Permittee Sample Handling Procedures

Proper sample handling procedures are necessary in the laboratory from the sample's receipt to its discard. Sample handling procedures for small permittees may differ from procedures for larger permittees because staff organizational structures and treatment facility designs vary from one facility to the next. However, proper sample handling procedures should be standardized, utilized and documented by all permittees. In evaluating laboratory sample handling procedures, the inspector should verify the following:

- The laboratory area is secure and restricts entry to authorized personnel only.

- The laboratory has a sample security area that is dry, clean, and isolated; has sufficient refrigerated space; and can be locked securely.
- The laboratory has a sample custodian and a back-up custodian.
- The custodian receives all incoming samples, signs the chain-of-custody record sheet accompanying the samples, and locks the samples in the sample security area refrigerator.
- The custodian ensures that samples are properly stored.
- The custodian performs or analyzes checks of proper preservation, container type, and holding times and documents the results.
- The custodian distributes and retrieves samples to and from personnel who perform the analyses (i.e., analysts) and documents the transfer of the samples in the chain-of-custody record, which is retained as a permanent record. The chain-of-custody record typically identifies the sample identification number, sample collection date and time, sample type, sample location, sample volume, and preservatives.
- The custodian and analysts ensure the minimum possible number of people handle the samples.
- The custodian only disposes of samples and records upon direction from the laboratory director, in consultation with previously designated enforcement officials, when it is certain that the information is no longer required or that the samples have deteriorated.

Laboratory Analyses Techniques Evaluation
Evaluation of Permittee Laboratory Analytical Procedures
The permittee's laboratories or its contract laboratories must use uniform methods, thus, eliminating methodology as a variable when data are compared or shared among laboratories. The permittee's laboratory must consult 40 CFR Part 136 for the alternative methods approval process. A permittee may only use alternative test procedures if the procedures have EPA approval, as specified by 40 CFR 136.4 and 136.5, and promulgated under Public Law (PL) 92-500.

Many standardized test procedures promulgated under 40 CFR Part 136 are covered in EPA's *Methods for Chemical Analysis of Water and Wastes* (EPA, 1983) and the latest accepted edition of *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), 2013). Revisions and new additions to this manual are made whenever new analytical techniques or instruments are developed. These are considered accepted after final publication in the Federal Register.3 Other approved methods from United States Geological Survey (USGS), American Society for Testing and Materials (ASTM), and several commercial vendor methods are also referenced in 40 CFR Part 136.

In evaluating laboratory analytical procedures, the inspector should verify the following:
- The laboratory personnel follow analytical methods specified in the most current 40 CFR Part 136.
- The laboratory personnel properly perform any deviations allowed by 40 CFR Part 136 and maintain documentation of any EPA-approved deviation from specified procedures.
- The laboratory personnel follow QA/QC procedures that conform to the procedures specified in the permit, analytical method, or methods compendium for approved 40 CFR Part 136 methods from a consensus organization. For example, the Standard Methods for the Examination of Water and Wastewater (APHA, AWWA, and WEF) contains QA/QC procedures.
- The laboratory personnel maintain a QA/QC record on reagent preparation, instrument calibration and maintenance, incubator temperature, and purchase of supplies.

Wastewater Chemical Testing Sub-Section

Approved CWA Chemical Test Methods
The analytical methods promulgated under Clean Water Act section 304(h) are sometimes referred to as the "304(h)" or "Part 136" methods. The methods measure chemical and biological pollutants in media, such as wastewater, ambient water, sediment, and biosolids (sewage sludge). These various CWA methods are tested in a variety of labs and matrices.

In addition to 40 CFR Part 136 methods, some approved industry-specific methods are published or incorporated by reference at 40 CFR Parts 401 through 503.

Approved Inorganic Non-Metals Methods

Number	Method Title
120.1	Conductance (Specific Conductance, µmhos, 25 °C) by Conductivity Meter
130.1	Hardness, Total (mg/L as $CaCO_3$) (Colorimetric, Automated EDTA) by Spectrophotometer
150.2	pH, Continuous Monitoring (Electrometric) by pH Meter
160.4	Residue, Volatile (Gravimetric, Ignition at 550 °C) by Muffle Furnace
180.1	Turbidity by Nephelometry. *Revision 2.0*
300	Inorganic Anions by Ion Chromatography. *Revision 2.1*
300.1	Inorganic Anions in Drinking Water by Ion Chromatography. *Revision 1.0*
310.2	Alkalinity, Colorimetric, Automated Methyl Orange
335.4	Total Cyanide by Semi-Automated Colorimetry. *Revision 1.0*
350.1	Ammonia Nitrogen by Semi-Automated Colorimetry. *Revision 2.0*
351.1	Total Kjeldahl Nitrogen (Colorimetric, Automated Phenate) by Autoanalyzer
351.2	Total Kjeldahl Nitrogen by Semi-Automated Colorimetry. *Revision 2.0*
352.1	Nitrogen, Nitrate (Colorimetric, Brucine) by Spectrophotometer

353.2	Nitrate-Nitrite by Automated Colorimetry. *Revision 2.0*
365.1	Phosphorus by Semi-Automated Colorimetry. *Revision 2.0*
365.3	Phosphorus, All Forms, Colorimetric, Ascorbic Acid, Two Reagent
365.4	Phosphorus, Total, Colorimetric, Automated, Block Digester, Automated Analyzer II
375.2	Sulfate by Automated Colorimetry. *Revision 2.0*
410.3	Chemical Oxygen Demand (Titrimetric, High Level for Saline Waters) by Titration
410.4	Chemical Oxygen Demand by Semi-Automated Colorimetry. *Revision 2.0*
1627	Kinetic Test Method for the Prediction of Mine Drainage Quality
OIA-1677-09	Available Cyanide by Ligand Exchange and Flow Injection Analysis (FIA)

Approved Metals Methods

Number	Method Title
200.2	Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements. *Revision 2.8*
200.5	Trace Elements in Drinking Water by Axially Viewed Inductively Coupled Plasma-Atomic Emission Spectrometry. *Revision 4.2*
200.7	Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry. *Revision 4.4*
200.8	Trace Elements in Water and Wastes by Inductively Coupled Plasma-Mass Spectrometry. *Revision 5.4*
200.9	Trace Elements by Stabilized Temperature Graphite Furnace Atomic Absorption Spectrometry. *Revision 2.2*
206.5	Arsenic, Sample Digestion Prior to Total Arsenic Analysis by Silver Diethyldithiocarbamate or Hydride Procedures
218.6	Dissolved Hexavalent Chromium in Drinking Water, Groundwater, and Industrial Wastewater by Ion Chromatography. *Revision 3.3*
231.2	Gold, Atomic Absorption, Furnace Technique
235.2	Iridium, Atomic Absorption, Furnace Technique
245.1	Mercury in Water by Cold Vapor Atomic Absorption Spectrometry. *Revision 3.0*
245.2	Mercury, Cold Vapor Technique, Automated
245.7	Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry. *Revision 2.0*
252.2	Osmium, Atomic Absorption, Furnace Technique
253.2	Palladium, Atomic Absorption, Furnace Technique
255.2	Platinum, Atomic Absorption, Furnace Technique
265.2	Rhodium, Atomic Absorption, Furnace Technique
267.2	Ruthenium, Atomic Absorption, Furnace Technique
279.2	Thallium, Atomic Absorption, Furnace Technique
283.2	Titanium, Atomic Absorption, Furnace Technique
289.2	Zinc, Atomic Absorption, Furnace Technique

1631E	Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry. *Revision E*

Metals Sampling *(Example Procedure)*
Metals sampling will encompass a variety of individual samples within a sample, i.e., nickel, zinc, silver and others. As a general rule, metals samples need to be collected as a composite and preserved with 1:1 nitric acid to pH < 2.

If ICP (inductively coupled plasma) laboratory analysis will be used, a 500 ml sample is sufficient. ICP is used for a general scan; if more stringent detection limits are needed then furnace analysis is used.

If additional analysis is required, i.e., furnace method analysis, collect a 2 liter bottle of sample (instead of the 500 ml sample) and preserve with nitric acid.

Ice is not necessary for preservation, but it won't jeopardize the sample, either.

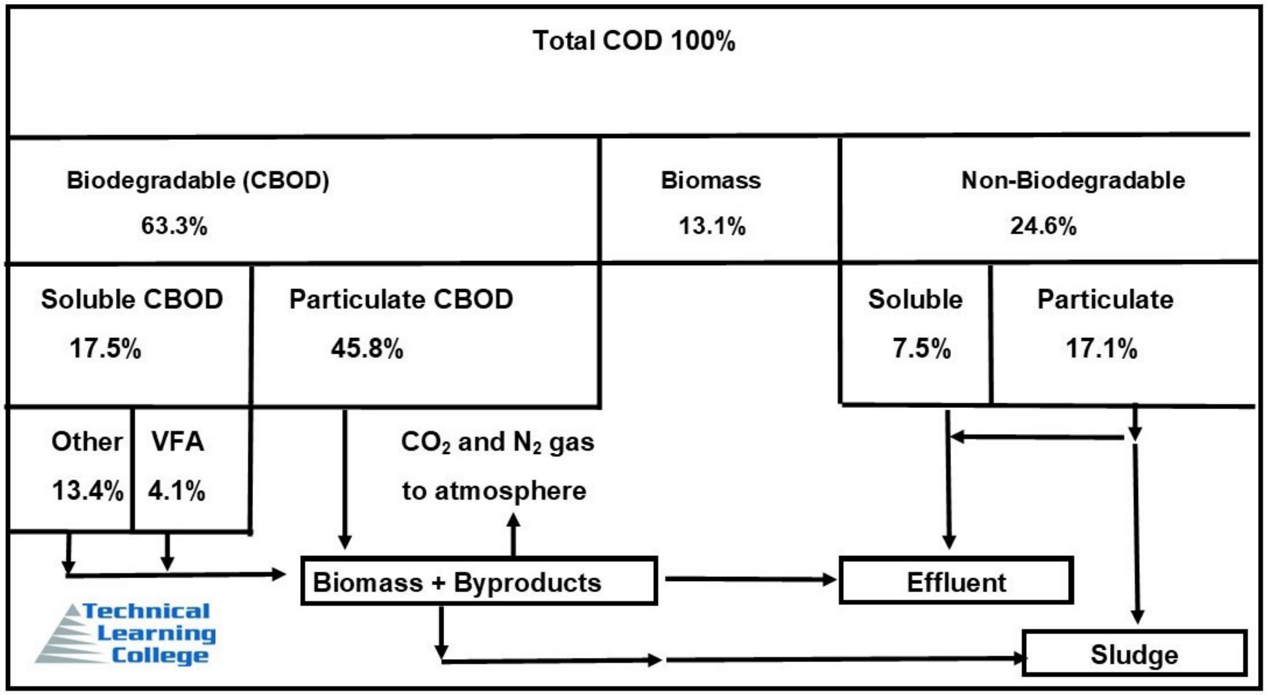
PARAMETER	CONTAINER	PRESERVATIVE	MAX. HOLDING TIME
Metals	P	HNO_3 to pH < 2	6 months

This course contains general EPA's CWA federal rule requirements. Please be aware that each state implements wastewater/safety/environmental /building regulations that may be more stringent than EPA's regulations. Check with your state environmental agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to be in compliance and do not follow this course for proper compliance.

Approved Organic Methods
Approved Methods Listed by Method Number

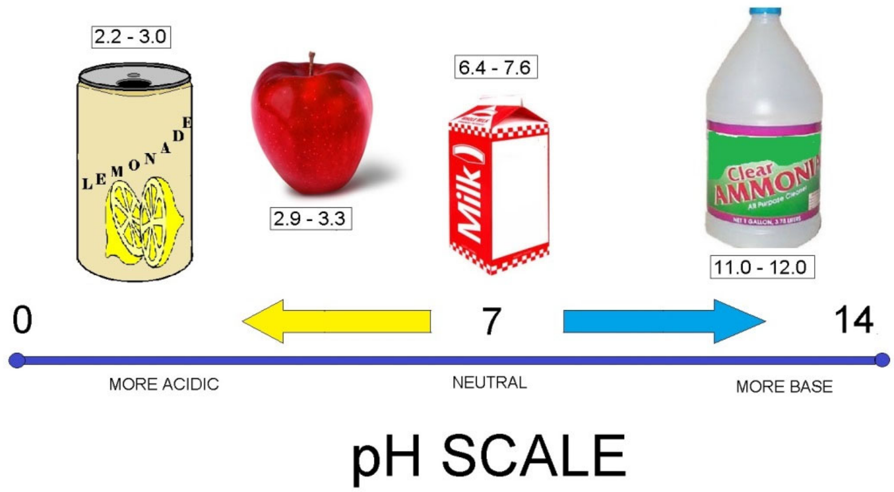
Number	Method Title
420.1	Phenolics, Total Recoverable, Spectrophotometric, Manual 4-AAP With Distillation
420.4	Total Recoverable Phenolics by Semi-Automated Colorimetry. *Revision 1.0*
525.1	Organic Compounds in Drinking Water by Liquids-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry. *Revision 2.2*
525.2	Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry. *Revision 2.0*
601	Purgeable Halocarbons
602	Purgeable Aromatics
603	Acrolein and Acrylonitrile
604	Phenols
605	Benzidines
606	Phthalate Ester
607	Nitrosamines
608.1	Organochlorine Pesticides in Municipal and Industrial Wastewater
608.2	Certain Organochlorine Pesticides in Municipal and Industrial Wastewater
608.3	Organochlorine Pesticides and PCBs by GC/HSD *(replaces Method 608)*
609	Nitroaromatics and Isophorone
610	Polynuclear Aromatic Hydrocarbons
611	Haloethers
612	Chlorinated Hydrocarbons

613	2,3,7,8-Tetrachloro Dibenzo-*p*-Dioxin
614	Organophosphorus Pesticides in Municipal and Industrial Wastewater
614.1	Organophosphorus Pesticides in Municipal and Industrial Wastewater



ORGANIC WASTEWATER FRACTION BREAKDOWN DIAGRAM #1

pH Testing Sub-Section

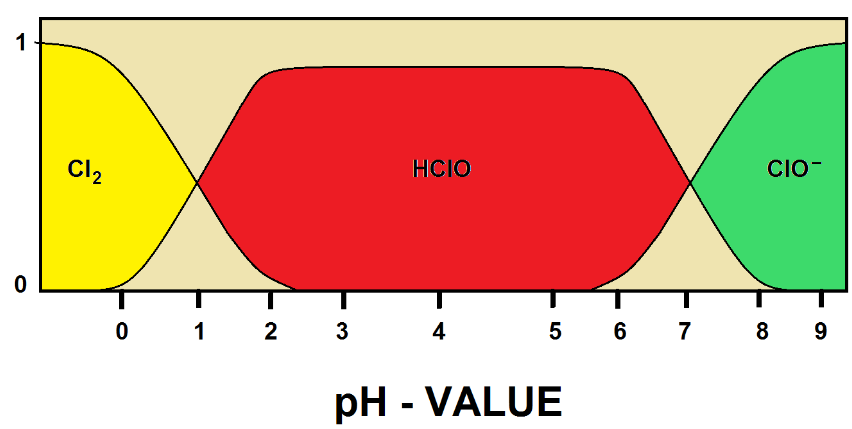


In water and wastewater processes, **pH** is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH greater than 7 are basic or alkaline and solution or samples with a pH less than 7 are said to be acidic. Pure water has a pH very close to 7.

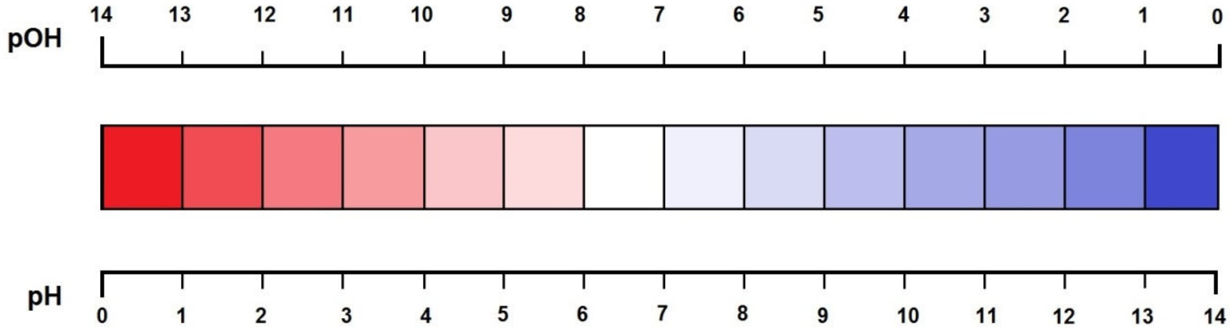
Primary pH standard values are determined using a concentration cell with transference, by measuring the potential difference between a hydrogen electrode and a standard electrode such as the silver chloride electrode. The pH scale is traceable to a set of standard solutions whose pH is established by international agreement.

Measurement of pH for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators like strip test paper.

pH measurements are important in water and wastewater processes (sampling) but also in medicine, biology, chemistry, agriculture, forestry, food science, environmental science, oceanography, civil engineering, chemical engineering, nutrition, water treatment & water purification, and many other applications.



Mathematically, pH is the measurement of hydroxyl ion activity and expressed as the negative logarithm of the activity of the (solvated) hydronium ion, more often expressed as the measure of the hydronium ion concentration.



IN RELATION BETWEEN p(OH) AND p(H) (red= ACIDIC / blue= BASIC)

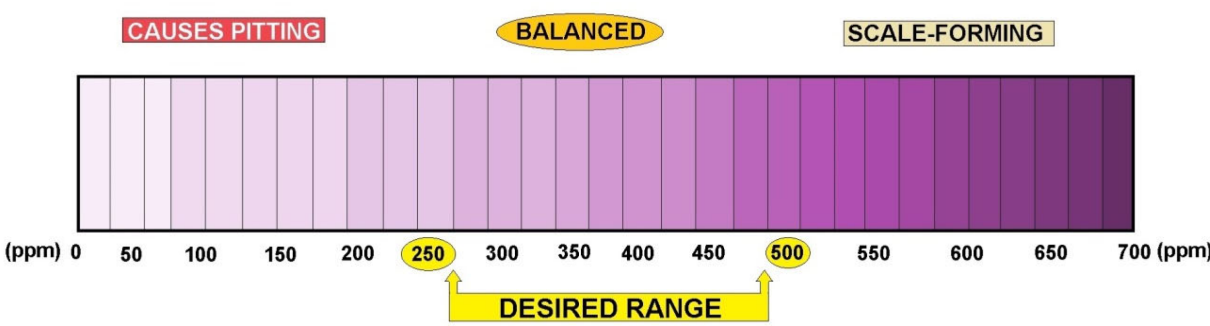
Contents

History

The scientific discovery of the p[H] concept of was first introduced by Danish chemist Søren Peder Lauritz Sørensen at the Carlsberg Laboratory back in 1909 and revised to the modern pH in 1924 to accommodate definitions and measurements in terms of electrochemical cells. In the first papers, the notation had the "H" as a subscript to the lowercase "p", as so: pH.

Alkalinity

Alkalinity is the quantitative capacity of an aqueous solution to neutralize an acid. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It is one of the best measures of the sensitivity of the stream to acid inputs. There can be long-term changes in the alkalinity of rivers and streams in response to human disturbances.



CALCIUM HARDNESS MEASUREMENT

Reference. Bates, Roger G. Determination of pH: theory and practice. Wiley, 1973.

pH Definition and Measurements

CONCENTRATION OF HYDROGEN IONS COMPARED TO DISTILLED H2O	pH	EXAMPLES OF SOLUTIONS AND THEIR RESPECTIVE pH
1/10,000,000	14	LIQUID DRAIN CLEANER CAUSTIC SODA
1/1,000,000	13	BLEACHES OVEN CLEANERS
1/100,000	12	SOAPY WATER
1/10,000	11	HOUSEHOLD AMMONIA (11.9)
1/1,000	10	MILK OF MAGNESIUM (10.5)
1/100	9	TOOTHPASTE (9.9)
1/10	8	BAKING SODA (8.4) / SEA WATER EGGS
0	7	"PURE" WATER (7)
10	6	URINE (6) / MILK (6.6)
100	5	ACID RAIN (5.6) BLACK COFFEE (5)
1000	4	TOMATO JUICE (4.1)
10,000	3	GRAPEFRUIT & ORANGE JUICE SOFT DRINK
100,000	2	LEMON JUICE (2.3) VINEGAR (2.9)
1,000,000	1	HYDROCHLORIC ACID SECRETED FROM STOMACH LINING (1)
10,000,000	0	BATTERY ACID

pH Scale

Technical Definition of pH
In technical terms, pH is defined as the decimal logarithm of the reciprocal of the hydrogen ion activity, *a*H+, in a solution.

$$pH = -\log_{10}(a_H+) = \log_{10}\left(\frac{1}{aH+}\right)$$

Ion-selective electrodes are often used to measure pH, respond to activity.

In this calculation of electrode potential, *E*, follows the Nernst equation, which, for the hydrogen ion can be written as

$$E = E^0 + \frac{RT}{F} \ln(a_H +) = E^0 - \frac{2.303RT}{F} pH$$

where *E* is a measured potential, E^0 is the standard electrode potential, *R* is the gas constant, *T* is the temperature in kelvin, *F* is the Faraday constant.

For H^+ number of electrons transferred is one. It follows that electrode potential is proportional to pH when pH is defined in terms of activity.

International Standard ISO 31-8 is the standard for the precise measurement of pH as follows: A galvanic cell is set up to measure the electromotive force (EMF) between a reference electrode and an electrode sensitive to the hydrogen ion activity when they are both immersed in the same aqueous solution.

The reference electrode may be a silver chloride electrode or a calomel electrode. The hydrogen-ion selective electrode is a standard hydrogen electrode.

Reference electrode | concentrated solution of KCl || test solution | H_2 | Pt

Firstly, the cell is filled with a solution of known hydrogen ion activity and the emf, E_S, is measured. Then the emf, E_X, of the same cell containing the solution of unknown pH is measured.

$$pH(X) = pH(S) + \frac{E_s - E_x}{z}$$

The difference between the two measured emf values is proportional to pH. This method of calibration avoids the need to know the standard electrode potential. The proportionality constant, *1/z* is ideally equal to $\frac{1}{2.303RT/F}$ the "Nernstian slope".

If you were to apply this practice the above calculation, a glass electrode is used rather than the cumbersome hydrogen electrode. A combined glass electrode has an in-built reference electrode. It is calibrated against buffer solutions of known hydrogen ion activity. IUPAC has proposed the use of a set of buffer solutions of known H^+ activity.

Two or more buffer solutions should be used in order to accommodate the fact that the "slope" may differ slightly from ideal.

The electrode is first immersed in a standard solution and the reading on a pH meter is adjusted to be equal to the standard buffer's value, to implement the proper calibration. The reading from a second standard buffer solution is then adjusted, using the "slope" control, to be equal to the pH for that solution. Further details, are given in the IUPAC recommendations.

When more than two buffer solutions are used the electrode is calibrated by fitting observed pH values to a straight line with respect to standard buffer values. Commercial standard buffer solutions usually come with information on the value at 25 °C and a correction factor to be applied for other temperatures.

The pH scale is logarithmic and pH is a dimensionless quantity.

pH Indicators

Visual comparison of the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number. Indicators may be used to measure pH, by making use of the fact that their color changes with pH. More precise measurements are possible if the color is measured spectrophotometrically, using a colorimeter of spectrophotometer. Universal indicator consists of a mixture of indicators such that there is a continuous color change from about pH 2 to pH 10. Universal indicator paper is made from absorbent paper that has been impregnated with universal indicator.

pOH

pOH is sometimes used as a measure of the concentration of hydroxide ions, OH^-, or alkalinity. pOH values are derived from pH measurements. The concentration of hydroxide ions in water is related to the concentration of hydrogen ions by

$$[\mathrm{OH^-}] = \frac{K_W}{[\mathrm{H^+}]}$$

where K_W is the self-ionization constant of water. Taking logarithms

$$\mathrm{pOH} = \mathrm{pK_W} - \mathrm{pH}$$

So, at room temperature pOH ≈ 14 − pH. However this relationship is not strictly valid in other circumstances, such as in measurements of soil alkalinity.

Extremes of pH

Measurement of pH below about 2.5 (ca. 0.003 mol dm^{-3} acid) and above about 10.5 (ca. 0.0003 mol dm^{-3} alkali) requires special procedures because, when using the glass electrode, the Nernst law breaks down under those conditions.

Extreme pH measurements imply that the solution may be concentrated, so electrode potentials are affected by ionic strength variation. At high pH the glass electrode may be affected by "alkaline error", because the electrode becomes sensitive to the concentration of cations such as Na^+ and K^+ in the solution. Specially constructed electrodes are available which partly overcome these problems. Runoff from industrial outfalls, restaurant grease, mines or mine tailings can produce some very low pH values.

Non-Aqueous Solutions

Hydrogen ion concentrations (activities) can be measured in non-aqueous solvents. pH values based on these measurements belong to a different scale from aqueous pH values, because activities relate to different standard states. Hydrogen ion activity, a_{H^+}, can be defined as:

$$a_{H+} = \exp\left(\frac{\mu_{H+} - \mu^{\ominus}_{H+}}{RT}\right)$$

where μ_{H^+} is the chemical potential of the hydrogen ion, $\mu^{\ominus}_{H^+}$ is its chemical potential in the chosen standard state, R is the gas constant and T is the thermodynamic temperature. Therefore pH values on the different scales cannot be compared directly, requiring an intersolvent scale which involves the transfer activity coefficient of hydrolyonium ion.

pH is an example of an acidity function. Other acidity functions can be defined. For example, the Hammett acidity function, H_0, has been developed in connection with superacids.

The concept of "Unified pH scale" has been developed on the basis of the absolute chemical potential of the proton. This scale applies to liquids, gases and even solids.

Applications
Water has a pH of $pK_w/2$, so the pH of pure water is about 7 at 25 °C; this value varies with temperature. When an acid is dissolved in water, the pH will be less than that of pure water. When a base, or alkali, is dissolved in water, the pH will be greater than that of pure water.

A solution of a strong acid, such as hydrochloric acid, at concentration 1 mol dm^{-3} has a pH of 0.

A solution of a strong alkali, such as sodium hydroxide, at concentration 1 mol dm^{-3}, has a pH of 14. Thus, measured pH values will lie mostly in the range 0 to 14, though negative pH values and values above 14 are entirely possible.

Since pH is a logarithmic scale, a difference of one pH unit is equivalent to a tenfold difference in hydrogen ion concentration.

The pH of an aqueous solution of pure water is slightly different from that of, a salt such as sodium chloride even though the salt is neither acidic nor basic. In this case, the hydrogen and hydroxide ions' activity is dependent on ionic strength, so K_w varies with ionic strength.

The pH of pure water decreases with increasing temperatures. One example is the pH of pure water at 50 °C is 6.55.

Seawater
The pH of seawater plays an important role in the ocean's carbon cycle, and there is evidence of ongoing ocean acidification caused by carbon dioxide emissions. pH measurement can be complicated by the chemical properties of seawater, and several distinct pH scales exist in chemical oceanography.

As part of its operational definition of the pH scale, the IUPAC defines a series of buffer solutions across a range of pH values (often denoted with NBS or NIST designation).

These solutions have a relatively low ionic strength (~0.1) compared to that of seawater (~0.7), and, as a consequence, are not recommended for use in characterizing the pH of seawater, since the ionic strength differences cause changes in electrode potential.

To resolve this problem, an alternative series of buffers based on artificial seawater was developed. This new series resolves the problem of ionic strength differences between samples and the buffers.

The newest pH scale is referred to as the **total scale**, often denoted as **pH_T**.

pH Calculations

The calculation of the pH of a solution containing acids and/or bases is an example of a chemical speciation calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution.

The complexity of the procedure depends on the nature of the solution.

If the pH of a solution contains a weak acid requires the solution of a quadratic equation.

If the pH of a solution contains a weak base may require the solution of a cubic equation.

For strong acids and bases no calculations are necessary except in extreme situations.

The general case requires the solution of a set of non-linear simultaneous equations.

A complicating factor is that water itself is a weak acid and a weak base. It dissociates according to the equilibrium

$$2H_2O \rightleftharpoons H_3O^+(aq) + OH^-(aq)$$

with a dissociation constant, K_w defined as

$$K_w = [H^+][OH^-]$$

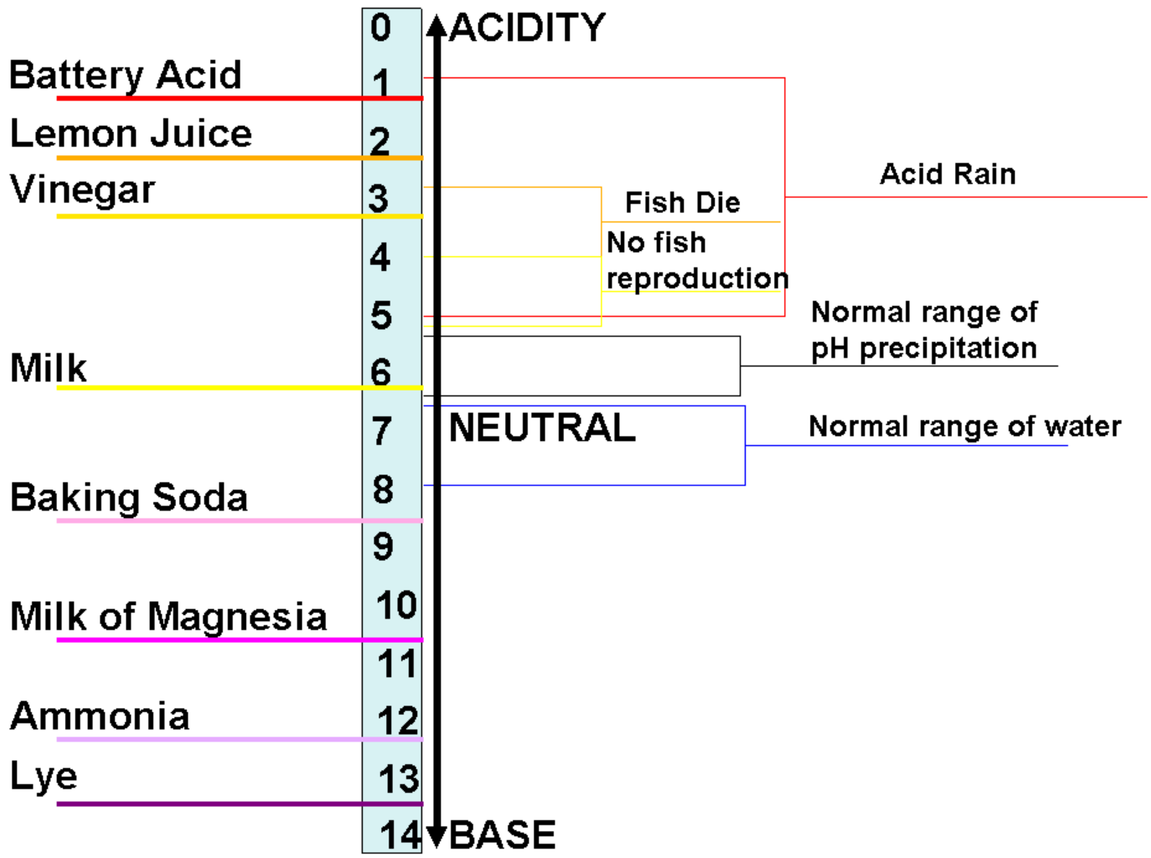
where $[H^+]$ represents for the concentration of the aquated hydronium ion and $[OH^-]$ stands for the concentration of the hydroxide ion. K_w has a value of about 10^{-14} at 25 °C, so pure water has a pH of approximately 7.

This equilibrium needs to be considered at high pH and when the solute concentration is extremely low.

Hydrogen Ion pH Comparison Chart

pH	Hydrogen Ion Concentration, mmol/L
14	0.00000000000001
13	0.0000000000001
12	0.000000000001
11	0.00000000001
10	0.0000000001
9	0.000000001
8	0.00000001
7	0.0000001
6	0.000001
5	0.00001
4	0.0001
3	0.001
2	0.01
1	0.1

pH Summary



pH: A measure of the acidity of water. The pH scale runs from 0 to 14 with 7 being the mid-point or neutral. A pH of less than 7 is on the acid side of the scale with 0 as the point of greatest acid activity. A pH of more than 7 is on the basic (alkaline) side of the scale with 14 as the point of greatest basic activity.

pH = (**Power of Hydroxyl Ion Activity**).
The acidity of a water sample is measured on a pH scale. This scale ranges from **0** (maximum acidity) to **14** (maximum alkalinity). The middle of the scale, **7**, represents the neutral point. The acidity increases from neutral toward **0**.

Because the scale is logarithmic, a difference of one pH unit represents a tenfold change. For example, the acidity of a sample with a pH of **5** is ten times greater than that of a sample with a pH of **6**. A difference of 2 units, from **6** to **4**, would mean that the acidity is one hundred times greater, and so on.

Normal rain has a pH of **5.6** – slightly acidic because of the carbon dioxide picked up in the earth's atmosphere by the rain.

Strong Acids and Bases

Strong Acids and Bases
Strong acids and bases are compounds that, for practical purposes, are completely dissociated in water. Under normal circumstances this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of the concentration value.

Hydrochloric acid (HCl) is an example of a strong acid. The pH of a 0.01M solution of HCl is equal to $-\log_{10}(0.01)$, that is, pH = 2.

Sodium hydroxide, NaOH, is an example of a strong base. The p[OH] value of a 0.01M solution of NaOH is equal to $-\log_{10}(0.01)$, that is, p[OH] = 2.

From the definition of p[OH] above, this means that the pH is equal to about 12. For solutions of sodium hydroxide at higher concentrations the self-ionization equilibrium must be taken into account.

Weak Acids and Bases
A weak acid or the conjugate acid of a weak base can be treated using the same formalism.

Acid: $HA \rightleftharpoons H^+ + A^-$
Base: $HA^+ \rightleftharpoons H^+ + A$

First, an acid dissociation constant is defined as follows. Electrical charges are omitted from subsequent equations for the sake of generality

$$K_a = \frac{[H][A]}{[HA]}$$

and its value is assumed to have been determined by experiment. This being so, there are three unknown concentrations, [HA], [H^+] and [A^-] to determine by calculation. Two additional equations are needed.

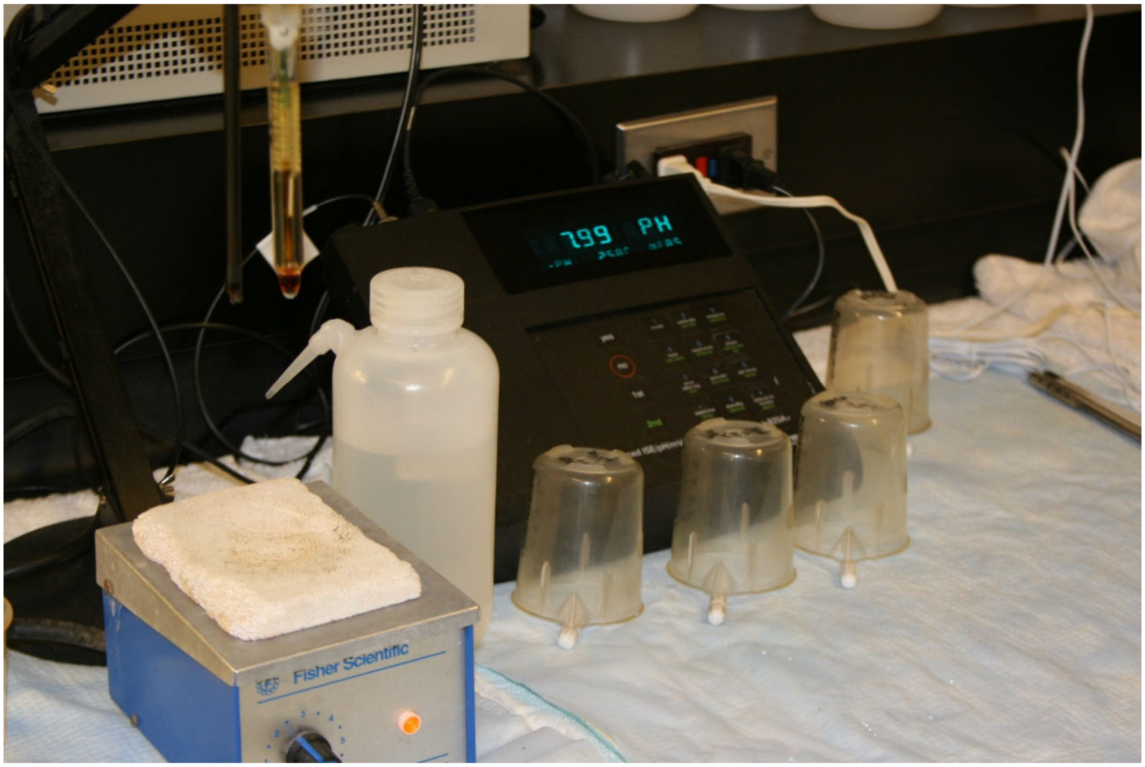
One way to provide them is to apply the law of mass conservation in terms of the two "reagents" H and A.

$$C_A = [A] + [HA]$$
$$C_H = [H] + [HA]$$

C stands for analytical concentration. In some texts one mass balance equation is replaced by an equation of charge balance. This is satisfactory for simple cases like this one, but is more difficult to apply to more complicated cases as those below.

Together with the equation defining K_a, there are now three equations in three unknowns. When an acid is dissolved in water $C_A = C_H = C_a$, the concentration of the acid, so [A] = [H]. After some further algebraic manipulation an equation in the hydrogen ion concentration may be obtained.

$$[H]^2 + K_a[H] - K_aC_a = 0$$



Electronic pH probe

Alkalinity Sub-Section

Introduction
Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the end-point pH used. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

Alkalinity is significant in many uses and treatments of natural waters and wastewaters. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents. The measured values also may include contributions from borates, phosphates, silicates or other bases if these are present. Alkalinity in excess of alkaline earth metal concentrations is significant in determining the suitability of water for irrigation. Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes.

Titration Method
a. Principle
Hydroxyl ions present in a sample, because of dissociation or hydrolysis of solutes react with additions of standard acid. Alkalinity thus depends on the end-point pH used.

b. Reagents
i) Standard Hydrochloric Acid – 0.02 N.
ii) Methyl Orange Indicator – Dissolve 0.1 g of methyl orange in distilled water and dilute to 1 liter.
iii) Sodium carbonate solution, 0.02 N : Dry 3 to 5 g primary standard Na_2CO_3 at 250^oC for 4 h and cool in a desiccator. Weigh 1.03 gm. (to the nearest mg), transfer to a 1-L volumetric flask, fill flask to the mark with distilled water, dissolve and mix reagent. Do no keep longer than 1 week.

c. Procedure
Titrate over a white surface 100 ml of the sample contained in a 250-ml conical flask with standard hydrochloric acid using two or three drops of methyl orange Indicator. (**NOTE** – If more than 30 ml of acid is required for the titration, a smaller suitable aliquot of the sample shall be taken.)

d. Calculation
Total alkalinity (as $CaCO_3$), mg/l = 10 V or NxVx50x1000

T.A. (as $CaCO_3$) = ----------------------
Sample Amount
Where N = Normality of HCl used
V = volume in ml of standard hydrochloric acid used in the titration.

Alkalinity to Phenolphthalein
The sample is titrated against standard acid using phenolphthalein indicator.

a. Reagents
i) Phenolphthalein Indicator Solution :
Dissolve 0.1 g of phenolphthalein in 60 ml of ETHANOL and dilute with Distilled water to 100 ml.
ii) Standard hydrochloric Acid – 0.02 N.

b. Procedure
Add 2 drops of phenolphthalein indicator solution to a sample of suitable size, 50 or 100 ml, in a conical flask and titrate over a while surface with standard hydrochloric acid.

c. Calculation

$$\textbf{Alkalinity to phenolphthalein (as } \mathbf{CaCO_3}\textbf{)}\text{, mg/l} = \frac{1000\ V_1}{V_2}$$

Where
V_1 = volume in ml of standard hydrochloric acid used in the titration, and
V_2 = Volume in ml of the sample taken for the test.
Caustic Alkalinity
a. General
Caustic alkalinity is the alkalinity corresponding to the hydroxides present in water and is calculated from total alkalinity (T) and alkalinity to phenolphthalein (P).

b. Procedure Determine total alkalinity and alkalinity to phenolphthalein and calculate caustic alkalinity as shown in Table below. Result of Titration Caustic Alkalinity or Hydroxide Alkalinity as $CaCO_3$ Carbonate Alkalinity as $CaCO_3$ Bicarbonate Concentration as $CaCO_3$ **Result of Titration**	**Caustic Alkalinity or Hydroxide Alkalinity as $CaCO_3$**	**Carbonate Alkalinity as $CaCO_3$**	**Bicarbonate Concentration as $CaCO_3$**
P=0	0	0	0
P<1/2T	0	2P	T-2P
P=1/2T	0	2P	0
P>1/2T	2P-T	2(T-P)	0
P=T	T	0	0

The alkalinity of water is a measure of its capacity to neutralize acids. The alkalinity of natural water is due to the salts of carbonate, bicarbonate, borates, silicates and phosphates along with the hydroxyl ions in free state.

However, the major portion of the alkalinity in natural waters is caused by hydroxide, carbonate, and bicarbonates that may be ranked in order of their association with high pH values.

Alkalinity values provide guidance in applying proper doses of chemicals in water and wastewater treatment processes, particularly in coagulation and softening.

Alkalinity (Total)

References: ASTM D 1067-92, Acidity or Alkalinity of Water.
APHA Standard Methods, 19th ed., p. 2-26, method 2320B (1995).
EPA Methods for Chemical Analysis of Water and Wastes, method 310.1 (1983).

The alkalinity of water is a measurement of its buffering capacity or ability to react with strong acids to a designated pH. Alkalinity of natural waters is typically a combination of bicarbonate, carbonate, and hydroxide ions. Sewage and wastewaters usually exhibit higher alkalinities either due to the presence of silicates and phosphates or to a concentration of the ions from natural waters.

Alkalinity inhibits corrosion in boiler and cooling waters and is therefore a desired quality that must be maintained. Alkalinity is also measured as a means of controlling water and wastewater treatment processes or the quality of various process waters. In natural waters, excessive alkalinity can render water unsuitable for irrigation purposes and may indicate the presence of industrial effluents.

The Titrimetric Method
CHEMetrics' tests determine total or "M" alkalinity using an acid titrant and a pH indicator. The end point of the titration occurs at pH 4.5. Results are expressed as ppm (mg/L) $CaCO_3$.

Hardness (Calcium)

Reference: West, T. S., DSC, Ph.D., Complexometry with EDTA and Related Reagents, 3rd ed., p. 46, 164 (1969).

Originally described as water's capacity to precipitate soap, hardness is one of the most frequently determined qualities of water. It is a composite of the calcium, magnesium, strontium, and barium concentrations in a sample. The current practice is to assume total hardness refers to the calcium and magnesium concentrations only.

Completely de-hardened water, resulting from sodium zeolite or other suitable ion exchange treatment, is required for various processes-including power generation, printing and photo finishing, pulp and paper manufacturing, and food and beverage processing.

Hard water can cause scale formation on heat exchange surfaces, resulting in decreased heat transfer and equipment damage.

The Titrimetric Method. This method is specific for calcium hardness. The EGTA titrant in alkaline solution is employed with zincon indicator. Results are expressed as ppm (mg/L) $CaCO_3$.

Shelf-life. 8 months. Although the reagent itself is stable, the endpoint indicator has a limited shelf-life. We recommend stocking quantities that will be used within 7 months.

Dissolved Oxygen Testing Sub-Section

Dissolved oxygen (**DO**) in water is not considered a contaminant. However, the (DO) level is important because too much or not enough dissolved oxygen can create unfavorable conditions. Generally, a lack of (DO) in natural waters creates anaerobic conditions. Anaerobic means without air. Certain bacteria thrive under these conditions and utilize the nutrients and chemicals available to exist. *Under anaerobic conditions the reaction is:*

Anaerobic:

Organics → intermediates + CO_2 + H_2O + energy

Where the intermediates are butyric acid, mercaptans and hydrogen sulfide gas. At least two general forms of bacteria act in balance in a wastewater digester: Saprophytic organisms and Methane Fermenters. The saprophytes exist on dead or decaying materials. The methane fermenters live on the volatile acids produced by these saprophytes. The methane fermenting bacteria require a pH range of 6.6 to 7.6 to be able to live and reproduce. Aerobic conditions indicate that dissolved oxygen is present. Aerobic bacteria require oxygen to live and thrive. When aerobes decompose organics in the water, the result is carbon dioxide and water.

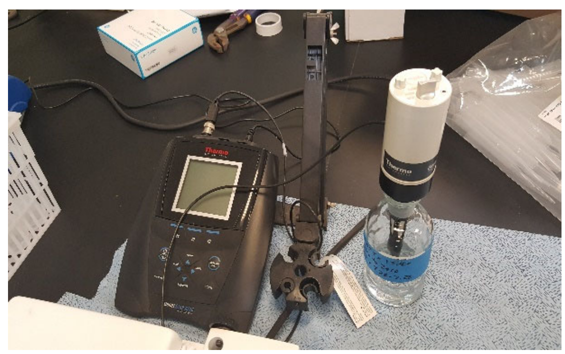
Aerobic:

Organics + Oxygen → CO_2 + H_2O + energy

Dissolved Oxygen in a water sample can be detrimental to metal pipes in high concentrations because oxygen helps accelerate corrosion. Oxygen is an important component in water plant operations. Its primary value is to oxidize iron and manganese into forms that will precipitate out of the water. It also removes excess carbon dioxide. The amount of dissolved oxygen in a water sample will affect the taste of drinking water also.

Methods of Determination

There are two methods that we will be using in the lab. The membrane electrode method procedure is based on the rate of diffusion of molecular oxygen across a membrane. The other is a titrimetric procedure (Winkler Method) based on the oxidizing property of the (DO). Many factors determine the solubility of oxygen in a water sample. Temperature, atmospheric pressure, salinity, biological activity and pH all have an effect on the (DO) content.



Iodometric Test

The Iodometric (titration) test is very precise and reliable for (DO) analysis of samples free from particulate matter, color and chemical interferences. Reactions take place with the addition of certain chemicals that liberate iodine equivalent to the original (DO) content. The iodine is then measured to the starch iodine endpoint. We then calculate the dissolved oxygen from how much titrate we use. Certain oxidizing agents can liberate iodine from iodides (positive interference), and some reducing agents reduce iodine to iodide (negative interferences).

The alkaline Iodide-Azide reagent effectively removes interference caused by nitrates in the water sample, so a more accurate determination of (DO) can be made.

Methods of analysis are highly dependent on the source and characteristics of the sample. The membrane electrode method involves an oxygen permeable plastic membrane that serves as a diffusion barrier against impurities.

Only molecular oxygen passes through the membrane and is measured by the meter. This method is excellent for field testing and continuous monitoring. Membrane electrodes provide an excellent method for (DO) analysis in polluted, highly colored turbid waters and strong waste effluents.

These interferences could cause serious errors in other procedures. Prolonged usage in waters containing such gases as H_2S tends to lower cell sensitivity. Frequent changing and calibrating of the electrode will eliminate this interference. Samples are taken in BOD bottles where agitation or contact with air is at a minimum. Either condition can cause a change in the gaseous content. Samples must be determined immediately for accurate results.

The dissolved oxygen test is the one of the most important analyses in determining the quality of natural waters. The effect of oxidation wastes on streams, the suitability of water for fish and other organisms and the progress of self-purification can all be measured or estimated from the dissolved oxygen content. In aerobic sewage treatment units, the minimum objectionable odor potential, maximum treatment efficiency and stabilization of wastewater are dependent on maintenance of adequate dissolved oxygen. Frequent dissolved oxygen measurement is essential for adequate process control.

Term Review

Aerobic (AIR-O-bick) - a condition in which free or dissolved oxygen is present in the aquatic environment.

Aerobic Bacteria (aerobes) – bacteria which will live and reproduce only in an environment containing oxygen. Oxygen combined chemically, such as in water molecules (H_2O), cannot be used for respiration by aerobes.

Anaerobic (AN-air O-bick) - a condition in which ***"free"*** or dissolved oxygen is not present in the aquatic environment.

Anaerobic Bacteria (anaerobes) – bacteria that thrive without the presence of oxygen.

Saprophytic Bacteria – bacteria that break down complex solids to volatile acids.

Methane Fermenters – bacteria that break down the volatile acids to methane (CH_4) carbon dioxide (CO_2) and water (H_2O).

Oxidation – the addition of oxygen to an element or compound, or removal of hydrogen or an electron from an element or compound in a chemical reaction. The opposite of reduction.

Reduction – the addition of hydrogen, removal of oxygen or addition of electrons to an element or compound. Under anaerobic conditions in wastewater, sulfur or compounds elemental sulfur are reduced to H_2S or sulfide ions.

Procedure for Dissolved Oxygen Determination

Meter Probe Method

Collect a water sample in the clean 300-ml glass stoppered BOD bottle for two or three minutes to make sure there are no air bubbles trapped in the bottle. Do one Tap water sample and one DI water sample. Mark the BOD bottles.

Insert the DO probe from the meter into your BOD bottles. Record the DO for Tap and DI water. Now continue with the Winkler Burette method.

Winkler Burette Method

Add the contents of one MANGANESE SULFATE powder pillow and one ALKALINE IODIDE-AZIDE reagent powder pillow to each of your BOD bottles (TAP and DI)

1. Immediately insert the stoppers so that no air is trapped in the bottles and invert several times to mix. A flocculent precipitate will form. It will be brownish-orange if dissolved oxygen is present or white if oxygen is absent.

2. Allow the samples to stand until the floc has settled and leaves the solution clear (about 10 minutes). Again invert the bottles several times to mix and let stand until the solution is clear.

3. Remove the stoppers and add the contents of one SULFAMIC ACID powder pillow to each bottle. Replace the stoppers, being careful not to trap any air bubbles in the bottles, and invert several times to mix. The floc will dissolve and leave a yellow color if dissolved oxygen is present.

4. Measure 200 ml of the prepared solution by filling a clean 250-ml graduated cylinder to the 200-ml mark. Pour the solutions into clean 250-ml Erlenmeyer flasks. Save the last 100 mls for a duplicate.

5. Titrate the prepared solutions with PAO Titrant, 0.025N, to a pale yellow color. Use a white paper under the flask.

6. Add two droppers full of Starch Indicator Solution and swirl to mix. A dark blue color will develop.

7. Continue the titration until the solution changes from dark blue to colorless (end point). Go Slow-drop by drop. Record the burette reading to the nearest 0.01mls.

8. The total number of ml of PAO Titrant used is equal to the mg/L dissolved oxygen.

Dissolved Oxygen Results

Meter Results

1. De-ionized water ____________________________________mg/L

2. Tap water ____________________________________mg/L

3. What is the meter procedure measuring?

4. What factors would determine which the best method to use is?

5. What are two forms of bacteria present in a wastewater digester?

Wrinkler Method Results

1. **De-ionized Water**

200ml final Burette reading-
Sample initial Burette reading- -________________ = _______________mg/L

100ml final Burette reading-
duplicate initial Burette reading- -_______________dup=______________mg/L
mls x 2

2. **Tap water**

200ml final Burette reading-
Sample initial Burette reading- -_______________=_________________mg/L
mls
100ml final Burette reading
Sample initial Burette reading- -_______________=__________________mg/L
mls x 2

3. What are some factors that can alter the (DO) content prior to testing?

4. Were your samples anaerobic or aerobic?

5. Why is it important to monitor the (DO) content of water and wastewater?

Be specific and give a detailed explanation.

Biochemical Oxygen Demand (BOD) Sub-Section

In the BOD test, microorganisms are charged with eating all the organics (food). In a BOD bottle, organics from a sample are added to dilution water containing nutrients, oxygen, and microorganisms, then capped and incubated at 20°C for 5 days. Initially the microorganism level is fairly low, but the environmental growing conditions are excellent, so the microorganisms quickly enter the log growth reproduction phase and begin to consume the organics.

The lack of food causes a slowing in the reproduction rate as well as a decrease in the amount of oxygen used. With the high microorganism population, the remaining organics are quickly consumed and the microorganism enter the endogenous phase. During the endogenous phase, the microorganisms utilize internal food reserves, and many die (endogenous phase).

Microorganisms are Hungry
If everything is okay, most of the microorganisms are hungry, but alive and there is still sufficient oxygen left in the bottle to be measured. The amount of oxygen that has been consumed over the 5 days is proportional to the amount of organics (BOD) consumed.

Carbonaceous Demand and Nitrogenous Demand
The test measures the oxygen required for the biochemical degradation of organic material (carbonaceous demand) and the oxygen used to oxidize inorganic material such as sulfides and ferrous iron. It may also measure the oxygen used to oxidize reduced forms of nitrogen (nitrogenous demand) unless their oxidation is prevented by an inhibitor

The method consists of placing a sample in a full, airtight bottle and incubating the bottle under specified conditions for a specific time. Dissolved oxygen (DO) is measured initially and after incubation. The BOD is calculated from the difference between the initial and final DO.

English Legend
Normally a 5-day BOD test period (English legend has it that 5 days was the time period taken between sewage entering a river and reaching the ocean) is used where samples are incubated in the dark (to restrict algal growth) at 20°C (the temperature believed to be reasonably representative of field conditions).

Most wastewaters contain more oxygen demanding materials than the amount of DO available in air-saturated water. Therefore, it is necessary to dilute certain samples before incubation to bring the oxygen demand and supply into appropriate balance.

Bacterial growth requires nutrients such as nitrogen, phosphorus and trace metals. These are added to dilution water, which is buffered to ensure that the pH of the incubated sample remains in a range suitable for bacterial growth.

General Materials Illustration

1. BOD nutrient buffer pillows
2. Nitrification inhibitor
3. D(+)Glucose
4. L-Glutamic acid
5. Purified water or equivalent
6. BOD dilution water container
7. BOD dilution water aerator
8. BOD bottles
9. DO meter and electrode
10. Water bath (20 to 30°C)
11. Balance (4 decimal places)
12. Weighing boats
13. Porcelain crucibles
14. Dessicator
15. Spatula
16. Magnetic stirrer
17. Incubator (20°C +/- 1°C)
18. Oven (103°C)
19. Volumetric flask (1000mL)
20. Graduated cylinders (10 to 1000mL volume)
21. Parafilm
22. Pasteur pipettes
23. Gloves
24. Marker Pen
25. Scissors

Preservation Method

If more than a 2-hour delay before analysis of grab sample(s) takes place the sample(s) should be kept at or below 4°C from the time of collection and analysis should begin within 6 hours of collection.

If this is not possible store sample(s) at or below 4°C and report length and temperature of storage with the results.

In no case start analysis more than 24 hours after grab sample collection. Keep composite samples at or below 4°C during composting.

Limit composting period to 24 hours. Use the same criteria as for storage of grab samples, starting the measurement of holding time from the end of the composting period. State storage time and conditions as part of the results.

Preparation of BOD Dilution Water

1. Place a desired volume of purified water in a BOD dilution water container.
2. Place a BOD aerator in the BOD dilution water
3. Aerate the BOD dilution water overnight.
4. Add a BOD nutrient buffer pillow to the BOD dilution water.
5. Continue aeration of the BOD dilution water until sample dilution is ready to take place.

Preparation of 2% Glucose-Glutamic Acid Solution (Prepare immediately before use)

1. Dry D(+)Glucose and L-Glutamic acid at 103°C for 1 hour.
2. Add 0.150g of D(+)Glucose and 0.150g of L-Glutamic acid to a 1000mL volumetric flask containing purified water, mix thoroughly and make up to the mark with purified water.
3. Prepare a 1:50 (2%) dilution of the Glucose-Glutamic Acid solution using BOD dilution water.

BOD Determination

1. Prepare dilutions, where appropriate, of the sample(s) to be tested. Dilutions that result in a residual DO of at least 1mg/L and a DO uptake of at least 2mg/L after 5 days incubation provide the most reliable results.
2. Transfer the diluted or undiluted sample(s) to a corresponding glass stoppered BOD bottle(s).
3. Bring the diluted or undiluted sample(s) to 20°C.
4. Measure the DO_o of the sample(s) in mg/L using a DO meter and electrode. The DO should be approximately 9.2mg/L at 20°C.
5. Add an appropriate quantity of nitrification inhibitor to the sample(s).
6. Stopper the BOD bottle.
7. Treat a BOD blank, containing BOD dilution water instead of sample in the same manner as the sample.
8. Treat the 2% Glucose-Glutamic Acid Solution in the same manner as the sample.
9. Incubate the sample(s), blank and Glucose-Glutamic Acid Solution at 20±1oC for 5 days.
10. Measure the DO_5 of the sample(s), blank and Glucose-Glutamic Acid solution and determine their BOD_5 according to the formula in section 6:0.

The DO uptake of the blank after 5 days should not be more than 0.2 mg/L and preferably not more than 0.1 mg/L. If the oxygen depletion exceeds 0.2 mg/L obtain satisfactory water by improving purification or from another source balance.

The BOD_5 of the Glucose-Glutamic Acid solution should be 200±37mg/L. If it is outside this range reject any BOD determinations made with the BOD dilution water and seek the cause of the problem balance.

If more than one sample dilution meets the criteria of a residual DO of at least 1mg/L and a DO depletion of at least 2mg/L and there is no evidence of toxicity at higher sample concentrations or the existence of an obvious anomaly, average results in the acceptable range.

BOD Formula

BOD formula when sample dilution is less than 1:10

$$BOD_5 = \frac{[(DO_o - DO_5) - (X\text{-}1/X)(DO_o - DO_5)]}{\text{Sample Blank}} \times X$$

X = Dilution factor

BOD formula when sample dilution is 1:10 or greater than 1:10

$$BOD_5 = \frac{[(DO_o - DO_5) - (DO_o - DO_5)]}{\text{Sample Blank}} \times X$$

X = Dilution factor

BOD formula when sample is undiluted

$$BOD_5 = \frac{(DO_o - DO_5)}{\text{Sample}}$$

Specific Oxygen Uptake Rate (SOUR) Sub-Section

This laboratory activity explores the Specific Oxygen Uptake Rate analysis (SOUR) and its use in measuring the metabolic activity of organisms in aquatic systems.

Focus
Microorganisms use oxygen as they consume food in an aerobic aquatic system. The rate at which they use oxygen is an indicator of the biological activity of the system and is called the Oxygen Uptake Rate (OUR).

High oxygen uptake rates indicate high biological activity; low oxygen uptake rates indicate low biological activity. In biological waste treatment facilities, oxygen uptake rates are used to monitor performance of process units. The analysis is based on a series of dissolved oxygen (DO) measurements taken on a sample over a period of time. The test is most valuable for plant operations when combined with volatile suspended solids data.

Combining oxygen uptake and volatile suspended solids data yields a value called the Specific Uptake Rate (SOUR). Specific Uptake Rates (SOUR) describe the amount of oxygen used by the microorganisms to consume one gram of food and is reported as mg/L of oxygen used per gram of organic material per hour.

The specific uptake rate is valuable when comparing one aquatic system with another or if a single system is to be charted over time. The performance of one aeration basin can be compared with another or the biological activity in a stream can be studied and compared both above and below a waste outfall. Furthermore, toxic or high organic loads can often be detected before severe deterioration of effluent quality occurs. Changes in the SOUR on effluent samples will indicate changes in loading.

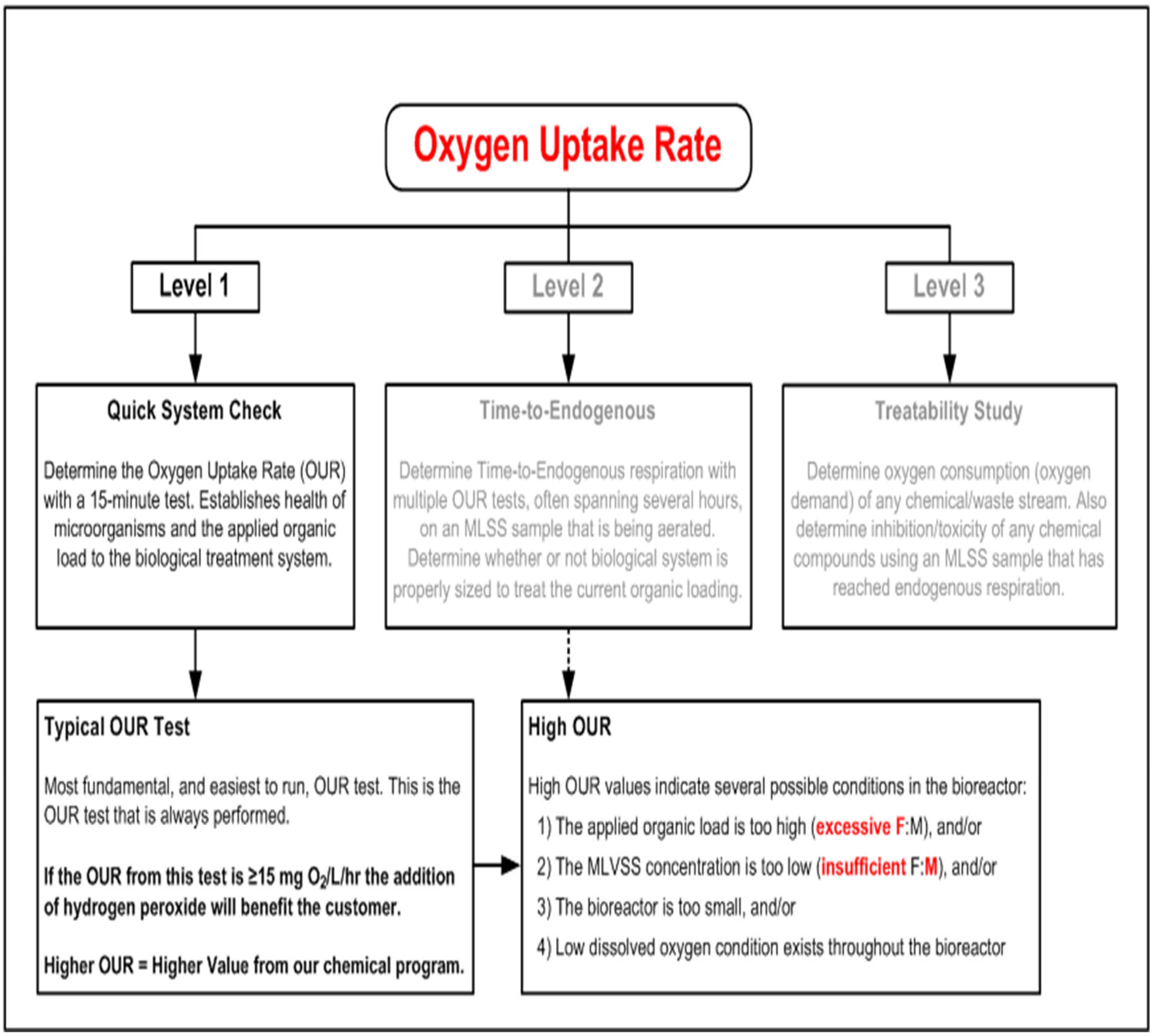
Reason for Testing
Biological waste treatment in the activated sludge process is based on the ability of the microorganisms to utilize dissolved oxygen in breaking down soluble organic substances. The oxygen uptake test is a means of measuring the respiration rate of the organisms in the activated sludge process. Since it measures the oxygen used in the process, it is a useful tool in the evaluation of process performance, aeration equipment and biodegradability of the waste. So that comparisons can be made between various plants, it is usually expressed as the SOUR (specific uptake rate); i.e. the amount of oxygen in mg utilized by one gram of the volatile suspended solids in the activated sludge.

Significance of SOUR Values Values (mg/hr/g VSS)	Rate of Oxygen Consumption	Significance
>20	High	Not enough solids for the BOD loading
12-20	Normal	Good BOD removal and sludge settling
<12	Low	Too many solids or presence of toxicity

Typical Ranges of Specific Oxygen Uptake Rates (SOUR) for Various Modifications of the Activated Sludge Process at Aeration Tank Effluent

Process Modification SOUR Range (mg/hr/g VSS)
Conventional 8-20
Step aeration 8-20
Extended aeration 3-12
Contact stabilization 5-15

$$\mathrm{SOUR,\ (mg/g)/hr} = \frac{\mathrm{OUR,\ mg\ O_2/L/min} \times \frac{60\ \mathrm{min}}{1\ hr}}{VSS\ (mg/L) \times \frac{1\ g}{1000\ mg}}$$



Total Dissolved Solids (TDS) Sub-Section

Water is a good solvent and picks up impurities easily. Pure water is tasteless, colorless, and odorless and is often called the universal solvent.

Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and some small amounts of organic matter that are dissolved in water.

TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process, and the nature of the piping or hardware used to convey the water, i.e., the plumbing. In the United States, elevated TDS has been due to natural environmental features such as: mineral springs, carbonate deposits, salt deposits, and sea water intrusion, but other sources may include: salts used for road de-icing, anti-skid materials, drinking water treatment chemicals, stormwater and agricultural runoff, and point/non-point wastewater discharges.

In general, the total dissolved solids concentration is the sum of the cations (positively charged) and anions (negatively charged) ions in the water. Therefore, the total dissolved solids test provides a qualitative measure of the amount of dissolved ions, but does not tell us the nature or ion relationships.

In addition, the test does not provide us insight into the specific water quality issues, such as: Elevated Hardness, Salty Taste, or Corrosiveness. Therefore, the total dissolved solids test is used as an indicator test to determine the general quality of the water.

Total Solids

The term "total solids" refers to matter suspended or dissolved in water or wastewater, and is related to both specific conductance and turbidity.

Total solids (also referred to as total residue) are the term used for material left in a container after evaporation and drying of a water sample.

Total Solids includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids, the portion that passes through a filter (American Public Health Association, 1998).

Total solids can be measured by evaporating a water sample in a weighed dish, and then drying the residue in an oven at 103 to 105° C.

The increase in weight of the dish represents the total solids. Instead of total solids, laboratories often measure total suspended solids and/or total dissolved solids.

Types of Solids on Wastewater

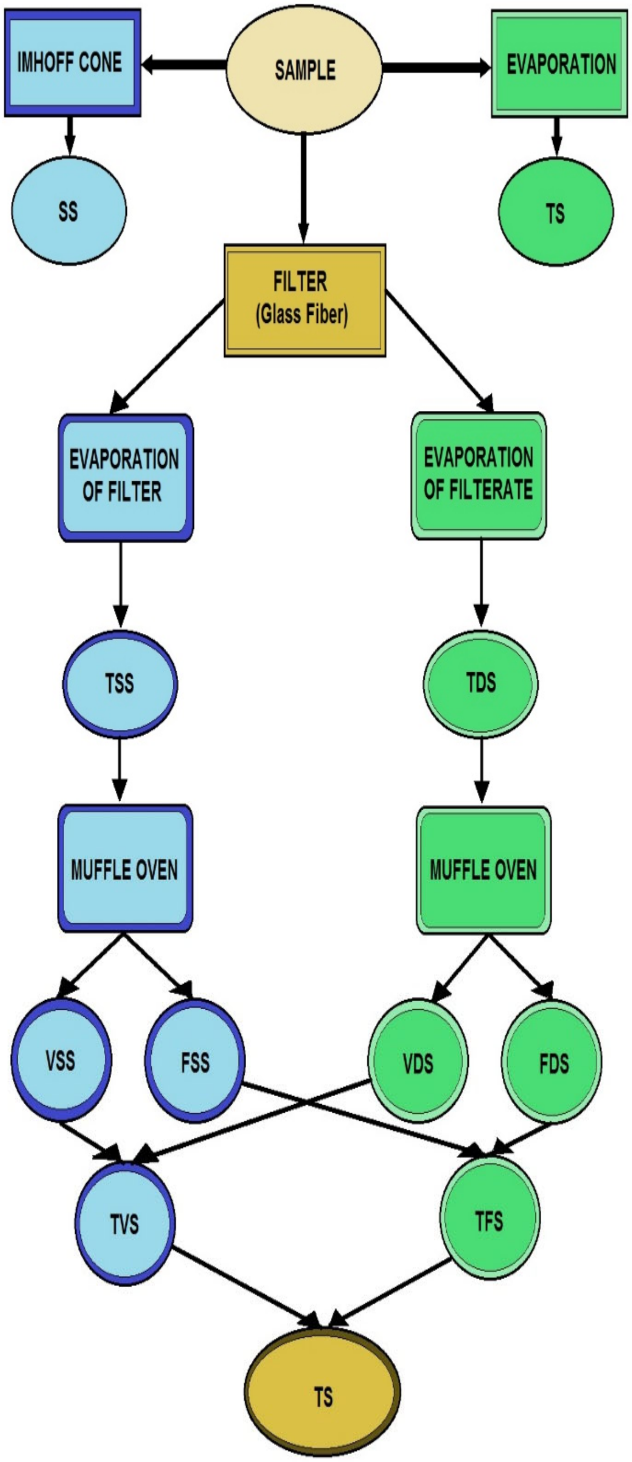
ACRONYM	COMMON TERM	EXPLANATION
TSS	Total Suspended Solids	Solids that cannot pass through a 1.2-μm filter.
TVSS	Total Volatile Suspended Solids	Solids that cannot pass through a 1.2 - μm filter and are burned away when placed in a furnace at 550° C.
TDS	Total Dissolved Solids	Solids that are small enough to pass through a 1.2 - μm filter. The sample must be dried completely before the dissolved solids can be seen with the naked eye.
TS	Total Solids	All of the solid material in a sample. This includes both organic and inorganic solids. TS = TSS + TDS
TVS	Total Volatile Solids	All of the solids in a sample that are burned away when placed in a furnace at 550° C

Total Suspended Solids (TSS)

Total suspended solids (TSS) is the dry-weight of suspended particles that are not dissolved, in a sample of water that can be trapped by a filter that is analyzed using a filtration apparatus.

It is a water quality parameter used to assess the quality of a specimen of any type of water or water body, ocean water for example, or wastewater after treatment in a wastewater treatment plant. It is listed as a conventional pollutant in the U.S. Clean Water Act.

Total dissolved solids is another parameter acquired through a separate analysis which is also used to determine water quality based on the total substances that are fully dissolved within the water, rather than undissolved suspended particles.



FSS: Fixed Suspended Solids
TDS: Total Dissolved Solids
VDS: Volatile Dissolved Solids
FDS: Fixed Dissolved Solids
TVS: Total Volatile Solids
TFS: Total Fixed Solids

EQUIPMENT USED TO MEASURE AND DETERMINE TYPES OF SOLIDS

DETERMINATION OF DIFFERENT TYPES OF SOLIDS

Lab tech removing filter for TSS analysis.

Total Suspended Solids (TSS) Sub-Section

Total Suspended Solids (TSS) are solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.

High TSS can block light from reaching submerged vegetation. As the amount of light passing through the water is reduced, photosynthesis slows down. Reduced rates of photosynthesis causes less dissolved oxygen to be released into the water by plants. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and will die. As the plants are decomposed, bacteria will use up even more oxygen from the water. Low dissolved oxygen can lead to fish kills.

Sampling downstream from a wastewater plant's discharge point.

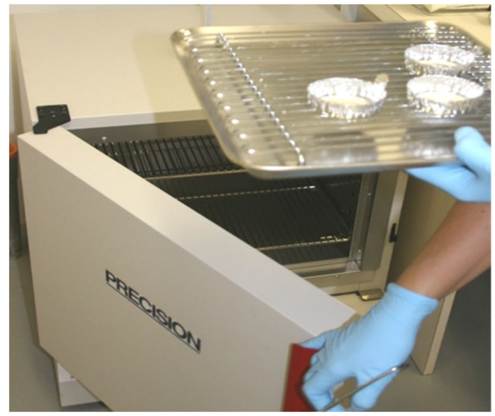
High TSS can also cause an increase in surface water temperature, because the suspended particles absorb heat from sunlight. This can cause dissolved oxygen levels to fall even further (because warmer waters can hold less DO), and can harm aquatic life in many other ways, as discussed in the temperature section. (The decrease in water clarity caused by TSS can affect the ability of fish to see and catch food.

Suspended sediment can also clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. When suspended solids settle to the bottom of a water body, they can smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae. Settling sediments can fill in spaces between rocks which could have been used by aquatic organisms for homes.

Dead fish in lake using reclaimed water.

High TSS in a water body can often mean higher concentrations of bacteria, nutrients, pesticides, and metals in the water. These pollutants may attach to sediment particles on the land and be carried into water bodies with storm water. In the water, the pollutants may be released from the sediment or travel farther downstream. High TSS can cause problems for industrial use, because the solids may clog or scour pipes and machinery.

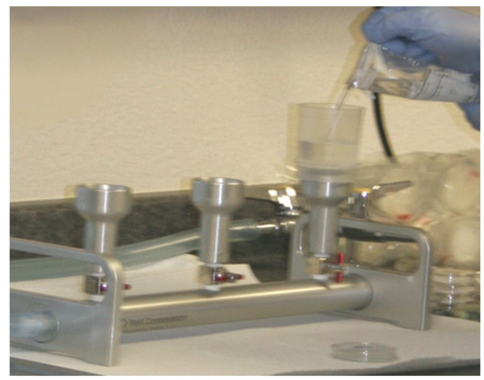
Measurement of Total Suspended Solids



To measure TSS, the water sample is filtered through a pre-weighed filter. The residue retained on the filter is dried in an oven at 103 to 105° C until the weight of the filter no longer changes. The increase in weight of the filter represents the total suspended solids. TSS can also be measured by analyzing for total solids and subtracting total dissolved solids.

Total Dissolved Solids (TDS) are solids in water that can pass through a filter (usually with a pore size of 0.45 micrometers). TDS is a measure of the amount of material dissolved in water.

This material can include carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, organic ions, and other ions. A certain level of these ions in water is necessary for aquatic life.



Changes in TDS concentrations can be harmful because the density of the water determines the flow of water into and out of an organism's cells (Mitchell and Stapp, 1992). However, if TDS concentrations are too high or too low, the growth of many aquatic lives can be limited, and death may occur.

Similar to TSS, high concentrations of TDS may also reduce water clarity, contribute to a decrease in photosynthesis, combine with toxic compounds and heavy metals, and lead to an increase in water temperature.

TDS is used to estimate the quality of drinking water, because it represents the amount of ions in the water. Water with high TDS often has a bad taste and/or high water hardness, and could result in a laxative effect.

The TDS concentration of a water sample can be estimated from specific conductance if a linear correlation between the two parameters is first established. Depending on the chemistry of the water, TDS (mg/l) can be estimated by multiplying specific conductance (micromhos/cm) by a factor between 0.55 and 0.75. TDS can also be determined by measuring individual ions and adding them up.

Settleometer Test

A simple procedure called the Settleometer Test is used to determine the settling characteristics of mixed liquor. The test requires a settleometer, which is typically a clear plastic cylinder with a capacity of 2 liters. Graduations on the cylinder range from 100 to 1000 cubic centimeters (or milliliters) of settled sludge per liter.

A sample of mixed liquor should be obtained from the discharge end of the aeration tank, being careful not to include scum in the sampling container. Do not allow the sample to set for more than a few minutes before the settling test is performed. Determine the MLSS concentration in milligrams per liter on a portion of this sample.

Mix the sample well, and fill the settleometer to the 1000 graduation. Immediately start a timer and at the end of 30 minutes record the settled sludge volume in the settleometer.

It is a good idea to occasionally record the settled sludge volume every 5 minutes while the solids are settling and prepare a graph of settled sludge volume versus minutes. This allows the operator to see whether the solids are settling too quickly or slowly. Solids that settle too quickly may be an indication of an old sludge that will probably leave straggler floc in the effluent, while solids that settle too slowly or do not compact well may be washed out of the clarifier during times of high hydraulic load.

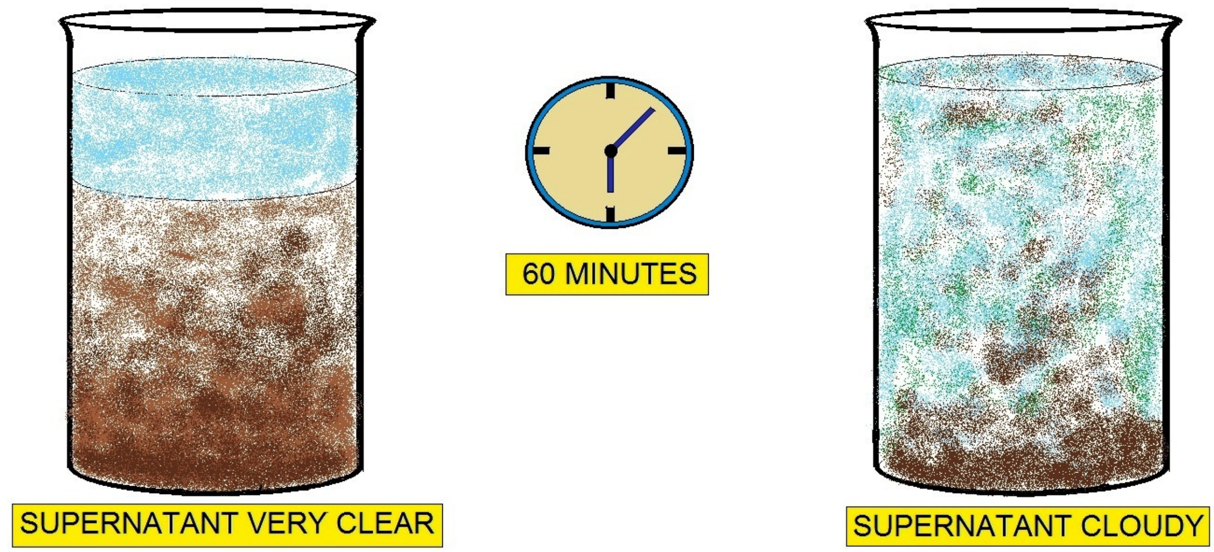
Denitrification
It is also a good practice to allow the sample to set in the settleometer for an additional 30 to 60 minutes after the settling test. Watch for tiny bubbles that form in the settled sludge. These nitrogen bubbles form as nitrate is reduced to nitrogen gas (denitrification) under anoxic conditions.

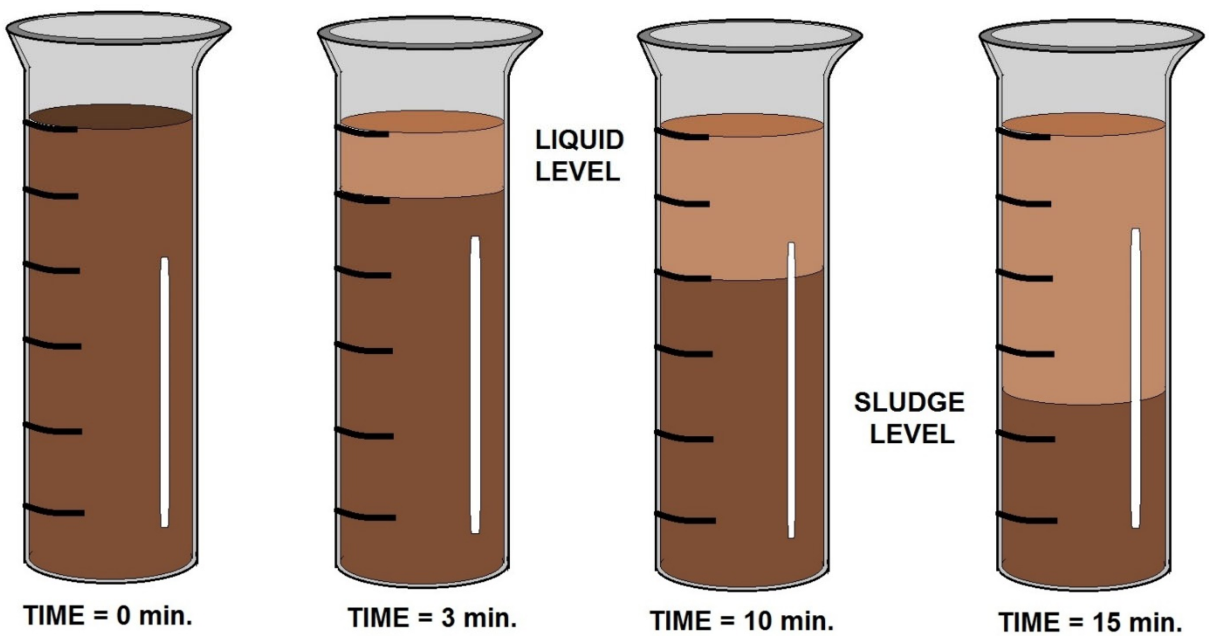
As the bubbles rise, they attach themselves to floc particles and float them to the surface. A small amount of denitrification occurring in the secondary clarifier will cause a scum to form on the surface, while a large amount of denitrification may float a significant portion of the biomass to the top of the clarifier. The settleometer test may give the operator the first warning that this may become a problem.

Volume of the Biomass
Two main factors determine the settled sludge volume in the settleometer at the end of the 30 minutes. The first, solids compaction indicates how much volume the biomass will occupy. But the operator must recognize the influence of the second factor, MLSS concentration, in settled sludge volume. As long as the MLSS does not change, settleometer test results can be compared from one day to the next.

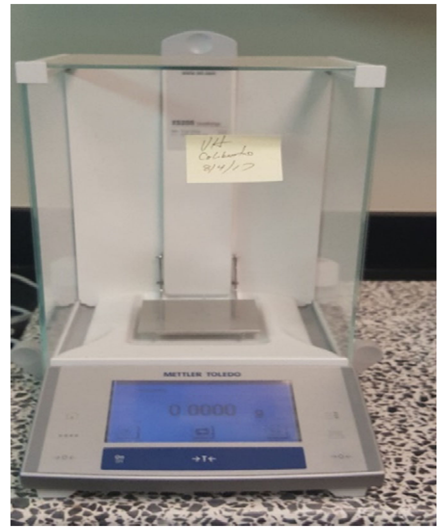
Nevertheless, as the MLSS increases, the settled sludge volume in the settleometer will increase. Since we use the settleometer test mainly to indicate how well the mixed liquor compacts, we must account for the concentration of the biomass in the settleometer. This allows the operator to track changes in sludge quality even though the MLSS concentration changes.

SETTLING TEST OBSERVATION / LOOKING FOR BULKING SLUDGE





Suspended Matter for Mixed Liquor and Return Sludge (MLSS)



Suspended matter in mixed liquor and return sludge can be used to determine process status, estimate the quantity of biomass, and evaluate the results of process adjustments.

Apparatus

- Buchner funnel and adaptor
- Filter flask
- Filter paper 110 mm diam., Whatman 1-4
- 103^0 drying oven
- Desiccator
- Balance
- Graduated Cylinder

Procedure

1. Dry the filter papers in oven at 103^0 c to remove all traces of moisture.

2. Remove papers from oven and desiccate to cool for approximately 5 minutes.

3. Weigh to the nearest 0.01g and record the mass (W_1)

4. Place the paper in the bottom of the Buchner funnel and carefully arrange so that the outer edges lay snugly along the side. Careful not to touch it with your finger. Use a glass rod. Wet the paper, turn on the vacuum and make a good seal, make a pocket covering the bottom of the funnel.

5. Add 20 to 100 mls of sample at a sufficient rate to keep the bottom of the funnel covered, but not fast enough to overflow the pocket made by the filter paper. Record the Volume used.

6. Remove the filter paper with tweezers. Dry in a 103^0 c oven for 30 minutes. Remove and desiccate. Reweigh the filter paper (W_2) to the nearest 0.01g.

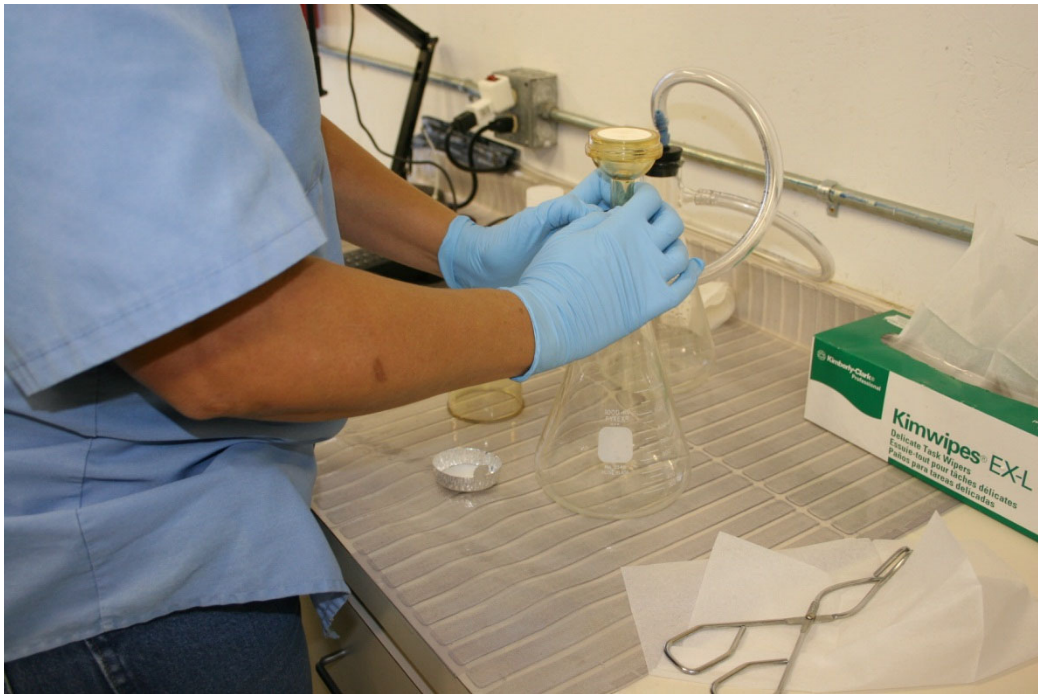
Calculation:

mg/L Suspended Matter

$$\frac{(W_2) - (W_1) \times 1000 \text{ ML/L}}{\text{ML Sample}}$$

Where:

(W_1) and (W_2) are expressed in mg.
(W_1) = mass of the prepared filter
(W_2) = mass of the filter and sample after the filtration step.



Total dissolved solids - The weight per unit volume of all volatile and non-volatile solids dissolved in a water or wastewater after a sample has been filtered to remove colloidal and suspended solids.

Top left, filters being baked at 105ºC. Right photograph, filters in desiccant.

Sludge Volume Index (SVI) Formula

SVI is used by operators to determine and compare mixed liquor settleability. It mathematically relates settled sludge volume in the settleometer to MLSS concentration. The definition for SVI is: The volume in milliliters occupied by one gram of activated sludge that has settled for 30 minutes. Note that SVI relates sludge volume in milliliters to MLSS concentration in grams per liter.

A simple formula for SVI is:

$$\textbf{SVI} = \frac{\text{mls Settled in 30 min}}{\text{MLSS Conc, grams/L}} \quad \text{or} \quad \textbf{SVI} = \frac{\text{mls Settled}}{\text{MLSS, mg/l / 1000}}$$

Sludge Density Index (SDI)
SDI is another way to express sludge compaction, makes use of the same information as SVI, but expresses it as sludge density (weight per volume rather than volume per weight). The definition for SDI is: The grams of activated sludge which occupies a volume of 100 ml after 30 minutes of settling. The formula for SDI is:

$$\textbf{SDI} = \frac{\text{grams/L of MLSS}}{\text{mls settled in 30 min / 100}} \quad \text{or} \quad \frac{\text{MLSS, mg/L / 1000}}{\text{mls settled in 30 min / 100}}$$

Consider the example given above where MLSS is 2400 mg/L and after 30 minutes of settling the sludge occupies a volume of 260 ml.

The SDI is calculated as follows:

$$\textbf{SDI} = \frac{\text{2400 mg/l / 1000}}{\text{260 ml / 100}} = \frac{2.4}{2.6} = 0.92$$

Oxygen Uptake Rate (OUR) and Specific Oxygen Uptake Rate (SOUR)
Oxygen Uptake Rate **(OUR)** is an important wastewater control parameter for activated sludge process carried out using dissolved oxygen analyzer that measures the amount of oxygen used up by the microorganisms expressed in unit time of mg/L (ppm) per hour.

Conducting the Level 1 OUR Test
The OUR test is easily performed by recording a series of dissolved oxygen measurements in one minute increments over a 15 minute time period from a mixed liquor suspended solids (MLSS) sample collected from the discharge of a bioreactor. It should be noted that high organic loading conditions will result in oxygen depletion in the MLSS sample in less than 15 minutes.

Sludge Volume Index (SVI) Procedure

1. Pour sample of mixed liquor from the process into a 2 liter settlometer.

2. Allow it to settle for 30 minutes

3. After the time period, read the marking to determine the volume occupied by the settled sludge and the reading is expressed in terms of mL/L and this is figure is known as the sludge volume SV value.

4. Next, for MLSS, there are actually two approaches to get the value. A conventional standard approach is by filtering the sludge, drying it and then weigh the second portion of the mixed liquid. However, this can be time consuming and a faster way is by using MLSS meter.
.

Calculation:
The results obtained from the suspended matter test and settleability test on aerated mixed liquor are used to obtain the SVI.

Calculation:

$$\textbf{SVI} = \frac{\text{sludge volume SV}}{\text{MLSS}} \times 1000$$

SETTLEABILITY TEST

The settleability test is an analysis of the settling characteristics of the activated sludge mixed liquor suspended solids (MLSS). This analysis is often referred to as "running a settleometer." The analysis is normally done within the treatment plant rather than a certified laboratory.

This analysis includes five basic items:

1. A clear container to hold the MLSS
2. A timing device or clock to track elapsed time
3. A paddle or other mixing device
4. A clip board, or place to record the readings
5. Operator patience, attentiveness and diligence

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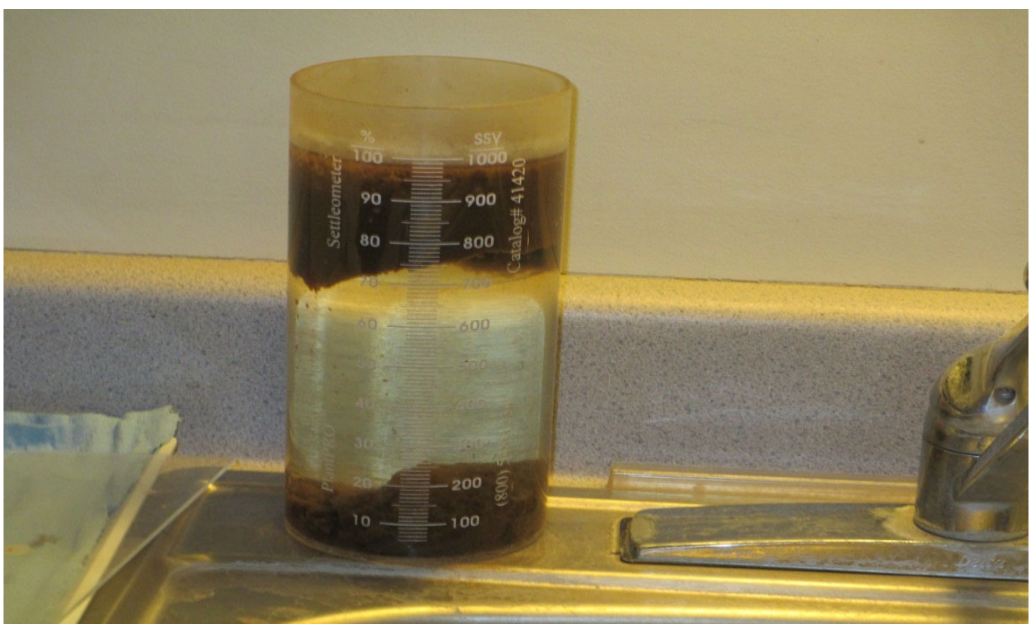
The settleometer is a great tool for operators. It indicates how the solids will settle in the clarifier and the density of the sludge.



During the settleometer test, operators not only check how the solids settle out they can also determine the rate of denitrification in the clarifier.

Sludge Volume Index Lab Report Worksheet

Suspended Mater Calculations:

(W_1) = ______mg Duplicate (W_1) = _______mg

(W_2) = _______mg (W_2) = _______mg

mls Sample = _________________ mls Sample = ________________ .

mg/L suspended matter = ________________ dup. _________________ .

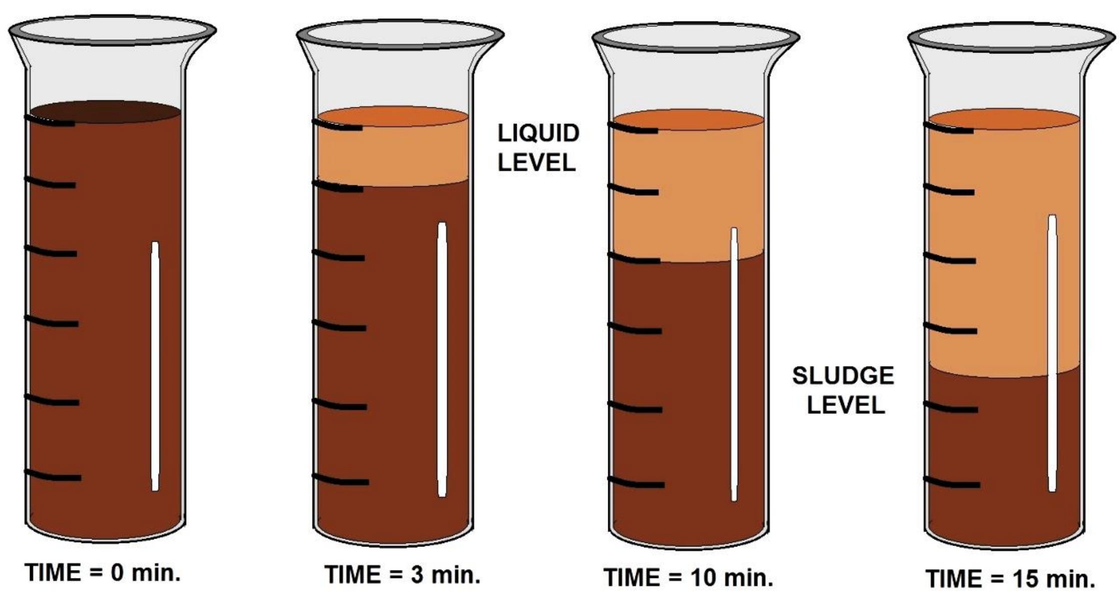
Settleability Calculations:

% settled sludge = ___________________________

$$\frac{\text{ml of sludge in settled mixed liquor or returned sludge} \times 100}{1000}$$

Sludge Volume Index Calculations:

$$\frac{\text{ml of sludge in settled mixed liquor in 30 minutes} \times 1000\ \text{mg/g}}{\text{mg/L of suspended matter in mixed liquor}}$$



MIXED LIQUOR DEFINITION

Mixed liquor suspended solids (MLSS) is the concentration of suspended solids, in an aeration tank during the activated sludge process, which occurs during the treatment of wastewater. The units MLSS is primarily measured in are milligrams per liter (mg/L). Mixed liquor is a combination of raw or unsettled wastewater and activated sludge within an aeration tank.

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MLSS

Mixed Liquor Suspended Solids (**MLSS**) is a test for the total suspended solids in a sample of mixed liquor. This test is essentially the same as the test you performed for **TSS** in the last lab, except for the use of mixed liquor as the water sample. In addition, the concentration of suspended solids found in the mixed liquor is typically much greater than that found in the raw or treated water. **MLSS** concentrations are often greater than 1,000 mg/L, but should not exceed 4,000 mg/L.

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MLVSS

Mixed Liquor Volatile Suspended Solids is generally defined as the microbiological suspension in the aeration tank of an activated-sludge biological wastewater treatment plant.

The biomass solids in a biological waste water reactor are usually indicated as **total suspended solids (TSS)** and **volatile suspended solids (VSS).** The mixture of solids resulting from combining recycled sludge with influent wastewater in the bioreactor is termed **mixed liquor suspended solids (MLSS)** and **mixed liquor volatile suspended solids (MLVSS).** The solids are comprised of biomass, **nonbiodegradable volatile suspended solids (nbVSS),** and inert **inorganic total suspended solids (iTSS).**

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MIXED LIQUOR CALCULATION

$$MLSS\ (g/L) = SV\ [mL/L]/SVI\ [mL/g]$$

Where:

SVI = sludge volume index (mL/g)
SV = Volume of settled solids per 1 litre after 30 minutes
SVI is a calculation from two analyses: SV30 and MLSS.

$$0=(Q+Q_r)(X')-(Q_r X'_r+Q_w X'_r)$$

Where:

Q = wastewater flow rate (m^3/d)
Q_r = return sludge flow rate (m^3/d)
X' = MLSS (kg/m^3)
X'_r = return sludge concentration (kg/m^3)
Q_w = sludge wasting flow rate (m^3/d)

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MIXED LIQUOR ADJUSTMENT

If content is too high

1. The process is prone to bulking of solids and the treatment system can become overloaded.
2. This can cause the dissolved oxygen content to drop; this may reduce the efficiency of nitrification and the settleability of the sludge.
3. Excessive aeration will be required, which wastes electricity.
4. It will create thick foam on upper layer.

If content is too low

1. The process may not remove sufficient organic matter from the wastewater.
2. The sludge age may be too low to enable nitrification.

The typical control band for the concentration of MLSS is 2 to 4 g/L for conventional activated sludge, or up to 15 g/l for membrane bioreactors.

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Fecal Coliform Analysis Sub-Section

FECAL TESTING CONCEPT

A sample is collected and analyzed using aseptic (sterile) technique. A measured volume of sample is filtered through a sterile 0.45µ membrane filter, transferred to an absorbent pad containing m-FC broth, then incubated at 44.5°C for 24 hours. Blue/blue gray colonies are counted and reported as colony forming units (cfu) per 100 ml of sample. The method is limited by turbidity in the sample. Excessive turbidity will reduce fecal coliform recovery, requiring the MPN method to be used instead of the membrane filter method.

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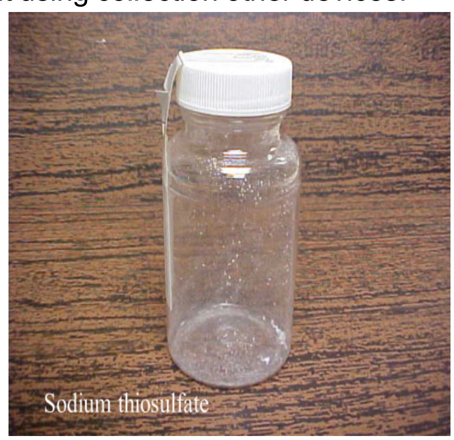
Sample Collection
Fecal coliform must be collected in a clean, sterile borosilicate glass or plastic bottle containing sodium thiosulfate. Pre-sterilized bags or bottles containing sodium thiosulfate can also be used. Sodium thiosulfate is added to remove residual chlorine which will kill fecal coliforms during transit. 0.1 ml of 10% sodium thiosulfate is added to a 120 ml sample bottle prior to sterilization. The minimum bottle size should be 120 ml to allow enough head space (1") for proper sample mixing.

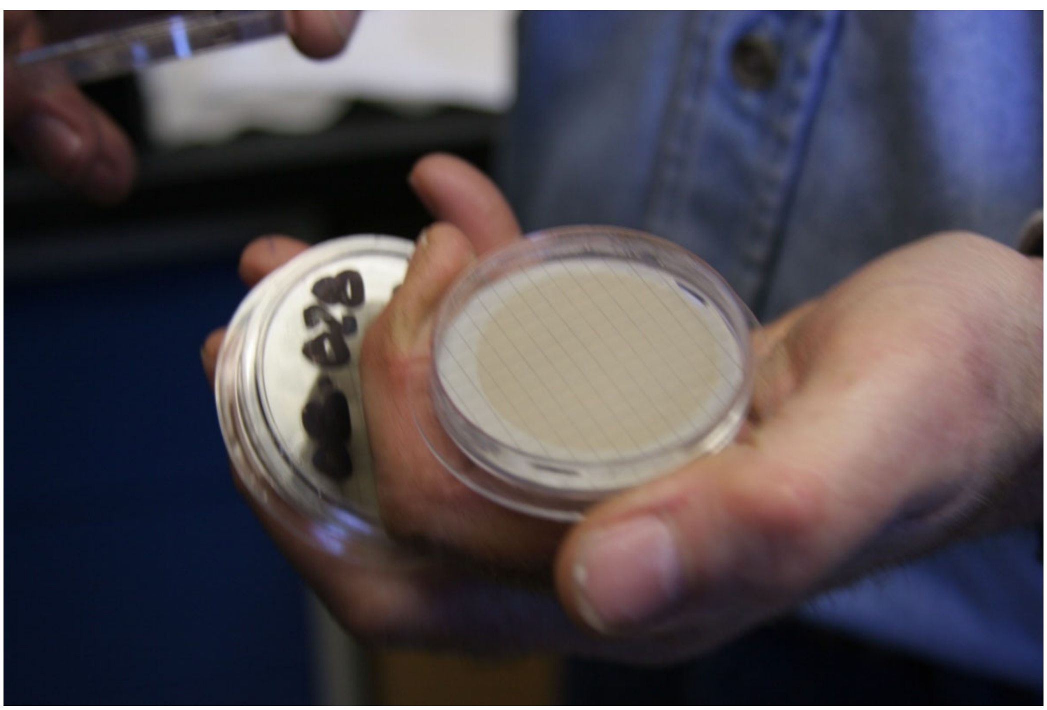
Collection Procedure
Select a site that will provide a representative sample. Fecal coliform samples are always grab samples and should be drawn directly from the flow stream without using collection other devices. We do not want to cross contaminate the sample. Keep the sample bottle lid closed tightly until it is to be filled.



Remove the cap and do not contaminate the inner surface of the bottle, neck, threads or cap. Fill the container without rinsing, being sure to leave ample air space to allow mixing. Rinsing will remove the dechlorinating agent. All samples should be labeled properly with date and time of collection, sampler's name, and sample collection location. Leaking sample bottles allow for contamination of the sample and should be discarded and the sampling repeated.

Preservation
Fecal coliform samples should be analyzed as soon as possible after collection to prevent changes to the microorganism population. Fecal coliforms must be transported on ice, if they cannot be analyzed within 1 hour of collection. Fecal coliforms transported at ambient temperature may reproduce and higher bias to the numbers than desired or they may be killed off resulting in lower numbers, if handled poorly such as transport in sunlight. Fecal coliform samples should be stored by the laboratory in a refrigerator until time of analysis. The maximum holding time for state or federal permit reporting purposes is 6 hours.

Phase microscopes are used to see indicator bugs and other MO's microorganisms. This examination is used so that the operator knows how well the process is working.



This is a filter used for the coliform test.

Pass-Through /Emerging Wastewater Contaminants Section

This section provides a brief background on emerging contaminants and key findings from studies on the co-removal of emerging contaminants by nutrient removal technologies.

The term “emerging contaminants” refers broadly to those synthetic or naturally occurring chemicals, or to any microbiological organisms, that have not been commonly monitored in the environment but which are of increasing concern because of their known or suspected adverse ecological or human health effects.

Some chemicals that we use in our everyday lives including medicines (such as prescription and non-prescription drugs), personal hygiene products (for example, soaps, disinfectants, …) and their chemical additives (such as preservatives) are present in the environment and associated with various sources such as municipal wastewater treatment plants, runoff from agricultural and urban land surfaces, and septic systems. These contaminants are referred to collectively as “contaminants of emerging concern” and represent a shift in traditional thinking as many are produced industrially yet are dispersed to the environment from domestic uses.

This investigation identifies and quantifies the environmental sources, presence, and magnitude of environmental contaminants with the underlying theme of understanding the contaminants from their source to a “receptor organism.” The goal of the investigation is to understand the actual versus the perceived health risks to humans or wildlife due to low-level exposures from understudied chemical contaminants in the environment.

Background on Emerging Contaminants

Emerging contaminants can fall into a wide range of groups defined by their effects, uses, or by their key chemical or microbiological characteristics. Two groups of emerging contaminants that are of particular interest and concern at present are endocrine disrupting chemicals (EDCs) and pharmaceutical and personal care products (PPCPs). These compounds are found in the environment, often as a result of human activities.

EDCs may interfere with the endocrine systems by damaging hormone-producing tissues, changing the processes by which hormones are made or metabolized, or mimicking hormones.

In addition to natural and synthetic forms of human hormones that are released into the environment, there are a multitude of synthetic organic compounds that are able to disrupt the endocrine system. Public concern about EDCs in the environment has been rapidly increasing since the 1990s when researchers reported unusual sexual characteristics in wildlife. A report by the USGS, found that fish in many streams had atypical ratios of male and female sex hormones (Goodbred et al., 1997).

In England, researchers found that male trout kept in cages near WWTP outfalls were developing eggs on their testes and had increased levels of the protein that is responsible for egg production (vitellogenin) (Sumpter, 1995; Kaiser, 1996). Follow-up laboratory studies showed that synthetic forms of estrogen (17α-ethynylestradiol (EE2)) could increase vitellogenin production in fish at levels as low as 1-10 ng/L, with positive responses seen down to the 0.1-0.5 ng/L level (Purdom et al., 1994).

Human estrogens have the ability to alter sexual characteristics of aquatic species at trace concentrations as low as 1 ng/L (Purdom et al., 1994). WWTP effluents have been identified as a primary source for EDCs in the environment, with the bulk of their endocrine disrupting activity resulting from human estrogen compounds (Desbrow et al., 1998, Snyder et al., 2001). The synthetic estrogen, EE2, and the natural estrogens, estrone (E1) and 17β-estradiol (E2), are the greatest contributors to endocrine disrupting activity in WWTP effluent (Johnson et al., 2001) with EE2 showing the greatest recalcitrance in WWTPs (Joss et al., 2004). Influent concentrations range from below detection to 70 ng/L for EE2, 670 ng/L for E1 and 150 ng/L for E2 (Vethaak et al., 2005, Clara et al., 2005b). Other EDCs include tributyl tin, which was previously used in paints to prevent marine organisms from sticking to ships, nonylphenol (a surfactant), and bisphenol A (platicizer and preservative).

PPCPs encompass a wide variety of products that are used by individuals for personal health or cosmetic reasons, and also include certain agricultural and veterinary medicine products.

PPCPs comprise a diverse collection of thousands of chemical substances, including prescription and over-the counter therapeutic drugs, veterinary drugs, fragrances, sun-screen products, vitamins, and cosmetics. Many of these products, notably the pharmaceuticals for human or animal use, are specifically designed to be biologically active, and some PPCPs may also fall into the category of EDCs described previously.

Estrogens of Concern

Name Chemical Structure Name Chemical Structure		
E1	Estrone	$C18H22O2$
E2	17β-estradiol	$C18H24O2$
E3	Estriol	$C18H24O3$
EE2	17α-ethynylestradiol	$C20H24O2$

Currently, municipal sewage treatment plants are engineered to remove conventional pollutants such as solids and biodegradable organic material but are not specifically designed for PPCP removal or for other unregulated contaminants. Wastewater treatment commonly consists of primary settling followed by biological treatment, secondary settling, and disinfection. This treatment can remove more than 90 percent of many of the most commonly known or suspected EDCs found in wastewater influent; however, low concentrations of some suspected EDCs may remain in the wastewater treatment sludge or effluent (WERF, 2005). As discussed in the next section, studies have shown enhanced nutrient removal technologies to be effective in removing low concentrations of some emerging contaminants.

Removal of Emerging Contaminants by Nutrient Removal Technologies

Several studies have examined the effectiveness of current wastewater treatment technologies in the removal of emerging contaminants. Some of these studies are discussed below and their major findings are organized under three subsections: role of activated sludge SRT in removal efficiency, role of nitrifying bacteria in biodegradation, and use of RO to improve removal efficiencies. Details regarding the study design, such as evaluated treatments and contaminants, and a summary of major study findings are provided at the end of this section.

The significant findings are also presented as follows:

- Removal efficiencies were enhanced for several investigated contaminants at longer SRTs, with critical SRTs for some beyond which removal rates did not improve.
- Longer SRTs allow for the establishment of slower growing bacteria (e.g., nitrifying bacteria in activated sludge), which in turn provide a more diverse community of microorganisms with broader physiological capabilities.
- Nitrifying bacteria may play a key role in biodegradation but the role of heterotrophic bacteria may also play a significant role.
- Reverse osmosis has been found to effectively remove PPCPs below detection limits including those that that were not consistently removed at longer SRTs.

EPA Quality Control Procedures for Field Analysis and Equipment Table

Parameter	General	Daily	Other Frequency
Dissolved Oxygen			
Membrane Electrode	• Enter the make, model, and serial and/or ID number for each meter in a logbook. • Report data to nearest 0.1 mg/L.	• Calibrate meter using manufacturer's instructions or Winkler-Azide method. • Check membrane for air bubbles and holes. Change membrane and Potassium chloride (KCl) solution if necessary. • Check leads, switch contacts, etc., for corrosion and shorts if meter pointer remains off-scale.	• Annually, check instrument calibration and linearity using a series of at least three dissolved oxygen standards. • Annually, take all meters to the laboratory for maintenance, calibration, and quality control checks.
Winkler-Azide Method	Record data to nearest 0.1 mg/L.	Duplicate analysis should be run as a precision check. Duplicate values should agree within ±0.2 mg/l.	
pH			
Electrode Method	Enter the make, model, and serial and/or ID number for each meter in a logbook.	• Calibrate the system against traceable standard buffer solutions of known pH value that closely brackets the actual sample pH (e.g., 4, 7, and 10 at the start of a sampling run). • Periodically check the buffers during the sample run and record the data in the logbook. • Be on the alert for erratic meter response arising from weak batteries, cracked electrodes, fouling, etc. • Check response and linearity following highly acidic or alkaline samples. Allow additional time for equilibration. • Check against the closest reference solution each time a violation is found. • Rinse electrodes thoroughly between samples and after calibration. Blot dry. • Store the probe in approved storage solution (e.g., KCl)	

Parameter	General	Daily	Other Frequency
Conductivity			
	Enter the make, model, and serial and/or ID number for each meter in a logbook.	• Standardize with KCl standard solutions having similar specific conductance values to those anticipated in the samples. Calculate the cell constant using two different standards. • Rinse cell after each sample to prevent carryover.	• Quarterly, take all meters to lab for maintenance, calibration, and quality control checks. • Quarterly, check temperature compensation. • Quarterly, check date of last platinizing, if necessary. • Quarterly, analyze NIST or EPA reference standard solutions, and record actual vs. observed readings in the logbook.
Residual Chlorine			
Amperometric Titration	Enter the make, model, and ID and/or serial number of each titration apparatus in a logbook. Report results to nearest 0.01 mg/l.	Refer to instrument manufacturer's instructions for proper operation and calibration procedures.	Biweekly, return instrument to lab for maintenance and addition of fresh, standardized reagents.
Temperature			
Manual Thermometer	• Enter the make, model, and serial and/or ID number and temperature range. • All standardization should be against a traceable NIST or NIST calibrated thermometer. Reading should agree within ±1°C. If enforcement action is anticipated, calibrate the thermometer before and after analysis. All data should be read to the nearest 1°C. Report data between 10° and 99°C to two significant figures.	Check for air spaces of bubbles in the column, cracks, etc. Compare with a known source if available.	• Initially and annually, determine accuracy throughout the expected working range of 0°C to 50°C. A minimum of three temperatures within the range should be used to verify accuracy. Preferably, the 3 temperature readings should be taken within the following ranges: 5–10°C, 15–25°C, and 35–45°C.

Parameter	General	Daily	Other Frequency
Thermistors, Thermographs	Enter the make, model, and serial and/or ID number of the instrument in a log- book. All standardization shall be against a NIST or NIST calibrated thermometer.	Check thermistor and sensing device for response and operation according to the manufacturer's instruction. Record actual versus standard temperature in logbook.	Initially and annually, determine accuracy throughout the expected working range of 0°C to 50°C. A minimum of three temperatures within the range to verify accuracy
	Reading should agree within ±1°C. If enforcement action is anticipated, refer to the procedure listed above.		Preferably, the 3 temperature readings should be taken within the following ranges: 5–10□C, 15–25°C, and 35–45°C.
Flow Measurement			
	Enter the make, model, and serial and/or ID number of each flow measurement instrument in a logbook.	Install the device in accordance with the manufacturer's instructions and with the procedures given in owner's manual.	Annually affix record of calibration (as per NIST standard or manufacturer's suggested standard) to the instrument log.
Automatic Samplers			
	Enter the make, model, and serial and/or ID number of each sampler in a logbook.		For each sampling event, check intake velocity vs. head (using a minimum of three samples), and clock time setting vs. actual time interval. Calibrate annually and record results in a logbook.

Reference: U.S. EPA Interim Revised NPDES Inspection Manual | 2017

Laboratory Analysis/ Process Control Section Post Quiz

1. What is the proper term used that are determined using a concentration cell with transference, by measuring the potential difference between a hydrogen electrode and a standard electrode such as the silver chloride electrode?

2. In chemistry, *pH* is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline. Pure water has a pH very close to?

3. Mathematically, pH is the negative logarithm of the activity of the (solvated) hydronium ion, more often expressed as the measure of the?

4. Which terms is used for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators?

5. The pH scale is logarithmic and therefore pH is?

6. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It is one of the best measures of the sensitivity of the stream to acid inputs. There can be long-term changes in the _________________ of rivers and streams in response to human disturbances.

7. pH is defined as the decimal logarithm of the reciprocal of the ____________, $a_{H}+$, in a solution.

8. Alkalinity is the name given to the quantitative capacity of an aqueous solution to neutralize an?

9. What is the term used for the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number?

10. The calculation of the pH of a solution containing acids and/or bases is an example of a chemical speciation calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution. The complexity of the procedure depends on the?

11. Under normal circumstances this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of?

12. Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the?

13. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires the solution of a quadratic equation. The pH of a solution containing a weak base may require the?

14. Alkalinity is a measure of this missing term and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

15. More precise measurements are possible if the color is measured spectrophotometrically, using a?

16. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires?

17. The calculation of the pH of a solution containing acids and/or bases is an example of a ______________ calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution

18. What is the term used for measurements in the interpretation and control of water and wastewater treatment processes?

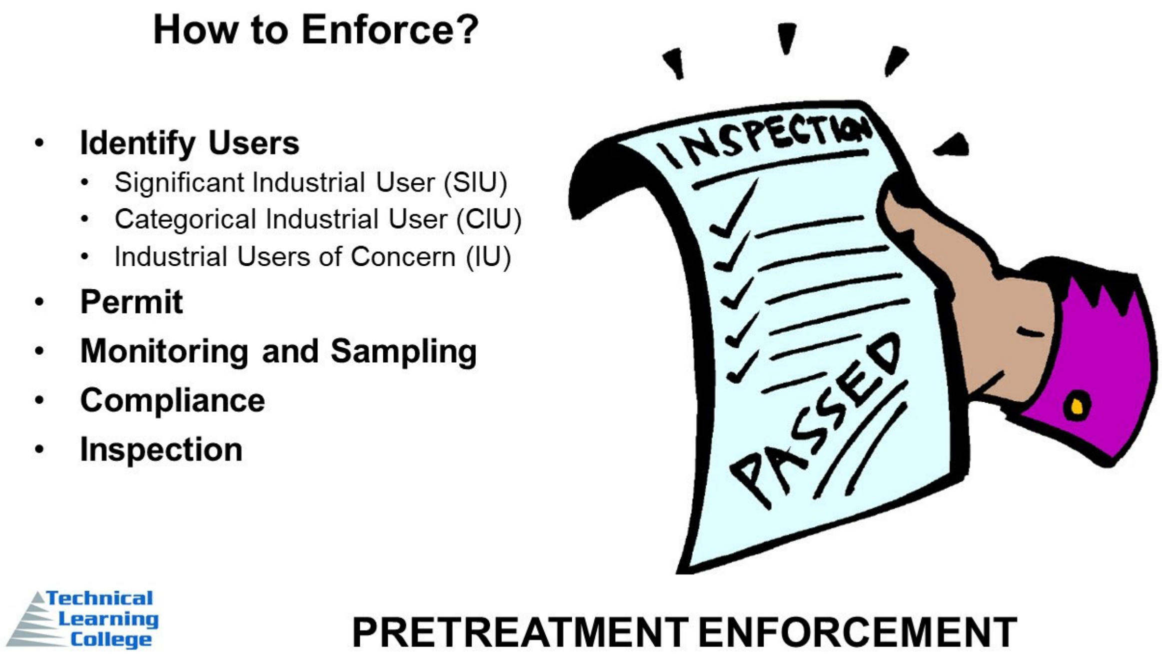
Laboratory Analysis/ Process Control Section Post Quiz

1. Primary pH standard values, 2. 7, 3. Hydronium ion concentration, 4. Measurement of pH, 5. A dimensionless quantity, 6. Alkalinity, 7. Hydrogen ion activity, 8. Acid, 9. Visual comparison, 10. Nature of the solution, 11. The concentration value, 12. End-point pH, 13. Solution of a cubic equation, 14. An aggregate property of water, 15. Colorimeter of spectrophotometer, 16. The solution of a quadratic equation, 17. Chemical speciation, 18. Alkalinity

Chapter 7 - Enforcement

Section Focus: You will learn the basics of the Clean Water Act, the need for wastewater treatment and common wastewater constituents. At the end of this section, you will be able to describe the need for wastewater treatment and the composition/components of wastewater. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.



In addition to requirements for permitting, sampling, and inspecting IUs, the General Pretreatment Regulations also require Control Authorities to review IU reports and plans, and respond to instances of IU noncompliance in a timely, fair, and consistent manner.

Enforcement of pretreatment requirements is a critical element of the Pretreatment Program, but in the past extenuating circumstances may have prevented POTWs from taking adequate enforcement.

For example, political and economic pressures from local officials could keep POTW personnel from taking appropriate actions. After this was identified as a major concern, the EPA promulgated regulations in 1990 *(55 FR 3008*2) that require all POTWs with approved pretreatment programs to adopt and implement an Enforcement Response Plan (ERP).

These ERP regulations, at 40 CFR §403.8(f)(5), established a framework for POTWs to formalize procedures for investigating and responding to instances of IU noncompliance. With an approved ERP in place, POTWs can enforce against IUs on a more objective basis and minimize outside pressures.

IU Compliance

To evaluate IU compliance, Control Authorities must first identify applicable requirements for each IU. In general, IU reports and POTW monitoring activities are the basis for POTW evaluation of IU compliance. Discharge permit limit exceedances, discrepancies, deficiencies, and lateness are all violations that must be resolved.

To ensure enforcement response is appropriate and the Control Authority actions are not arbitrary or capricious, the EPA strongly recommends that an Enforcement Response Guide (ERG) be included as part of the approved ERP.

The ERG identifies responsible Control Authority officials, general time frame for actions, expected IU responses, and potential escalated actions based on:

- The nature of the violation
- Pretreatment standards
- Reporting (late or deficient)
- Compliance schedules
- Magnitude of the violation
- Duration of the violation
- Frequency of the violation (isolated or recurring)
- (potential) impact of the violation (e.g., interference, pass through, or POTW worker safety)
- Economic benefit gained by the violator
- Attitude of the violator

How Complete is Your ERG?

Q: Is a Control Authority response required for all violations identified?

Q: Is the IU notified by the Control Authority when a violation is found?

Q: Is the IU required to respond to each violation with an explanation and, as appropriate, a plan to correct the violation within a specified time period?

Q: Where noncompliance continues and/or the IU response is inadequate, does the Control Authority's response become more formal and commitments (or schedules, as appropriate) for compliance established in an enforceable document?

Q: Is the enforcement response selected related to the seriousness of the violation?

Q: Where the violation constitutes SNC, and is ongoing, is the minimum response an administrative order?

The types of questions that dictate whether an ERP is adequate are presented above. Factors that should be considered in determining appropriate enforcement responses to noncompliance events are discussed in detail in the EPA's 1989 *Guidance for Developing Control Authority Enforcement Response Plan*s.

The General Pretreatment Regulations set as an enforcement priority, facilities that meet the criteria for "***Significant Noncompliance*** (**SNC**)" as defined in 40 CFR §403.8(f)(2)(vii) and depicted in Figure 27. A decision to seek formal enforcement is generally triggered by an unresolved instance of SNC, failure to achieve compliance in a specified time period through less formal means, or the advice of legal counsel.

SNC evaluations are to be conducted in six-month increments; names of IUs found to be in SNC must be published in the local newspaper (see Public Participation in this Chapter).

Formal enforcement must be supported by well-documented records of the violations and of any prior efforts by the Control Authority to obtain compliance. Where effluent limitations have been exceeded, records must be reviewed to verify compliance with 40 CFR Part 136 test methods. If the IU has received conflicting information from the Control Authority regarding its compliance status, its status must be clarified in writing.

Although not required, the Control Authority may consider a "**show cause**" meeting with the IU before commencing formal enforcement action. Similarly, the regulations do allow, in certain instances, an affirmative defense for violations. The range of enforcement mechanisms available to a Control Authority depends on the specific legal authorities it has been given by city, county, and State legislatures. These mechanisms may range from a simple telephone call to suits seeking significant criminal penalties. Common enforcement mechanisms include:

Informal notice to IU - This may consist of a telephone call or "***reminder***" letter to an appropriate IU official to notify them of a minor violation and to seek an explanation.

Such informal notice may be used to correct minor instances of noncompliance.

Administrative Tools

Informal meetings - Used to obtain an IU's commitment to comply with their pretreatment obligations or to inform the IU of stronger enforcement mechanisms available for unresolved and/or continued, noncompliance.

Warning letter or Notice of Violation (NOV) - Written notice to the IU in response to a violation of pretreatment standards or requirements. These notices should request an explanation of the noncompliance and measures that will be taken to eliminate future violations.

Administrative orders and compliance schedules - These require an IU to "**show cause**" to the Control Authority as to why formal enforcement action should not be taken and/or sewer service discontinued, or actions that will be taken to comply with pretreatment standards or requirements. Orders as such may be negotiated (i.e., Consent Order) or issued at the reasonable discretion of the Control Authority (i.e., Compliance Order).

For more egregious or serious violations, the Control Authority may issue a Cease and Desist Order.

Administrative fines - Assessed by Control Authorities against IUs for violations and intended to recapture partial or full economic benefit for the noncompliance and to deter future violations.

Civil suits - Formal process of filing lawsuits against IUs to correct violations and to obtain penalties for violations. Civil penalty amounts are generally limited through State or municipal laws. However, 40 CFR §403.8(f)(1)(vi) requires that Control Authorities have the legal authority to seek or assess civil or criminal penalties of at least $1,000 per day for each violation.

A civil suit for injunctive relief may be used when the IU is unlikely to successfully execute the steps that the Control Authority believes are necessary to achieve or maintain compliance, when the violation is serious enough to warrant court action to deter future similar violations, or when the danger presented by an IU's lengthy negotiation of a settlement is intolerable.

NOTE: Surcharges are not penalties or fines. Surcharges are intended to recoup the cost of treatment of wastes by the POTW and must not be used to allow discharges of toxic pollutants that cause interference or pass through.

Definition of Significant Noncompliance (SNC) An IU is in SNC if its violation meets one or more of the following criteria (40 CFR 403.8(f)(2)(vii):
(A) Chronic violations of wastewater discharge limits, defined here as those in which sixty-six percent or more of all of the measurements taken during a six-month period exceed **(by any magnitude)** the daily maximum limit or the average limit for the same pollutant parameter;
(B) Technical Review Criteria (TRC) violations, defined here as those in which thirty-three percent or more of all of the measurements for each pollutant parameter taken during a six-month period equal or exceed the product of the daily maximum or the average limit multiplied by the applicable TRC (TRC = 1.4 for BOD 5 , TSS, fats, oil, and grease, and 1.2 for all other pollutants except pH);
(C) Any other violation of a pretreatment effluent limit (**daily maximum or longer-term average**) that the Control Authority determines has caused, alone or in combination with other discharges, interference or pass through (including endangering the health of POTW personnel or the general public);
(D) Any discharge of a pollutant that has caused imminent endangerment to human health, welfare or to the environment or has resulted in the POTW's exercise of its emergency authority under 40 CFR § 403.8(f)(1)(vi)(B) of this section to halt or prevent such a discharge;

(E) Failure to meet, within 90 days after the schedule date, a compliance schedule milestone contained in a local control mechanism or enforcement order for starting construction, completing construction, or attaining final compliance;
(F) Failure to provide, within 30 days after the due date, required reports such as baseline monitoring reports, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules;
(G) Failure to accurately report noncompliance;
(H) Any other violation or group of violations which the Control Authority determines will adversely affect the operation or implementation of the local pretreatment program.

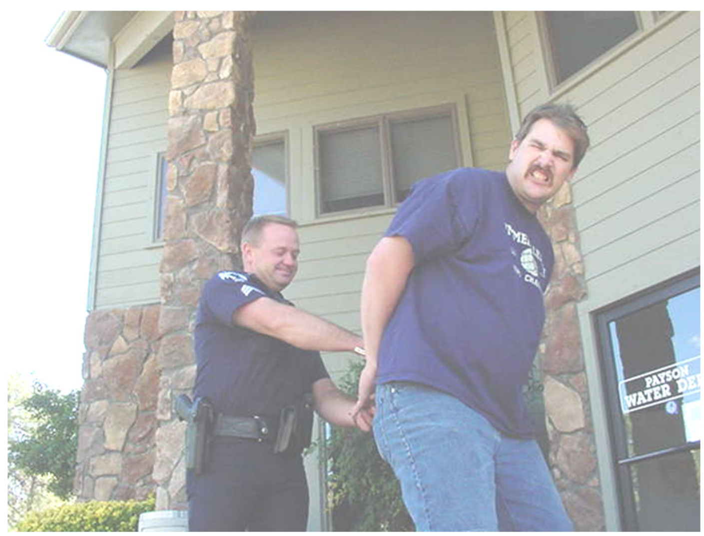
Criminal Prosecution

This type of enforcement is a formal judicial process where sufficient admissible evidence exists to prove beyond a reasonable doubt that a person has willfully or negligently violated pretreatment standards or that a person has knowingly made a false statement regarding any report, application, record, or other document required by the General Pretreatment Regulations.

As noted above, Control Authorities must have the legal authority to seek or assess civil or criminal penalties of at least $1,000 per day for each violation. Examples of criminal violations include falsification of data and tampering with sampling results or equipment.

Termination of service (revocation of permit) - These actions may be pursued by Control Authorities to immediately halt an actual or threatened discharge to the POTW that may represent an endangerment to the public health, the environment, or the POTW. Use of these remedies may also be used in bringing recalcitrant users into compliance.

Regardless of the response taken, the Control Authority should document and track all contact, notices, and meetings with IUs and IU responses. Control Authority responses and IU responses (or lack thereof) should be documented and include a record of any direct contact with the IU to attempt to resolve the noncompliance.



Control Authorities must take timely and effective enforcement against violators. Unresolved IU noncompliance may result in the Approval Authority enforcing directly against the IU and/or the Control Authority. The EPA may also take enforcement action where it deems action by the State or the Control Authority is inappropriate. An Approval Authority will routinely review the overall performance of a Control Authority in monitoring IUs, identifying violations, and in enforcing regulations.

Performance will be evaluated based on POTW self-monitoring data, written enforcement response plans, audits, inspections, and pretreatment program reports. Therefore, it is essential for Control Authorities to effectively manage program information to demonstrate proper implementation. Section 505 of the CWA allows citizens to file suit against a Control Authority that has failed to implement its approved pretreatment program as required by its NPDES permit. The Control Authority may be fined as well as required to enforce against violations of pretreatment standards and requirements in a court order.

ENFORCEMENT RESPONSE PLAN EVALUATION CHECKLIST

Name of POTW:	**Date of Review:**

Requirement	YES	NO	N/A	Section Reference
A. Does the Enforcement Response Plan (ERP) describe how the POTW will investigate instances of noncompliance?				
1. Does it indicate that inspections and sampling will be used as a means to identify IU noncompliance?				
2. Does it indicate that inspections and sampling will be used as a means to follow-up on IU noncompliance?				
3. Does it identify personnel responsible for conducting inspections and sampling?				
4. Does it identify personnel responsible for entering inspection and sampling results into the IU's file?				
5. Does it specify time frames for entering inspection and sampling data?				
6. Does it describe procedures for tracking and reviewing (including evaluating report completeness and accuracy) all IU reports and notifications?				
7. Does it specify personnel responsible for reviewing reports and notifications?				
8. Does it specify personnel responsible for recommending enforcement action?				
9. Does it describe procedures for tracking responses to enforcement actions?				
10. Does it include appropriate procedures for determining violations and calculating SNC based on continuous pH monitoring?				
11. Does it clearly indicate the enforcement response that will be taken in response to SNC, including causing interference, pass through, filing late reports, etc.?				
12. Does it indicate that the POTW will respond to instances of SNC with an enforceable order within 30 days of identification?				
B. Does the ERP describe the types of escalating enforcement responses the POTW will take in response to all anticipated types of violations?				
1. Does it identify all possible types of noncompliance, including:				
a. Discharge without a permit (no harm)				
b. Discharge without a permit (harm)				

Requirement	YES	NO	N/A	Section Reference
c. Failure to renew permit				

Requirement	YES	NO	N/A	Section Reference
d. Isolated violations of discharge limit (no harm)				
e. Isolated violations of discharge limit (harm)				
f. Recurring violation of discharge limit (no harm)				
g. Recurring violation of discharge limit (harm)				
h. Reported slug load (no harm)				
i. Reported slug load (harm)				
j. Late report				
k. Report is incomplete				
l. Failure to monitor all regulated pollutants				
m. Report is improperly signed or certified				
n. Failure to submit a report or notice				
o. Falsification of data				
p. Use of improper sampling procedures				
q. Failure to install monitoring equipment				
r. Missed compliance schedule milestones (no effect on final compliance date)				
s. Missed compliance schedule milestones (effect on final compliance date)				
t. Use of dilution instead of treatment				
u. Failure to properly operate and maintain pretreatment equipment				
v. Denial of entry to POTW personnel				
w. Failure to maintain records				
x. Failure to report additional monitoring				
2. Does the ERP reflect the full range of enforcement responses that are allowed under State law and the POTW's sewer use ordinance?				
3. Does the POTW's sewer use ordinance provide adequate legal authority for all enforcement actions the POTW proposes to initiate?				
4. When identifying appropriate enforcement actions, does the ERP allow for consideration of the following factors?				
a. Magnitude of the violation				
b. Duration of the violation				

Requirement	YES	NO	N/A	Section Reference
c. Effect on receiving water				
d. Effect on POTW				
e. IU's compliance history				
f. IU's good faith				

Requirement	YES	NO	N/A	Section Reference
5. Does the ERP adequately describe procedures for escalating enforcement responses?				
6. Does the ERP include associated time frames for all activities including data review, initial and escalated enforcement actions, and follow-up actions?				
7. Does the ERP indicate that data will be reviewed no later than 5 working days after its receipt?				
8. Does the ERP indicate that initial enforcement actions will be taken no more than 30 days after detection of a violation?				
9. Do the proposed time frames in the ERP for initial enforcement actions make sense? For example, will NOVs be issued more promptly than more stringent enforcement action?				
10. Does the ERP allow for strong enforcement action to be taken immediately in the event of a major violation?				
11. Does the ERP indicate that initial follow-up compliance activities (e.g., inspections, sampling) will occur no later than 30 to 45 days after taking initial enforcement action?				
12. If the violation persists, does the ERP specify that escalating enforcement actions will be taken 60 to 90 days after the initial enforcement action?				
C. Does the ERP identify by title the persons responsible for each enforcement response?				
1. Are the positions described in the ERP consistent with those described in the POTW's program implementation procedures and sewer use ordinance?				
2. Do the positions identified in the ERP allow enforcement actions to be initiated in a timely and effective manner?				
D. Is the POTW's responsibility to enforce all pretreatment standards and requirements reflected in the ERP?				

Requirement	YES	NO	N/A	Section Reference
1. Do the enforcement procedures in the ERP allow for final resolution of noncompliance? For example, is there a procedure to ensure that the same enforcement action will not be taken again and again without final resolution?				
2. Are the procedures identified in the ERP consistent with those contained in the program implementation procedures and sewer use ordinance?				
E. In general, are the relevant elements of the ERP referenced and incorporated into other sections of the implementation manual?				

Data Management and Recordkeeping

Any IU subject to pretreatment program reporting requirements is required to maintain records resulting from monitoring in a readily accessible manner for a minimum of 3 years (longer if during periods of any ongoing litigation). While the means for maintaining files is usually at the discretion of the POTW, all pretreatment activities should be documented and the documents maintained.

Types of IU records that the Control Authority should maintain ***include:***

Types of IU Records Retained

- Industrial waste questionnaire
- Permit applications, permits and fact sheets
- Inspection reports
- IU reports
- Monitoring data (including laboratory reports)
- Required plans (e.g., slug control, sludge management, pollution prevention)
- Enforcement activities
- **All** correspondence to and from the IU
- Phone logs and meeting summaries.

Types of POTW Records Retained

- Legal authority (e.g., SUO)
- Program procedures
- Program approval and modifications
- Copy of POTW NPDES permit(s)
- Local limits development
- ERP
- Correspondence to and from the EPA/State
- Annual reports to the Approval Authority
- Public notices
- Funding and resource changes
- Applicable Federal and State regulations
- IU compliance and permitting records

Tracking due dates, submissions, deficiencies, notifications, etc. and calculating effluent limitation noncompliance may be facilitated by a computerized data management system. Similarly, many Control Authorities use standardized forms (e.g., inspection questionnaires, chains-of-custody, field measurement records) and procedures (e.g., sampling, periodic compliance report reviews) to promote consistency and organization of program data.

In addition to specific IU records, Control Authorities should also maintain general program files that document specific program development and implementation activities that are not IU-specific. All information should be filed in an orderly manner and be readily accessible for inspection and copying by the EPA and State representatives or the public.

The pretreatment regulations specify that all information submitted to the Control Authority or State must be available to the public without restriction, except for confidential business information.

Substantial Modifications of POTW *Figure 30*

Pretreatment Programs (40 CFR §403.18)
1. Modifications that relax POTW legal authorities (as described in 40 CFR §403.8(f)(1)), except for modifications that directly reflect a revision to 40 CFR Part 403, and are reported pursuant to 40 CFR §403.18(d) - Approval procedures for nonsubstantial modifications;
2. Modifications that relax local limits, except for modifications to local limits for pH and reallocations of the Maximum Allowable Industrial Loading of a pollutant that do not increase the total industrial loadings for a pollutant, which are reported pursuant to 40 CFR §403.18(d) - Approval procedures for nonsubstantial modifications;
3. Changes to POTW's control mechanism, as described in 40 CFR §403.(f)(1)(iii);
4. A decrease in the frequency of self-monitoring or reporting required of industrial users;
5. A decrease in the frequency of industrial user inspections or sampling by the POTW;
6. Changes to the POTW's confidentiality procedures; and
7. Other modifications designated as substantial modifications by the Approval Authority on the basis that the modification could have a significant impact on the operation of the POTW's Pretreatment Program; could result in an increase in pollutant loadings at the POTW; or could result in less stringent requirements being imposed on Industrial users of the POTW.

Public Participation and POTW Reporting
Section 101(e) of the CWA establishes public participation as one of its goals, in the development, revision, and enforcement of any regulation, standard, effluent limitation, plan, or program established by the EPA or any State. The General Pretreatment Regulations encourage public participation by requiring public notices and/or hearings for program approval, removal credits, program modifications, local limits development and modifications, and IUs in SNC.

POTW pretreatment program approval requests require the Approval Authority to publish a notice (including a notice for a public hearing) in a newspaper of general circulation within the jurisdiction served by the POTW. All comments regarding the request, as well as any request for a public hearing must be filed with the Approval Authority within the specified comment period, which generally last 30 days.

The Approval Authority is required to account for all comments received when deciding to approve or deny the submission. The decision is then provided to the POTW and other interested parties, published in the newspaper with all comments received available to the public for inspection and copying.

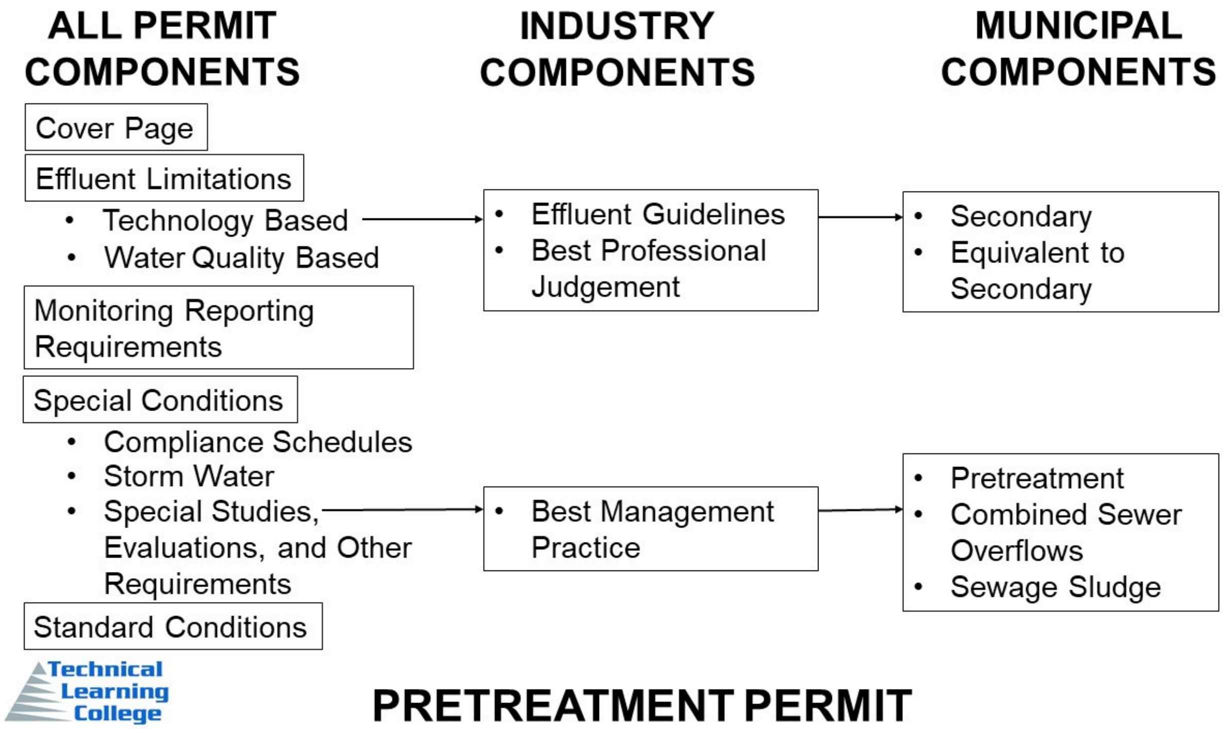
Once a local pretreatment program is approved, the Control Authority must implement that program as approved. Before there is a significant change in the operation of a POTW pretreatment program, a program modification must be initiated. For substantial program modifications (see Figure 30), the Control Authority is required to notify the Approval Authority of the desire to modify its program and the basis for the change. These changes become effective upon approval.

Approval Authorities (or POTWs) are required to give public notice of the request for a modification, but are not required to notify the public of the decision if no comments are received and the request is approved without changes. Nonsubstantial modifications must also be submitted to the Approval Authority for review and approval, but these changes do not require public notice.

And unlike substantial modifications, nonsubstantial modifications become effective 45 days after submission unless the Approval Authority notifies the POTW otherwise.

Annual Publication

The POTW is also required to provide annual publication, in the largest daily newspaper in the municipality in which the POTW is located, of IUs that at any time during the previous twelve months were in SNC. In accordance with 40 CFR §403.12(I), Control Authorities are required to submit annual reports to the Approval Authority documenting program status and activities performed during the previous calendar year.



At a minimum, these reports must contain the following information:
1. A list of all POTW's IUs including names, addresses, pretreatment standards applicable to each user, IUs subject to categorical pretreatment standards or a brief explanation of deletions and a list of additions (with the aforementioned information) keyed to a previously submitted list;
2. A summary of the status of the IU compliance during the reporting period;
3. A summary of compliance and enforcement activities (including inspections) conducted by the POTW during the reporting period;
4. A summary of changes to the POTW's pretreatment program that have not been previously reported to the Approval Authority; and
5. Any other relevant information requested by the Approval Authority.

The first report is due within one year after program approval and at least annually thereafter. Approval Authorities may require additional information, or require that the reports be submitted in a specific format and/or at an increased frequency (e.g., semi-annually).

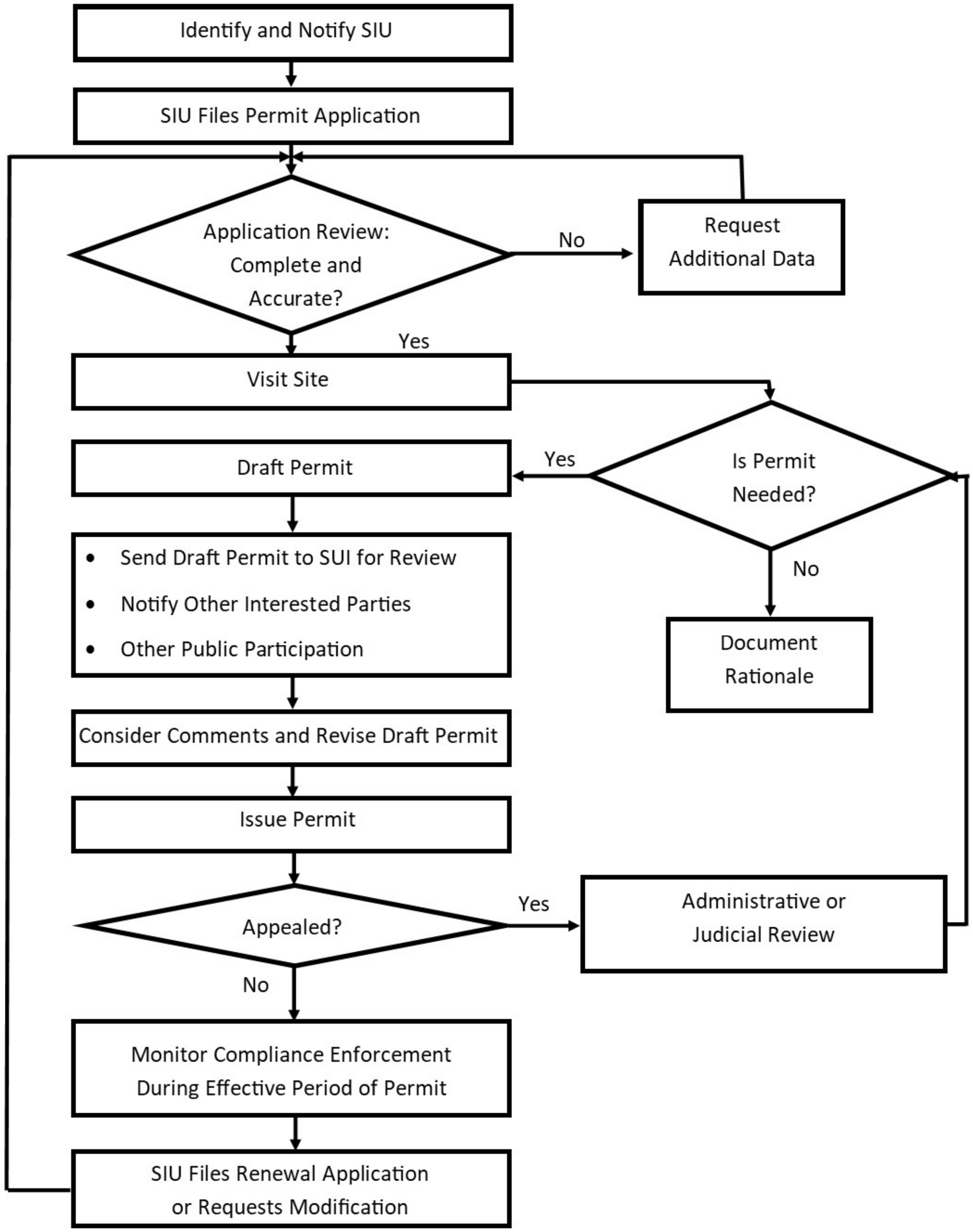


FIGURE 3-1. COMMON ELEMENTS OF AN INDIVIDUAL PERMIT ISSUANCE PROCESS

Industrial User Pretreatment Program Responsibilities
Industrial Users (**IUs**) are required to comply with all applicable pretreatment standards and requirements. Demonstration of compliance requires certain IUs to submit reports, self-monitor, and maintain records. A summary of the reporting requirements are provided, with details of each of these requirements discussed below.

Reporting Requirements
Minimum Federal Pretreatment Program reporting requirements for IUs are specified in 40 CFR §403.12. Since Control Authorities are responsible for communicating applicable standards and requirements to IUs and for receiving and analyzing reports, it is essential for Control Authority personnel to understand IU reporting and notification requirements contained in the General Pretreatment Regulations. These requirements are summarized below.

Categorical Industrial User (CIU) Reporting Requirements
Baseline Monitoring Report (BMR) [40 CFR §403.12(b)]

Each existing IU that is subject to a categorical pretreatment standard (identified as a Categorical Industrial User, or CIU) is required to submit a BMR within 180 days after the effective date of the standard.

If a category determination has been requested, the BMR is not due until 180 days after a final administrative decision has been made concerning the industry's inclusion in the category. The BMR must contain the following information:

- ➢ Name and address of the facility and names of the operator and owners.
- ➢ List of all environmental control permits held by, or for, the facility.
- ➢ Description of operations, including the average rate of production, and applicable Standard Industrial.

SIC Codes
Classification (**SIC**) codes, schematic process diagrams, and points of discharge to the POTW from regulated processes:

- ✓ Flow measurements (average daily and maximum daily) for regulated process wastestreams and nonregulated wastestreams, where necessary.
- ✓ Pollutant measurements [daily maximum, average concentration, and mass (where applicable)] and applicable standards.
- ✓ Certification, by a qualified professional (reviewed by a representative of the CIU), of whether applicable pretreatment standards are being met and, if not, a description of the additional operation and maintenance (O&M) or pretreatment facilities that are needed to comply with the standards.

A schedule by which the IU will provide the additional O&M or pretreatment needed to comply with the applicable pretreatment standards.

Is entry necessary?

Can the task be accomplished from the outside? For example, measures that eliminate the need for employees to enter confined spaces should be carefully evaluated and implemented if at all possible before considering human entry into confined spaces to perform non-emergency tasks.

BMRs

In addition to the certification noted above, BMRs must be signed and certified as detailed in 40 CFR §403.12(l) and as described later in this Chapter. If a CIU has already submitted the specific information required in a permit application or data disclosure form and this information is still current, it need not be reproduced and resubmitted in the BMR. The BMR is a one-time report, unless changed Federal categorical standards require submission of a new BMR.

At least 90 days prior to commencement of discharge, new sources are required to submit the above information (excluding the certification and compliance schedule), as well as information on the method that the source intends to use to meet the applicable pretreatment standards.

Compliance Schedule Progress Report [40 CFR §403.12(c)(3)]
A CIU that is not in compliance with applicable categorical standards by the time the standards are effective often will have to modify process operations and/or install end-of-pipe treatment to comply. Federal regulations require that the Control Authority develop and impose a compliance schedule for the CIU to install technology to meet applicable standards. As part of the BMR, a CIU that is unable to comply with the categorical standards must include a schedule for attaining compliance with the discharge standards.

In no case can the final or completion date in the schedule be later than the final compliance date specified in the categorical standards.

If deemed appropriate, the Control Authority may require compliance earlier than the final compliance date specified in the Federal regulations.

Compliance schedules are to contain increments of progress in the form of dates (not to exceed nine months per event) for commencement and completion of major actions leading to construction and operation of a pretreatment system and/or in-plant process modifications. Major activities could include hiring an engineer, completing preliminary analysis and evaluation, finalizing plans, executing a contract for major components, commencing construction, completion of construction, or testing operations.

In addition, the CIU must submit progress reports to the Control Authority no later than 14 days following each date in the compliance schedule (and final date for compliance), that include:

- A statement of the CIU's status with respect to the compliance schedule
- A statement of when the CIU expects to be back on schedule if it is falling behind, and the reason for the delay and steps being taken by the IU to return to the established schedule.

The Control Authority should review these reports as quickly as possible. When a CIU is falling behind schedule, the Control Authority should maintain close contact with the CIU. If the CIU fails to demonstrate good faith in meeting the schedule, the Control Authority may consider initiating appropriate enforcement action to correct the problem(s).

90-Day Compliance Reports [40 CFR §403.12(d) Section 403.12(d)] of the General Pretreatment Regulations requires a CIU to submit a final compliance report to the Control Authority.

An existing source must file a final compliance report within 90 days following the final compliance date specified in a categorical regulation or within 90 days of the compliance date specified by the Control Authority, whichever is earlier. A new source must file a compliance report to the POTW within 90 days from commencement of discharge.

These reports must contain:

Flow measurements (average daily and maximum daily) for regulated process wastestreams and nonregulated wastestreams, where necessary. Pollutant measurements [daily maximum, average concentration, and mass (where applicable)] and applicable standards.

Certification, by a qualified professional, reviewed by a representative of the CIU, of whether pretreatment standards are being met and, if not, a description of the additional operation and maintenance (O&M) or pretreatment facilities that are needed to comply with the standards.

In addition to the certification noted above, 90-day final compliance reports must be signed and certified as detailed in 40 CFR §403.12(l) and as described later in this Chapter.

Figure 31. Definition of Upset (40 CFR §403.16)
Upset is defined as an exceptional incident in which there is unintentional and temporary noncompliance with categorical standards due to factors beyond the reasonable control of the CIU. An upset does not include noncompliance to the extent caused by operational error, improperly designed or inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

CIUs are allowed an affirmative defense for noncompliance with categorical standards if they can demonstrate that the noncompliance was the result of an upset (Figure 31).

Conditions necessary to demonstrate an upset has occurred are detailed in 40 CFR §403.16 and require the CIU to submit at least an oral report to the Control Authority within 24 hours of becoming aware of the upset and containing the following information:

a description of the indirect discharge and the cause of the noncompliance the date(s) and times of the noncompliance steps being taken and/or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

If this notification is provided orally, a written report must also be submitted within five days.

In any enforcement action, the IU has the burden of proof in establishing that an upset has occurred. The EPA is responsible for determining the technical validity of this claim.

Categorical and Significant Industrial User (SIU) Reporting Requirements
Periodic Compliance Reports [40 CFR §403.12 (e) & (h)]

After the final compliance date, CIUs are required to report, during the months of June and December, the self-monitoring results of their wastewater discharge(s).

The Control Authority must also require semi-annual reporting from SIUs not subject to categorical standards. The EPA established a minimum frequency of once every six months, determining this to be adequate for small SIUs or other facilities that have little potential to cause pass-through or interference or to contaminate the sewage sludge.

Periodic Compliance Reports

The EPA assumed that larger IUs and those that have more potential to cause problems would be required by the Control Authority to sample and report more often. All results for self-monitoring performed must be reported to the Control Authority, even if the IU is monitoring more frequently than required. Periodic compliance reports must include:

- ✓ nature and concentration of pollutants limited by applicable categorical standards or required by the Control Authority.
- ✓ flow data (average and maximum daily) as required by the Control Authority.
- ✓ mass of pollutants discharged (applicable to CIUs where mass limits have been imposed).
- ✓ production rates (applicable to CIUs where equivalent limits have been imposed or where limits imposed are expressed in allowable pollutant discharged per unit of production).

A Control Authority may choose to monitor IUs in lieu of the IU performing the self-monitoring. Additionally, 40 CFR §403.12(e) and (h) require compliance with 40 CFR Part 136 (Guidelines for Establishing Test Procedures for the Analysis of Pollutants).

To demonstrate compliance with these requirements, IUs may have to submit information regarding sample handling and analytical procedures to the Control Authority. Development of standardized forms for use by IUs and their testing labs can facilitate documentation and submission of all required information and can streamline the IU and Control Authority review process.

Bypass [40 CFR §403.17] The General Pretreatment Regulations define ***"bypass"*** as the intentional diversion of wastestreams from any portion of a user's treatment facility. If a bypass results in noncompliance, even if it was due to essential maintenance, the IU must provide a report to the Control Authority detailing a description of the bypass and the cause, the duration of the bypass, and the steps being taken and/or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

Oral notice must be provided to the Control Authority within 24 hours of the detection of an unanticipated bypass, with a written follow-up due within 5 days. For an anticipated bypass, the IU must submit notice to the Control Authority, preferably 10 days prior to the intent to bypass.

Notification of Potential Problems [40 CFR §403.12(f)]
All IUs are required to notify the Control Authority immediately of any discharges which may cause potential problems. These discharges include spills, slug loads, or any other discharge which may cause a potential problem to the POTW.

Noncompliance Notification [40 CFR §403.12(g)(2)]
If monitoring performed by an IU indicates noncompliance, the IU is required to notify the Control Authority within 24 hours of becoming aware of the violation. In addition, the IU must repeat sampling and analysis, and report results of the re-sampling within 30 days.

The repeat sampling is not required if the Control Authority samples the IU at least once per month or if the Control Authority samples the IU between the time of the original sample and the time the results of the sampling are received.

Notification of Changed Discharge [40 CFR §403.12(j)]
All IUs are required to promptly notify the Control Authority in advance of any substantial changes in the volume or character of pollutants in their discharge.

Notification of Discharge of Hazardous Wastes [40 CFR §403.12(p)]

IUs discharging more than 15 kilograms per month of a waste, which if otherwise disposed of, would be a hazardous waste pursuant to the RCRA requirements under 40 CFR Part 261 are required to provide a one-time written notification of such discharge to the Control Authority, State, and the EPA.

IUs discharging any amount of waste, which if disposed of otherwise, would be an acutely hazardous waste pursuant to RCRA must also provide this notification. This written notification must contain the EPA hazardous waste number and the type of discharge (i.e., batch, continuous).

If the IU discharges more than 100 kilograms per month of the hazardous waste, the written notification must also include:

- ✓ An identification of the hazardous constituent in the IU's discharge,
- ✓ An estimate of the mass and concentration of the constituents in the IU's discharge, and
- ✓ An estimate of the mass and concentration of constituents in the IU's discharge in a year.

IUs must also provide a certification accompanying this notification that a waste reduction program is in place to reduce the volume and toxicity of hazardous wastes to the greatest degree economically practical.

Within 90 days of the effective date of the listing of any additional hazardous wastes pursuant to RCRA, IUs must provide a notification of the discharge of such wastes.

Signatory and Certification Requirements [40 CFR §403.12(l)]
Pursuant to 40 CFR §403.12(l), BMRs, 90-day compliance reports and periodic compliance reports from CIUs must be signed by an authorized representative of the facility and contain a certification statement attesting to the integrity of the information reported. The reports should be signed by one of the following:

- ✓ A responsible corporate officer if the IU is a corporation.
- ✓ A general partner or proprietor if the IU is a partnership or sole proprietorship.
- ✓ A duly authorized representative of the above specified persons if such authorization is in writing, submitted to the Control Authority and specifies a person or position having overall responsibility for the facility where the discharge originates or having overall responsibility of environmental matters for the facility.

As required in 40 CFR §403.6(a)(2)(ii), the certification statement must read as follows:
"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

While Federal regulations only require Control Authorities to require these signatures and certifications from CIUs, many POTWs have found it important to impose these requirements for all IU reports. To facilitate compliance, many Control Authorities have developed forms that include the certification statement and signatory requirements for use by all IUs.

Self-Monitoring Requirements

All SIUs, including CIUs must conduct self-monitoring as part of several different reporting requirements as noted above. For CIUs, this includes the BMR, 90-day compliance report and periodic compliance reports (40 CFR §§403.12(b),(d), and (e), respectively). Non-categorical SIUs are required to self-monitor as part of the periodic reporting requirements (40 CFR §403.12(h)). As noted in 40 CFR §§403.12(g)(4), sample collection and analysis for all required pretreatment program reports must be conducted using 40 CFR Part 136 procedures and amendments thereto.

Refer to Chapter 4 of this manual and the EPA's 1994 *Industrial User Inspection and Sampling Manual for POTWs* for additional information on sample collection and analysis procedures.

Based on the specific pollutants regulated by categorical standards, different types of samples may have to be collected. For BMR and 90-day compliance reports, a minimum of four grab samples must be collected for pH, cyanide, total phenols, oil and grease, sulfide, and volatile organics.

If these pollutants are not regulated by the specific categorical standard, monitoring is not required. Twenty-four hour flow-proportional composite samples must be collected for all other pollutants. The Control Authority may waive flow-proportional composite sampling if an IU demonstrates that flow-proportional is not feasible. In these cases, time-proportional composite samples may be collected.

Self-monitoring for periodic compliance reports must be conducted in accordance with the IU's discharge permit requirements. The Control Authority must ensure that these permits specify sampling location(s), required sampling frequencies, sample types to be collected, sampling and analytical procedures (40 CFR Part 136), and associated reporting requirements. At a minimum, CIUs must monitor for all categorically regulated pollutants at least once every six months, although permits issued by the local Control Authority may require more frequent monitoring.

TTO
In certain instances, CIUs subject to TTO standards may implement alternatives in lieu of monitoring all regulated toxic organic compounds.

TOMP
For example, the electroplating and metal finishing standards allow IUs to monitor only for those toxic organic compounds that are reasonably expected to be present. Additional TTO guidance related to the electroplating and metal finishing categories can be found in the EPA's 1984 *Guidance Manual for Electroplating and Metal Finishing Pretreatment Standard*s.

For certain industries (i.e., electroplating, metal finishing, and electrical and electronic components) Control Authorities have the option of allowing the CIU to prepare and implement a Toxic Organic Management Plan (TOMP) in lieu of periodic monitoring.

In those instances, the TOMP should identify all potential sources from which toxic organic materials could enter the wastestream and propose control measures to eliminate the possibility. Where a TOMP is allowed, an IU can demonstrate compliance through adherence to the TOMP and submission of periodic certification statements attesting to the fact that: *"no dumping of concentrated toxic organic pollutants has occurred and that the facility's TOMP is being implemented."*

TOMPs cannot be used in lieu of monitoring for BMRs and 90-day compliance reporting requirements. The categorical standards for some industries (i.e., aluminum forming, copper forming, coil coating, and metal molding and casting) allow IUs to monitor oil and grease (O&G) as an alternative to TTO monitoring.

This option may be used to fulfill TTO monitoring requirements of the BMR, 90-day compliance report, and periodic compliance reports and allows the IU to determine whether it wants to demonstrate compliance with the TTO or the O&G standards. A detailed description of TTO monitoring requirements is provided in the EPA's 1985 *Guidance Manual for Implementing Total Toxic Organics (TTO) Pretreatment Standard*s.

Recordkeeping Requirements

IUs are required to maintain records of their monitoring activities [40 CFR §403.12(O)]. Information, at a minimum, shall include the following:

- ✓ sampling methods, dates and times,
- ✓ identity of the person(s) collecting the samples and of the sampling location(s),
- ✓ the dates the analyses were performed and the methods used,
- ✓ the identity of the person(s) performing the analyses and the results of the analyses.

These records shall be retained for at least 3 years, or longer in cases where there is pending litigation involving the Control Authority or IU, or when requested by the Approval Authority.

These records must be available to the Control Authority and Approval Authority for review and copying. Historically, most Control Authorities do not dispose of any records; rather, older records are archived at an off-site location.

Database personnel are essential to the pretreatment data management operation.

Figure 32. Industrial User Reporting Requirements

REQUIRED REPORT AND CITATION	APPLY TO	REPORT DUE DATE	PURPOSE OF REPORT
Baseline Monitoring Report (BMR) *40 CFR §403.12(b)(1-7)*	CIUs	Existing Source - Within 180 days of effective date of the regulation or an administrative decision on category determination. New Source - At least 90 days prior to commencement of discharge.	- To provide baseline information on industrial facility to Control Authority - To determine wastewater discharge sampling points - To determine compliance status with categorical pretreatment standards
Compliance Schedule Progress Reports *40 CFR §403.12(c)(1-3)*	All IUs	Within 14 days of each milestone date on the compliance schedule; at least every 9 months.	- To track progress of the industrial facility through the duration of a compliance schedule.
90-Day Compliance Report *40 CFR §403.12(d)*	CIUs	Within 90 days of the date for final compliance with applicable categorical pretreatment standard; for new sources, the compliance report is due within 90 days following commencement of wastewater discharge to the POTW.	- To notify Control Authority as to whether compliance with the applicable categorical pretreatment standards has been achieved - If facility is noncompliant, to specify how compliance will be achieved.
Periodic Compliance Report *40 CFR §403.12(e)*	CIUs	Every June and December after the final compliance date (or after commencement of a discharge for new sources) unless frequency is increased by the Control Authority.	- To provide the Control Authority with current information on the discharge of pollutants to the POTW from categorical industries.
Notice of Potential Problems *40 CFR §403.12(f)*	All IUs	Notification of POTW immediately after occurrence of slug load, or any other discharge that may cause problems to the POTW.	- To alert the POTW to the potential hazards of the discharge.
Noncompliance Notification *40 CFR §403.12(g)(2)*	All IUs	Notification of POTW within 24 hours of becoming aware of violation.	- To alert the POTW of a known violation and potential problems which may occur.
Periodic Compliance Reports for Noncategorical Users *40 CFR §403.12(h)*	Non-Cat. SIUs	Every six months on dates specified by the Control Authority.	- To provide the POTW with current information on the discharge of pollutants to the POTW from industrial users not regulated by categorical standards.
Notification of Changed Discharge *40 CFR §403.12(j)*	All IUs	In advance of any substantial changes in the volume or character of pollutants in the discharge.	- To notify POTW of anticipated changes in wastewater characteristics and flow which may affect the POTW.
Notification of Hazardous Wastes Discharge *40 CFR §403.12(p)*	All IUs	For new discharges, within 180 days after commencement of discharge.	- To notify POTW, EPA, and State of discharges of hazardous wastes under 40 CFR Part 261.
Upset *40 CFR §403.16*	CIUs	24 hours of becoming aware of the upset (5 days where notification was provided orally)	- To notify the POTW of unintentional and temporary noncompliance with categorical standards.
Bypass *40 CFR §403.17*	All IUs	10 days prior to date of the bypass or oral notice within 24 hours of the IU becoming aware of the bypass with written notification within 5 days.	- To notify the POTW of noncompliance and potential problems which may occur

WASTEWATER CHARACTERISTICS & SPECIFIC SOURCES	
PHYSICAL	
SOLIDS	Domestic - Industrial Wastes / Soil Erosion / Inflow, etc.
COLOR	Industrial - Domestic Wastes / Natural Decaying of Organic Matter
ODOR	Industrial Wastes / Decomposition of Wastewater
CHEMICAL	
PHENOLS	Industrial Wastes
pH	Industrial Wastes
TOXIC COMPOUNDS	Industrial Wastes
HEAVY METALS	Industrial Wastes
PESTICIDES	Run-Off From Agriculture
BIOLOGICAL	/ Open Water Courses / Treatment Units, etc

CHART IDENTIFYING BASIC SOURCES AND CHARACTERISTICS OF WASTEWATER

This course contains general EPA's CWA federal rule requirements. Please be aware that each state implements wastewater/safety/environmental /building regulations that may be more stringent than EPA's regulations. Check with your state environmental agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to not be in non-compliance and do not follow this course for proper compliance.

Examples of Enforcement and Regulatory Letters

____
Contact Person

____
Company Name

____
Company Address

____
City, State, Zip

<u>Certified Mail</u>

<u>Return Receipt Requested</u>

OR

Hand Delivered

Rec'd by _______________Date__________
Company Name

<u>NOTICE OF VIOLATION</u>
RE: Reporting

Wastewater Discharge Permit# ________________issued to____________________________
Permit issue No. Company Name
requires _______________________________________to submit______________________
Company Name Type of Report
reports to the City of Sunflower____________________________________
Qualification of Report
The report submitted by _____________________________________on________________
Individual or Company Name Date Received by E &
for____________________________was due on _________________, ______________
Description or Violation Date Number
days late. ______________________________is therefore in violation with its permit.
Company Name

_____________________________is required to submit to the Enforcement Company Name
and Monitoring Section a written report outlining the reason(s) for failure to meet this

requirement and detailing the corrective action(s) taken to prevent future violations.

This receipt must be received by____________________
Mailing date + 15 Days (ESTABLISHED BY SECRETARY)

Failure to comply with the requirements of this letter will subject__________________________
Company Name
to further enforcement action(s). This Notice does not preclude the City from taking additional

enforcement action(s) under Chapter 10 of the Sunflower City Code.

Should you have any questions regarding this Notice, please contact Water Quality Division at 474-8888. Our office hours are 7:00 a.m. to 3:30 p.m., Monday through Friday.

Sincerely,

____
Name of Inspector

____
Title

____
Department

Date

____
Representative

____
Company

____
Address

____
City, State, Zip

Dear__________________________:
Representative

Re: **NOTICE OF VIOLATION NO**. ____
Nov No. Assigned

Thank you for submitting the ____
Analysis, Report

required by the Notice of Violation (**NOV**) dated___________________________________,
Date

covering the ____violations (s).
Parameter (s)

____has met all the requirements of
Company
this Notice of Violation and no further action is required at this time. This letter does not preclude the City from taking additional enforcement action(s) under Chapter 10 of the Sunflower City Code.

Should you have any questions regarding this letter, please contact the Water Quality Division at 474-8888. Our office hours are 7:30 a.m. to 3:30p.m. Monday through Friday.

Sincerely,

____
Inspector

____
Title

NOTICE TO SHOW CAUSE

________________________________has been previously notified of _________________________ violations. In light of the pretreatment violations identified in the attached Notice)s) and in this Notice to Show Cause, the City of Sunflower, acting as the Control Authority pursuant to the legal authority established by Title 40, Code of Federal Regulations, Part 403, and in accordance with Chapter 10 of the Sunflower City Code, hereby notifies

_______________________________of its intent to utilize all appropriate

remedies to address these pretreatment violations. These remedies include monetary penalties.

Representatives from ____are required

to attend a Meeting to Show Cause to be held at:

Place: Water Quality Conference Room
POTW Waste Water Treatment Plant
8111 W. Montebello
Sunflower, AZ 85296

Date: __________, _________________

Time: _______________

During the Show Cause meeting, ______________________________________will be given the opportunity to respond to the allegations stated below and will be asked to show cause why the City should not seek monetary and / or other penalties in response to the following:

During the time period referred to above,

_____________________________ discharged in violation of its permit on at least _________ occasion(s).

A____________________ report was submitted ________days late.

A 24 Hour Notification was __________days late.

It is hereby requested that_______________________________________ have in Attendance at this meeting persons knowledgeable about the matters alleged in this Notice as well as persons having decision making authority. Your representatives may be accompanied by legal counsel if you so desire.

A representative from the City Attorney’s office may be present at the meeting. Any written response to this Notice that you would like us to consider must be in my office on or before_______________.

We would appreciate if you would let us know by____________________.

A copy of the latest edition of the City's Civil Penalty Policy together with the Civil Penalty Calculation Worksheet is enclosed.

Your failure to appear will mean that the City of Sunflower will take all appropriate enforcement action it deems necessary based on the facts as outlined in this notice and attachments.

Should you have any questions regarding this notice, please contact Water Quality Division at 474-8888. Our office hours are 7:00 a.m. to 3:30 p.m., Monday through Friday.

Sincerely,

Chris Binder,
Water Quality Supervisor

Company

<u>Certified Mail</u>

Hand delivered

NOTICE OF VIOLATION

RE: Permit Conditions

A review and evaluation of ___________________________’s ___________________

Report that was received on____________________________________, indicates that

your monthly analysis for____ was not included. The monthly analysis is required as indicated on your Wastewater Discharge Permit # _____________________, and also aids the City of Sunflower in determining compliance with the discharge standards.

____is therefore required to immediately

sample for _______________________and submit the analysis by _______________.

You are also required to submit a written report outlining the reason(s) for failure to meet this requirement and the corrective action(s) taken to prevent future violations.

This written report must be submitted by_________________________.

Failure to comply with the requirements of this letter will subject ___________________ to further enforcement action(s). This notice does not preclude the City from taking additional enforcement action(s) under Chapter 10 of the Sunflower City Code.

Should you have any questions regarding this notice, please contact Water Quality Division at 474-8888. Our office hours are 7:00 a.m. to 3:30 p.m., Monday through Friday.

____

Inspector

____
Contact Person

____
Company Name

____
Company Address

____
City, State, Zip

Certified Mail

Return Receipt Requested

OR

Hand Delivered

Rec'd by ________________Date__________
Company Name

NOTICE OF VIOLATION

RE: Effluent Limits (City Monitoring)

The discharge to sewer from ____________________________________ exceeded the maximum
Company Name
Allowable limit for ______________________as established in your Wastewater Discharge
Effluent
Permit No. ____________________

Date	Parameter	Discharge Concentration	Discharge Limit

______________________________is required to submit to the Enforcement and Monitoring
Company Name
section a detailed written report outlining the reason(s) the violation(s) occurred and the corrective action taken to prevent future violations. This report (must be/was) (submitted/received) (by/on)

____
Mailing Date + 15 Days (ESTABLISHED BY SECRETARY)

Failure to comply with the requirements of this letter will subject __________________________
Company Name
to further enforcement action(s).

This Notice does not preclude the City from taking additional enforcement action(s) under Chapter 10 of the Sunflower City Code.

Should you have any questions regarding this notice, please contact Water Quality Division at 474-8888.

Our office hours are 7:30 a.m. to 3:00 p.m., Monday through Friday.

____
Name of Inspector

____
Title

Company

Re: **Wastewater Discharge Permit Renewal**

Dear:

A review of ____’s industrial waste

file indicates that your Wastewater Discharge Permit # _________________________,

for your _______________________________facility expires______________________

In order for a valid permit to be issued, the enclosed Industrial Waste Permit Application

must be properly filled out and returned to our office by___________________________.

Should you have any questions regarding these results, please contact Water Quality Division at 474-8888. Our office hours are 7:00a.m. to 3:30p.m., Monday through Friday.

Signature

Permit Appeals Process Example

(Section 7-88- Chapter 10, Sunflower City Code)

Any Permit applicant or Permittee (aggrieved party) may petition the Director to reconsider the conditions and limitations of a Permit issued or amended under the authority of Section 28-46(a) of the Sunflower City code by filing a petition for review with the Director within twenty (20) days of receipt of the Permit.

Failure to submit a timely petition for review shall be deemed to be a waiver of the administrative appeal.

In its petition, the aggrieved party must identify the Permit provisions objected to, specify in detail the reasons for objection, and present the alternative condition, if any, it seeks to place in the Permit.

The provisions of the Permit that are not objected to shall not be stayed pending the appeal.

If the Director fails to act within 30 days from receipt of the petition, it shall be deemed to be denied. Decisions not to reconsider the issued or amended Permit, not to issue a Permit, or not to amend a Permit shall be considered final administrative actions for purposes of judicial review.

The aggrieved party seeking judicial review of the final Permit decision may file a complaint with the Superior Court for Gila County, Arizona.

The petition for review should be addressed to:

Bill Walker, Superintendent
City of Sunflower
Pollution Control Division
8111 W. Montebello Ave
Sunflower, Arizona 85629

Zero Discharge Examples

May 8, 2024

Mr. Mike Ploughe
Plant Superintendent
Ploughe Products
8111 West Montebello Lane
Sunflower, Arizona 85027

RE: Class B Zero Process Discharge Permit inspection conducted by the City of Sunflower Pollution Control Division on July 12, 2015.

Dear Mr. Ploughe:

As per our phone conversation of July 18, 2015, the purpose of this letter is to clarify the findings listed in the inspection report, dated July 12, 2015. In the description of findings section of the inspection report, it was noted that "All hazardous wastes are shipped off site for disposal."

During the inspection it was noted that hazardous waste were in fact shipped off site for disposal from the former Ploughe Products (PP) location at 3632 West Heidi, Sunflower, Arizona. It was also noted that since PP relocated to 8111 West Montebello Lane, Sunflower, Arizona, no hazardous waste have been shipped off site for any reason.

Please be aware that your facility may be subject to solid or hazardous waste management requirements pursuant to the Federal Resource Conservation and Recovery Act (PL 94-580 as amended) and state hazardous waste management regulations.

The attached general material describes federal requirements for hazardous waste generators and transporters. This packet includes descriptions of hazardous waste management requirements, which may apply to your operation if it involves generating or transporting hazardous waste.

In order to insure that your operation comply with federal, state, and local hazardous waste management regulations, please review the enclosed material and consult the following agencies to determine all specific requirements that apply to your operation:

U.S. EPA
RCRA/Superfund
Washington, D.C.
Information Hotline
(800) 424-9346

Mr. Patrick Kuefler
Arizona Dept. of Environmental Quality
Hazardous Waste Compliance
3033 North Central Ave
Sunflower, AZ 85012
(602) 207-4105

Should you have any questions, please contact me at 474-8888. Our office hours are 8:00 a.m. to 5:00 p.m., Monday through Friday.

Sincerely,

Bill Fields
Water Quality Inspector

Ms. Melissa Durbin
Environmental/ Safety Manager
ACME Corporation
556 North 39th Avenue
Sunflower, Arizona 85093

July 10, 2021

RE: WARNER POWDER COATING FACILITY INSPECTION
556 N. 39TH AVENUE, SUNFLOWER, AZ. 85093

ACME CORPORATION FACILITY INSPECTION
4325 W. MONROE AVENUE, SUNFLOWER, AZ 85093

Dear Ms. Davis:

Thank you again for your time and cooperation during inspection of the above-referenced facilities conducted by the City of Sunflower Pollution Control Division (PCD) on June 1, 2021. Inspection reports are attached for your information.

Based on the inspection findings and review of previously submitted Industrial Wastewater Permit Applications for both Warner Coatings and Acme Corporation (dated October 11, 2001 and January 30, 2021, respectively), PCD has determined that:

1) Warner Technical and Acme Corporation are subject to Categorical Standards for Metal Finishing, pursuant to Title 40 Code of Federal Regulations Part 433 (Metal Finishing Point Source Category, copy attached);

2) Pursuant to Sunflower City Code Chapter 28 Article VI (Industrial User and Pretreatment Requirements, copy attached), Warner Technical and Acme Corporation must obtain a Class B Zero Process Discharge Permit and a Zero Categorical Process Discharge Permit, respectively; to discharge existing process and non-process wastewater to the City sanitary sewer system.

Presently, PCD is processing a Class B Zero Categorical Process Discharge Permit for each facility. As you requested during the inspections, all future correspondence regarding Warner Technical Coatings or Acme Corporation will be directed to Able Lopez (Warner Technical Coatings Production Manager) and Willie Clinton (Acme Corporation Manufacturing Coordinator), respectively.

Should you have any questions, please contact me at 534-3681. Our office hours are 8:00 a.m. to 5:00 p.m., Monday through Friday.

Sincerely,

Bill Fields
Senior Water Quality Inspector

Summary

Along with establishing self-monitoring requirements, the permit writer must specify reporting requirements in the permit. At least once every 6 months, SIUs are required to submit a characterization of their discharge.

These periodic compliance reports must contain the following:

- The concentration, or production and mass, of regulated pollutants in the Industrial User's effluent
- The measured or estimated average and maximum flow rates for the reporting period
- Documentation to evaluate compliance with any BMP or pollutant prevention requirements

In cases where the Control Authority conducts all the sampling and analysis and the Control Authority collects the flow data, the Control Authority might determine that the Industrial User does not need to submit a monitoring report.

If the Control Authority has chosen this alternative and is collecting all the data that would ordinarily be required from the Industrial User (e.g., flow data, production data) and at a frequency that would be expected of the user if it were conducting self-monitoring, the Control Authority may waive the requirement that the Industrial User report continuing compliance [40 CFR 403.12(g)].

In such a case, the Control Authority should explicitly state in the permit that periodic monitoring and reporting requirements are waived but still include a list of all applicable effluent limits in the permit. Even if the Control Authority has decided to waive an Industrial User's continued compliance reporting requirements, the Industrial User is still required to submit documentation required by the Control Authority to determine compliance with any BMP or pollution prevention alternatives.

The permit writer should review this table and include applicable reporting requirements in each permit. These reporting requirements can be placed in the permit together with any additional local reporting conditions.

The Control Authority must require appropriate reporting from Industrial Users. When drafting an Industrial User's reporting requirements, the permit should contain the following information in sufficient descriptive detail:

- *What* types of information are to be contained in each report (e.g., analytical data, flow data, or production data)

- *When* each report is to be submitted to the Control Authority (specifying the dates and frequency for submission)

- *Who* is responsible for signing and certifying the reports (e.g., an authorized corporate official)

- *Where* the reports are to be sent, including the Control Authority's address and, if appropriate, the name of the person responsible for receiving each report

- *How* the reports can be submitted to the Control Authority (e.g., electronic versus hardcopy submittals)

Post Quiz

1. The ERP regulations, at 40 CFR §403.8(f)(5), established a framework for POTWs to formalize procedures for investigating and responding to________________.

2. With an approved ERP in place, ____________________on a more objective basis and minimize outside pressures.

IU Compliance

3. Discharge permit limit exceedances, discrepancies, deficiencies, and lateness are ________________that must be resolved.

Definition of Significant Noncompliance (SNC) An IU is in SNC if its violation meets one or more of the following criteria (40 CFR 403.8(f)(2)(vii):

4. _________________ represents wastewater discharge limits, defined here as those in which sixty-six percent or more of all of the measurements taken during a six-month period exceed (by any magnitude**)** the daily maximum limit or the average limit for the same pollutant parameter.

5. Any other violation of a pretreatment effluent limit (daily maximum or longer-term average) that the Control Authority determines has caused, alone or in combination with other discharges, _________________________ (including endangering the health of POTW personnel or the general public);

6. Any discharge of a pollutant that has caused imminent endangerment to human health, welfare or to the environment or has resulted in the POTW's exercise of its ____________under 40 CFR § 403.8(f)(1)(vi)(B) of this section to halt or prevent such a discharge;

7. Failure to meet, within _____________ days after the schedule date, a compliance schedule milestone contained in a local control mechanism or enforcement order for starting construction, completing construction, or attaining final compliance;

8. Failure to provide, within ___________ days after the due date, required reports such as baseline monitoring reports, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules;

Summary

9. Along with establishing self-monitoring requirements, the ____________________must specify reporting requirements in the permit.

10. At least once every ________________ months, SIUs are required to submit a characterization of their discharge.

These periodic compliance reports must contain the following:

11. The concentration, or production and mass, of regulated pollutants in the__________________.

12. The measured or estimated ______________________for the reporting period.

13. Documentation to evaluate __________________with any BMP or pollutant prevention requirements.

14. In cases where the Control Authority conducts all the sampling and analysis and the Control Authority collects the flow data, the Control Authority might determine that the _________________ does not need to submit a monitoring report.

15. If the Control Authority has chosen this alternative and is collecting all the data that would ordinarily be required from the Industrial User and at a frequency that would be expected of the user if it were conducting self-monitoring, the __________________________may waive the requirement that the Industrial User report continuing compliance [40 CFR 403.12(g)].

16. Even if the Control Authority has decided to waive an Industrial User's continued compliance reporting requirements, the Industrial User is still required to submit documentation required by the Control Authority to determine compliance with any BMP or pollution prevention alternatives.

Answers

1. Instances of IU noncompliance, 2. POTWs can enforce against IUs, 3. All violations, 4. Chronic violations, 5. Interference or pass through, 6. Emergency authority, 7. 90, 8. 30, 9. Permit writer, 10. 6, 11. Industrial User's effluent, 12. Average and maximum flow rates, 13. Compliance, 14. Industrial User, 15. Control Authority, 16. BMP or pollution prevention alternatives

Chapter 8 - Pollution Prevention

Section Focus: You will learn the basics of the Clean Water Act, the need for pollution prevention plans. At the end of this section, you will be able to describe the need for pollution prevention. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: The CWA aims to prevent, reduce, and eliminate pollution in the nation's water in order to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters", as described in CWA section 101(a).

As the nation's environmental laws and regulations have developed over the past three decades, a new paradigm has shifted the approach to waste management. Initially, the EPA focused on managing the pollution generated through treatment and disposal in an environmentally safe manner. However, we have learned that conventional treatment and disposal can transfer pollutants from one medium to another with no net reduction. In striving to meet new and often more stringent environmental laws, industries have found ways to reduce or prevent pollution at the source.

Recognizing that source reduction is more desirable than treatment and disposal, the EPA now emphasizes preventing or eliminating the generation of waste. The Pollution Prevention Act of 1990 (PPA) established pollution prevention (referred to as “P2") as a national objective.

Pollution Prevention Act PPA
Pollution prevention is indirectly defined in the PPA as source reduction. Source reduction is any practice that reduces or eliminates the creation of pollutants. Thus, the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) is reduced prior to recycling, treatment, or disposal.

Source reduction can be achieved through equipment or technology modifications, process or procedural modifications, reformulation or redesign of products, substitution of raw materials, or improvements in housekeeping, maintenance, training, or inventory control.

The PPA established a pollution prevention hierarchy as national policy, declaring that:

- ✓ Pollution should be prevented or reduced at the source.
- ✓ Pollution that cannot be prevented should be recycled in an environmentally safe manner.
- ✓ Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner.
- ✓ Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

Thus, under the Pollution Prevention Act, recycling, energy recovery, treatment, and disposal are not included within the definition of pollution prevention. However, some practices commonly described as "in-process recycling" may qualify as pollution prevention. Although recycling is not pollution prevention, as indicated in the hierarchy, it is the next desirable practice where pollution cannot be prevented or reduced.

Recycling conducted in an environmentally sound manner shares many of the advantages of prevention, for it can reduce the need for treatment or disposal and conserve energy and resources.

OPPTS

The EPA's Office of Pollution Prevention and Toxic Substances (OPPTS) developed a pollution prevention strategy for incorporating pollution prevention concepts into the EPA's ongoing environmental protection efforts.

The specific objectives of the strategy are to provide guidance and direction for efforts to incorporate pollution prevention within the EPA's existing regulatory and non-regulatory programs, and to set forth an initiative to achieve specific objectives in pollution prevention within a reasonable time frame.

The EPA's numerous activities include the following:

- ✓ Coordinating development of regulations that will help identify the potential for multi-media.
- ✓ Prevention strategies that reduce end of pipe compliance costs.
- ✓ Examining the use of pollution prevention in enforcement actions and negotiations.
- ✓ Investigating the feasibility of overcoming identified regulatory barriers to encourage cost effective (source reduction) strategies.
- ✓ Working with State and local governments and trade associations to promote pollution prevention among small and medium size businesses that often lack the capital to make changes.
- ✓ Investing in outside programs, usually States, by providing grant funds for the reduction of target chemicals, the agricultural and transportation industry, etc.
- ✓ Providing scientific and technical knowledge necessary to implement pollution prevention. initiatives on a cross media basis, pursuant to the Pollution Prevention Research Strategic Plan.

Pollution Prevention and the Pretreatment Program

Although pollution prevention is not a required element of the National Pretreatment Program, source reduction is not new to the Program.

The Pretreatment Program is designed to prevent toxic pollutants from being discharged to POTWs through controls on the sources that discharge these pollutants. Thus, pollution prevention may be considered an extension of current pretreatment program implementation activities.

For example, Pretreatment Programs have the authority to require and enforce waste management practices in order to meet NPDES permit requirements and eliminate interference with treatment facilities.

Requiring slug control plans and developing compliance schedules for improved operation and maintenance (O&M) procedures are examples of pollution prevention activities that have long been required by many Control Authorities. Other pretreatment program implementation tools available to make pollution prevention a more integral part of a pretreatment program include:

Inspections - Pretreatment personnel are usually quite familiar with processes performed at their local industrial facilities and have exposure to a variety of industries performing the same or similar processes; therefore, they can easily disseminate (non-confidential) information about actual pollution prevention measures implemented as well as identify new P2 opportunities.

Permits - Where local regulations allow, questions about pollution prevention measures and plans can be made part of the permit application process. Also, a permittee may be required to undergo a pollution prevention assessment and/or develop a pollution prevention plan as a condition of the permit.

Local limits - POTWs near or above maximum allowable headworks loadings may institute POTW wide-pollution prevention programs to reduce specific pollutants.

Enforcement negotiations - A pollution prevention audit may be required through a consent or compliance order, or implementation of pollution prevention measures may be required as part of a settlement.

Several Control Authorities have implemented these pollution prevention activities. For example, the City of Palo Alto, CA established a silver local limit for photoprocessors and Best Management Practices (BMPs) for automotive facilities. To reduce mercury loadings from dental offices, Western Lake Superior Sanitary Sewer District (WLSSD) in Duluth, MN developed and implemented pollution prevention BMPs.

These and many other POTWs that have successfully integrated pollution prevention into their pretreatment programs have become recognized environmental leaders in their communities.

While pollution prevention activities can be unique to each POTW, the following are key elements of successful pollution prevention programs:

Integrate pollution prevention into existing activities - POTWs that view pollution prevention as an enhancement (instead of an additional requirement) to their existing pretreatment programs make small modifications to existing pretreatment activities efficiently and effectively.

Start Small - POTWs that slowly phase in new pollution prevention activities overcome impediments such as limited resources and resistance.

- ✓ Decrease pollutant loadings to POTW that result in lower O&M costs and reduce or eliminate need for capital expenditures for POTW treatment plant expansions
- ✓ Enables continued or expanded growth in the community without harm to the environment.

Figure 34. Benefits of Pollution Prevention to POTWs

This approach enables pollution prevention activities to become an accepted integral part of the pretreatment program.

Define attainable goals and measure success - Short-term, narrowly focused efforts have a greater chance of succeeding. For example, POTWs have targeted a specific pollutant and group of industries, established specific pollution prevention activities, and monitored the progress and success of these activities. With each new success recorded, the benefits of pollution prevention are illustrated and the demand for further activities will grow.

Provide incentives - Incentives are effective tools for persuading users to investigate pollution prevention opportunities. POTWs have used a wide range of tools such as public recognition of pollution prevention achievements and reduction of regulatory requirements.

Benefits of Pollution Prevention

For both IUs and POTWs, pollution prevention has many benefits (Figures 34 and 35) that can be broadly categorized under tangible economic rewards and public goodwill and support.
For example, pollution prevention:

- ✓ Creates cost savings
- ✓ Enhances process efficiency
- ✓ Avoids or reduces regulatory costs
- ✓ Reduces future liabilities
- ✓ Improves protection of worker health
- ✓ Improves public image.

Figure 35. Benefits of Pollution Prevention to IUs

Common impediments include the following:

Technology

- ✓ Decrease product quality.
- ✓ Unable to change raw materials because of currently available technology.

Financial

- ✓ Incur high costs associated with implementing alternatives (i.e., new equipment or materials, or personnel and training).
- ✓ Loss due to downtime during switch overs and startups.
- ✓ Foreign competitors may have an economic advantage if they are not obligated to comply with US regulations.
- ✓ Binding contracts with existing waste haulers and Treatment, Storage and Disposal (**TSD**) facilities may exist.

Organizational

- ✓ Lack of or poor communication between persons possessing the knowledge and ideas for improvements and those that can actually implement the changes.
- ✓ Limited personnel or internal resources available to investigate and/or make changes.
- ✓ Lack of coordination and cooperation among divisions in the corporation.

Behavioral

- ✓ Alternatives may be considered inconvenient by personnel (e.g., dry sweeping then a wet wash down as opposed to just a wet wash down).

Regulatory

- ✓ Elimination of regulated wastewater discharges, and hence, monitoring requirements.
- ✓ Reduced paperwork requirements for waste hauling and treatment.
- ✓ Compliance with RCRA reports on waste reduction (i.e., companies generating RCRA wastes are required to certify that they have a program to reduce the volume and toxicity of hazardous waste generated).
- ✓ Compliance with land disposal restrictions and bans.

Environmental

- ✓ Minimization of material emissions to all media resulting in reduced health risks to workers and the community.

Financial

- ✓ Reduced landfill and treatment costs due to less waste being generated (includes reduced transportation costs as well).
- ✓ Reduced raw material and manufacturing costs (e.g., by preventing spills or leaks, improving equipment maintenance and inventory control techniques, reuse, etc. raw materials are handled more efficiently and do not have the chance to become waste. With a greater percentage of raw material going into process, raw material use goes down in relation to volume of product produced).
- ✓ Increased manufacturing efficiency and productivity and improved product quality with fewer offspec products.

Compliance and public relations

- ✓ Achieving compliance with local limits and categorical standards.
- ✓ Reducing waste and implementing best management practices can improve public and community relations.

Regulatory

- ✓ Concentrating a pollutant for recycling may classify it as a hazardous waste (e.g., silver). As such, an industrial user may choose to discharge the pollutant rather than be subject to regulations regarding the handling, treatment and disposal of a hazardous waste.

Paint separation and battery collection.

P2 Implementation

Although the numerous benefits make pursuing pollution prevention attractive, implementation of source reduction in some situations may not be possible. Before implementing a pollution prevention practice, the benefits and barriers of the potential opportunity must be evaluated.

Household Hazardous Wastes or Products: paints, cleaning supplies, solvents and other products.

Pollution Prevention Assistance

With the creation of the PPA came an abundance of pollution prevention related assistance. This includes direct technical assistance, training courses, and a variety of publications.

POTWs can find further information on integrating pollution prevention into their pretreatment programs in the EPA's 1993 *Guides to Pollution Prevention - Municipal Pretreatment Program*s. Specific industry trade associations and university technology transfer and outreach departments are usually aware of pollution prevention assistance materials, specific pollution prevention opportunities, and the costs and success of implementing these.

Some further sources that disseminate pollution prevention information include:

Pollution Prevention Information Clearinghouse (PPIC) - a free, non-regulatory clearinghouse available to the public which focuses on source reduction and recycling for industrial toxic wastes.

State Programs - provide technical assistance to conduct pollution prevention assessments, develop guidance manuals on conducting these assessments, actually conduct these assessments, provide assistance in developing POTW-wide pollution prevention plans, provide training for industry, State and POTW personnel, and offer grants for pollution prevention projects.

Envirosense - an on-line computer system of summary information for PPIC documents, includes pollution prevention news, upcoming events, and mini-exchanges (discrete pollution prevention topic areas, pollution prevention databases, and message centers).

National Institute of Standards and Technology (NIST) - an office of the Department of Commerce, NIST develops technology to improve product quality, modernize manufacturing processes, ensure product reliability, and facilitate rapid commercialization of products based on new scientific discoveries.

NIST web sites for different industry sectors are available. For example, the metal finishing web site (i.e., the National Metal Finishing Resource Center) is found at www.nmfrc.org.

How would you dispose of used oil filters?

Other P2 Related Subjects

- ✓ Primary EPA Model Ordinance Example
- ✓ Second Model Ordinance Example
- ✓ Grease Removal
- ✓ Combined Sewer Overflow (CSOs)
- ✓ Stormwater
- ✓ Concentrated Animal Feeding Operations CAFO

Toilet retrofit program are a part of pollution prevention program. Most cities are changing high water use toilets to low water use toilets 1.6 gallons to conserve water and the other big water conservation device is no-flush or waterless urinals.

Model Pretreatment Ordinance - Example

SECTION 10.400: PRETREATMENT PROGRAM

This section adopts by reference, the applicable regulations of Title 40 Code of Federal Regulations, Part 403, "General Pretreatment Regulations for Existing and New Sources of Pollution," and other applicable State and Federal laws, including but not limited to, the Clean Water Act. These regulations are herein referred to as General Pretreatment regulations.

10.401 PURPOSE AND APPLICABILITY

(1) Purpose

This section forms the basis of the City of Sunflower pretreatment program to regulate non-domestic discharges to its sewage collection and treatment facilities. Regulation of such discharges is necessary to prevent interference with the operation of the facilities, to prevent pass-through of the treatment facilities, and to prevent any other condition which would be incompatible with the facilities.

(2) Applicability

This section shall be applicable to all non-domestic dischargers to the City's POTW.

10.402 DEFINITIONS

(1) The following words and phrases shall have the meanings herein:

Act or "the Act" means the Federal Water Pollution Control Act, also known as the Clean Water Act, 33 U.S.C. Section 1251 et.seq.

Approval Authority means the Regional Administrator of the United States Environmental Protection Agency.

Approved Test Procedures means those procedures found at Title 40 Code of Federal Regulations, Part 136 and those alternate procedures approved by the Administrator of the United States Environmental Protection Agency under the provisions of Title 40.

Authorized Representative of User means a duly authorized representative of a user in accordance with the General Pretreatment Regulations.

BOD (biochemical oxygen demand) means the oxygen required for the biochemical degradation of organic material in five (5) days at twenty degrees Celsius (20^{o}C), expressed in milligrams per liter (mg/L), as determined by approved test procedures.

Categorical User means a user that is subject to the National Categorical Standards.

City means the City of Sunflower, Texas or any authorized person acting in its behalf.

Cooling Water means the water discharged from any system of condensation, such as air conditioning, cooling, and refrigeration systems.

COD (chemical oxygen demand) means the measure of the oxygen equivalent of the organic matter content that is susceptible to oxidation by a strong chemical oxidant, expressed in mg/L as determined by approved test procedures.

Composite sample means a sample resulting from the combination of individual aliquots taken at equal intervals based on increments of time, flow or both.

Control Authority means the City Manager, Director of Public Works or a duly authorized representative.

Control Point means point of access to a user's sewer where sewage monitoring can be done.

Dilution means the addition of any material, either liquid or nonliquid, or any other method to attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the national categorical standards or local limits set by this section.

Director means the City of Sunflower Director of Public Works or his authorized representative unless otherwise specified.

Domestic Sewage means water-borne materials normally discharged from sanitary conveniences of dwellings, including apartment houses and hotels, office buildings, factories and institutions, free from storm water, utility and process discharges. Normal domestic sewage means normal sewage for Sunflower, Texas, in which the average daily concentration of biochemical oxygen demand (BOD) and total suspended solids (TSS) are established at two hundred-fifty (250) mg/L each, on the basis of the normal contribution of twenty-hundredths (0.20) pounds per capita per day each, and in which the average daily concentration of chemical oxygen demand (COD) is established at four hundred-fifty (450) mg/L. It is further expressly provided that for the purpose of this section, any discharge that exceeds the above concentration of BOD, TSS or COD shall be classified as non-domestic and made subject to all regulations pertaining thereto, whether or not such discharge was partially of domestic origin.

Environmental Protection Agency (EPA) means the U.S. Environmental Agency, or where, appropriate, The Regional Water Management Division director, or other duly authorized official of said agency.

Existing Source means any source of discharge, the construction or operation of which commenced prior to the publication by EPA of proposed categorical pretreatment standards, which will be applicable to such source if the standard is thereafter promulgated in accordance with Section 307 of the Act.

General Pretreatment Regulations means Title 40 Code of Federal Regulations, Part 403, "General Pretreatment Regulations for Existing and New Sources of Pollution."

Grab sample means an individual sample collected without regard to flow in a time not to exceed fifteen minutes.

Headworks means the location where raw (untreated) sewage is introduced into the sewage treatment facilities.

Interference is as defined in the General Pretreatment Regulations.

Maximum Allowable Discharge Limit means maximum concentration of a pollutant allowed to be discharged at any time, determined from the analysis of any discrete or composite sample collected, independent of the industrial flow rate and the duration of the sampling event.

Monthly Average Limit means a discharge limit based on the average of the analytical results of all samples for a parameter taken during a calendar month using approved methods for both sampling and analysis.

National Categorical Standards means the pretreatment regulations of Title 40 of the Code of Federal Regulations, Chapter I, Subchapter N, "EPA Effluent Guidelines and Standards."

New Source shall mean the following:

(1) Any building, structure, facility or installation from which there is or may be a discharge of pollutants, the construction of which commenced after the publication of proposed Pretreatment Standards under Section 307(c) of the Act which will be applicable to such source if such standards are thereafter promulgated in accordance with that section, provided that:

(a) The building, structure, facility or installation is constructed at a site which no other source is located; or

(b) The building, structure, facility or installation totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or

(c) The production or wastewater generating processes of the building, structure, facility or installation are substantially independent of an existing source at the same site. In determining whether these are substantially independent, factors such as the extent to which the new facility is integrated with the existing plant, and the extent to which the new facility is engaged in the same general type of activity as the existing source should be considered.

(2) Construction on a site at which an existing source is located results in a modification rather than a new source if the construction does not create a new building, structure, facility or installation meeting the criteria of Title 40 CFR 403.3(k)(1)(ii) and Title 40 CFR 403.3(k)(1)(iii) but otherwise alters, replaces, or adds to existing process or production equipment.

(3) Construction of a new source as defined herein has commenced if the owner or operator has:

(1) Begun, or caused to begin as part of a continuous onsite construction program any placement, assembly, or installation of facilities or equipment; or significant site preparation work including

clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment; or

(2) Entered into a binding contractual obligation for the purchase of facilities or equipment which are intended to be used in its operation within a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss and contracts for feasibility, engineering, and design studies do not constitute a contractual obligation.

Noncontact cooling water means water used for cooling that does not come into direct contact with any raw material, intermediate product, waste product, or finished product.

Noncategorical User means a user that is not subject to the national categorical standards.

Non-domestic Sewage means a discharge to the POTW that is not domestic sewage.

Nonprocess flows means sewage that is not classified as domestic or process, such as noncontact cooling water, cooling tower blowdown, air conditioner condensates, and demineralizer blowdown.

Outfall means a discharge of sewage that is expressly identified by the Control Authority for control and monitoring purposes.

Overload means the imposition of mass or hydraulic loading on a treatment facility in excess of its engineered design capacity.

Pass-through means a discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the City of Sunflower NPDES permits, including an increase in the magnitude or duration of a violation.

Person means any individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity, or any other legal entity; or their legal representatives, agents, or assigns. This definition includes all Federal, State and local governmental entities.

pH means the logarithm (base 10) of the reciprocal of the hydrogen ion concentration.

Pollutant means dredged spoil, solid waste, incinerator residue, filter backwash sewage, garbage, sewage sludge, munitions, medical wastes, chemical wastes biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, municipal, agricultural and industrial wastes, and certain characteristics of wastewater (e.g., pH, temperature, TSS, turbidity, color, BOD, COD, toxicity, or odor).

POTW (Publicly Owned Treatment Works) means the sewage treatment works owned by the City of Sunflower. This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of sewage. It includes sewers, pipes, and other conveyances only if they convey sewage the City of Sunflower POTW.

Pretreatment means the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW. The reduction or alteration may be obtained by physical, chemical or biological processes, process changes or by other means, except as prohibited by 40 CFR 403.6(d).

Pretreatment Requirements means all of the requirements that are set forth in this ordinance.

Process Flow means sewage that is generated during manufacturing or processing, which comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product.

Removal is as defined in the General Pretreatment Regulations.

Sewage means solids, liquids, or gaseous materials discharged to the City's POTW. Sewage includes both domestic and non-domestic sewage.

Sewer (sanitary sewer) means an artificial pipe or channel that carries sewage and to which storm water and ground water are not intentionally admitted.

Significant User means a user that is: (1) subject to national categorical standards; (2) discharges an average of twenty-five thousand (25,000) gallons per day (gpd) or more of process flow to the POTW; (3) discharges of process flow which makes up five (5) percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant, or; (4) has a reasonable potential, in the opinion of the Control Authority, to adversely affect the POTW treatment plant.

Slug Load means any discharge at a flow rate or concentration which could cause a violation of the prohibited discharge standards stated herein.

Standard Industrial Classification (SIC) means a classification pursuant to the Standard Industrial Classification Manual issued by the Office of Management and Budget.

Storm Water means any flow occurring during or following any form of natural precipitation, and resulting from such precipitation, including snowmelt.

Surcharge means the additional wastewater service charge incurred by any user discharging waste containing higher concentrations of BOD, TSS and COD than those defined for domestic sewage herein.

To Discharge includes to deposit, conduct, drain, emit, throw, run, allow to seep, or otherwise release or dispose of, or to allow, permit or suffer any of these acts.

TSS (total suspended solids, nonfilterable residue) means solids that either float on the surface or are in suspension, measure at one hundred-three to one hundred-five degrees Celsius (103-105'C), expressed in mg/L, as determined by approved test procedures.

User means a discharger of any non-domestic sewage to the POTW. A user includes, but is not limited to, any individual, firm, company, partnership, corporation, group, association, organization, agency, city, county, or district.

The meaning of all terms used in this ordinance that are not defined above shall be as defined in Title 40, Code of Federal Regulations.

10.403 PRETREATMENT STANDARDS

There are three types of pretreatment standards: prohibited discharge standards - including general, specific, and dilution prohibitions; national categorical standards; and local limits. These standards shall apply to a user whether or not the user is subject to other federal, state, or local requirements.

The standards in this subsection shall apply to each user, as applicable. Users in an industrial manufacturing category specified in Title 40 of the Code of Federal Regulations Chapter I, Subchapter N, "EPA Effluent Guidelines and Standards,: shall be subject to prohibited discharge standards, national categorical standards, and local limits. Other users shall be subject to prohibited discharge standards and local limits. Where these standards overlap, the most stringent standard shall apply to the user.

The Control Authority, at his discretion, has the right to apply these standards to individual non-domestic discharges before they are commingled.

(1) Prohibited Discharge Standards

(a) General Prohibitions

A user may not discharge to the POTW any material which causes pass-through or interference.

(b) Specific Prohibitions

The following shall not be discharged to the POTW:

(i)Discharges which are capable of creating a fire or explosion hazard in the POTW. These discharges include, but are not limited to, discharges with a closed cup flashpoint of less than one hundred forty degrees Fahrenheit (140^{o}F), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in ASTM (American Society for Testing and Materials) standard D-93-79 or D-93-80K or a Seta flash Closed Cup Tester, using the test method specified in ASTM standard D-3278-78;

(ii)Discharges which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.5 or greater than 9.5;

(iii) Discharges containing solid or viscous materials in amounts which will cause obstruction to the flow in or proper operation of the POTW resulting in interference. Discharges shall not contain any materials such as wax, grease, oil, or plastics that will solidify or become discernibly viscous

at temperatures between thirty-two and one hundred-fifty degrees Fahrenheit (32-150°F). Discharges shall not contain petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through. Discharges shall not contain any materials such as ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, whole blood, paunch manure, hair and fleshings, entrails, lime slurry, lime residues, slops, chemical residues, paint residues or bulk solids in such quantities capable of causing interference with the POTW. Discharges shall not contain free or emulsified oil and grease in combination exceeding one hundred (100) mg/L;
(iv) Discharges having a temperature higher than one hundred-fifty degrees Fahrenheit (150°F) (sixty-five degrees Celsius, 65°C), or any discharge which contains heat in amounts which will inhibit biological activity or cause interference with the POTW, but in no case heat in such quantities that the temperature at the headworks of the POTW exceeds one hundred-four degrees Fahrenheit (104°F) (forty degrees Celsius, 40°C);
(v) Discharges that contain any noxious or malodorous materials which can form a gas, which either singly or by interaction with other discharges, are capable of causing objectionable odors; or hazard to life; or creates any other condition deleterious to the POTW; or requires unusual provisions, attention, or expense to handle;

(vi) Discharges which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute workers health and safety problems;
(vii) Discharges that are capable of causing excessive discoloration in the POTW effluent;
(viii)Discharges with unusual flow and concentration, including those with oxygen demanding materials, at a flow rate or concentration which will cause interference with the POTW, or if such materials can cause damage to collection facilities, impair the treatment processes, incur excessive treatment cost, or cause the City to be noncompliant with the conditions of its discharge permits;

(ix) Discharges containing a BOD (biochemical oxygen demand) or TSS (total suspended solids) concentration in excess of 7,000 mg/L;
(x) Discharges classified by the Texas Natural Resource Conservation Commission as hazardous waste at 31 TAC (Texas Administrative Code) Chapter 335 without the written approval of the Control Authority;
(xi) Discharges containing radioactive materials without the written approval of the Control Authority;

(xii) Materials that are trucked or hauled in, except at discharge points that are designated by the Control Authority; or
(xiii) Discharges from steam cleaning and chemical cleaning businesses unless a facility or process is provided that will produce an effluent compliant applicable Pretreatment Requirements. There shall be no discharge of visible foam.

(c) <u>Dilution Prohibitions</u>
(i) No user shall ever add any material, either liquid or nonliquid, or in any other way attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the national categorical standards or local limits.
(ii) This prohibition does not include dilution which is a normal part of the production process or a necessary part of the process to treat a waste, such as adding lime for neutralization or precipitation, or the mixture of compatible wastes in order to treat at capacity levels rather than treating wastes in small batches.
(iii) The Control Authority, at his discretion, may impose mass limitations on a user that is using dilution to meet applicable pretreatment standards or requirements, or in cases where the imposition of mass limitations is appropriate.

(2) National Categorical Standards
National Categorical standards apply to specific industrial subcategories under Title 40 of the Code of Federal Regulations, Chapter I, Subchapter N, "EPA Effluent Guidelines and Standards." A user that falls into one of these subcategories shall be subject to the pretreatment standards applicable to that subcategory and is classified as a categorical user.

(3) Local Limits
Local limits are quantitative limits on discharges applicable to all users. Local limits are designed to meet the general and specific prohibitions in 10.403(1)(a) and (b) of this ordinance.

(a) Existing Local Limits
Local limits are periodically reviewed by the Control Authority and revised as necessary to respond to changes in federal, state, or local regulations, environmental protection criteria, plant design and operational criteria, and the nature of industrial discharges to the POTW. Local limits are as follows:

Constituent*	Maximum Allowable Concentration in a Daily Composite, mg/L
Cadmium	0.2
Chloroform	4
Chromium (total)	17
Copper	3.5
Ethyl benzene	16
Lead	0.5
Naphthalene	15
Nickel	4.5
Silver	0.07
Tetrachloroethylene(perchloroethylene)	5
Toluene	14
Zinc	3.8
	***limits for metals based on unfiltered samples**

(b) Case-by case Local Limits
Local limits that have not yet been established for a material may be developed on a case-by-case, user specific basis. A user must have the case-by-case local limit(s) included in a permit before discharging to the POTW.

10.404 SIGNIFICANT USERS
(1) Option to Exclude Noncategorical Users
The Control Authority need not list as significant any noncategorical user that, in the opinion of the Control Authority, has no potential for adversely affecting the POTW's operation or for violating any of the Pretreatment Requirements.
(2) Delisting of Noncategorical Users
Any noncategorical user that has been listed as a significant user may petition the Control Authority to be removed from the significant user list and reclassified as nonsignificant on the grounds that it has no potential for adversely affecting the POTW's operation or for violating any of the Pretreatment Requirements.
(3) Notification Requirements

If a noncategorical user has been listed as a significant user by the control Authority for whatever reason, prior to removal from the list, the control Authority will notify the Approval Authority.

10.405 Discharge Permits

(1) Applicability

All users shall obtain a permit from the Control Authority in order to discharge non-domestic sewage to the City's POTW. Permit applications shall be submitted to the Control Authority prior to permit issuance. Either the owner or operator of a user's facility shall submit the application.

(2) Denial or Condition of Permit

The Control Authority has the right to deny or condition a permit for any non-domestic discharges that do not meet the Pretreatment Requirements or would cause the City to be noncompliant with the conditions of the City's discharge permits.

(3) Permit Conditions

(a) Minimum Conditions

The permit will contain the following minimum conditions:

(i) Period during which the permit is effective, in no case greater than five years;

(ii) Transferability of the permit to a new owner or operator allowable only with notification and approval of Control Authority;

(iii) Limits on the volume and quality of sewage discharged based on the Pretreatment Standards;

(iv) Requirements for self-monitoring programs such as location, type, and frequency of sampling, measurement, and analysis; and

(v) Requirements for notifications, reports, and recordkeeping.

(vi) A statement of applicable civil and criminal penalties for violation of pretreatment standards and requirements, and any applicable compliance schedule. Such schedules may not extend the compliance date beyond applicable federal deadlines.

(b) Other Conditions

The following conditions, as applicable, will be in the permit:

(i) Conditions and compliance schedule necessary to achieve compliance with the Pretreatment Requirements.

(ii) Plans to prevent and control spills and batch discharges;

(iii) Any other conditions necessary to ensure compliance with the Pretreatment Requirements, and other federal, state and local requirements, and;

(vi) A statement requiring that all reports contain the certification statement at 40 CFR 403.6(a)(2).

(4) Permit Application Form

Applications for new permits, permit renewals, and permit modifications shall be made on a standard form provided by the Control Authority. Applications shall be submitted to the Control Authority.

(5) Existing Users

Significant users with existing non-domestic discharges prior to March 14, 1990, shall submit a permit application before September 15, 1990. Other users with existing non-domestic discharges prior to March 14, 1990 shall submit a permit application before June 15, 1990. Existing users shall be allowed to discharge non-domestic sewage without a permit until the Control Authority has issued the user a permit, if the user has submitted a permit application with the applicable time period.

(6) New Users

A new user shall submit a permit application and obtain a permit before discharging to the POTW. An application shall be submitted by significant users at least one hundred eighty (180) days before the date the discharge will begin. It is recommended that an application be submitted by other user at least ninety (90) days before the date the discharge will begin.

(7) Discharge and Permit Modifications

If a user with a discharge permit wishes to add or change a process or operation which would change the nature or increase the quantities of materials discharged to the POTW such that the user would be noncompliant with the user's permit requirements or the Pretreatment Requirements, the user shall obtain approval by the Control Authority prior to making these additions or changes to the discharge. Approval shall be given by the Control Authority by a modification, or revocation and re-issuance of the permit. A significant user shall submit an application for permit modification at least one hundred eighty (180) days before the date the change in discharge is expected to begin. It is recommended that an application be submitted by other users at least ninety (90) days before the date the change in discharge is expected to begin.

(8) Permit Renewal

A permit may have a period of duration up to five (5) years. A permit shall be renewed by submitting an application for renewal. An application shall be submitted by significant users at least one hundred eighty (180) days before the expiration date of the existing permit. An application for other users shall be submitted at least ninety (90) days before the expiration date of the existing permit.

(9) Re-opening of Permit

The Control Authority has the right to re-open a permit before its expiration date to include compliance schedules, or to achieve compliance with new or revised Pretreatment Requirements, federal, state, or local requirements.

(10) Changes in Owner or Operator

(a) Transfer of Permit

A permit shall only be transferred to a new owner or operator if the following conditions are met. The expiration date of the permit is not extended by the transfer. The control Authority will send to the owner or operator a revision to the permit to reflect the change in owner or operator.

(i) The nature of the discharge or operation of the facility will not change under the new owner or operator;

(ii) The current owner or operator notifies the Control Authority at least thirty (30) days in advance of the proposed transfer date;

(iii) The notification includes a written agreement between the current and new owner or operator continuing a specific date for transfer of permit responsibility, coverage, and liability between them; and

(iv) The Control Authority does not notify the current and new owner or operator of the Control Authority's intent to revoke and reissue the permit. If the Control Authority does not notify, the transfer is effective on the date specified in the written agreement.

(b) Revocation and Re-issuance of Permit

If above conditions in paragraph (a) are not met, the Control Authority shall require the new owner or operator to submit a permit application as a new user and obtain a permit before discharging to the POTW. In addition, the current owner or operator shall notify the Control Authority at least thirty (30) days in advance of the proposed date on which the ownership will change.

10.406 REMOVAL CREDITS

(1) The Control Authority may, at his discretion, grant removal credits to a categorical user to reflect removal by the POTW of materials specified in the national categorical standards. The Control Authority may grant a removal credit equal to or, at his discretion, less than the POTW's consistent removal rate. Removal credits may only be given for indicator or surrogate materials regulated in a national categorical standard if the standard so specifies.

(2) A user shall submit a removal credit application to the Control Authority. Written approval by the Control Authority shall be obtained prior to taking the removal credit. Application shall be made on a standard form provided by the Control Authority.

(3) The Control Authority has the right to grant removal credits only after meeting the requirements of the General Pretreatment Regulations.

10.407 NOTIFICATION REQUIREMENTS

Notification to the Control Authority is required for any of the following. The timing, content, and form of notification are established either in the discharge application or discharge permit, as applicable.

(1) A condition or event that would cause pass-through of or interference with the POTW, including slug loadings as defined by 10.402 and 10.403 herein.

(2) Permit noncompliance.

(3) Bypasses and upsets.

(4) A change in pretreatment processes.

(5) A change in monitoring facilities such as location and type of equipment.

(6) Discharges of hazardous waste.

(7) Discharges containing radioactive materials.

(8) Other appropriate conditions or events to ensure compliance with the Pretreatment Requirements, and other federal, state, or local requirements.

10.408 REPORTING REQUIREMENTS

(1) Baseline Report

Categorical users shall submit baseline reports in accordance with the General Pretreatment Regulations.

(a) Within either one hundred eighty (180) days after the effective date of the categorical pretreatment standard, or the final administrative decision on a category determination under 40 CFR 403.6(a)(4), whichever is later, existing categorical users currently discharging to or scheduled to discharge to the POTW shall submit to the Control Authority a report which contains the information listed in paragraph (b) below. At least ninety days prior to commencement of their discharge, new sources, and sources that become categorical users subsequent to the promulgation of an applicable categorical standard, shall submit to the Control Authority a report which contains the information listed in paragraph (b) below. A new source shall report the method of pretreatment it intends to use to meet applicable categorical standards. A new source also shall give estimates of its anticipated flow and quantity of pollutants to be discharged.

(b) Users described above shall submit the following:

(i) Identifying Information - The name and address of the facility, including the name of the operator and owner.

(ii) Environmental Permits - A list of any environmental control permits held by or for the facility.

(iii)Descriptions of Operations - A brief description of the nature, average rate of production, and standard industrial classifications of the operation(s) carried out by such user. This description should include a schematic process diagram which indicates points of discharge to the POTW from the regulated processes.

(iv) Flow Measurement - Information showing the measured average daily and maximum daily flow, in gallons per day, to the POTW from regulated process streams and other streams, as necessary, to allow use to the combined wastestream formula.

(v) Measurement of Pollutants - The categorical pretreatment standards applicable to each regulated process. The results of sampling and analysis identifying the nature and concentration, and/or mass, where required by the standard or by the Control Authority, of regulated pollutants in the discharge from each regulated process. Instantaneous, daily maximum, and long-term average concentrations, or mass, where required, shall be reported. The sample shall be representative of daily operations and shall be collected and analyzed in accordance with procedures set out in 40 CFR 136.

(vi) Signature and Certification - All baseline monitoring reports must be signed and certified in accordance with 40 CFR 403.6 (a)(2).

(2) Compliance Schedule Progress Reports

(a) Should additional pretreatment or operation and maintenance be required to meet pretreatment standards, a compliance schedule will be issued. The schedule shall contain

progress increments in the form of dates for the commencement and completion of major events leading to the construction and operation of additional pretreatment facilities required for the user to meet the applicable pretreatment requirements.
(b) No increment shall exceed nine months;
(c) The user shall submit a progress report to the Control Authority no later than fourteen days following each date in the schedule and the final date of compliance. This report shall include as a minimum, whether or not the user complied with the progress increments, reasons for any delays, and steps being taken by the user to return to the established schedule;
(3) Reports on Compliance with Categorical Pretreatment Standard Deadline
Within ninety days following the date for final compliance with applicable categorical pretreatment standards, or in the case of a new source following commencement of the introduction of wastewater into the POTW, any user subject to such pretreatment standards and requirements shall submit to the Control Authority a report containing the information described in 10.408(1)(b) herein. For users subject to equivalent mass or concentration limits established in accordance with 40 CFR 403.6(c), this report shall contain a reasonable measure of the user's long-term production rate. For all other users subject to categorical pretreatment standards expressed in terms of allowable pollutant discharge per unit of production this report shall include the user's actual production during the appropriate sampling period. All compliance reports must be signed and certified in accordance with 40 CFR 403.6(a)(2). Categorical users shall submit reports in accordance with the General Pretreatment Regulations on compliance schedule progress, compliance with categorical pretreatment standard deadlines, and continued compliance with categorical pretreatment standards.
(4) Periodic Reports on Continued Compliance
(a) All significant industrial users shall, at a frequency determined by the Control Authority but in no case less than twice per year, submit a report indicating the nature and concentration of pollutants and the estimated or measured daily maximum and average flows of the discharges to which pretreatment requirements are applicable. All periodic reports must be signed and certified in accordance with 40 CFR 403.6(a)(2).
(b) The Control Authority may require all other users and/or persons discharging non-domestic wastewater into the POTW to submit appropriate reports concerning the nature and concentration of pollutants in the discharge.
(5) Reports of Additional Samples Taken
If a user subject to pretreatment requirements monitors any pollutant more frequently than required using approved test procedures, the results of this monitoring shall be included in the periodic reports.
(6) Repeat Sampling and Reporting
If sampling performed by a user indicates a violation, the user must notify the Control Authority with twenty-four (24) hours of becoming aware of the violation. The user shall also repeat the sampling and analysis and submit the results of the repeat analysis to the Control Authority within thirty (30) days after becoming aware of the violation.
(7) Sample Collection and Monitoring Requirements
All sampling techniques and pollutant analyses used for compilation of data required to be submitted as part of a wastewater discharge application or report required by any pretreatment requirement shall be performed in accordance with the techniques prescribed in Title 40, Code of Federal Regulations, Part 136 unless otherwise specified in an applicable categorical pretreatment standard.
(8) Additional Reports
The Control Authority has the right to request any additional reports from a user that are necessary to assess and assure compliance with the Pretreatment Requirements.
(9) Record Keeping
(a) Users subject to the reporting requirements of this ordinance shall retain, and make available for inspection and copying, all records of information obtained pursuant to any monitoring

activities required by this ordinance and additional records obtained pursuant to monitoring activities undertaken by the user independent of such requirements.
(b) Records shall include the date, exact place, method, and time of the sampling and the name of the person(s) taking the sample; dates analyses were performed; who performed the analyses; the analytical techniques or methods used; and the results of the analyses.
(c) Records shall remain available for a period of at least three (3) years. This period shall be automatically extended for the duration of any litigation concerning the user of the Control Authority, or where the user has been specifically notified of a linger retention period by the Control Authority.

10.409 PRETREATMENT FACILITIES
Users shall provide pretreatment facilities if they are necessary in order to comply with the pretreatment standards in 10.403 of this ordinance.
(1) Approval of Proposed Pretreatment Facilities
Plans, specifications, and any other pertinent information related to proposed pretreatment facilities for significant users shall be submitted to the Control Authority. Other users may be requested by the Control Authority to submit plans, specifications, and any other pertinent information related to proposed pretreatment facilities. Construction of such facilities prior to acceptance by the Control Authority may be done solely at the risk of the user. This acceptance shall in no way relieve the user of the obligation to install, operate, maintain and, if necessary, modify the pretreatment facilities to maintain compliance with the Pretreatment Requirements. Pretreatment facilities shall be constructed so as to provide the following:
(a) Prevention of prohibited discharges from entering a sewer;
(b) Control of the quantities and rates of discharge of non-domestic sewage into a sewer; and
(c) An accessible entry so that any authorized employee of the City may readily and safely inspect and monitor the non-domestic discharges.
(2) Pretreatment Facilities To Be Maintained
Pretreatment facilities shall be maintained in satisfactory and effective operation by the user at the user's expense. Operation and maintenance records shall be maintained by the user as specified in the user's discharge permit.
(3) Accidental Discharge/Slug Control Plans
Users discharging non-domestic wastewater into the POTW shall provide protection from the accidental discharge of prohibited wastes. Prior to the commencement of any non-domestic discharge and at least once every two years the Control Authority shall evaluate whether each significant user requires an accidental discharge/slug control plan. The Director may require any user to develop, submit for approval, and implement such a plan. Alternatively, the Director may develop such a plan for any user. Each plan shall include the following as a minimum:
(a) Description of discharge practices, including non-routine batch discharges;
(b) Description of stored chemicals;
(c) Procedures for immediately notifying the Director of any accidental or slug discharge, as required by section 10.407 of this ordinance.
(d) Procedures to prevent adverse impact from any accidental or slug discharge. Such procedures include, but are not limited to, inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site runoff, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants, measures and equipment for emergency response and any other procedures deemed necessary to prevent accidental/slug discharges from entering the POTW.

(4) Additional Pretreatment Measures
(a) Whenever deemed necessary, the Control Authority may require user to restrict their discharge during peak flow periods, designate that certain wastewater be discharged only into specific sewers, relocate and/or consolidate points of discharge, separate sewage wastestreams

from industrial wastestreams, and such other conditions as may be necessary to protect the POTW and determine the user's compliance with the requirements of the ordinance.
(b) Grease, oil and sand interceptors shall be provided when deemed necessary by the Control Authority for the proper handling of wastewater containing excessive amounts of grease and oil or sand. Such interceptors shall not be required for residential users. All interception units shall be of type and capacity approved by the Control Authority and shall be so located to be easily accessible for cleaning an inspection. Such interceptors shall be inspected, cleaned, and repaired regularly, as needed, by the user at their expense.
(c) Users with the potential to discharge flammable substances may be required to install and maintain an approved combustible gas detection meter.

10.410 INSPECTION, SURVEILLANCE, AND MONITORING
(1) Minimum Monitoring Requirements
(a) Significant users shall be required to self-monitor to meet, at a minimum, the requirements of the General Pretreatment Regulations.
(b) Users that have the potential to routinely discharge non-domestic sewage that contains concentrations of BOD, TSS, and COD higher than those defined for domestic sewage herein shall be independently monitored by the City for flow, BOD, TSS, COD and pH at least once a year. The Control Authority shall determine which users have this potential.
(c) The City shall independently monitor all other users for flow, BOD, TSS, COD, and pH at a frequency in relation to their potential impact on the POTW, as determined by the Control Authority.
(d) The Control Authority may increase the frequency and/or add parameters to a user's self-monitoring program or the City's independent monitoring program to ensure compliance with the Pretreatment Requirements.
(2) Sampling and Analysis
(a) Significant users shall meet the requirements of the General Pretreatment Regulations for sampling and analysis. Other users shall meet the requirements for sampling and analysis as stated herein or in the user's control document.

(b) For all users, containers, preservation techniques, and holding times for samples shall comply with methods and procedures found at Title 40 Code of Federal Regulations, Part 136.
(c) For all users, sample analysis shall be in accordance with approved test procedures. The Control Authority, at this discretion, may specify which approved test procedure shall be used.
(d) Type of samples (grab or composite) and flow measurement shall be consistent with the type of discharge and parameters being regulated and shall be specified by the Control Authority in the permit.
(3) Control Point
A user shall provide a control point for the purpose of sampling and flow measurement. The location and design of the control point shall be approved by the Control Authority. The control point shall be placed so that non-domestic sewage can be sampled and measured prior to any commingling with domestic sewage or non-process flows.

Written approval of exceptions to this requirement shall be obtained by a user form the Control Authority. It is recommended that the control point for sampling and flow measurement be at the same location. Flow may be determined by water supply meter measurements if no other flow device is available and no other source of raw water is used. Other methods for estimating wastewater discharge flow must approved by the Control Authority.
(4) Inspection and Entry
The Control Authority or his duly authorized representative, Federal and State Officials, upon presentation of credentials and other documentation as may be required by law, shall be permitted to gain access to such properties as may be necessary for the purpose of inspection,

observation, sampling, set up and use of monitoring equipment, and inspection and copying of records having a direct bearing on the discharges of non-domestic sewage. Unreasonable delays in allowing access to the user's premises shall be a violation of this ordinance.

(5) Use of Contractors

The Control Authority may select an independent contractor to conduct the independent monitoring by the City.

10.411 ENFORCEMENT

(1) Administrative Order

In addition to any other actions or remedies authorized in this ordinance, the Control Authority or its duly authorized representative is authorized to enforce this ordinance through the exercise of any one or more of the following administrative actions. Unless otherwise expressly set forth herein, the selection or use of one such action or remedy by the Control Authority shall not be construed to prevent the Control Authority from pursuing any other enforcement actions or remedies nor require the pursuit of a particular action or remedy as a condition precedent to the use of any other such action or remedy.

(2) Notice of Violation

The Control Authority shall serve a user that is found non-complaint with the Pretreatment Requirements with a notice stating the nature of the noncompliance. This notice may or may not be in writing.

Any violation of pretreatment standards incurs immediate liability. Each day of violation constitutes a separate noncompliance.

Within thirty (30) days after the date of receipt of this notice, a user shall submit a written response to the Control Authority with an explanation of the noncompliance, what steps are currently being taken to prevent the noncompliance, and a plan for the correction and continued prevention of the noncompliance. Submission of this response in no way relieves the user of liability for any violations occurring before or after receipt of the notice of violation.

(3) Consent Order

The Control Authority may enter into Consent Orders, assurances of voluntary compliance, or other similar documents establishing an agreement with any user responsible for noncompliance. Such documents will include specific action to be taken by the user to correct the noncompliance within a time period specified by the document.

(4) Show Cause Hearing

The Control Authority may order a user which has violated or continues to violate, any provision of this ordinance, a wastewater discharge permit or enforcement action issued, or any other pretreatment requirement, to appear the Director and show cause why the proposed enforcement action should not be taken. Notice shall be served on the user specifying the time and place for the meeting, the proposed enforcement action, the reasons for such action, and a request that the user show cause why the proposed enforcement action should not be taken. The notice of the meeting shall be served by hand or certified mail at least ten days prior to the hearing. Such notice may be served on any authorized representative of the user. A show cause hearing shall not be a bar against, or prerequisite for, taking any other action against the user.

(5) Compliance Order/Compliance Schedules

(a) Applicability

If a user cannot comply with the pretreatment standards in section 10.403 or any other pretreatment requirement, the Control Authority may provide a compliance order containing a schedule for achieving compliance.

(b) Allowable Time for Compliance

The compliance schedule shall be the shortest time in which the user is able to provide pretreatment facilities or changes in operation and maintenance that will achieve compliance. If a user is given a compliance schedule for national categorical standards, the completion date of this schedule shall not be later than the compliance date established for the applicable national categorical standard and shall be in accordance with the General Pretreatment Requirements. A user shall not continue discharging in noncompliance of the Pretreatment Requirements beyond the time limit provided in the compliance schedule.

(c) Form of Compliance Schedule

Compliance schedules may be provided by the Control Authority by notice of noncompliance, enforcement order, or as part of the discharge permit. The Control Authority has the right to re-open a user's discharge permit in order to add a compliance schedule.

(6) Cease and Desist Order

When the Control Authority finds that a user has violated, or continues to violate, any provision of this ordinance, a wastewater discharge permit or order issued herein, or any other pretreatment standard or requirement, or that the user's past violations are likely to recur, the Control Authority may issue an order to the user directing it to cease and desist all such violations and directing the user to:

(a) Immediately comply with all requirements; and

(b) Take such appropriate remedial or preventive actions may be needed to properly address a continuing or threatened violation, including halting operations and/or terminating the discharge.

(7) Authority to Disconnect Service

(a) Conditions for Disconnection

The City shall have the right to disconnect a user's sewer service when a user's discharge reasonable appears to:

(i) Damage sewer lines or POTW treatment processes;

(ii) Cause the City to be noncompliant with the conditions of its discharge permits;

(iii) Present an endangerment to the environment or which threatens to interfere with the operation of the POTW; or

(iv) Present an imminent endangerment to the health or welfare of persons.

(b) Notification

In the case of an imminent endangerment to the health or welfare of persons, the Control Authority shall give oral or written notice to a user before disconnecting sewer service. Under all other conditions for disconnection, the control Authority shall give written notice to a user before disconnection. Within ten (10) days after receipt of notification of disconnection, the user must submit a written response to the Control Authority with an explanation of the cause of the problem and what measures have and will be taken to prevent any future occurrence. Submission of this response in no way relieves the user of liability for any violations occurring before or after receipt of the notice of disconnection.

(c) Reconnection of Service

The user's sewer shall remain disconnected until such time that the user has demonstrated that the cause of this noncompliance has been eliminated.

(d) Liability

The City shall not be liable for any resulting damage to the user's property as a result of disconnection under the conditions for disconnection.

(8) Termination of Permit

A user that violates any of the following conditions may be subject to permit termination:

(a) Failure to report a reasonable estimate of the volume and quality of its non-domestic sewage.

(b) Failure to notify the Control Authority of a change in process or operation which would significantly change the nature or increase the quantities of materials discharged to the POTW that would cause the user to be noncompliant with its discharge permit requirements or the Pretreatment Requirements.

(c) Refusal of right of entry to the user's premises in accordance with Subsection I of this ordinance.

(d) Intentional violation of permit conditions.

(e) Falsifying information.
(f) Failure to pay sewer charges or fines.
(9) Injunctive Relief
The Control Authority may seek injunctive relief to restrain or compel actions of a user.
(10) Civil and Criminal Penalties
The Control Authority has the right to seek or assess civil or criminal penalties in at least the amount of one thousand dollars ($1000) per day for each violation of the user's permit or the Pretreatment Requirements.

10.411.01 Affirmative Defenses to Discharge Violations
(1) Upset
(a) Upset means an exceptional incident in which there is unintentional and temporary noncompliance with pretreatment requirements because of factors beyond the reasonable control of the user. An upset does to include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.
(b) An upset shall constitute an affirmative defense to an action brought for noncompliance with pretreatment requirements if the following provisions are met.
(c) A user who wishes to establish the affirmative defense of upset shall demonstrate through properly signed contemporaneous operating logs or other relevant evidence that:
(i) An upset occurred and the user can identify the cause(s) of the upset;
(ii) The facility was being operated properly and in compliance with applicable and appropriate operation and maintenance procedures; and
(iii)The user has submitted the following information to the Control Authority within twenty-four (24) hours of becoming aware of the upset:
A description of the nature of the discharge and cause of the noncompliance;
The period of noncompliance, including the exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue;
Steps being taken and/or planned to reduce eliminate, and prevent recurrence of the noncompliance.
(vi) In any enforcement proceeding, the user seeking to establish the occurrence of an upset shall have the burden of proof.
(v) Users will have the opportunity for judicial determination on any claim of upset only in an enforcement action brought for noncompliance with categorical pretreatment standards.
(vi) Users shall control production of all discharges to the extent necessary to maintain compliance with pretreatment requirements upon reduction, loss, or failure of its treatment facility until the facility is restored or an alternative method of treatment is provided.

This requirement applies in the situation where, among other things, the primary source of power for the treatment facility is reduced, lost, or fails.
(2) Bypass
(a) Bypass means the intentional diversion of wastestreams from any portion of a user's treatment facility.
(b) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.
(c) A user may allow any bypass to occur which does not cause pretreatment standards or requirements to be violated, but only if it also is for essential maintenance to assure efficient operation.
(d) If a user knows in advance of the need for a bypass, it shall submit prior notice to the Control Authority at least ten days before the date of the bypass, if possible.

A user shall submit oral notice to the Control Authority of an unanticipated bypass that exceeds applicable pretreatment requirements within twenty-four hours from the time it becomes aware of the bypass. A written submission shall also be provided within five days from the time the user becomes aware of the bypass. The written submission shall contain a description of the bypass and its cause; the duration of the bypass, including exact dates and times, and, if the bypass has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce eliminate, and prevent reoccurrence of the bypass. The Control Authority may waive the written report on a case-by-case basis if proper oral notice has been given.
(e) Bypass is prohibited, and the Control Authority may take an enforcement action against a user for a bypass, unless
(i) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
(ii) There were no feasible alternatives to the bypass, such as the use auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
(iii)The user submitted notices as stated herein.
(iv) The Control Authority may approve an anticipated bypass, after considering its adverse effects, if the Control Authority determines that it will meet the three conditions in paragraph (e) above.

10.412 <u>FEE SCHEDULE</u> *Example*
(1) <u>Applications</u>
A user is subject to the following application fees:

	Significant Users	Other Users
New Permit	\$100	\$25
Permit Renewal	\$100	\$25
Permit Modification	\$100	\$25

Removal credit - A fixed fee for a removal credit application cannot be given because of the circumstances of each user and constituent the credit is applied for are highly variable. Any user or group of users wishing to apply for a removal credit shall assume responsibility for all costs incurred by the City.
(2) <u>Surcharge for Higher Concentrations</u>
Users shall be assessed a sewer surcharge for non-domestic sewage that contains concentrations of BOD, TSS, and COD higher than those defined for domestic sewage herein. The surcharge shall be in addition to any other sewer charges required by other City ordinances. If a user has more than one non-domestic outfall identified in a permit, the surcharge shall be applicable to the daily average total of all non-domestic discharges and not the individual non-domestic discharges.
(a) <u>When Surcharge Shall Be Applied</u>
A user shall be subject to a surcharge when its non-domestic discharge daily average total:
(i) Exceeds a BOD concentration of two hundred-fifty (250) mg/L;
(ii) Exceeds a total suspended solids concentration of two hundred-fifty (250 mg/; or
(iii) Exceeds a COD concentration of four hundred-fifty (450) mg/L.
(b) <u>Computation of Surcharge</u>
For those users with discharges exceeding a COD concentration of four hundred-fifty (450) mg/L, the surcharge shall be based on COD in lieu of BOD. Computations of surcharges shall be based on the formulas below. The surcharges for individual BOD or COD and
(i) <u>BOD surcharge</u>
S_{BOD} = V x 8.34 (A[BOD - 250])
(ii) TSS surcharge

S_{TSS} = V x 8.34 (B[TSS - 250])
(iii) COD surcharge
S_{COD} = V x 8.34 (C[COD - 450])
where:
S - Sum of surcharges in dollars that will appear on the user's monthly bill.
V - Monthly average volume of non-domestic discharge in millions of gallons whichever is the least of the following volumes: (1) total monthly water consumption during the billing period, (2) the average water consumption for the billing periods of December, January, and February of each fiscal year, or; (3) the total estimated or measured non-domestic discharge as determined by methods specified in the user's permit.
8.34 - Conversion factor for units of measure in surcharge equations.
A - cost per pound of BOD
B - cost per pound of TSS
C - cost per pound of COD
Fees may be found at Chapter 10 Section 10.202 of the City of Sunflower Code of Ordinances 1990 edition.
BOD- BOD concentration in mg/L. For more than one non-domestic discharge, this shall be the flow-weighted concentration.
TSS- total suspended solids concentration mg/L. For more than on non-domestic discharge, this shall be the flow-weighted concentration.
COD- COD concentration in mg/L. For more than one non-domestic discharge, this shall be the flow-weighted concentration.
250- normal daily average BOD and TSS concentration in mg/L.
450- normal daily average COD in mg/L.
(c) Sampling and Analysis
The City shall sample for BOD, TSS, and COD. The time of sampling shall be at the sole discretion of the Control Authority. The Control Authority may select an independent contractor to conduct the sampling and/or analyses.
(d) Period of Surcharge
If analyses for BOD, TSS, or COD shows that a surcharge is applicable, the surcharge shall be retroactive for two (2) monthly billing periods and shall continue for four (4) monthly billing periods.
(e) Costs of Analyses
When analyses show that a surcharge shall be applied, a fee of $50 shall be added to a user's bill to cover the sampling, handling, and laboratory analyses. When analyses show that a surcharge shall not be applied, then this fee shall not be added to the user's bill.
(3) Fees Shall be Periodically Reviewed
In order to ensure an equitable cost recovery system, the Control Authority shall periodically review the fees and adjust them as appropriate.

10.413 CONFIDENTIALITY

Any information provided by a user that is claimed as confidential by the user shall be treated in accordance with the confidentiality requirements of the General Pretreatment Regulations. All other information which is submitted by the user to the City shall be available to the public at least to the extent provided by Title 40 Code of Federal Regulations, 403.14.

10.414 RIGHT OF REVISION

The City shall have the right to revise the Pretreatment Requirements to ensure compliance with federal, state, or local requirements.

10.415 PUBLIC PARTICIPATION

The City shall comply with the public participation requirements of Title 40 Code of Federal Regulations, 403.8(f)(2)(vii) in the enforcement of these Pretreatment Requirements.

SECTION 10.500 CREATION OF MUNICIPAL UTILITY DISTRICTS
Each request or petition to the city for its written consent for the creation of a municipal utility district shall be accompanied by a fee of five thousand dollars ($5,000.00) which shall be paid to the city to defray the expense of reviewing and responding to said request or petition.
SECTION 10.600 ENVIRONMENTAL SERVICES FEES
Fees established in this Section shall be periodically reviewed and adjusted to ensure an equitable cost recovery system.
This Section reserved for future use.
This Section reserved for future use.
<u>ANALYTICAL AND SAMPLING FEES</u>
<u>Applicability</u>
The fees described herein do not apply to any sampling event or analytical work initiated by the City for the purposes of its own routine testing and monitoring.
<u>Analytical Fees</u>
<u>Analytical Fees for Wastewater</u>
Biochemical Oxygen Demand (BOD) $15.00per sample
Total Suspended Solids (TSS) $15.00per sample
Chemical Oxygen Demand (COD) $15.00per sample
<u>Water Bacteriological Fees</u>

Fees for bacteriological analysis shall be $10.00 per water sample.

<u>Sampling Fees</u>
The sampling fee for wastewater discharge is $75.00 per sampling event.
The wastewater discharge sampling event consists of a twenty four hour composite sample taken by automatic sampler. The scheduling of this service is subject to approval and availability of the appropriate Public Works personnel.

<u>Payment of Fees</u>
Fees for analytical or sampling work requested by a water or wastewater customer of the City shall be billed to the customer on the monthly utility bill. Fees for analytical sampling work requested by persons or entities that are not water or wastewater customers of the City must be paid in advance at the Public Works office. Requests for analytical or sampling work must be accompanied by the appropriate paper work and evidence of payment, if applicable.

Chapter 9- Collection Systems Section

Section Focus: You will learn the basics of the wastewater collection. At the end of this section, you will be able to describe the basics of the gravity collection system. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: As a pretreatment inspector, you will need knowledge of many different concerns of the collections and wastewater treatment systems in order to properly identify the pretreatment (pass-through or interference) problem. Master's level knowledge of the collection system is essential for all pretreatment inspectors.

Collection System and its Purpose

Every house, restaurant, business, and industry produces waste. Wastewater collection protects public health and the environment by removing this infectious waste and recycling the water. A network of interconnected pipes accepts the flow from each building's sewer connection and delivers it to the treatment facilities. In addition to what homes and businesses flush down the drain, the system also collects excess groundwater, infiltration liquids, and inflow water. Wastewater collection is therefore a comprehensive liquid waste removal system.

The fluid waste distributed through this system is about 98% water. The waste floats on, is carried along by, and goes into suspension or solution in water. Possible waste includes anything that can be flushed down the drain--human excretion, body fluids, paper products, soaps and detergents, foods, fats, oil, grease, paints, chemicals, hazardous materials, solvents, disposable and flushable items; the list is almost infinite. This mixture of water and wastes is called *"wastewater."* In the past, it was known as *"sewage,"* but this term is now falling out of favor because it refers specifically to domestic sanitary wastewater, like toilet flushing, which represents only a portion of the entire fluid waste content.

"Wastewater" is a more accurate description and has become the standard term for this fluid waste because it encompasses the total slurry of wastes in water that is gathered from homes and businesses.

Collection System Defined
A system composed of gravity pipes, manholes, tanks, lift stations, control structures, and force mains that gather used water from residential and nonresidential customers and convey the flow to the wastewater treatment plant.

Wastewater systems collect and dispose of household wastewater generated from toilet use, bathing, laundry, and kitchen and cleaning activities.

Any structure with running water, such as a house or office, must be connected to one of the following wastewater disposal systems:

- **Centralized** systems are *public sewer systems* that serve established towns and cities and transport wastewater to a central location for treatment.

- **Decentralized** systems do not connect to a public sewer system. Wastewater may be treated on site or may be discharged to a private treatment plant.

Centralized Systems
Large-scale public sewer systems (municipal wastewater treatment plants) are centralized systems. These systems generally serve established cities and towns and may provide treatment and disposal services for neighboring sewer districts. Where appropriate, centralized systems are preferred to decentralized systems, as one centralized system can take the place of several decentralized systems. Centralized systems are more economical, allow for greater control, require fewer people, and produce only one discharge to monitor instead of several. However, decentralized systems can be useful, and this option should be evaluated on a case-by-case basis.

Decentralized Systems
Homes and other buildings that are not served by public sewer systems depend on decentralized septic systems to treat and dispose of wastewater. Most decentralized systems are on-site systems (wastewater is treated underground near where it is generated). On-site systems are the most common wastewater treatment system used in rural areas. These systems can be a single septic system and drainfield serving one residence or a large soil absorption system serving an entire subdivision. Wastewater in decentralized systems can also be treated by a small, private wastewater treatment plant. These plants can have similar treatment processes and equipment as centralized systems but on a smaller scale.

Sewer Main
In a centralized wastewater treatment system, the sewer to which sewer connections are made from individual residences.

Trunk Lines
Sewer pipes measuring more than 12 inches in diameter and having a capacity of 1 to 10 million gallons per day. Trunk lines connect smaller sewer pipes, or collectors, to the largest transport pipes or interceptors.

Collectors
Small sewer pipes measuring twelve inches or less in diameter.

Gravity Sewage Collection System

Publicly owned treatment works (POTWs) collect wastewater from homes, commercial buildings, and industrial facilities and transport it via a series of pipes, known as a collection system, to the treatment plant.

Collection systems may flow entirely by gravity, or may include lift stations that pump the wastewater via a force main to a higher elevation where the wastewater can then continue on via gravity. Ultimately, the collection system delivers this sewage to the treatment plant facility. Here, the POTW removes harmful organisms and other contaminants from the sewage so it can be discharged safely into the receiving stream.

New sewer manhole with sewer mains before final burial.

Without treatment, sewage creates bad odors, contaminates water supplies, and spreads disease. Today, more than 16,000 sewage treatment plants exist in the U.S. treating more than 32 billion gallons per day of wastewater.

Modern sewer vactor or Camel. It is wise to make friends with the collection crews. The collection crews can greatly assist you in your enforcement efforts and can tell you lots of information, only if you develop a relationship with them.

Combined Sewer Overflows (CSOs)

Combined sewer systems are designed to collect both sanitary wastewater and storm water runoff. During dry weather, combined sewers carry sanitary waste to a POTW. During wet weather, the combined sanitary waste and storm water can overflow and discharge untreated wastewater directly to a surface water through a combined sewer overflow (CSO).

In 1994, the EPA published a CSO Control Policy (59 FR 18688). CSOs are regulated as point sources, and require NPDES permits.

The CSO Control Policy includes Nine Minimum Controls (NMC) for CSO management, which are requirements for any CSO NPDES Permit:

- ✓ Proper operation and regular maintenance programs for the sewer system and the CSOs;
- ✓ Maximum use of the collection system for storage;
- ✓ Review and modification of pretreatment requirements to ensure that CSO impacts are minimized;
- ✓ Maximization of flow to the POTW for treatment;
- ✓ Prohibition of CSOs during dry weather;
- ✓ Control of solid and floatable materials in CSOs;
- ✓ Establishment of pollution prevention programs;
- ✓ Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts;
- ✓ Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

Development of a Long Term Control Plan (LTCP) is also required for management of CSOs. For more information, visit the EPA Wet Weather information page, which includes a graphic representation of Urban Wet Weather Flows.

A Vactor clearing a Manhole.

Collection System Operators' Purpose

Collection system operators are charged with protecting public health and the environment, and therefore must have documented proof of their certifications in the respective wastewater management systems. These professionals ensure that the system pipes remain clear and open. They eliminate obstructions and are constantly striving to improve flow characteristics. They keep the wastewater moving underground, unseen and unheard. Because this wastewater collection system and the professionals who maintain it operate at such a high level of efficiency, problems are very infrequent. So much so that the public often takes the wastewater collection system for granted. In truth, these operators must work hard to keep it functioning properly.

Centralized sewer systems are generally broken out into three different categories: sanitary sewers, storm sewers, and combined sewers. Sanitary sewers carry wastewater or sewage from homes and businesses to treatment plants. Underground sanitary sewer pipes can clog or break, causing unintentional *"overflows"* of raw sewage that flood basements and streets. Storm sewers are designed to quickly get rainwater off the streets during rain events.

Chemical, trash and debris from lawns, parking lots, and streets are washed by the rain into the storm sewer drains. Most storm sewers do not connect with a treatment plant, but instead drain directly into nearby rivers, lakes, or oceans. Combined sewers carry both wastewater and storm water in the same pipe. Most of the time, combined sewers transport the wastewater and storm water to a treatment plant.

However, when there is too much rain, combined sewer systems cannot handle the extra volume and designed "overflows" of raw sewage into streams and rivers occur. The great majority of sewer systems have separated, not combined, sanitary and storm water pipes.

Leaking, overflowing, and insufficient wastewater collection systems can release untreated wastewater into receiving waters. Outdated pump stations, undersized to carry sewage from newly developed subdivisions or commercial areas, can also create a potential overflow hazard, adversely affecting human health and degrading the water quality of receiving waters. The maintenance of the sewer system is therefore a continuous, never-ending cycle.

As sections of the system age, problems such as corroded concrete pipe, cracked tile, lost joint integrity, grease, and heavy root intrusion must be constantly monitored and repaired. Technology has improved collection system maintenance with such tools as television camera assisted line inspection equipment, jet-cleaning trucks, and improvements in pump design. Because of the increasing complexity of wastewater collection systems, collection system maintenance is evolving into a highly skilled trade.

According to a recent Clean Water Needs Survey conducted by the USEPA, the U.S. will have to invest more than $10 billion to upgrade existing wastewater collection systems, over $20 billion for new sewer construction, and nearly $44 billion to improve sewer overflows, to effectively serve the projected population. As the infrastructure in the United States and other parts of the world ages, increasing importance is being placed on rehabilitating wastewater collection systems. Cracks, settling, tree root intrusion, and other disturbances that develop over time deteriorate pipelines and other conveyance structures that comprise wastewater collection systems, including stormwater, sanitary, and combined sewers.

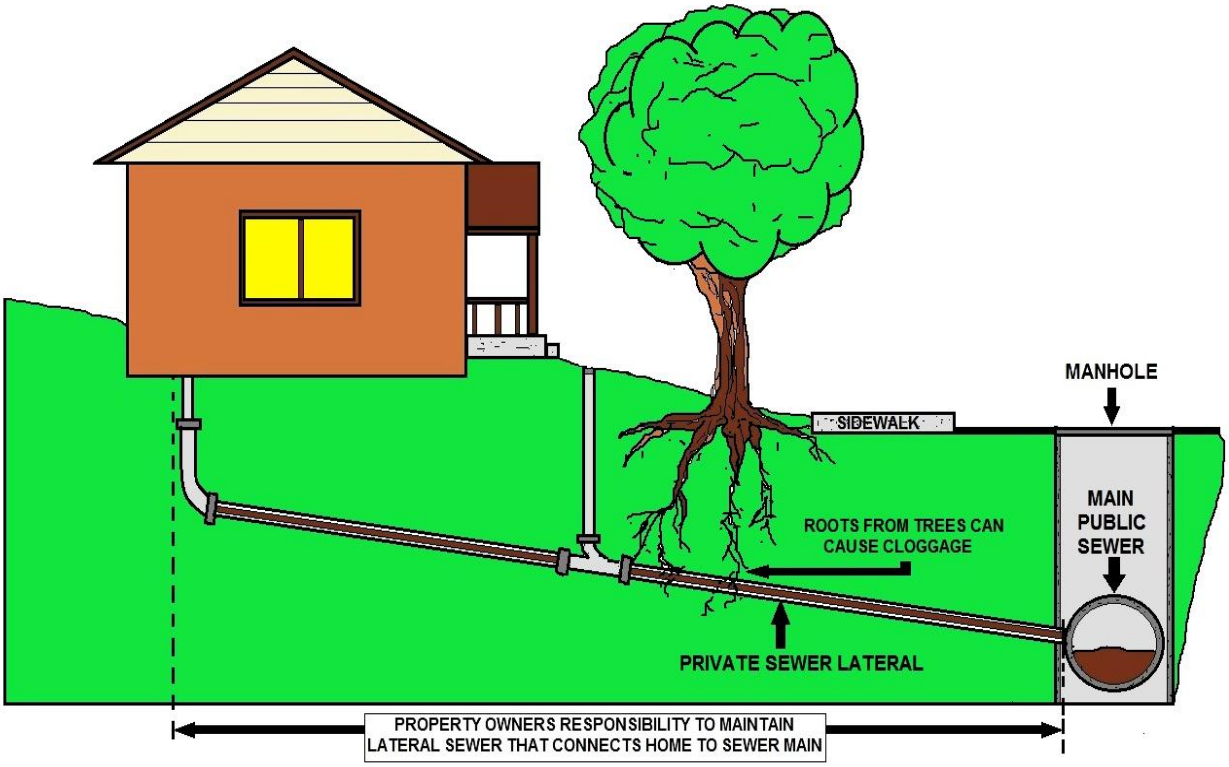
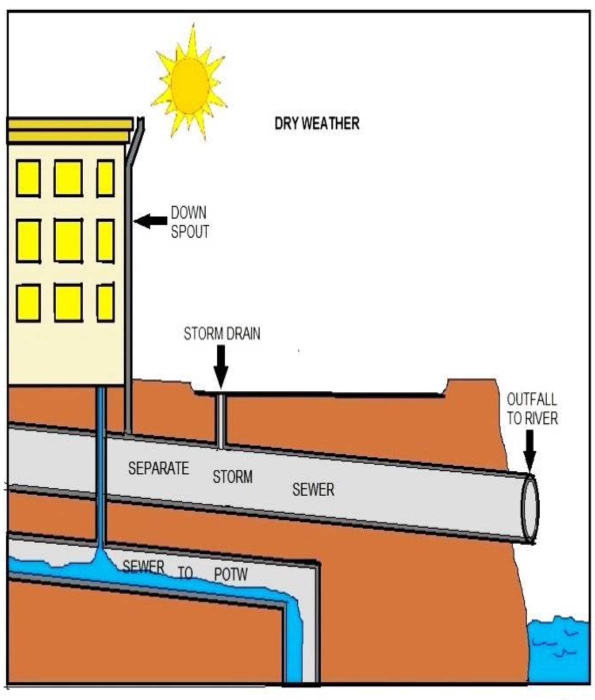
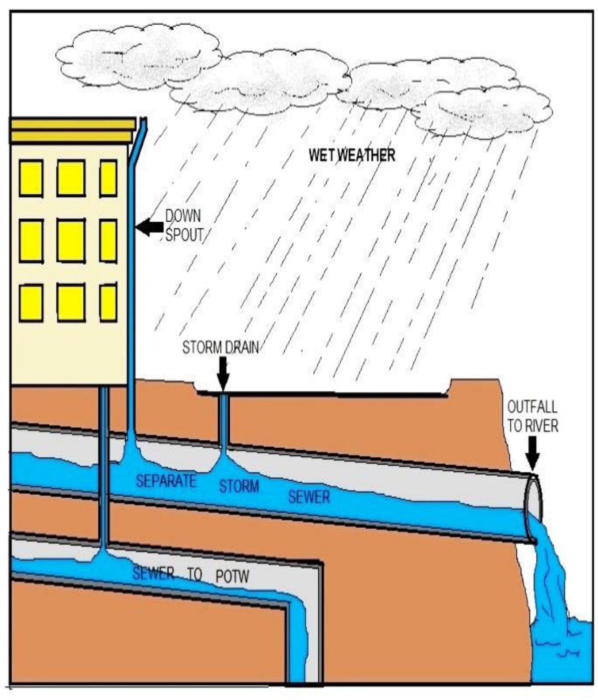


DIAGRAM OF SEWER LATERAL





Collections Daily Operations

The Sewer Cleaning Truck above is 38 feet long and 9 feet wide. The attached tank has a capacity of 1500 gallons and can hold 10 cubic yards of debris. The truck is equipped with a high pressure cleaning head that can move 800 feet down a sanitary line at 2500 PSI.

Out of sight, out of mind—that's your sanitary sewer collection system. Until there comes that inevitable emergency call due to a stoppage, then you have upset residents with sewage backed up in their toilets. A very economical and quick method of determining if a new sewer line is straight and unobstructed is called *"Lamping"* and can be done with a mirror and a bright source of light, for example a headlight at night or sunlight.

Video inspection coupled with a good cleaning program can be a highly effective maintenance tool. By cleaning and root sawing your lines, restrictions caused by debris, roots and grease buildup can be prevented—thus drastically reducing the number of emergency backups and surcharge calls.

Sewage collection systems that have video inspection closed circuit television (CCTV) and cleaning programs, report drastic reductions in the number of emergency calls because the system was cleaned and potential trouble spots were located prior to problems occurring.

Top photograph, new manhole. Bottom, a repaired sewer main after being damaged by the water distribution department using a backhoe without locates.

Rule to Protect Communities from Overflowing Sewers

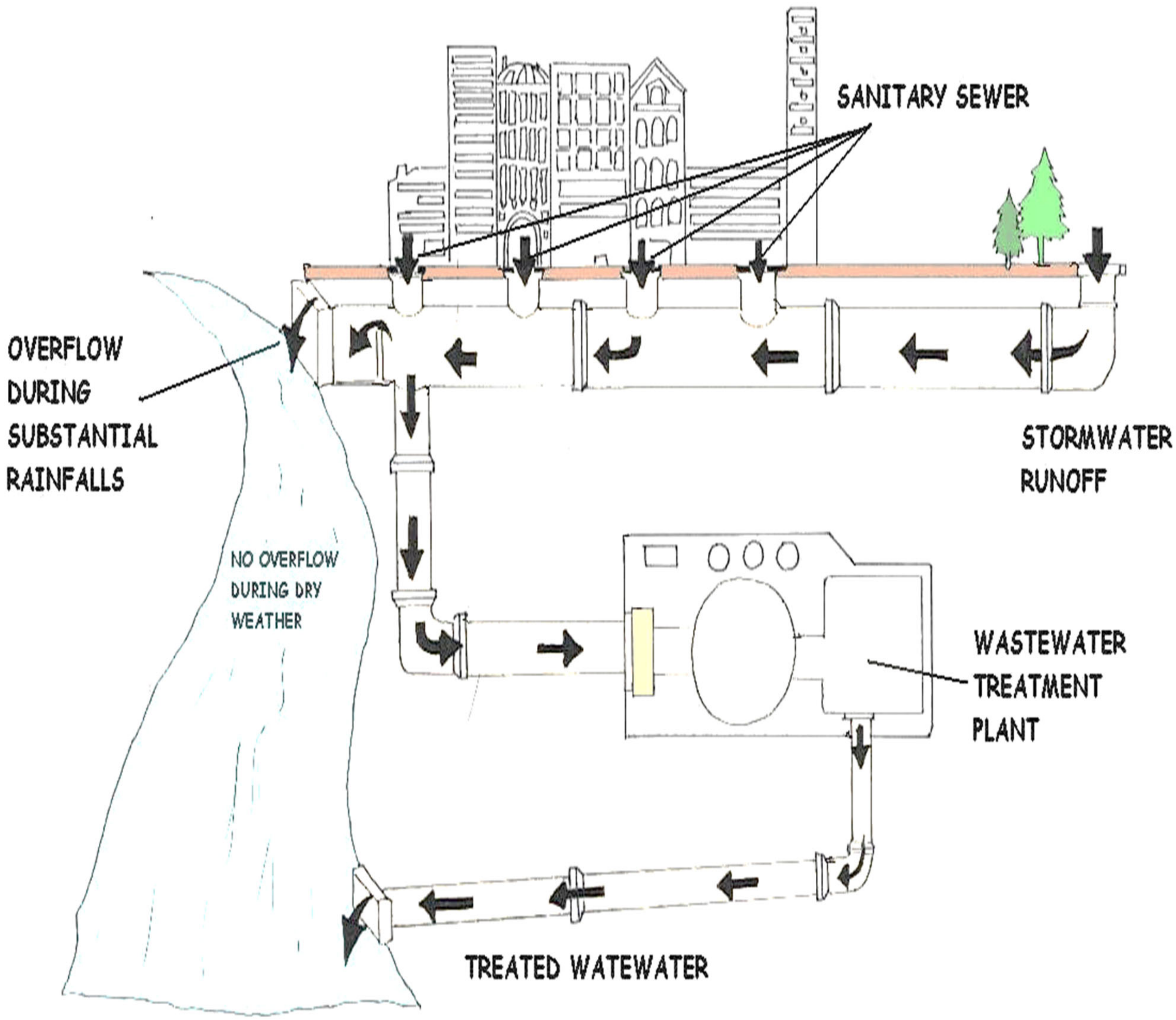
The Environmental Protection Agency (EPA) has clarified and expanded permit requirements under the Clean Water Act for 19,000 municipal sanitary sewer collection systems in order to reduce sanitary sewer overflows.

The requirements will help communities improve some of our Nation's most valuable infrastructure –our wastewater collection systems–by requiring facilities to develop and implement new capacity, management, operation, and maintenance programs and public notification programs.

The 19,000 systems covered by this rule include 4,800 municipal satellite collection systems that will be directly regulated under the Clean Water Act for the first time. These requirements will result in fewer sewer overflows, leading to healthier communities, fewer beach closures, and fish and shellfish that are safer to eat.


SBR #1 Motive Pump Impeller after 3 years, damage caused by, grass, grease, air, and other small solids in the Influent.

Various damage from undesirable materials in the sewer system. Bottom, heavy grease from not being regularly pumped. Photograph credit John Bougham.



The complexity and expense associated with a utility's CMOM or MOM programs is specific to the size and complexity of the Publicly Owned Treatment Works (POTW) and related infrastructure. Factors such as population growth rate and soil/groundwater conditions also dictate the level of investment that should be made.

Understanding the Gravity Sanitary Sewer System

A Sanitary Sewer has Two Main Functions:

- To convey the designed peak discharge.
- Transport solids so that the deposits are kept at a minimum.

Sanitary sewers are designed to transport the wastewater by utilizing the potential energy provided by the natural elevation of the earth resulting in a downstream flow. This energy, if not designed properly, can cause losses due to free falls, turbulent junctions, and sharp bends. Sewer systems are designed to maintain proper flow velocities with minimum head loss. However, higher elevations in the system may find it necessary to dissipate excess potential energy.

Design flows are based on the quantity of wastewater to be transported. Flow is determined largely by population served, density of population, and water consumption. Sanitary sewers should be designed for peak flow of population. Stormwater inflow is highly discouraged and should be designed separate from the sanitary system.

Gravity-flow sanitary sewers are usually designed to follow the topography of the land and to flow full or nearly full at peak rates of flow and partly full at lesser flows. Most of the time the flow surface is exposed to the atmosphere within the sewer and it functions as an open channel. At extreme peak flows the wastewater will surcharge back into the manholes. This surcharge produces low pressure in the sewer system.

In order to design a sewer system, many factors are considered. The purpose of this topic is to aid in the understanding of flow velocities and design depths of flow. The ultimate goal for our industry is to protect the health of the customers we serve. This is achieved by prevention of sewer manhole overflows.

Sewer System Capacity Evaluation - Testing and Inspection

The collection system owner or operator should have a program in place to periodically evaluate the capacity of the sewer system in both wet and dry weather flows and ensure the capacity is maintained as it was designed. The capacity evaluation program builds upon ongoing activities and the everyday preventive maintenance that takes place in a system. The capacity evaluation begins with an inventory and characterization of the system components.

The inventory should include the following basic information about the system:

- Population served
- Total system size (feet or miles)
- Inventory of pipe length, size, material and age, and interior and exterior condition as available
- Inventory of appurtenances such as bypasses, siphons, diversions, pump stations, tide or flood gates and manholes, etc., including size or capacity, material and age, and condition as available
- Force main locations, length, size and materials, and condition as available
- Pipe slopes and inverts
- Location of house laterals - both upper and lower

The system then undergoes general inspection which serves to continuously update and add to the inventory information.

Capacity Limitations
The next step in the capacity evaluation is to identify the location of wet weather related SSOs, surcharged lines, basement backups, and any other areas of known capacity limitations. These areas warrant further investigation in the form of flow and rainfall monitoring and inspection procedures to identify and quantify the problem. The reviewer should ensure that the capacity evaluation includes an estimate of peak flows experienced in the system, an estimate of the capacity of key system components, and identification of the major sources of I/I that contribute to hydraulic overloading events.

The capacity evaluation should also make use of a hydraulic model. This model will help identify areas where there is a need to alleviate capacity limitations.

Short and long term alternatives to address hydraulic deficiencies should be identified, prioritized, and scheduled for implementation. A sewer inspection is an important part of a sewer system capacity evaluation and determining your options or alternatives.

Flow Monitoring
Fundamental information about the collection system is obtained by flow monitoring. Flow monitoring provides information on dry weather flows as well as areas of the collection system potentially affected by I/I. Flow measurement may also be performed for billing purposes, to assess the need for new sewers in a certain area, or to calibrate a model.

There are three techniques commonly used for monitoring flow rates:
(1) permanent and long-term,
(2) temporary, and
(3) instantaneous.

Permanent installations are done at key points in the collection system such as the discharge point of a satellite collection system, pump stations, and key junctions. Temporary monitoring consists of flow meters typically installed for 30-90 days. Instantaneous flow metering is performed by collection system personnel, one reading is taken and then the measuring device is removed.

The collection system owner or operator should have a flow monitoring plan that describes their flow monitoring strategy, or should at least be able to provide the following information:

- Purpose of the flow monitoring
- Location of all flow meters
- Type of flow meters
- Flow meter inspection and calibration frequency

Flow Monitoring Plan
A flow monitoring plan should provide for routine inspection, service, and calibration checks (as opposed to actual calibration). In some cases, the data is calibrated rather than the flow meter. Checks should include taking independent water levels (and ideally velocity readings), cleaning accumulated debris and silt from the flow meter area, downloading data (sometimes only once per month), and checking the desiccant and battery state. Records of each inspection should be maintained.

Infiltration and Inflow Sub-Section

What is Infiltration/Inflow (I/I)?
Infiltration occurs when groundwater enters the sewer system through cracks, holes, faulty connections, or other openings. Inflow occurs when surface water such as storm water enters the sewer system through roof downspout connections, holes in manhole covers, illegal plumbing connections, or other defects.

The sanitary sewer collection system and treatment plants have a maximum flow capacity of wastewater that can be handled. I/I, which is essentially clean water, takes up this capacity and can result in sewer overflows into streets and waterways, sewer backups in homes, and unnecessary costs for treatment of this water. It can even lead to unnecessary expansion of the treatment plants to handle the extra capacity. These costs are passed on to the consumer.

I&I (Infiltration and Inflow)
- Infiltration is water (typically groundwater) entering the sewer underground through cracks or openings in joints.
- Inflow is water (typically stormwater or surface runoff) that enters the sewer from grates or unsealed manholes exposed to the surface.

Determining I/I
Flow monitoring and flow modeling provide measurements and data used to determine estimates of I/I. Flow meters are placed at varying locations throughout the sewer collection system to take measurements and identify general I/I source areas. Measurements taken before and after a precipitation event indicate the extent that I/I is increasing total flow. Both infiltration and inflow increase with precipitation. Infiltration increases when groundwater rises from precipitation, and inflow is mainly stormwater and rainwater. Rainfall monitoring is also performed to correlate this data.

Identifying Sources of I/I
A Sewer System Evaluation Survey (SSES) involves inspection of the sewer system using several methods to identify sources of I/I:

Visual inspection - accessible pipes, gutter and plumbing connections, and manholes are visually inspected for faults.

Smoke testing – smoke is pumped into sewer pipes. Its reappearance aboveground indicates points of I/I. These points can be on public property such as along street cracks or around manholes, or on private property such as along house foundations or in yards where sewer pipes lay underground.

TV inspection – camera equipment is used to do internal pipe inspections. The City will usually have one 2-3 person crew that can perform TV inspection on over 20 miles of sewer pipe per year.

Dye testing – Dye is used at suspected I/I sources. The source is confirmed if the dye appears in the sewer system.

Sources of I/I are also sometimes identified when sewer backups or overflows bring attention to that part of the system. The purpose of the SSES is to reduce these incidences by finding sources before they cause a problem.

Repairing I/I Sources
Repair techniques include manhole wall spraying, trenchless sewer pipe relining, manhole frame and lid replacement, and disconnecting illegal plumbing, drains, and roof downspouts.

Efficient Identification of Excessive I/I
The owner or operator should have in place a program for the efficient identification of excessive I/I. The program should look at the wastewater treatment plant, pump stations, permanent meter flows, and rainfall data to characterize peaking factors for the whole system and major drainage basins. The reviewer should evaluate the program, including procedures and records associated with the flow monitoring plan. Temporary meters should be used on a "roving" basis to identify areas with high wet weather flows. Areas with high wet weather flows should then be subject to inspection and rehabilitation activities.

Sewer System Testing
Sewer system testing techniques are often used to identify leaks which allow unwanted infiltration into the sewer system and determine the location of illicit connections and other sources of stormwater inflow.

Two commonly implemented techniques include smoke testing and dyed water testing. Regardless of the program(s) implemented by the owner or operator, the reviewer should evaluate any procedures and records that have been established for these programs. The reviewer should also evaluate any public relations program and assess how the owner or operator communicates with the public during these tests (i.e., when there is a possibility of smoke entering a home or building).

Smoke testing is a relatively inexpensive and quick method of detecting sources of inflow in sewer systems, such as down spouts, or driveway and yard drains, and works best for detecting cross connections and point source inflow leaks. Smoke testing is not typically used on a routine basis, but rather when evidence of excessive I/I already exists. With each end of the sewer of interest plugged, smoke is introduced into the test section. Sources of inflow can then be identified when smoke escapes through them.

Areas Usually Smoke Tested

- Drainage paths
- Ponding areas
- Cellars
- Roof leaders
- Yard and area drains
- Fountain drains
- Faulty service connections
- Abandoned building sewers

If the collection system owner or operator implements a regular program of smoke testing, the program should include a public notification procedure. The owner or operator should also have procedures to define:

- How line segments are isolated.
- The maximum amount of line to be smoked at one time.
- The weather conditions in which smoke testing is conducted (i.e., no rain or snow, little wind and daylight only).

The results of positive smoke tests should be documented with carefully labeled photographs. Building inspections are sometimes conducted as part of a smoke testing program and, in some cases, may be the only way to find illegal connections. If properly connected to the sanitary sewer system, smoke should exit the vent stacks of the surrounding properties. If traces of the smoke or its odor enter the building, it is an indication that gases from the sewer system may also be entering. Building inspections can be labor intensive and require advanced preparation and communication with the public.

Dye Testing

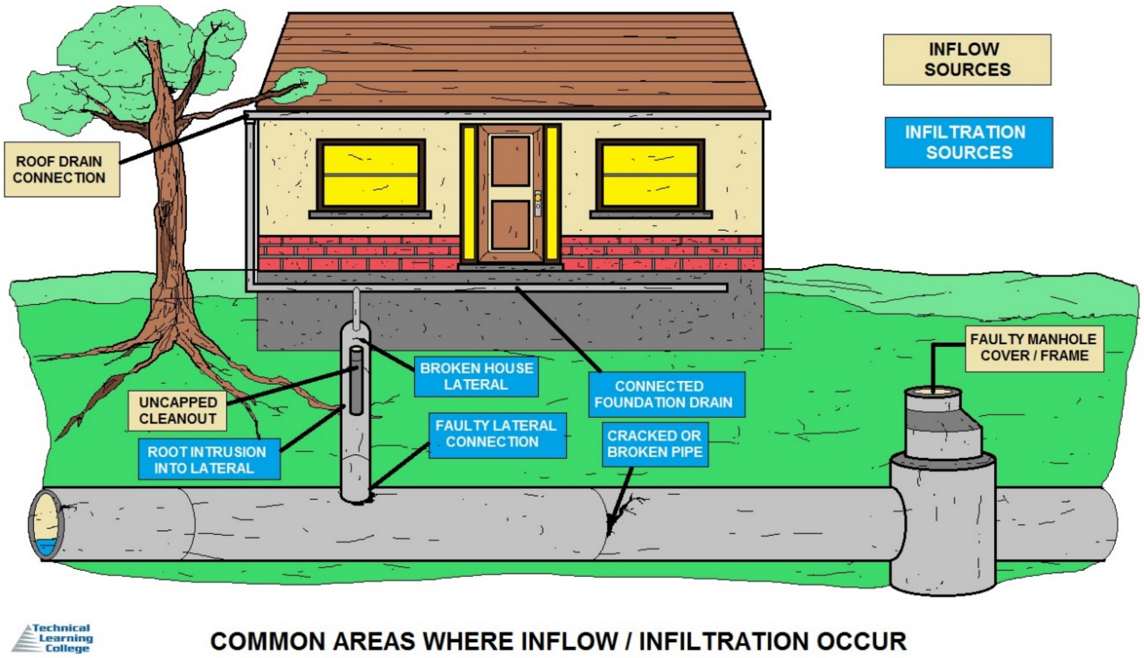
Dyed water testing may be used to establish the connection of a fixture or appurtenance to the sewer. It is often used to confirm smoke testing or to test fixtures that did not smoke. As is the case with smoke testing, it is not used on a routine basis, but rather in areas that have displayed high wet weather flows. Dyed water testing can be used to identify structurally damaged manholes that might create potential I/I problems. This is accomplished by flooding the area close to the suspected manholes with dyed water and checking for entry of dyed water at the frame-chimney area, cone or corbel, and walls of the manhole.

Sewer System Inspection

Visual inspection of manholes and pipelines is the first line of defense in the identification of existing or potential problem areas. Visual inspections should take place on both a scheduled basis and as part of any preventive or corrective maintenance activity. Visual inspections provide additional information concerning the accuracy of system mapping, the presence and degree of I/I problems, and the physical state-of-repair of the system. By observing the manhole directly and the incoming and outgoing lines with a mirror, it is possible to determine structural condition, the presence of roots, condition of joints, depth of debris in the line, and depth of flow.

The reviewer should examine the records of visual inspections to ensure that the following information is recorded:

- Manhole identification number and location.
- Cracks or breaks in the manhole or pipe (inspection sheets and/or logs should record details on defects.)
- Accumulations of grease, debris, or grit
- Wastewater flow characteristics (e.g., flowing freely or backed up.)
- Inflow - Infiltration (presence of clear water in or flowing through the manhole.)
- Presence of corrosion.
- Offsets or misalignments.
- Condition of the frame.
- Evidence of surcharge.
- Atmospheric hazard measurements (especially hydrogen sulfide.)
- If repair is necessary, a notation as to whether a work order has been issued.



COMMON AREAS WHERE INFLOW / INFILTRATION OCCUR

Low Pressure System Description and Operation

Vacuum Sewers

Wastewater from one or more homes flows by gravity to a holding tank known as the valve pit. When the wastewater level reaches a certain level, sensors within the holding tank open a vacuum valve that allows the contents of the tank to be sucked into the network of collection piping. There are no manholes with a vacuum system; instead, access can be obtained at each valve pit. The vacuum or draw within the system is created at a vacuum station. Vacuum stations are small buildings that house a large storage tank and a system of vacuum pumps.

Vacuum sewer systems are limited to an extent by elevation changes of the land. Rolling terrain with small elevation changes can be accommodated, yet steep terrain would require the addition of lift stations like those used for conventional sewer systems. It is generally recommended that there be at least 75 properties per pump station for the use of a vacuum sewer system to be cost effective.

This minimum property requirement tends to make vacuum sewers most conducive for small communities with a relatively high density of properties per acre. The maintenance and operation of this system requires a full-time system operator with the necessary training. This can make the operation and maintenance costs of vacuum sewers exceed those of other systems.

Applications

Vacuum collection and transportation systems can provide significant capital and ongoing operating cost advantages over conventional gravity systems, particularly in flat terrain, high water table, or hard rock areas. Vacuum sewer systems are installed at shallow depths, significantly reducing excavation, shoring and restoration requirements, and minimizing the disruption to the community. The alignment of vacuum mains is extremely flexible, without the need for manholes at changes in grade or direction.

Vacuum sewer mains can skip over and around other services or obstacles and can be used to achieve uphill flow. Turbulent velocities of 5 to 6m/sec are developed as the sewage and air passes through the interface valve. This disintegrates solids and reduces the risks of sewer blockages in a correctly designed and constructed vacuum system.

No electricity is required at the interface valve, enabling the system to be installed in virtually any location. Fractures in gravity systems may go undetected for a long time. A leak in a vacuum main will raise an alarm within minutes of the break. The mains have to be repaired for sewage transport to continue, ensuring up to date maintenance and eliminating deterioration and infiltration.

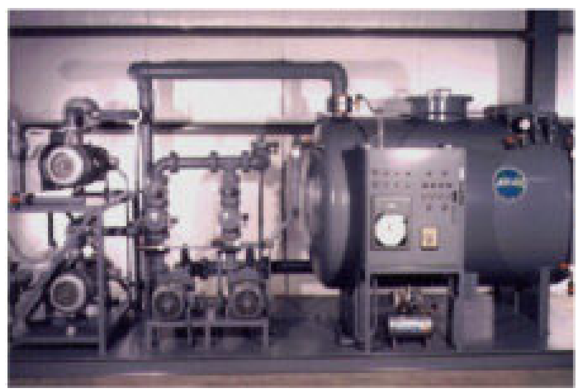
Due to the shallow depth of the installation, additional connections can be quickly and simply made by a small construction crew, thus reducing the disruption and restoration work normally required for conventional gravity sewers. Vacuum collection and transport systems have many applications in industry for collecting all forms of liquid waste, including toxic and radioactive fluids. Collection pipes may be installed above ground, overhead or in utility ducts.

The versatility of the vacuum sewer system can be employed in a variety of locations and situations, such as:

- Rural community sewerage schemes.
- Industrial redevelopments.

- Camping and caravan sites.
- New residential and industrial developments.
- Existing towns (especially where narrow streets or congested service corridors occur).
- Diversion of small sea outfalls.
- Hospital effluent collection.
- Airports/Shopping centers.
- Railway services.
- Replacement of failed gravity systems.
- Petrol-chemical industry.
- Food processing plants.
- Roof drainage.
- Retrofitting factories for the management of segregated wastestreams.
- Collection of toxic and radioactive waste.
- Condensate collection systems.
- Factory sewerage.
- Leachate from landfills.
- Spillage around tank farms.
- Collecting used oil and fluids.
- River and lakeside communities.
- Quayside redevelopments.
- Arctic communities.

Vacuum Interface Valves



There is an interface between the vacuum within the vacuum mains and the atmospheric pressure is maintained within the vacuum interface chamber. When sewage is entering the system from a source and the sewage level in the chamber rises, it pressurizes air in the 63mm sensor line. This air pressure is transmitted by a hose to the controller/sensor unit, which opens the valve and the wastewater is rapidly drawn into the vacuum main. This suction of the sewer creates a vortex in the sump and air is drawn into the sewer with the sewage.

As the valve opens, a pneumatic timer in the controller/sensor unit starts a pre-set time cycle. The timer holds the valve open for sufficient time to draw all the sewage out of the sump and allows a designated amount of air to enter the system. The interface valve is capable of serving at least four equivalent tenements, and multiple valve chambers may be installed to serve higher flow rates. No electricity is required at the valve chamber. The vacuum valve is automatically operated by the pressure generated with the rising sewage level and the pneumatic timer, and actuated by the vacuum in the sewer.

Differential air pressure is the driving force in vacuum sewer systems. The vacuum sewer lines are under a vacuum of 16"-20" Hg (-0.5 to -0.7 bar) created by vacuum pumps located at the vacuum station. The pressure differential between the atmospheric pressure and the vacuum in the sewer lines of 7 to 10 psi (0.5 - 0.7 bar) provides the energy required to open the vacuum interface valves and to transport the sewage. Sewage flows by gravity from homes into a collection sump.

When 10 gallons (40 liters) accumulates in the sump, the vacuum interface valve located above the sump automatically opens and differential air pressure propels the sewage through the valve and into the vacuum main. Sewage flows through the vacuum lines and into the collection tank at the vacuum station.

Sewage pumps transfer the sewage from the collection tank to the wastewater treatment facility or nearby gravity manhole. There are no electrical connections required at the home. Power is necessary only at the vacuum station.

Valve Pit Package

The Valve Pit Package connects the homes to the vacuum sewer system. Raw sewage flows by gravity from up to four homes into a sealed fiberglass sump. Located above the sewage sump and surrounded by a fiberglass valve pit is a 3" (90 mm) vacuum interface valve, which is pneumatically controlled and operated. Vacuum from the sewer line opens the valve and outside air from a breather pipe closes it.

Sewage level sensing is remarkably simple. As the sewage level rises, air trapped in the empty 2" (50 mm) diameter sensor pipe pushes on a diaphragm in the valve's controller/sensor unit, signaling the valve to open. When ten gallons of sewage accumulates in the sump the valve automatically opens. The differential air pressure propels the sewage at velocities of 15-18 feet per second (4.5 - 5.5 m/s), disintegrating solids while being transported to the vacuum station. The valve stays open for four to six seconds during this cycle.

Atmospheric air used for transport enters through the 4" (100 mm) screened air intake on the gravity line. There are no odors at this air inlet due to the small volumes of sewage (10 gallons - 40 liters) and short detention times in the sump. The valve is 3" and designed for handling nominal 3" (75 mm) solids. Homes connected to vacuum sewers don't require any special plumbing fixtures. Typically one valve pit package serves two homes. Install the valve pit package in the street, if desired. With the optional traffic cast iron cover the valve pit package has a water loading rating.

Vacuum Lines

Vacuum sewer lines are installed in narrow trenches in a saw tooth profile for grade and uphill transport. Vacuum lines follow grade for downhill transport. Vacuum lines are slightly sloped (0.2%) towards the collection station. Unlike gravity sewers that must be laid at a minimum slope to obtain a 2 ft./sec. (0.6 m/s) scouring velocity, vacuum has a flatter slope since a high scouring velocity is a feature of vacuum sewage transport.

Line Sizes

The vacuum service line from the valve to the main in the street is 3" diameter (90 mm). The vacuum mains are 4", 6", 8" and 10" diameter (110 mm to 250 mm) schedule 40 or SDR 21 gasketed PVC pipe. PE pipe can also be used. In general, a potential vacuum loss is associated with every lift. This limits the length of each vacuum line to about 2 to 3 miles (3 to 5 km) in flat terrain. Elevation changes can extend or reduce this range. Longer distances are possible depending on local topography.

Vacuum Station

The vacuum station is similar in function to a lift station in a gravity sewer system. Sewage pumps transfer the sewage from the collection tank, through a force main, to the treatment plant. Unlike a lift station, the vacuum station has two vacuum pumps that create vacuum in the sewer lines and an enclosed collection tank.

Vacuum Pumps
The vacuum pumps maintain the system vacuum in the 16" to 20" mercury vacuum (-0.5 to -0.7 bar) operating range. Vacuum pumps typically run 2 to 3 hours each per day (4 to 6 hours total) and don't need to run continuously since the vacuum interface valves are normally closed. As sewage enters the system, driven by air at atmospheric pressure, the system vacuum will slowly decrease from 20" to 16" Hg. The vacuum pumps are sized to increase the system vacuum from 16" to 20" Hg in three minutes or less.

Typical vacuum pump sizes are 10, 15, and 25 horsepower (7.5, 11 and 18.6 kw). Busch rotary vane vacuum pumps are standard. The two non-clog sewage pumps are each sized for peak flow. The collection tank is steel or fiberglass and is sized according to flow, with typical sizes ranging from 1,000 to 4,000 gallons (3.8 to 15 cubic meters). The incoming vacuum lines connect individually to the collection tank, effectively dividing the system into zones. A stand-by generator keeps the vacuum sewer system in operation during extended power outages. An automatic telephone dialer alerts the operator to alarm conditions.

Review
Pressure Sewers
Instead of relying on gravity, pressure sewers utilize the force supplied by pumps, which deliver the wastewater to the system from each property. Since pressure sewers do not rely on gravity, the system's network of piping can be laid in very shallow trenches that follow the contour of the land.

There are two kinds of pressure sewer systems, based upon the type of pump used to provide the pressure. Systems that use a septic tank/effluent pump combination are referred to as STEP pressure sewers.

Like the small diameter gravity system, STEP pressure sewers utilize septic tanks to settle out the solids; this allows for the use of piping that is extremely narrow in diameter. The effluent pump delivers the wastewater to the sewer pipes and provides the necessary pressure to move it through the system. The other type of pressure sewer uses a grinder pump.

Wastewater from each property goes to a tank containing a pump with grinder blades that shred the solids into tiny particles. Both solids and liquids are then pumped into the sewer system. Because the effluent contains a mixture of solids as well as liquids, the diameter of the pipes must be slightly larger. However, grinder pumps eliminate the need to periodically pump the septic tanks for all the properties connected to the system.

Both the STEP and grinder systems are installed with high water alarms. Because of the addition of the pumps, pressure sewers tend to require more operation and maintenance than small diameter gravity sewers.

Operators can usually be hired on a part time basis, as long as someone is on call at all times. Operators will need training on both the plumbing and electrical aspects of the system.

Manhole Sub-Section

Manholes should undergo routine inspection typically every one to five years. There should be a baseline for manhole inspections (e.g., once every two years) with problematic manholes being inspected more frequently. The reviewer should conduct visual observation at a small but representative number of manholes for the items listed below.

There are various pipeline inspection techniques, the most common include: lamping, camera inspection, sonar, and CCTV. These will be explained further in the following sections.

Sewer System Inspection Techniques
Sewer inspection is an important component of any maintenance program. There are a number of inspection techniques that may be employed to inspect a sewer system. The reviewer should determine if an inspection program includes frequency and schedule of inspections and procedures to record the results. Sewer system cleaning should always be considered before inspection is performed in order to provide adequate clearance and inspection results.

Additionally, a reviewer should evaluate records maintained for inspection activities, including whether information is maintained on standardized logs, and should include:

- Location and identification of line being inspected.
- Pipe size and type.
- Name of personnel performing inspection.
- Distance inspected.
- Cleanliness of the line.
- Condition of the manhole with pipe defects identified by footage from the starting manhole.
- Results of inspection, including estimates of I/I.

When designing a wastewater system, the design engineer begins by first determining the types and quantities of sewage to be handled. This is accomplished through a careful study of the area to be served. The design engineer bases his design on the average daily use of water per person in the area to be served. A typical value is 100 gallons per person per day. But, the use of water is not constant.

Use is greater in the summer than in the winter and greater during the morning and evening than it is in the middle of the day or at night. Therefore, the average daily flow (based on the average utilization) is multiplied by a peak flow factor to obtain the design flow.

Typical peak flow factors range from 4 to 6 times for small areas down to 1.5 to 2.5 times for larger areas. An allowance for unavoidable infiltration of surface and subsurface water into the lines is sometimes added to the peak flow to obtain the design flow.

A typical infiltration allowance is 500 gallons per inch of pipe diameter per mile of sewer per day. From the types of sewage and the estimated design flow, the engineer can then tentatively select the types, sizes, slopes, and distances below grade of the piping to be used for the system.

Upon acceptance of the preliminary designs, final design may begin. During this phase, adjustments to the preliminary design should be made as necessary, based upon additional surveys, soil analysis, or other design factors. The final designs should include a general map of the area that shows the locations of all sewer lines and structures.

They also should include detailed plans and profiles of the sewers showing ground elevations, pipe sizes and slopes, and the locations of any appurtenances and structures, such as manholes and lift stations.

Construction plans and details are also included for those appurtenances and structures.

Newly finished Manhole and Laterals

Lead and Oakum Joint, Compression Joint and No-Hub Joints
These types of joints are used to connect cast-iron soil pipes (CISP) and fittings. In lead and oakum joints, oakum (made of hemp impregnated with bituminous compound and loosely twisted or spun into a rope or yarn) is packed into the hub completely around the joint, and melted lead is poured over it. In compression joints, an assembly tool is used to force the spigot end of the pipe or fitting into the lubricated gasket inside the hub. A no-hub joint uses a gasket on the end of one pipe and a stainless steel shield and clamp assembly on the end of the other pipe.

Mortar or Bituminous Joints
This type of joint is common to vitrified clay and concrete pipes and fittings. Mortar joints may be made of grout (a mixture of cement, sand, and water).

The use of ***SPEED SEAL JOINTS*** (rubber rings) in joining vitrified clay pipe has become widespread. Speed seal joints eliminate the use of oakum and mortar joints for sewer mains. This type of seal is made a part of the vitrified pipe joint when manufactured. It is made of polyvinyl chloride and is called a plastisol joint connection

Closed Circuit Television (CCTV) Inspections

Camera Inspection
Lamping involves lowering a still camera into a manhole. The camera is lined up with the centerline of the junction of the manhole frame and sewer. A picture is the taken down the pipe with a strobe-like flash. A disadvantage of this technique is that only the first 10-12 feet of the pipe can be inspected upstream and downstream of the access point. Additionally, it has limited use in small diameter sewers. The benefits of this technique include not requiring confined space entry and little equipment and set-up time is required.

Camera inspection is more comprehensive than lamping in that more of the sewer can be viewed. A still camera is mounted on a floatable raft and released into a pipe. The camera takes pictures with a strobe-like flash as it floats through the sewer pipe. This technique is often employed in larger lines where access points are far apart. Similar to lamping, portions of the pipe may still be missed using this technique.

Obviously, there also must be flow in the pipe for the raft to float. This technique also does not fully capture the invert of the pipe and its condition. Sonar is a newer technology deployed similarly to CCTV cameras, and described in more detail below.

The sonar emits a pulse which bounces off the walls of the sewer. The time it takes for this pulse to bounce back provides data and an image of the interior of the pipe, including its structural condition. A benefit of this technique is that it can be used in flooded or inaccessible sections of the sewer. The drawback is that the technique requires heavy and expensive equipment.

Sewer scanner and evaluation is an experimental technology where a 360-degree scanner produces a full digital photograph of the interior of the pipe. This technique is similar to sonar in that a more complete image of a pipe can be made than with CCTV, but not all types of sewer defects may be identified as readily (i.e., infiltration, corrosion).

Closed Circuit Television (CCTV) Inspections
Closed Circuit Television (CCTV) inspections are a helpful tool for early detection of potential problems. This technique involves a closed-circuit camera with a light which is self-propelled or pulled down the pipe. As it moves it records the interior of the pipe. CCTV inspections may be done on a routine basis as part of the preventive maintenance program, as well as part of an investigation into the cause of I/I.

CCTV, however, eliminates the hazards associated with confined space entry. The output is displayed on a monitor and videotaped. A benefit of CCTV inspection is that a permanent visual record is captured for subsequent reviews.

A remotely controlled TV camera on the top left is utilized by crews to identify and video tape problem areas within the system. By using this equipment, staff can determine what the cause of the problem is, what materials will be needed for repair, and where the problem area is.

Repairs can be made quickly without digging up large areas to find and correct a problem, as was done in the past. There are many reasons for inspecting sewer lines with a closed circuit television (CCTV). All of the following are valid reasons; locating sources of inflow and infiltration, locating buried manholes, and locating illegal sewer taps such as industrial or storm drains.

The Televising Van should be equipped with two cameras, one color camera for televising main sanitary lines and one color or black & white camera for televising house services (connection from the main sanitary line to a house).

Sewer Flow Measurements

Flow measurements performed for the purpose of quantifying I/I are typically separated into three components: base flow, infiltration, and inflow. Base flow is generally taken to mean the wastewater generated without any I/I component. Infiltration is the seepage of groundwater into pipes or manholes through defects such as cracks, broken joints, etc. Inflow is the water which enters the sewer through direct connections such as roof leaders, direct connections from storm drains or yard, area, and foundation drains, the holes in and around the rim of manhole covers, etc.

Many collection system owners or operators add a third classification: rainfall induced infiltration (RII). RII is stormwater that enters the collection system through defects that lie so close to the ground surface that they are easily reached. Although not from piped sources, RII tends to act more like inflow than infiltration.

In addition to the use of flow meters, which may be expensive for a small owner or operator, other methods of inspecting flows may be employed, such as visually monitoring manholes during low-flow periods to determine areas with excessive I/I. For a very small system, this technique may be an effective and low-cost means of identifying problem areas in the system which require further investigation.

Inside a new manhole, the Invert is the inside bottom of the pipe. The Invert is used to determine the depth which is used to determine the Rise or Slope of the pipe.

The formula for figuring the slope is: rise divided by run.

Smoke Testing is accomplished by forcing a non-toxic smoke into the sewer system and looking for locations where it is improperly exiting.

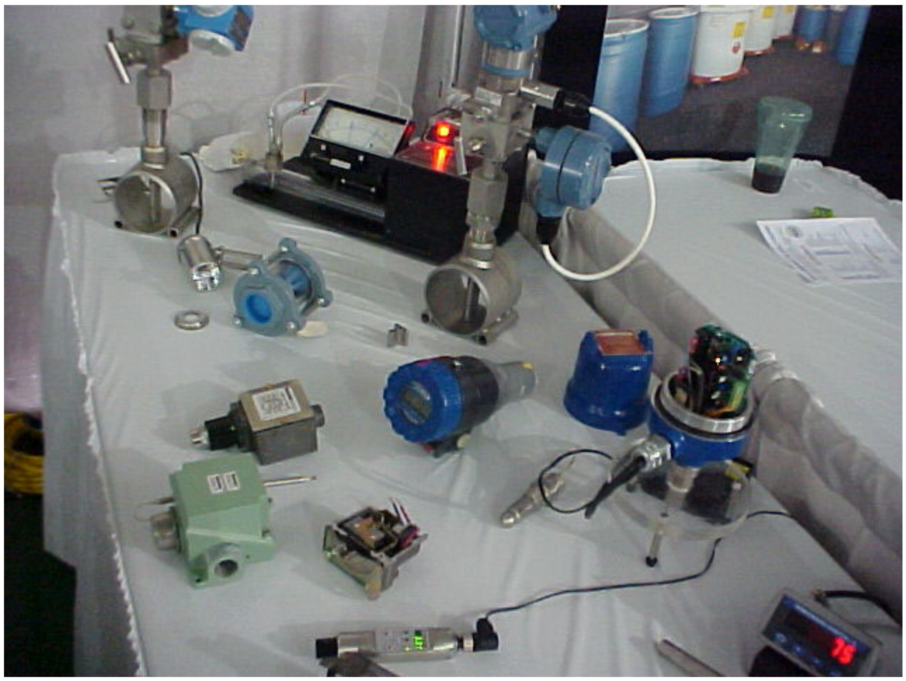
These locations are considered illegal connections in that they allow stormwater directly or indirectly to enter the sanitary sewer system.

Typical illegal connections found are roof drains tied directly into the system, abandoned customer sewer lines that were not properly capped, as well as an occasional broken sewer line.

Raising the Ring, jackhammer, install the crown, patch the street.

Sewer Flow Capacity

Most sewers are designed with the capacity to flow half full for less than 15 inches in diameter; larger sewers are designed to flow at three-fourths flow. The velocity is based on calculated peak flow, which is commonly considered to be twice the average daily flow. Accepted standards dictate that the minimum design velocity should not be less than 0.60 m/sec (2 fps) or generally greater than 3.5 m/sec (10 fps) at peak flow. A velocity in excess of 3.5 m/sec (10 fps) can be tolerated with proper consideration of pipe material, abrasive characteristics of the wastewater, turbulence, and thrust at changes of direction. The minimum velocity is necessary to prevent the deposition of solids.



Examples of various sewer flow measuring devices

The Use of a Dye at the Manhole to Determine the Velocity is Done as Follows:

1. Insert dye upstream and begin timing until the dye is first seen at the downstream manhole (t_1); and
2. Total the travel time, and the insertion time from the time the dye is no longer seen at the downstream manhole (t_2).

Once this is complete, add ($t_1 + t_2$) then divide it by 2. This will give you the total average time for the dye. In order to calculate the velocity the travel time is divided by the distance between manholes (note that the time needs to be converted to seconds):

$$\text{Velocity, ft/sec} = \frac{\text{Distance, ft}}{\text{Average time, sec}}$$

There are devices available to measure flow measurements; they all are based on the principle of the cross-sectional area of the flow in a sewer line. This is done by using the table below. Once this has been determined, then the following equations can be used:

Q, cubic feet of flow = Area, sq. ft multiplied by Velocity, ft/sec

d/D	Factor	d/D	Factor	d/D	Factor	d/D	Factor
0.01	0.0013	0.16	0.0811	0.31	0.2074	0.46	0.3527
0.02	0.0037	0.17	0.0885	0.32	0.2167	0.47	0.3627
0.03	0.0069	0.18	0.0961	0.33	0.2260	0.48	0.3727
0.04	0.0105	0.19	0.1039	0.34	0.2355	0.49	0.3827
0.05	0.0174	0.20	0.1118	0.35	0.2350	0.50	0.3927
0.06	0.0192	0.21	0.1199	0.36	0.2545	0.51	0.4027
0.07	0.0242	0.22	0.1281	0.37	0.2642	0.52	0.4127
0.08	0.0294	0.23	0.1365	0.38	0.2739	0.53	0.4227
0.09	0.0350	0.24	0.1449	0.39	0.2836	0.54	0.4327
0.10	0.0409	0.25	0.1535	0.40	0.2934	0.55	0.4426
0.11	0.0470	0.26	0.1623	0.41	0.3032	0.56	0.4526
0.12	0.0534	0.27	0.1711	0.42	0.3130	0.57	0.4625
0.13	0.0600	0.28	0.1800	0.43	0.3229	0.58	0.4724
0.14	0.0668	0.29	0.1890	0.44	0.3328	0.59	0.4822
0.15	0.0739	0.30	0.1982	0.45	0.3428	0.60	0.4920

This table works as follows:

To determine the cross-sectional flow for a 12-inch sewer main with a flow depth of 5 inches you would first:

d or depth 5 inches divided by **D** or diameter 12 inches equals 0.42 **d/D.** using the table above find the correct factor for 0.42 d/D.

The factor equals 0.3130, now calculate the cross-sectional area using the following formula:

$$\text{Pipe Cross-sectional Area, sq. ft} = \frac{(\text{Factor})(\text{Diameter, in})^2}{144 \text{ sq. in/sq. ft}}$$

$$\frac{(0.3130)(12 \text{ in})^2}{144 \text{ sq. in/sq./ft}}$$

$$= 0.0313 \text{ sq. ft}$$

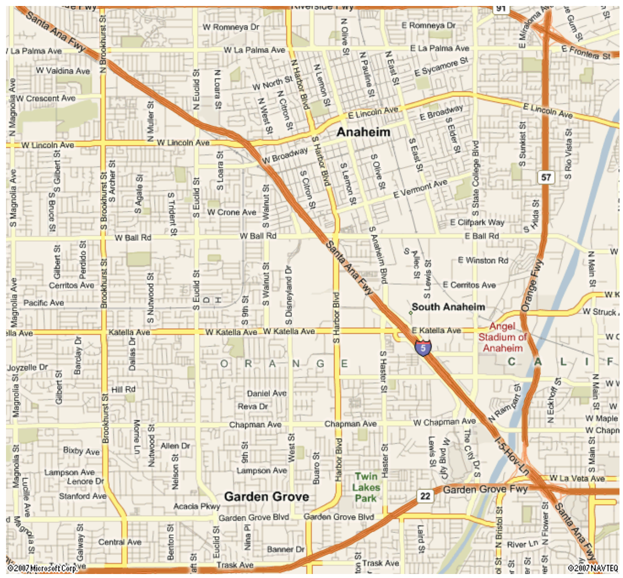
Once the Velocity and the cross-sectional area have been determined, the calculation for flow rate is used. This formula is as followed:

Q, cubic feet per second = (Area, sq. ft) (Velocity, ft/sec)

Once this calculation is made, cubic feet can be converted to gallons by multiplying it by 7.48 gal/cubic feet and seconds can be converted to minutes, hours or days by multiplying the gallons with the time.

Sewer Line Mapping

The importance of maintaining accurate, current maps of the collection system cannot be overstated. Efficient collection system maintenance and repairs are unlikely if mapping is not adequate. Collection system maps should clearly indicate the information that personnel need to carry out their assignments. The collection system maps should contain information on the following:



- Main, trunk and interceptor sewers
- Building/house laterals
- Manholes
- Cleanouts
- Force mains
- Pump stations
- Service area boundaries
- Other landmarks (roads, water bodies, etc.)

Collection system maps should have a numbering system that uniquely identifies all manholes and sewer cleanouts. The system should be simple and easy to understand. Manholes and sewer cleanouts should have permanently assigned numbers and never be renumbered. Maps should also indicate the property served and reference its cleanout.

Sewer line maps should indicate the diameter, the length between the centers of manholes, and the slope or direction of flow. The dimensions of easements and property lines should be included on the maps. Other information that should be included on maps are access and overflow points, a scale, and a north arrow. All maps should have the date the map was drafted and the date of the last revision. Although optional, maps often include materials of pipe construction.

Maps may come in different sizes and scales to be used for different purposes. Detailed local maps may be used by maintenance or repair crews to perform the duties. However, these detailed local maps should be keyed to one overall map that shows the entire system.

Geographic Information System (GIS)

GIS technology has made the mapping and map updating process considerably more efficient. GIS is a computerized mapping program capable of combining mapping with detailed information about the physical structures within the collection system. If a GIS program is being used by the owner or operator, the reviewer should ask if the program is capable of accepting information from the owner or operator's management program.

Specific procedures should be established for correction of errors and updating maps and drawings. Field personnel should be properly trained to recognize discrepancies between field conditions and map data and record changes necessary to correct the existing mapping system. Reviewers should check to see that maps and plans are available to the personnel in the office and to field personnel or contractors involved in all engineering endeavors.

Key Design Characteristics

- Line locations, grades, depths, and capacities
- Maximum manhole spacing and size
- Minimum pipe size
- Pumping Station dimensions and capacities
- Drop manholes
- Flow velocities and calculations (peak flow and low-flow)
- Accessibility features
- Other technical specifications (e.g., materials, equipment)

New Sewer Construction

The owner or operator should maintain strict control over the introduction of flows into the system from new construction. New construction may be public (i.e., an expansion of the collection system) or private (i.e., a developer constructing sewers for a new development).

Quality sanitary sewer designs keep costs and problems associated with operations, maintenance, and construction to a minimum. Design flaws are difficult to correct once construction is complete.

The reviewer should be aware that this has historically not been adequately addressed in some collection systems. The owner or operator should have standards for new construction, procedures for reviewing designs and protocols for inspection, start-up, testing, and approval of new construction. The procedures should provide documentation of all activities, especially inspection.

Reviewers should examine construction inspection records and be able to answer the following:

- Does the volume of records seem reasonable given system size?

- Do records reflect that the public works inspectors are complying with procedures?

The state or other regulatory authority may also maintain standards for new construction. The standards held by the owner or operator should be at least as stringent. Start-up and testing should be in accordance with the manufacturers' recommendations where applicable, and with recognized industry practices. Each step of the review, start-up, testing, and approval procedures should be documented.

The owner or operator approval procedure should reflect future ease of maintenance concerns. After construction is complete, a procedure for construction testing and inspection should be used. Construction supervision should be provided by qualified personnel such as a registered professional engineer.

See the ladder (right) on top photograph. See the collection crew under the steel plate and no shoring or trench protection. It looks like the steel plate is falling in, just another death trap for the uneducated unsafe collection worker.

The Vactor can be a very dangerous piece of equipment. Always use this equipment in the most safest manor.

Wastewater Collection Section Summary

Primary Collection System Problems
a. Fats, oil, and greases (FOG) are a major problem; this is primarily applicable to municipal wastestreams.

b. Odors, particularly those related to sulfides (H_2S), are a constant concern, as are other mercaptans and some indoles (skatole).

c. In many wastewater streams, particularly in industrial ones, problems center on highly toxic anions/cations that require chemical treatment of one sort or another.

d. Various POTW's proscribe effluent limitations on phosphates, nitrates, and various other organic entities.

Structural Sewer Problems
Structural problems can cause major headaches. CCTV is one of the best tools available to check the condition of your buried assets. During CCTV field inspections, pipe defects and maintenance issues are discovered and classified using a standardized coding system. Following data analysis, structural condition information is used to estimate a pipe's performance, remaining useful life and to plan for the future and make decisions about pipe repair or replacement.

CCTV inspections also reveal maintenance issues, which aid the manager in making any necessary operation or maintenance changes.

- Collapses
- Fractures
- Sags
- Infiltration
- Inflow

Hydraulic Capacity
Hydraulic capacity is a primary performance measure for a wastewater collection system. Capacity (both hydraulic and treatment) can be taken up by clean water entering the sewer collection system. It may be obvious, based on dry weather and wet weather flows, that rainwater or groundwater inflow or infiltration (I/I) is a problem.

CCTV evaluation can determine the specific location and cause of I/I in many cases, however, flow data gathered by flow meters has been used to guide sewer system capacity management for decades.

Flow data can be used as a tool in condition assessment either to identify areas for further CCTV inspection or to quantify the severity of I/I identified during CCTV work.

- Excess flow
- Infiltration
- Inflow

Wastewater Collection Post Quiz

Collection System Defined

1. Decentralized systems are public sewer systems that serve established towns and cities and transport wastewater to a central location for treatment.
A. True B. False

2. Homes and other buildings that are not served by public sewer systems depend on ____________________ septic systems to treat and dispose of wastewater.

3. Most decentralized systems are _____________ systems (wastewater is treated underground near where it is generated).

4. Centralized systems are more inexpensive, allow for greater control, require fewer people, and produce only one discharge to monitor instead of several. However, ____________________systems can be useful, and this option should be evaluated on a case-by-case basis.

5. __________________ are designed to collect both sanitary wastewater and storm water runoff.

Collection System Operators' Purpose

6. Collection system operators are charged with protecting public health and the environment, and therefore must have documented proof of their certifications in the respective ____________________.

7. _____________________ and the professionals who maintain it operate at such a high level of efficiency, problems are very infrequent.

8. Collection system operators ensure that the system pipes remain clear and open. They eliminate obstructions and are constantly striving to improve flow characteristics. They keep the wastewater moving underground, unseen and unheard.
A. True B. False

9. Underground sanitary sewer pipes can clog or break, causing unplanned "overflows" of raw sewage that flood basements and streets.
A. True B. False

10. Storm sewers are not designed to quickly get rainwater off the streets during rain events.
A. True B. False

11. Combined sewers deliver both wastewater and storm water in the same pipe. Most of the time, combined sewers transport the wastewater and storm water to a treatment plant.
A. True B. False

12. The public often takes the wastewater collection system for granted. In truth, these operators must work hard to keep it functioning properly.
A. True B. False

13. When there is too much rain, combined sewer systems cannot handle the extra volume and designed "overflows" of raw sewage into streams and rivers occur. The great majority of sewer systems have separated, not combined, sanitary and storm water pipes.
A. True B. False

14. The maintenance of the sewer system is a semi-continuous cycle.
A. True B. False

15. Outdated pump stations, undersized to carry sewage from newly developed subdivisions or commercial areas, will not create any potential overflow hazards, adversely affecting human health and degrading the water quality of receiving waters.
A. True B. False

Understanding Gravity Sanitary Sewers
16. Sanitary sewers are planned to transport the wastewater by utilizing the _________________ provided by the natural elevation of the earth resulting in a downstream flow.

17. Sewer systems are designed to maintain proper flow velocities with?

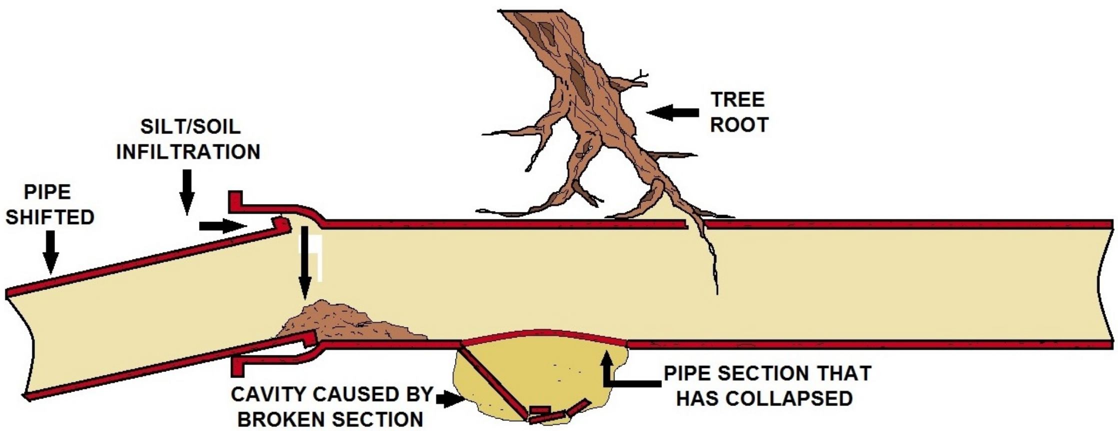
Sewer System Capacity Evaluation - Testing and Inspection
18. The collection system owner or operator should have a program in place to periodically evaluate this _________________________ in both wet and dry weather flows and ensure the capacity is maintained as it was designed.

Answers
1. False, 2. Decentralized, 3. Onsite, 4. Decentralized, 5. Combined sewer systems, 6. Wastewater management system, 7. Wastewater collection system, 8. True, 9. True, 10. False, 11. True, 12. True, 13. True, 14. False, 15. False, 16. Potential energy, 17. Minimum head loss, 18. Capacity of the sewer system

Chapter 10- Collection Systems O&M Section

Section Focus: You will learn the basics of the operation and maintenance of the collection system. At the end of this section, you will be able to describe the basics of proper operation and maintenance of the wastewater collection system. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: As a pretreatment inspector, you will need knowledge of many different concerns of the collections and wastewater treatment systems in order to properly identify the pretreatment (pass-through or interference) problem. Master's level knowledge of the collection system is essential for all pretreatment inspectors.



BROKEN SEWER PIPE

Operation and maintenance of wastewater collection systems on a trouble or emergency basis has been the usual procedure and policy in many systems. Planned operation and preventive maintenance of the collection system has been delayed or omitted, primarily for political or financial reasons.

Routine preventative operations and maintenance activities for wastewater collection lines shall be performed by the system's personnel and outside contractors. A qualified outside contractor can also be utilized to perform hydraulic cleaning using a jet hydro-vac combination truck and mechanical cleaning using a rodding machine. Routine operations and maintenance activities including cleaning and removing roots from small and large diameter lines. The system's goal should be a minimum of cleaning between 20-30% of the sewers every year.

Closed-circuit television (CCTV) is used to assess the condition of the sewers. There are four types of activities that the system or a CCTV contractor can also perform:
1) inspect new work,
2) inspect condition of older portions of the wastewater collection system,
3) routine inspection of approximately 10% of the wastewater collection, and 4) problem identification to determine the cause of selected overflow events. Manhole inspection, manhole coating (to prevent concrete deterioration) and manhole painting (for roach control) are also routinely performed.

Sewer filled with grass will damage your system, pumps, and upset the wastewater treatment system. Require your industrial users like golf courses to install grass, grease, and sand/oil interceptors.

Certain compounds and undesirable solids, like grease and grass clippings, can disturb this delicate balance and necessary process at the wastewater treatment facility.

There are compounds and mixtures that should never be introduced into a sanitary sewer system. These destructive compounds include but are not limited to: cleaning solvents, grease (both household and commercial), oils (both household and commercial), pesticides, herbicides, antifreeze and other automotive products.

Sewer Cleaning and Inspection

Inspection and testing are the techniques used to gather information to develop operation and maintenance programs to ensure that new and existing wastewater collection systems serve their intended purposes on a continuing basis. Inspection and testing are necessary to do the following:

- Identify existing or potential problem areas in the collection system,
- Evaluate the seriousness of detected problems,
- Locate the position of problems, and
- Provide clear, concise and meaningful reports regarding problems.

Two major purposes of inspecting and testing are to prevent leaks from developing in the wastewater collection system and to identify existing leaks so they can be corrected. The existence of leaks in a wastewater collection system is a serious and often expensive problem. When a sewer is under a water table, infiltration can take place and occupy valuable capacity in the sewer and the downstream treatment plant. Sewers located above a water table can exfiltrate, allowing raw wastewater to pollute soil and groundwater.

As sewer system networks age, the risk of deterioration, blockages, and collapses becomes a major concern. As a result, municipalities worldwide are taking proactive measures to improve performance levels of their sewer systems. Cleaning and inspecting sewer lines are essential to maintaining a properly functioning system; these activities further a community's reinvestment into its wastewater infrastructure.

Inspection Techniques
Inspection programs are required to determine current sewer conditions and to aid in planning a maintenance strategy. Ideally, sewer line inspections need to take place during low flow conditions. If the flow conditions can potentially overtop the camera, then the inspection should be performed during low flow times between midnight and 5 AM, or the sewer lines can be temporarily plugged to reduce the flow.

Most sewer lines are inspected using one or more of the following techniques:

- Closed-circuit television (CCTV).
- Cameras.
- Visual inspection.
- Lamping inspection.

Television (TV) inspections are the most frequently used, most cost efficient in the long term, and most effective method to inspect the internal condition of a sewer. CCTV inspections are recommended for sewer lines with diameters of 0.1-1.2 m (4 - 48 inches.) The CCTV camera must be assembled to keep the lens as close as possible to the center of the pipe. In larger sewers, the camera and lights are attached to a raft, which is floated through the sewer from one manhole to the next. To see details of the sewer walls, the camera and lights swivel both vertically and horizontally.

In smaller sewers, the cable and camera are attached to a sled, to which a parachute or droge is attached and floated from one manhole to the next. Documentation of inspections is very critical to a successful operation and maintenance (O&M) program.

CCTV inspections produce a video record of the inspection that can be used for future reference. In larger sewers where the surface access points are more than 300 1000 linear feet apart, camera inspections are commonly performed. This method requires less power than the CCTV, so the power cable is smaller and more manageable. Inspections using a camera are documented on Polaroid or digital still (computer jpeg) photographs that are referenced in a log book according to date, time, and location.

Visual inspections are vital in fully understanding the condition of a sewer system. Visual inspections of manholes and pipelines are comprised of surface and internal inspections. Operators should pay specific attention to sunken areas in the groundcover above a sewer line and areas with ponding water.

In addition, inspectors should thoroughly check the physical conditions of stream crossings, the conditions of manhole frames and covers or any exposed brickwork, and the visibility of manholes and other structures. For large sewer lines, a walk-through or internal inspection is recommended. This inspection requires the operator to enter a manhole, the channel, and the pipeline, and assess the condition of the manhole frame, cover, and chimney, and the sewer walls above the flow line.

When entering a manhole or sewer line, it is very important to observe the latest Occupational Safety and Health Administration confined space regulations. If entering the manhole is not feasible, mirrors can be used. Mirrors are usually placed at two adjacent manholes to reflect the interior of the sewer line. Lamping inspections are commonly used in low priority pipes, which tend to be pipes that are less than 20 years old.

Lamping

Lamping is also commonly used on sewer projects where funds are extremely limited. In the lamping technique, a camera is inserted and lowered into a maintenance hole and then positioned at the center of the junction of a manhole frame and the sewer. Visual images of the pipe interior are then recorded with the camera.

Several specialized inspection techniques have been recently developed worldwide. This includes: Light-line based and sonar-based equipment that measures the internal cross-sectional profile of sewer systems.

Sonar technology could be very useful in inspecting depressed sewers (inverted siphons), where the pipe is continually full of water under pressure. Melbourne Water and CSIRO Division of Manufacturing Technology have introduced a new technology called PIRAT, which consists of an in-pipe vehicle with a laser scanner. This instrument is capable of making a quantitative and automatic assessment of sewer conditions. The geometric data that is gathered is then used to recognize, identify, and rate defects found in the sewer lines.

Manhole Inspections - Sewer Inspections Recommendations

The information provided if employed is a good starting point for an inspection.

Manhole inspections should yield a report with the following information at a minimum:

- Exact location of the manhole;
- Diameter of the clear opening of the manhole;
- Condition of the cover and frame, including defects that would allow inflow to enter the system;
- Whether cover is subject to ponding or surface runoff;
- The potential drainage area tributary to the defects;
- Type of material and condition of the chimney corbel cone and walls;
- Condition of steps and chimney and frame-chimney joint;
- Configuration of the incoming and outgoing lines (including drops); and
- Signs of frame-chimney leakage or damage to the frame's seal

Additionally, the following data can be obtained by entering the manhole and using equipment such as portable lamps, mirrors, rulers, and probe rods:

- Type of material and condition of apron and trough;
- Any observed infiltration sources and the rate of infiltration;
- Indications of height of surcharge;
- Size and type of all incoming and outgoing lines; and
- Depth of flow indications of deposition and the characteristics of flow within all pipes.
- The condition of the manhole shaft;
- Any leakage in the channel;
- Any leakage between the manhole wall and the channel;
- Any damage or leakage where pipeline connects to the manhole; and
- Any flow obstructions.

Television Inspections
Sewer pipe inspections of small diameter sewers for infiltration are most effective when a closed circuit television camera is employed.

Television inspections should provide the following information:

- Definitions of problem(s)
- Determine if problem is in municipal sewer or private property sewer
- Effectiveness of existing cleaning program
- Future sewer cleaning requirements
- Sewer rehabilitation needs
- Ability to assess whether trenchless technology or excavation and replacement can solve the problem
- Ability to project repair budget
- Information to plan a permanent solution

Planning is Required to Define the Inspections Goals.

Inspections are performed to:

- Identify maintenance problems
- Determine general sewer conditions
- Identify extraneous flows

The following data is useful to have prior to beginning the inspection:

- Sewer map or as-built plans to locate sewer
- Site specific data
- accessibility of deploying equipment at manholes
- depth of flow in sewer
- pipe diameter
- traffic connections
- safety requirement
- sewer cleaning
- sewer backup records
- sewer cleaning records
- influence of pump station discharges
- influence of industrial discharges

If such records are not available or kept, then a system to retain such information should be established.

During the CCTV inspection the following information should be obtained:

Pipe structural condition	Pipe material	Joints
Joint interval distance	Pipe cracks	Root intrusion
Debris, sediment and/or oil and grease	Service connections	type
quadrant location	building number	active or inactive
rate of infiltration	Infiltration and inflow	Alignment
Sewer types	Sewer location	Sewer surface cover (depth)
Roadway surface material	Time of day	Weather conditions

Inspection for Sources of Inflow

- are most readily achieved through smoke testing and/or dye testing.

Smoke Testing of Sewers is Done to Determine:

- stormwater sewer connections
- proof that buildings or residences are connected to the sanitary sewer
- illegal connections such as roof leaders or downspouts, yard drains and industrial drains
- location of broken sewers due to settling of foundations, manholes and other structures
- location of uncharted manholes and diversion points

Dye testing can be used to verify connections of drains to sanitary or storm sewers. Dye testing can be used to verify the findings of smoke testing.

Suggested Inspection And Maintenance Frequencies	
Task	**Frequency in Years**
Video inspection/line testing (typical)	3 to 15
Video inspection/line testing (problem area)	1 to 3
Field check (problem area)	1
Walk alignment	1
Manhole/line lamping (typical)	3 to 15
Manhole/line lamping (problem area)	1 to 3
Cleaning (typical)	3 to 15
Cleaning (problem area)	0.5 to 3
System assessment	1
Source: Nelson, Richard E. “Collection System Maintenance: How Much is Enough?” Operation Forum, July 1996	

Sewer Cleaning Techniques and Schedules

To maintain its proper function, a sewer system needs a cleaning schedule. There are several traditional cleaning techniques used to clear blockages and to act as preventative maintenance tools. When cleaning sewer lines, local communities need to be aware of EPA regulations on solid and hazardous waste as defined in 40 CFR 261. In order to comply with state guidelines on testing and disposal of hazardous waste, check with the local authorities.

Hydraulic cleaning developments have also been emerging on the international frontier. France and Germany have developed several innovative flushing systems using a 'dam break' concept.

Hydrass

France has developed a flushing system called the Hydrass. The design of the Hydrass consists of a gate that pivots on a hinge to a near horizontal position. As the gate opens and releases a flow, a flush wave is generated that subsequently washes out any deposited sediments. Germany has also developed a similar system called GNA Hydroself®. This is a flushing system that requires no electricity, no maintenance and no fresh water. The Hydroself® consists of a hydraulically-operated gate and a concrete wall section constructed to store the flush water. This system can be installed into a large diameter sewer. There appears to be no limit on the flushing length, as more flush water may be stored without incurring any additional construction or operating costs.

Another example of such a technology is seen in the Brussels Sewer System. A wagon with a flushing vane physically moves along the sewer and disturbs the sediments so that they are transported with the sewer flow.

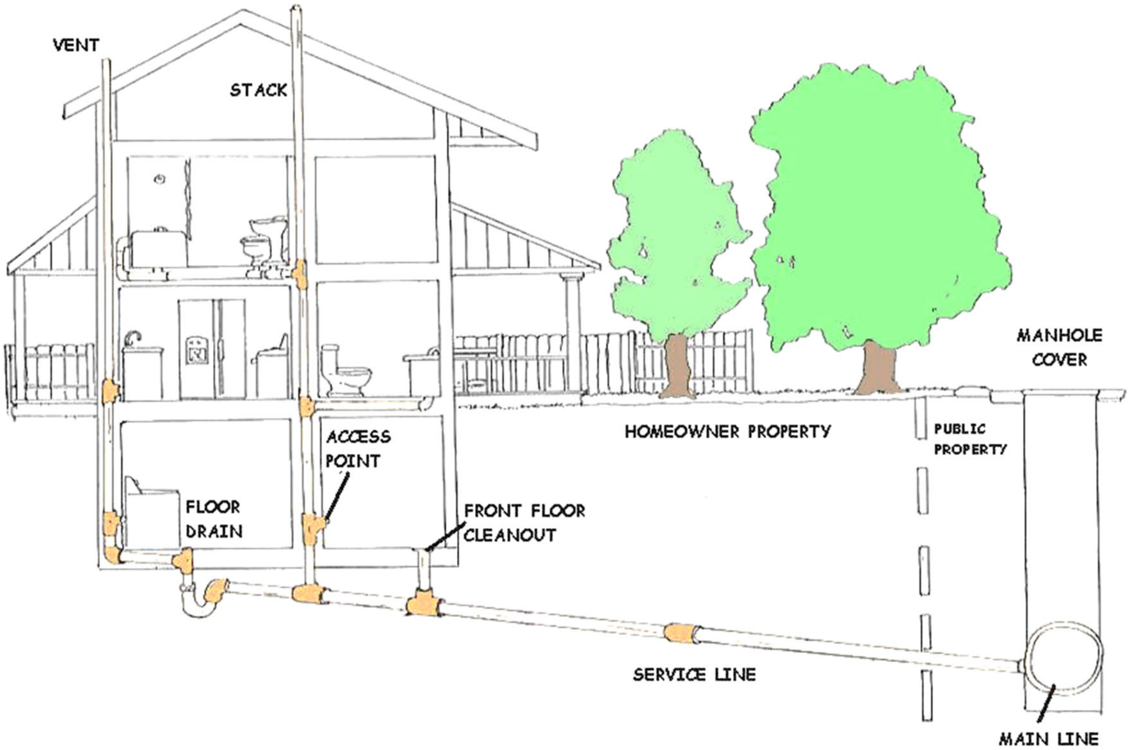
Public Education

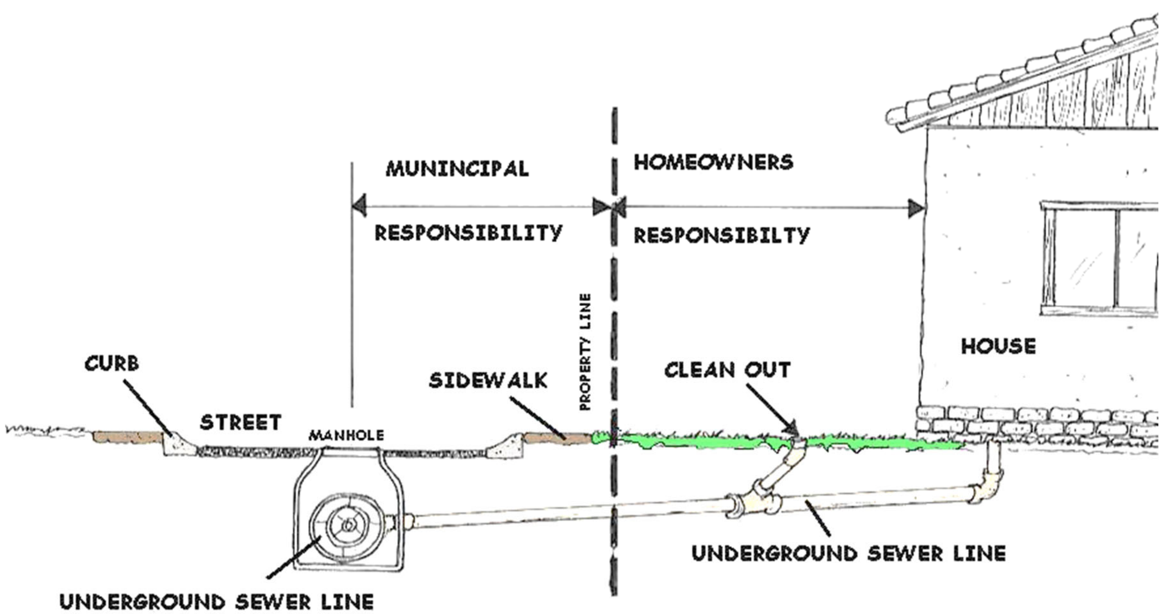
Although all of these methods have proven effective in maintaining sewer systems, the ideal method of reducing and controlling the materials found in sewer lines is education and pollution prevention. The public needs to be informed that common household substances such as grease and oil need to be disposed in the garbage in closed containers, and not into the sewer lines. This approach will not only minimize a homeowner's plumbing problems, but will also help keep the sewer lines clear.

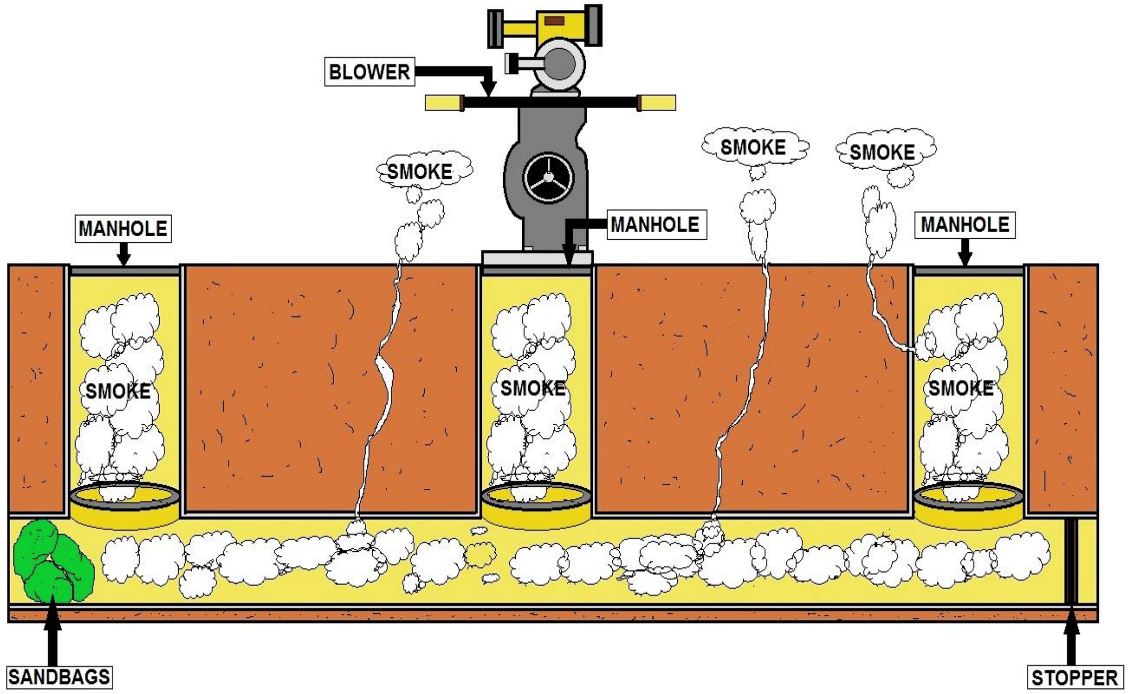
In recent years, new methodologies and accelerated programs have been developed to take advantage of the information obtained from sewer line maintenance operations. Such programs incorporate information gathered from various maintenance activities with basic sewer evaluations to create a system that can remedy and prevent future malfunctions and failures more effectively and efficiently.

Some systems have attempted to establish a program that would optimize existing maintenance activities to reduce customer complaints, sanitary sewer overflows, time and money spent on sewer blockages, and other reactive maintenance activities. Their plan is based on maintenance frequencies, system performance, and maintenance costs over a period of time. This plan was developed using Geographical Information System (GIS) and historical data to show areas of complaints, back-ups, and general maintenance information for the area.

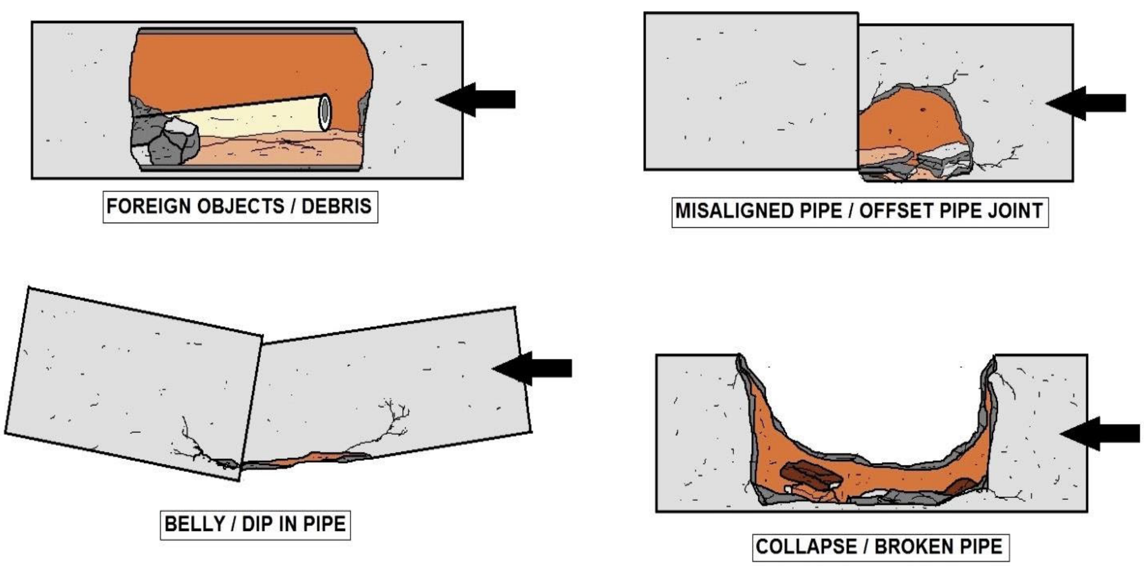
Homeowner Sewer Diagrams





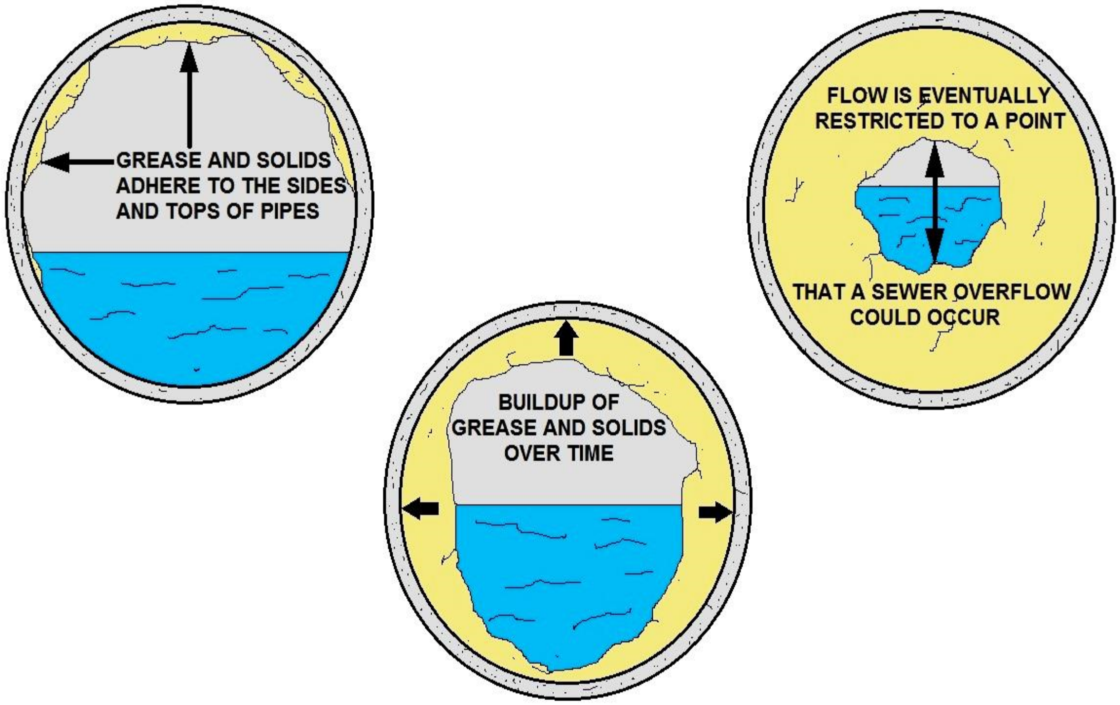


SMOKE TEST IN SEWER MAIN

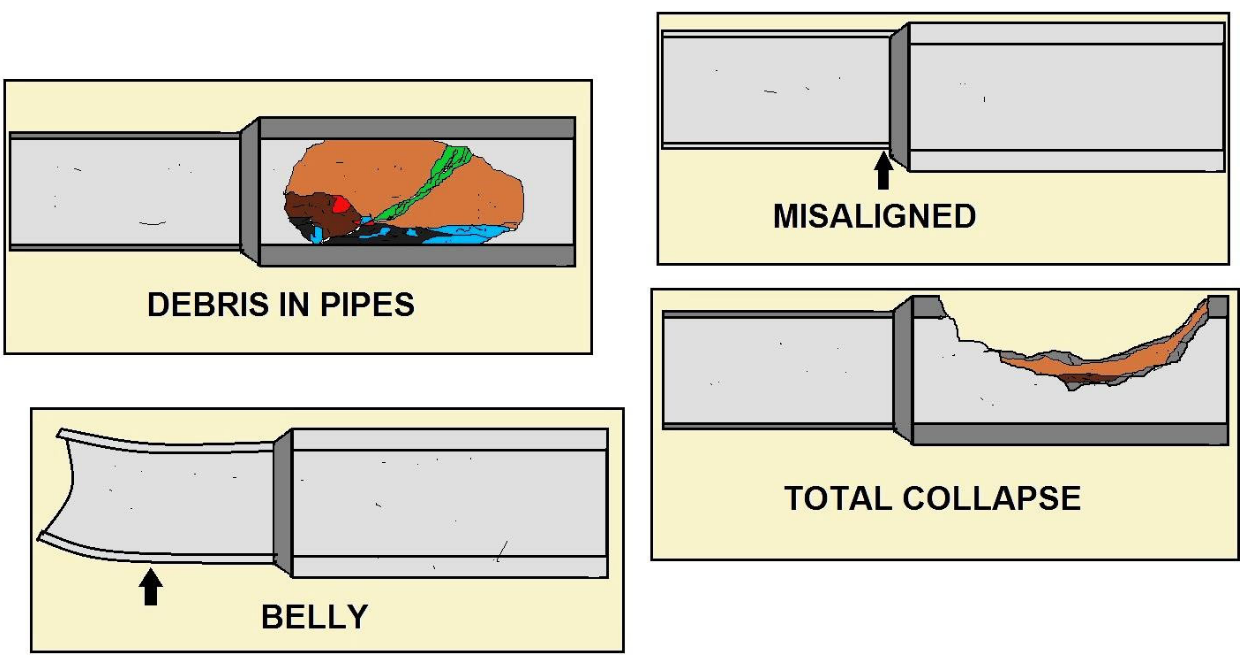


COMMON CAUSES OF SEWER LATERAL BLOCKAGES

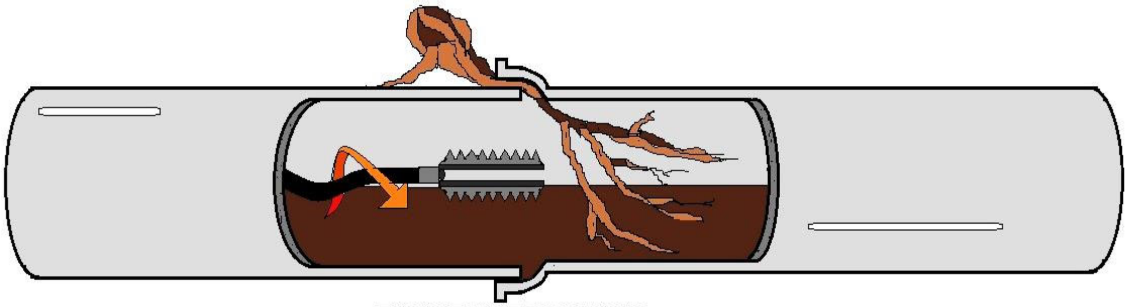
Common Sewer Problems and Solutions Diagrams



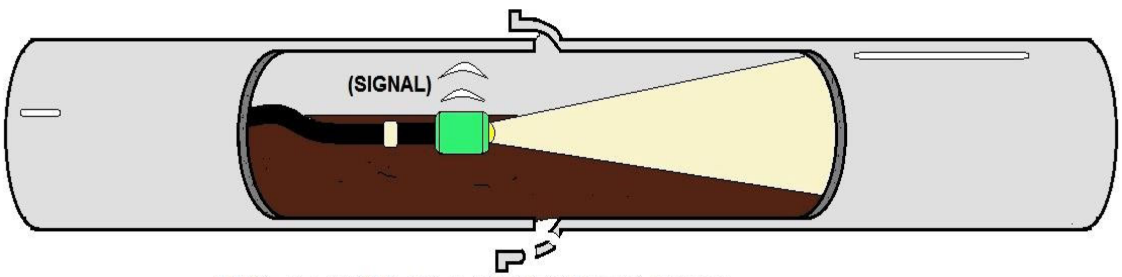
EFFECTS OF GREASE AND SOLIDS ON SEWER FLOW



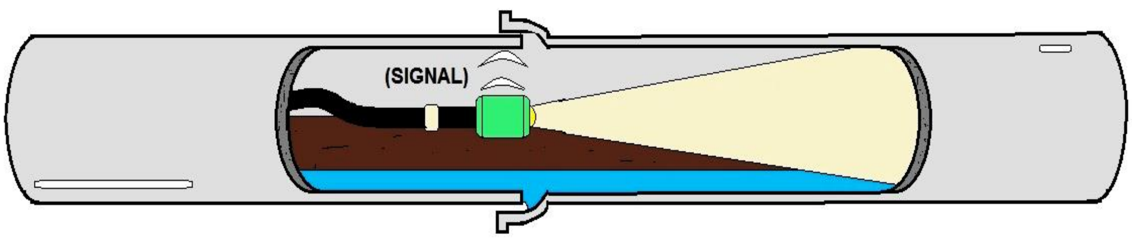
DAMAGED SEWER PIPE EXAMPLES



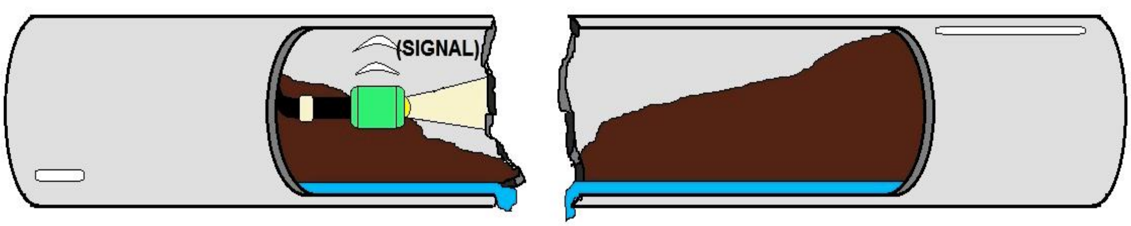
ROOT INTRUSION
(CLEANED WITH A CABLE FITTED WITH A ROOT-CUTTING BLADE)



MIS-ALIGNED / CRACKED PIPE
(A CAMERA IS USED TO SHOW THE LOCATION OF THE PROBLEM VIA A SIGNAL)

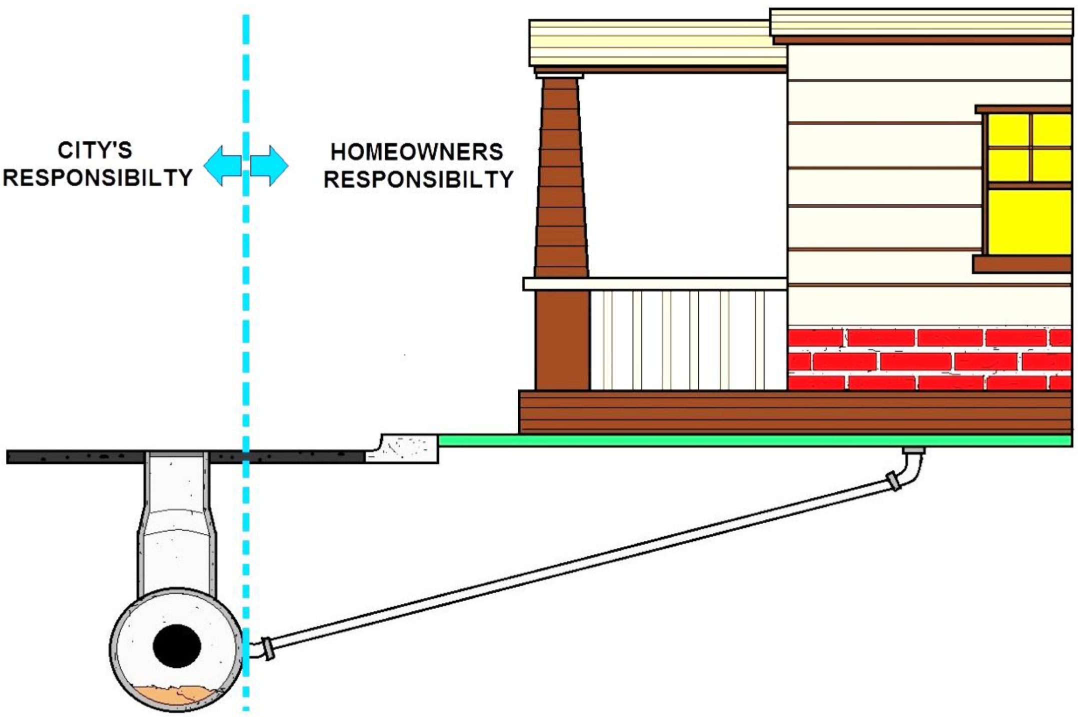


PIPE WITH A BELLY
(A CAMERA IS USED TO SHOW THE LOCATION OF THE PROBLEM VIA A SIGNAL)

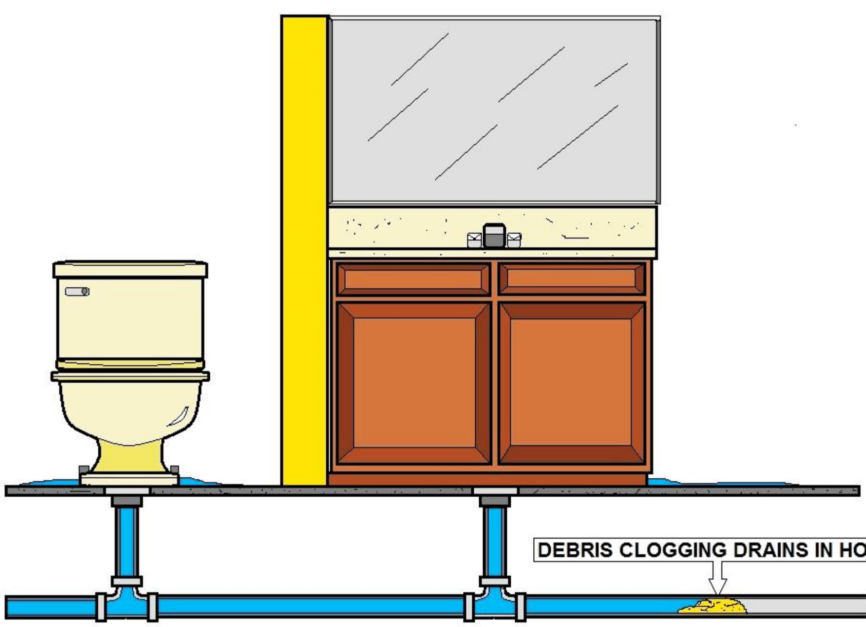


PIPE THAT HAS BEEN CRUSHED
(A CAMERA IS USED TO SHOW THE LOCATION OF THE PROBLEM VIA A SIGNAL)

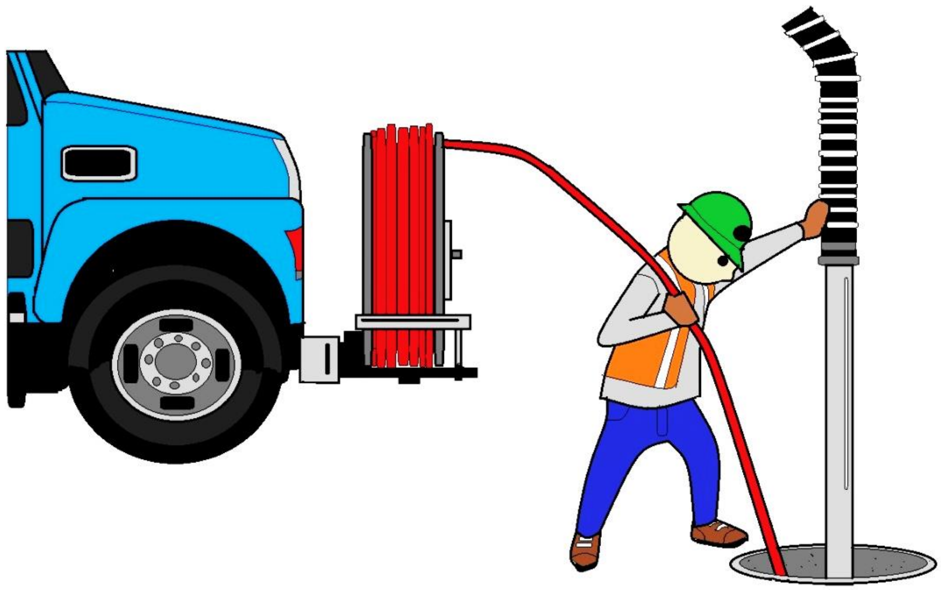
MAJOR SEWER PIPE PROBLEM DIAGRAM



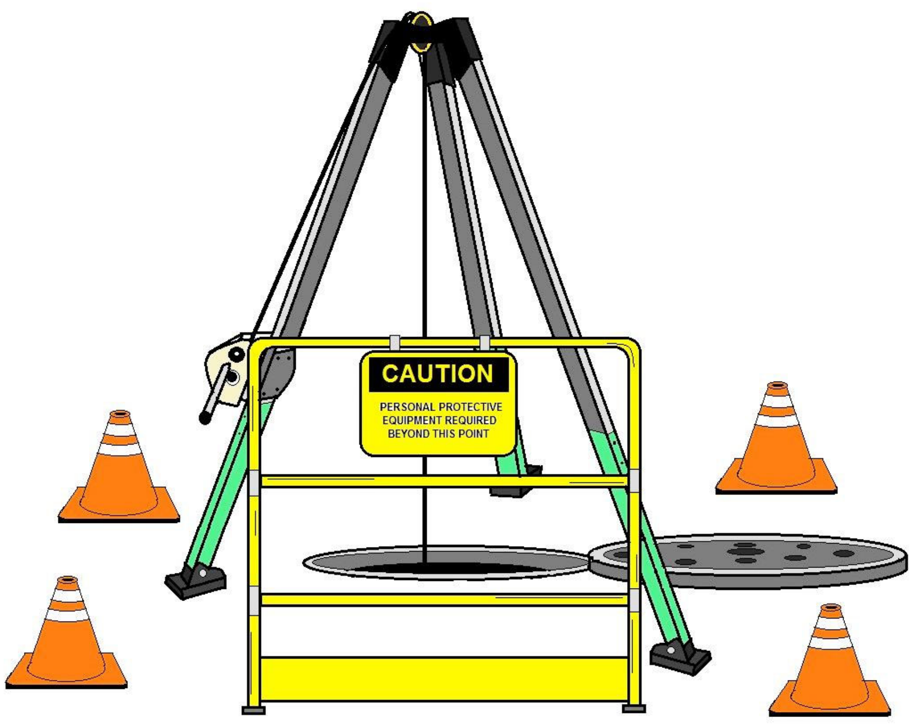
DESIGNATING SEWER MAINTENANCE RESPONSIBILTY



EXAMPLE OF A CLOGGED SEWER LINE

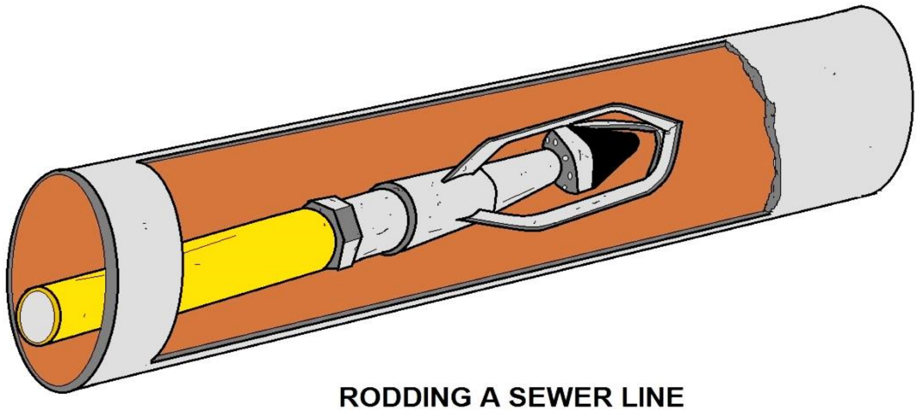


USING A VACUUM TRUCK TO CLEAN SEWER



SAFETY EQUIPMENT TO ENTER A SEWER SAFELY

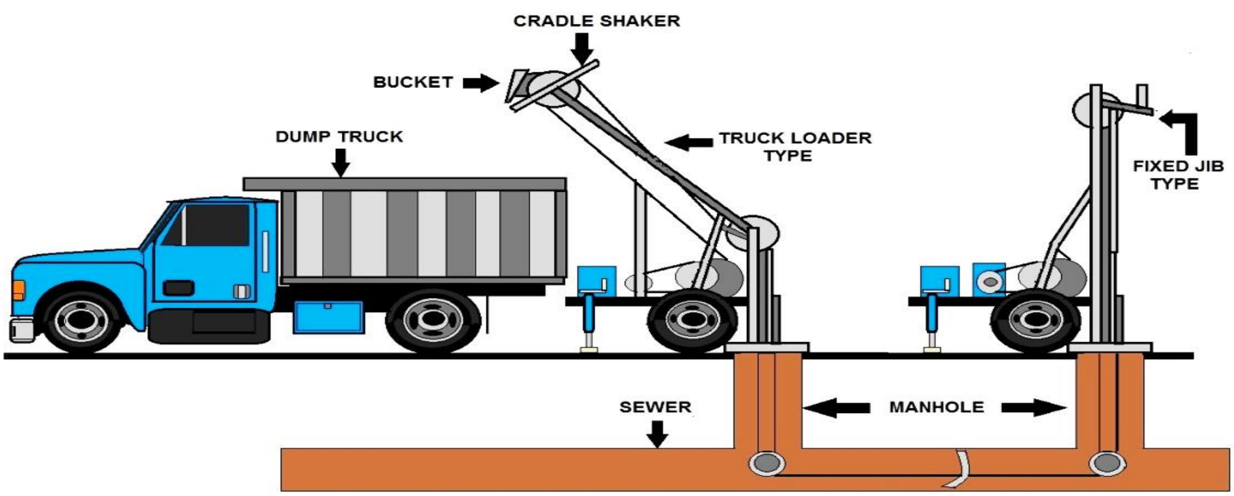
Sewer Technology Uses and Applications Diagrams



RODDING A SEWER LINE

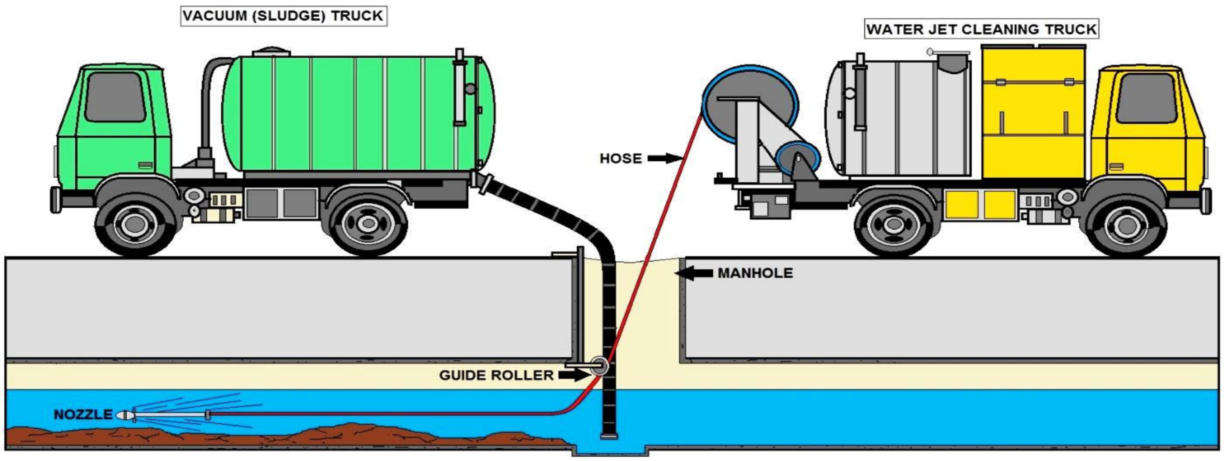
As a pretreatment inspector, you will need knowledge of many different concerns in order to properly identify the problem and sometimes you'll need to order the remedy, solution or correction.

Mechanical
Rodding
• Uses an engine and a drive unit with continuous rods or sectional rods.
• As blades rotate, they break up grease deposits, cut roots, and loosen debris.
• Rodders also help thread the cables used for TV inspections and bucket machines.
• Most effective in lines up to 12 inches in diameter.



TRAILER MOUNTED BUCKET MACHINES

Bucket Machine
• Cylindrical device, closed on one end with 2 opposing hinged jaws at the other.
• Jaws open and scrape off the material and deposit it in the bucket.
• Partially removes large deposits of silt, sand, gravel, and some types of solid waste.



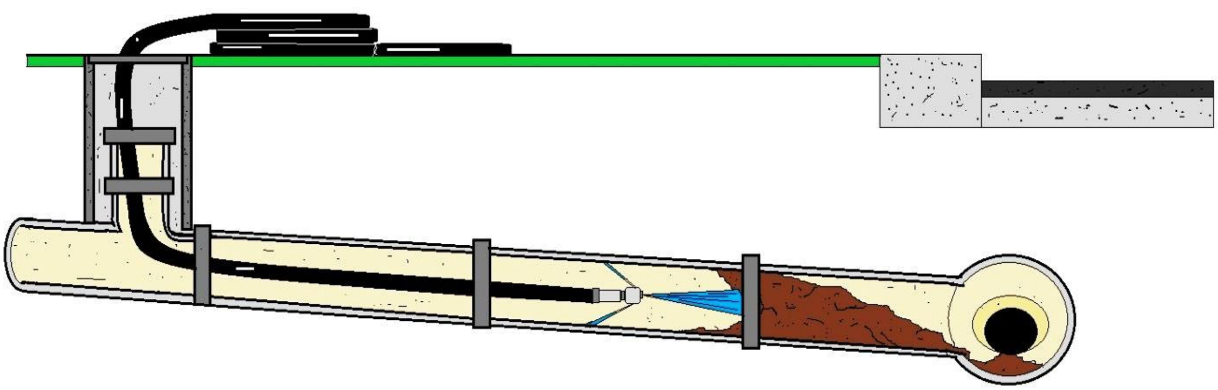
HYDRAULIC SEWER CLEANING PROCESS

Hydraulic
Balling

• A threaded rubber cleaning ball that spins and scrubs the pipe interior as flow increases in
the sewer line.
• Removes deposits of settled inorganic material and grease build-up.
• Most effective in sewers ranging in size from 5-24 inches.

Flushing

• Introduces a heavy flow of water into the line at a manhole.
• Removes floatables and some sand and grit.
• Most effective when used in combination with other mechanical operations, such as rodding or bucket machine cleaning.

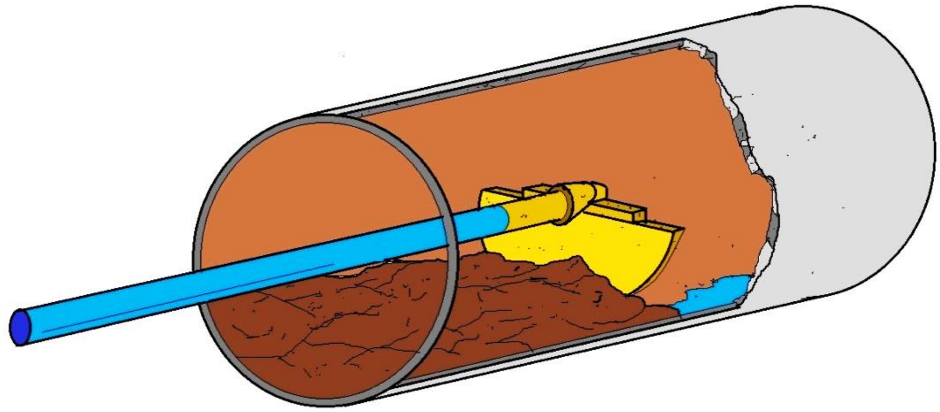


JETTING A SEWER LINE

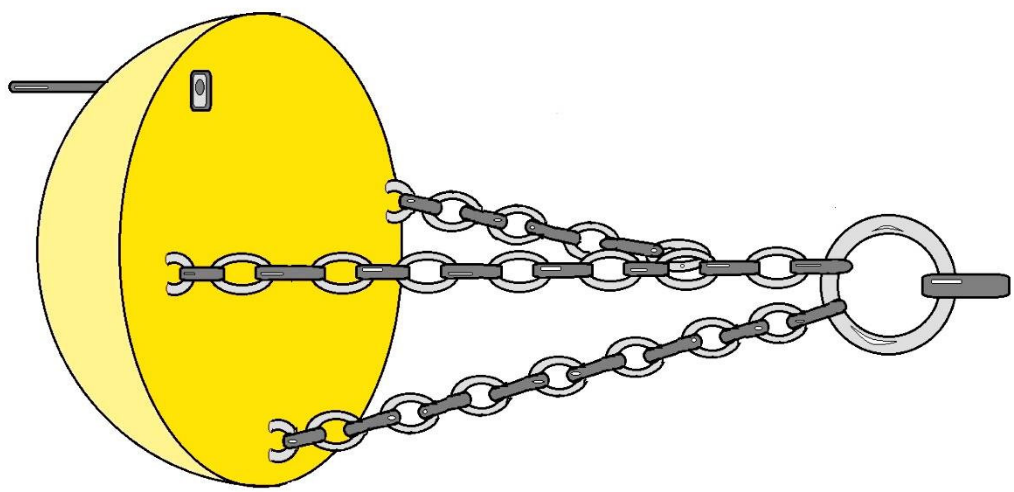
Jetting

• Directs high velocities of water against pipe walls.
• Removes debris and grease build-up, clears blockages, and cuts roots within small diameter pipes.
• Efficient for routine cleaning of small diameter, low flow sewers.

Sewer Cleaning - Technology Applications Diagrams



DROP SCRAPER



SEWER SCRAPER

Scooter

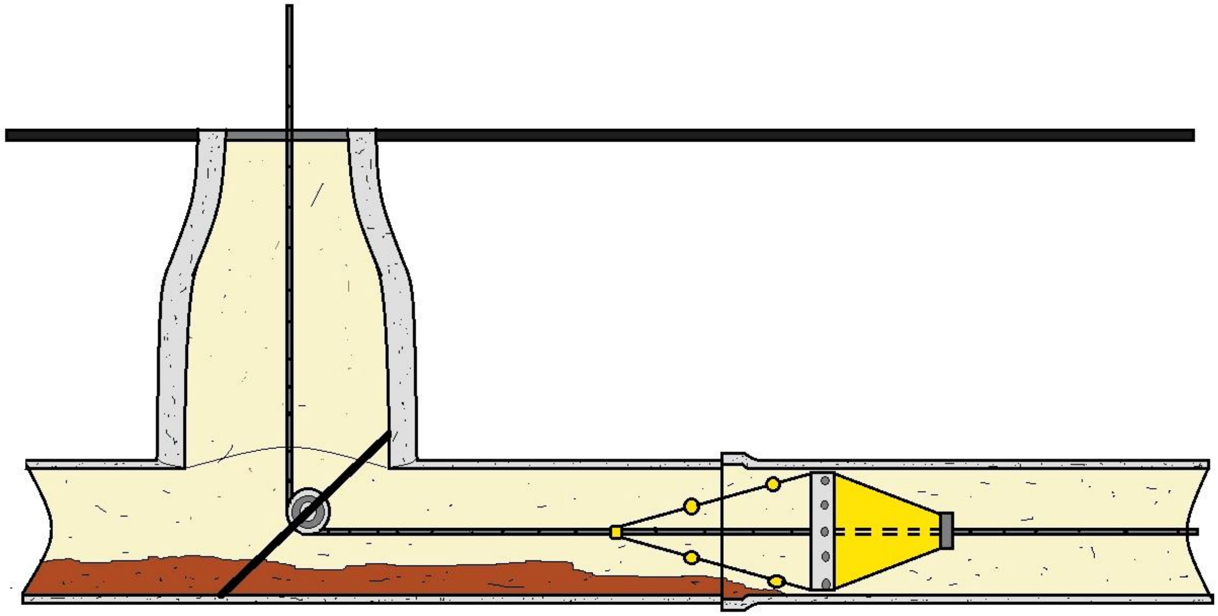
- Round, rubber-rimmed, hinged metal shield that is mounted on a steel framework on small wheels. The shield works as a plug to build a head of water.
- Scours the inner walls of the pipe lines.
- Effective in removing heavy debris and cleaning grease from line.

Kites, Bags, and Poly Pigs

- Similar in function to the ball.
- Rigid rims on bag and kite induce a scouring action.
- Effective in moving accumulations of decayed debris and grease downstream.

Silt Traps

- Collect sediments at convenient locations.
- Must be emptied on a regular basis as part of the maintenance program.



SEWER KITE DIAGRAM

Grease Traps and Sand/Oil Interceptors

• The ultimate solution to grease build-up is to trap and remove it.
• These devices are required by some uniform building codes and/or sewer-use ordinances.
Typically sand/oil interceptors are required for automotive business discharge.
• Need to be thoroughly cleaned to function properly.
• Cleaning frequency varies from twice a month to once every 6 months, depending on the amount of grease in the discharge.
• Need to educate restaurant and automobile businesses about the need to maintain these traps.

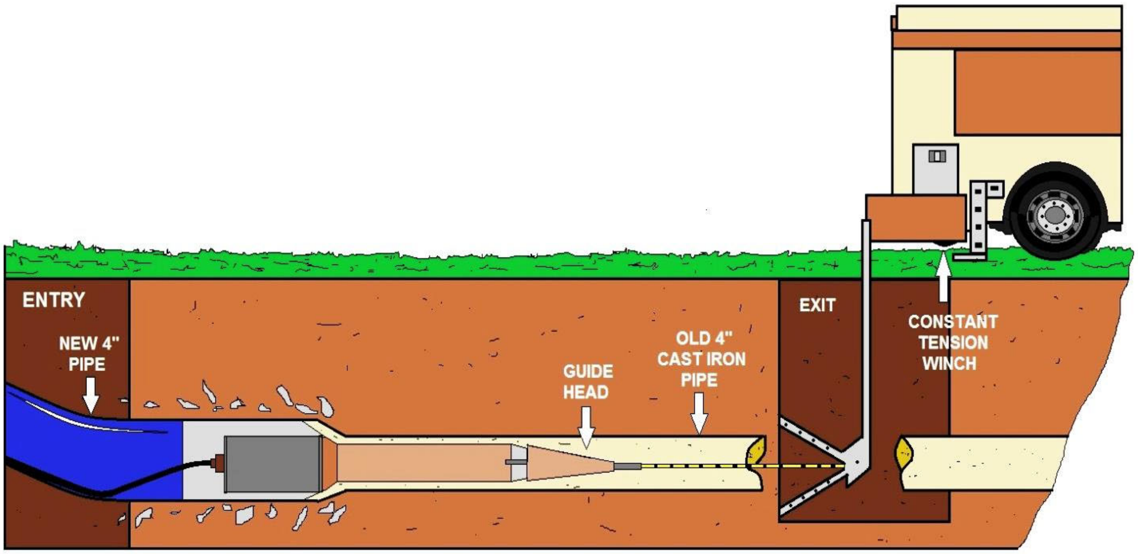
Chemicals

Before using these chemicals review the Safety Data Sheets (SDS) and consult the local authorities on the proper use of chemicals as per local ordinance and the proper disposal of the chemicals used in the operation. If assistance or guidance is needed regarding the application of certain chemicals, contact the U.S. EPA or state water pollution control agency.

• Used to control roots, grease, odors (H_2S gas), concrete corrosion, rodents and insects.
• *Root Control* - longer lasting effects than power rodder (approximately 2-5 years).
• *H_2S gas* - some common chemicals used are chlorine (Cl_2), hydrogen peroxide (H_2O_2), pure
Oxygen (O_2), air, lime ($Ca(OH_2)$), sodium hydroxide (NaOH), and iron salts.
• *Grease and soap problems* - some common chemicals used are bioacids, digester, enzymes, bacteria cultures, catalysts, caustics, hydroxides, and neutralizers.

Source: Information provided by Arbour and Kerri, 1997 and Sharon, 1989.

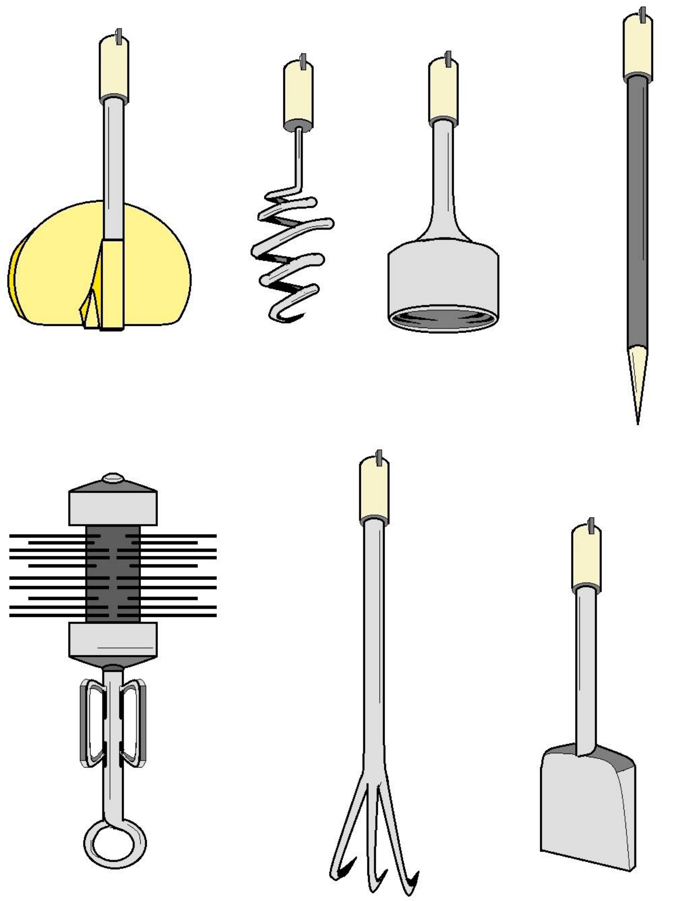
More on Sewer Cleaning Procedures



TRENCHLESS SEWER REPAIR DIAGRAM

Most cities that take advantage of sewer cleaning procedures are able to determine that as the maintenance frequency increased, there was an increase in system performance. Garland recommended 70 inspections and maintenance activities for every 30 cleanings. Inspections are considered more important because they help define and prevent future problems. A study performed by the American Society of Civil Engineers reports that the most important maintenance activities are cleaning and CCTV inspections. A maintenance plan attempts to develop a strategy and priority for maintaining pipes based on several of the following factors:

- Problems- frequency and location; 80 percent of problems occur in 25 percent of the system (Hardin and Messer, 1997).
- Age- older systems have a greater risk of deterioration than newly constructed sewers.
- Construction material- pipes constructed of materials that are susceptible to corrosion have a greater potential of deterioration and potential collapse. Non-reinforced concrete pipes, brick pipes, and asbestos cement pipes are examples of pipes susceptible to corrosion.
- Pipe diameter/volume conveyed- pipes that carry larger volumes take precedence over pipes that carry a smaller volume.
- Location- pipes located on shallow slopes or in flood prone areas have a higher priority.
- Force main vs. gravity-force mains have a higher priority than gravity, size for size, due to the complexity of the cleaning and repairs.
- Subsurface conditions- depth to groundwater, depth to bedrock, soil properties (classification, strength, porosity, compressibility, frost susceptibility, erodibility, and pH).
- Corrosion potential- Hydrogen Sulfide (H_2S) is responsible for corroding sewers, structures, and equipment used in wastewater collection systems. The interior conditions of the pipes need to be monitored and treatment needs to be implemented to prevent the growth of slime bacteria and the production of H_2S gases.



COMMON SEWER CLEANING TOOLS

Limitations of Cleaning Methods

• Sewer Cleaning and Stoppage Section- this section responds to customer complaints, pinpoints problems within the lines, and clears all blockages.

• TV Section- this section locates defects and building sewer connections (also referred to as taps) within the system.

• Preventive Maintenance Section- this section cleans and inspects the lines and also provides for Quality Assurance and Quality Control (QA/QC).

Most of collection inspections use CCTV system. However, a large percent of the lines in the worst and oldest sections of the system are inspected visually. Visual inspections are also used in the most recently installed lines and manholes.

The collection system will normally utilize a variety of cleaning methods including jetting, high velocity cleaning, rodding, bucket machining, and using stop trucks (sectional rods with an attached motor).

As part of a preventive maintenance approach, most collection system operators also have been using combination trucks with both flush and vacuum systems. To control roots, most collection system operators uses a vapor rooter eradication system which can ensure that no roots return to the line for up to five years. The cleaning and inspection crews will usually consist of two members to operate each of the combination trucks and TV trucks.

Detailed Cleaning Methods

The purpose of sewer cleaning is to remove foreign material from the sewer and generally is undertaken to alleviate one of the following conditions:

- Blockages (semisolid obstructions resulting in a virtual cessation of flow). These generally are dealt with on an emergency basis, although the underlying cause can be treated preemptively.
- Hydraulic capacity. In some cases, sediment, roots, intrusions (connections or other foreign bodies), grease, encrustation and other foreign material restrict the capacity of a sewer, causing surcharge or flooding. Cleaning the sewer may alleviate these problems permanently, or at least temporarily.
- Pollution caused by either the premature operation of combined wastewater overflows because of downstream restrictions to hydraulic capacity or pollution caused by the washing through and discharge of debris from overflows during storms.
- Odor caused by the retention of solids in the system for long periods resulting in, among other things, wastewater turning septic and producing hydrogen sulfide.
- Sewer inspections, where the sewer needs to be cleaned before inspection. This requirement most often occurs when using in-sewer CCTV inspection techniques.
- Sewer rehabilitation where it is necessary to clean the sewers immediately before the sewer being rehabilitated.

Common cleaning methods include jet rodding, manual rodding, winching or dragging, cutting, and manual or mechanical digging. The method usually is determined in advance and is normally contingent on the pipe type and size and on the conditions expected in the pipe.

Jet Rodding
This method depends on the ability of high-velocity jets of water to dislodge materials from the pipe walls and transport them down the sewer. Water under high pressure (approximately 2000 psi) is fed through a hose to a nozzle containing a rosette of jets sited so the majority of flow is ejected in the opposite direction of the flow in the hose. These jets propel the hose through the sewer and dislodge the materials on the sewer walls. A range of nozzles is available to cope with the different pipe diameters and materials encountered. The hoses, nozzles, water supply and necessary pumps usually are incorporated in a purpose-built vehicle.

Rodding
This method is generally a manual push-pull technique used to clear blockages in smaller-diameter, shallow sewer systems typically not exceeding (10 in. in diameter or 6 ft. in depth. For sewer greater than 10 in. in diameter, the rods tend to wander are not very effective. The distance from the access point is limited to approximately 60 ft.

Dragging
This is a technique where custom buckets are dragged through the sewer and the material deposited into skips.

Cutting
This method generally is used for removing roots from sewers. High-pressure water jet cutters have been developed for removing even more solid intrusions, such as intruding

connections. Care is required to eliminate damage to the existing sewer structure.

Manual or Mechanical Digging
Traditionally used in larger-diameter sewers, this method involves manually excavating the material and placing it in buckets for removal. As the sewer system can be hazardous, the technique now is used infrequently. High-pressure jet equipment also can be used manually in larger sewers.

Balling, Jetting, Scooter
In general, these methods are only successful when necessary water pressure or head is maintained without flooding basements or houses at low elevations. Jetting - The main limitation of this technique is that cautions need to be used in areas with basement fixtures and in steep-grade hill areas.

Balling
Balling cannot be used effectively in pipes with bad offset joints or protruding service connections because the ball can become distorted.

Scooter
When cleaning larger lines, the manholes need to be designed to a larger size in order to receive and retrieve the equipment. Otherwise, the scooter needs to be assembled in the manhole. Caution also needs to be used in areas with basement fixtures and in steep-grade hill areas.

Bucket Machine
This device has been known to damage sewers. The bucket machine cannot be used when the line is completely plugged because this prevents the cable from being threaded from one manhole to the next. Set-up of this equipment is time-consuming.

Flushing
This method is not very effective in removing heavy solids. Flushing does not remedy this problem because it only achieves temporary movement of debris from one section to another in the system.

High Velocity Cleaner
The efficiency and effectiveness of removing debris by this method decreases as the cross-sectional areas of the pipe increase. Backups into residences have been known to occur when this method has been used by inexperienced operators. Even experienced operators require extra time to clear pipes of roots and grease.

Kite or Bag
When using this method, use caution in locations with basement fixtures and steep-grade hill areas.

Rodding
Continuous rods are harder to retrieve and repair if broken and they are not useful in lines with a diameter of greater than 300 mm (0.984 feet) because the rods have a tendency to coil and bend. This device also does not effectively remove sand or grit, but may only loosen the material to be flushed out at a later time. Source: U.S. EPA, 1993.

Sewer – Hydraulic Cleaning Sub-Section

The purpose of sewer cleaning is to remove accumulated material from the sewer. Cleaning helps to prevent blockages and is used to prepare the sewer for inspections. Stoppages in gravity sewers are usually caused by a structural defect, poor design, poor construction, an accumulation of material in the pipe (especially grease), or root intrusion. Protruding traps (lateral sewer connections incorrectly installed so that they protrude into the main sewer) may catch debris, which then causes a further buildup of solids that eventually block the sewer.

Results of Various Flow Velocities
Velocity Result
2.0 ft/sec...............................Very little material buildup in pipe.
1.4-2.0 ft/sec.........................Heavier grit (sand and gravel) begin to accumulate.
1.0-1.4 ft/sec.........................Inorganic grit and solids accumulate.
Below 1.0 ft/sec....................Significant amounts of organic and inorganic solids accumulate.
1.0 to 1.4 feet per second, grit and solids can accumulate leading to a potential blockage.

Sewer Cleaning Methods
There are three major methods of sewer cleaning: hydraulic, mechanical, and chemical.

Hydraulic cleaning (also referred to as flushing) refers to any application of water to clean the pipe. Mechanical cleaning uses physical devices to scrape, cut, or pull material from the sewer.

Chemical cleaning can facilitate the control of odors, grease buildup, root growth, corrosion, and insect and rodent infestation.

Sewer Cleaning Records
The backbone of an effective sewer cleaning program is accurate recordkeeping. Accurate recordkeeping provides the collection system owner or operator with information on the areas cleaned. Typical information includes

- Date, time, and location of stoppage or routine cleaning activity
- Method of cleaning used
- Identity of cleaning crew
- Cause of stoppage
- Further actions necessary and/or initiated
- Weather conditions

The owner or operator should be able to identify problem collection system areas, preferably on a map. Potential problem areas identified should include those due to grease or industrial discharges, hydraulic bottlenecks in the collection system, areas of poor design (e.g., insufficiently sloped sewers), areas prone to root intrusion, sags, and displacements. The connection between problem areas in the collection system and the preventive maintenance cleaning schedule should be clear.

The owner or operator should also be able to identify the number of stoppages experienced per mile of sewer pipe. If the system is experiencing a steady increase in stoppages, the reviewer should try to determine the cause (i.e., lack of preventive maintenance funding, deterioration of the sewers due to age, an increase in grease producing activities, etc.).

Parts and Equipment Inventory
An inventory of spare parts, equipment, and supplies should be maintained by the collection system owner or operator. The inventory should be based on the equipment manufacturer's recommendations, supplemented by historical experience with maintenance and equipment problems. Without such an inventory, the collection system may experience long down times or periods of inefficient operation in the event of a breakdown or malfunction. Files should be maintained on all pieces of equipment and major tools. The owner or operator should have a system to assure that each crewmember has adequate and correct tools for the job.

The owner or operator should maintain a yard where equipment, supplies, and spare parts are maintained and personnel are dispatched. Very large systems may maintain more than one yard. In this case, the reviewer should perform a visual survey at the main yard. In small to medium size systems, collection system operations may share the yard with the department of public works, water department, or other municipal agencies. In this case, the reviewer should determine what percentage is being allotted for collection system items. The most important features of the yard are convenience and accessibility.

The reviewer should observe a random sampling of inspection and maintenance crew vehicles for equipment as described above. A review of the equipment and manufacturer's manuals aids will determine what spare parts should be maintained.

The owner or operator should then consider the frequency of usage of the part, how critical the part is, and finally, how difficult the part is to obtain when determining how many of the part to keep in stock. Spare parts should be kept in a clean, well-protected stock room.

Owner or Operator - Point to Note
The owner or operator should have a procedure for determining which spare parts are critical for the proper operation of the collection system. Similar to equipment and tools management, a tracking system should be in place, including Guide for Evaluating CMOM Programs at Sanitary Sewer Collection Systems procedures on logging out materials, and when maintenance personnel must use them.

The owner or operator should be able to produce the spare parts inventory and clearly identify those parts deemed critical. The reviewer should evaluate the inventory and selected items in the stockroom to determine whether the specified numbers of these parts are being maintained.

Sewer Maintenance - Advantages and Disadvantages

The primary benefit of implementing a sewer maintenance program is the reduction of SSOs, basement backups, and other releases of wastewater from the collection system due to substandard sewer conditions. Improper handling of instruments and chemicals used in inspecting and maintaining sewer lines may cause environmental harm.

Examples include:

- Improperly disposing of collected materials and chemicals from cleaning operations.
- Improperly handling chemical powdered dyes.
- Inadequately maintaining inspection devices.

Visual Inspection
In smaller sewers, the scope of problems detected is minimal because the only portion of the sewer that can be seen in detail in near the manhole. Therefore, any definitive information on cracks or other structural problems is unlikely. However, this method does provide information needed to make decisions on rehabilitation.

Camera Inspection
When performing a camera inspection in a large diameter sewer, the inspection crew is essentially taking photographs haphazardly, and as a result, the photographs tend to be less comprehensive.

Closed Circuit Television (CCTV)
This method requires late night inspection and as a result the TV operators are vulnerable to lapses in concentration. CCTV inspections are also expensive and time consuming. The video camera does not fit into the pipe and during the inspection it remains only in the maintenance hole.

Lamping Inspection
As a result, only the first 10 feet of the pipe can be viewed or inspected using this method.
Source: Water Pollution Control Federation, 1989. Some instruments have a tendency to become coated with petroleum based residues and if not handled properly they can become a fire hazard. The following case study provide additional case study data for sewer cleaning methods.

Fairfax County, Virginia
The Fairfax County Sanitary Sewer System comprises over 3000 miles of sewer lines. As is the case with its sewer rehabilitation program, the county's sewer maintenance program also focuses on inspection and cleaning of sanitary sewers, especially in older areas of the system. Reorganization and streamlining of the sewer maintenance program, coupled with a renewed emphasis on increasing productivity, has resulted in very significant reductions in sewer backups and overflows during the past few years.

1998, there were a total of 49 such incidents including 25 sewer backups and 24 sewer overflows. The sewer maintenance program consists of visual inspections, scheduled sewer cleanings based on maintenance history, unscheduled sewer cleanings as determined by visual or closed circuit television inspections, and follow-up practices to determine the cause of backups and overflows.

Visual inspections are carried out by using a mirror attached to a pole; however, use of portable cameras has been recently introduced to enhance the effectiveness of visual inspections.

Older areas of the sewer system are inspected every two years; whereas, the inspection of relatively new areas may be completed in 3 to 4 years. Cleaning is an important part of pipe maintenance.

Sewer line cleaning is prioritized based on the age of the pipe and the frequency of the problems within it. The county uses rodding and pressurized cleaning methods to maintain the pipes.

Bucket machines are rarely used because cleaning by this method tends to be time consuming. Many cities use mechanical, rather than chemical, methods to remove grease and roots. Introducing chemicals into the cleaning program may require hiring an expert crew, adopting a new program, and instituting a detention time to ensure the chemicals' effectiveness.

Record keeping is also vital to the success of such a maintenance program. The county has started tracking the number of times their sewer lines were inspected and cleaned and the number of overflows and backups a sewer line experienced. This information has helped the county re-prioritize sewer line maintenance and adapt a more appropriate time schedule for cleaning and inspecting the sewer lines.

Sewer System Rehabilitation

The collection system owner or operator should have a sewer rehabilitation program. The objective of sewer rehabilitation is to maintain the overall viability of a collection system. This is done in three ways:

(1) ensuring its structural integrity;
(2) limiting the loss of conveyance and wastewater treatment capacity due to excessive I/I; and
(3) limiting the potential for groundwater contamination by controlling exfiltration from the pipe network.

The rehabilitation program should build on information obtained as a result of all forms of maintenance and observations made as part of the capacity evaluation and asset inventory to assure the continued ability of the system to provide sales and service at the least cost. The reviewer should try to gain a sense of how rehabilitation is prioritized. Priorities may be stated in the written program or may be determined through interviews with system personnel.

There are many rehabilitation methods; the choice of methods depends on pipe size, type, location, dimensional changes, sewer flow, material deposition, surface conditions, severity of I/I, and other physical factors. Non-structural repairs typically involve the sealing of leaking joints in otherwise sound pipe.

Structural repairs involve either the replacement of all or a portion of a sewer line, or the lining of the sewer. These repairs can be carried out by excavating, usually for repairs limited to one or two pipe segments (these are known as point repairs) or by trenchless technologies (in which repair is carried out via existing manholes or a limited number of access excavations).

The rehabilitation program should identify the methods that have been used in the past, their success rating, and methods to be used in the future. A reviewer who wants further guidance on methods of rehabilitation may consult the owner's or operator's policies regarding service lateral rehabilitation, since service laterals can constitute a serious source of I/I.

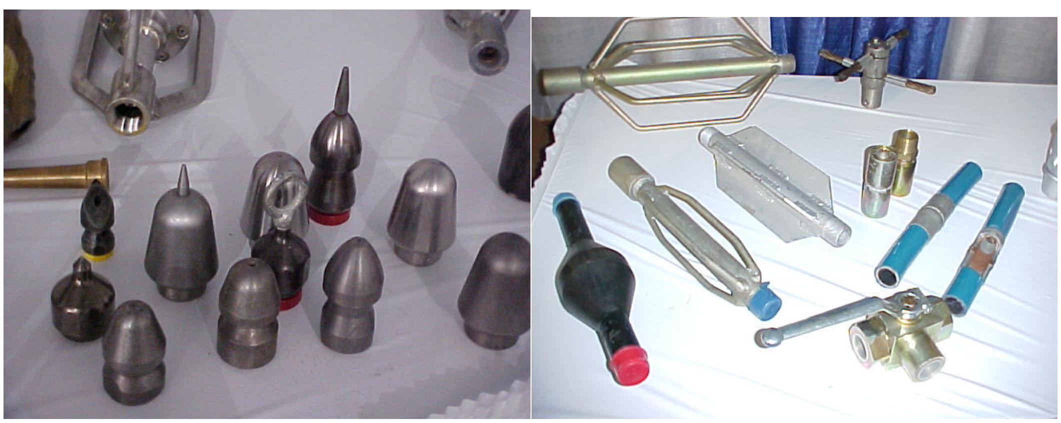
Manholes should not be neglected in the rehabilitation program. Manhole covers can allow significant inflow to enter the system because they are often located in the path of surface runoff.

Manholes themselves can also be a significant source of infiltration from cracks in the barrel of the manhole. The owner or operator should be able to produce documentation on the location and methods used for sewer rehabilitation. The reviewer should compare the rehabilitation accomplished with that recommended by the capacity evaluation program.

When examining the collection system rehabilitation program, the reviewer should be able to answer the following questions:

- Is rehabilitation taking place before it becomes emergency maintenance?
- Are recommendations made as a result of the previously described inspections?
- Does the rehabilitation program take into account the age and condition of the sewers?

The sewer vacuum truck utilizes both a high pressure stream of water and a vacuum system to clean and remove built up debris from sewer lines. These versatile vehicles are also used to clean lift station wet wells, stormwater catch basins, and to perform excavations to locate broken water or sewer lines. It reduces repair times and costs by over 50%.



Above, various Jetter or hydraulic cleaning attachments.

Root intrusion

Tree Roots vs. Sanitary Sewer Lines

Root Growth in Pipes

Roots require oxygen to grow, they do not grow in pipes that are full of water or where high ground water conditions prevail. Roots thrive in the warm, moist, nutrient rich atmosphere above the water surface inside sanitary sewers. The flow of warm water inside the sanitary sewer service pipe causes water vapor to escape to the cold soil surrounding the pipe. Tree roots are attracted to the water vapor leaving the pipe and they follow the vapor trail to the source of the moisture, which are usually cracks or loose joints in the sewer pipe. Upon reaching the crack or pipe joint, tree roots will penetrate the opening to reach the nutrients and moisture inside the pipe. This phenomenon continues in winter even though trees appear to be dormant.

Problems Caused by Roots Inside Sewers

Once inside the pipe, roots will continue to grow, and if not disturbed, they will completely fill the pipe with multiple hair-like root masses at each point of entry. The root mass inside the pipe becomes matted with grease, tissue paper, and other debris discharged from the residence or business. Homeowners will notice the first signs of a slow flowing drainage system by hearing gurgling noises from toilet bowls and observing wet areas around floor drains after completing the laundry. A complete blockage will occur if no remedial action is taken to remove the roots/blockage. As roots continue to grow, they expand and exert considerable pressure at the crack or joint where they entered the pipe. The force exerted by the root growth will break the pipe and may result in total collapse of the pipe. Severe root intrusion and pipes that are structurally damaged will require replacement.

Tree Roots in Sewer

Tree roots growing inside sewer pipes are generally the most expensive sewer maintenance item experienced by City residents. Roots from trees growing on private property and on parkways throughout the City are responsible for many of the sanitary sewer service backups and damaged sewer pipes.

Homeowners should be aware of the location of their sewer service and refrain from planting certain types of trees and hedges near the sewer lines. The replacement cost of a sanitary sewer service line as a result of damage from tree roots may be very expensive.

Pipes Susceptible to Root Damage

Some pipe material is more resistant to root intrusion than others are. Clay tile pipe that was commonly installed by developers and private contractors until the late 1980's is easily penetrated and damaged by tree roots. Concrete pipe and PVC pipe may also allow root intrusions, but to a lesser extent than clay tile pipe. PVC pipe is more resistant to root intrusion because it usually has fewer joints. The tightly fitting PVC joints are less likely to leak as a result of settlement of backfill around the pipe.

Root Spread

During drought conditions and in winter, tree roots travel long distances in search of moisture. As a general rule, tree roots will extend up to 2.5 times the height of the tree, and some species of trees may have roots extending five to seven times the height of the tree.

Root Growth Control
The common method of removing roots from sanitary sewer service pipes involves the use of augers, root saws, and high pressure flushers. These tools are useful in releasing blockages in an emergency, however, cutting and tearing of roots encourages new growth. The effect is the same as pruning a hedge to promote faster, thicker, and stronger regrowth.

Roots removed by auguring are normally just a small fraction of the roots inside the pipe. To augment the cutting and auguring methods, there are products available commercially that will kill the roots inside the pipe without harming the tree. The use of products such as copper sulfate and sodium hydroxide are not recommended because of negative environmental impacts on the downstream receiving water. Also, these products may kill the roots but they do not inhibit regrowth.

The more modern method used throughout Canada and the United States for controlling root growth involves the use of an herbicide mixed with water and a foaming agent. The foam mixture is pumped into the sewer pipe to kill any roots that come into contact with the mixture. New root growth will be inhibited from three to five years after the treatment, according to the manufacturers.

FlexKid is an accessory for Ripper tools designed to clear roots and other blockages from sewer pipes. The unit readily passes through pipes and around or over typical obstructions like offset joints, hand taps and debris. Available for pipes 18 inches and larger, it features durable cable and easy attachment to the rear of any root-cutting motor. It is designed for quick setup and quick size changes in field. No underground (in-manhole) assembly is required, and no manhole modification is necessary.

The Knocker is a chain cleaner designed to use in conjunction with The Ripper. The Ripper positions The Knocker's chain-knocking action in the center of the pipe and keeps the chain from hanging up on offsets and hand-taps. The Ripper follows up by removing loose debris - leaving pipes cleaner than any other sewer cleaning tool - period.

Courtesy of DML, LLC
419 Colford Avenue
West Chicago, Il 60185
Phone (630) 293-3653
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Smoking out Sewer Leaks

*An overview of smoke testing, an important part of successful **I & I** studies.*
By Paul Tashian, Superior Signal Company, Inc.

Used extensively for over 40 years, smoke testing has proven to be a vital ingredient of successful inflow and infiltration (I&I) studies. It is as important now as it has ever been, as growing municipalities increase demands on aging, often deteriorating collection systems. In addition, programs such as the EPA's new CMOM (capacity, management, operations, and maintenance) emphasize a focus on proactive, preventive maintenance practices. Smoke testing is an effective method of documenting sources of inflow and should be part of any CMOM program.

Just as a doctor would require the aid of several instruments to evaluate the status of one's health, various test methods should be used in performing a complete sanitary sewer evaluation survey (SSES). In addition to smoke testing, these could include dyed water testing, manhole inspection, TV inspection, flow monitoring, and more. Specializing in sanitary sewer evaluation surveys, Wade & Associates of Lawrence Kansas states a reduction of 30 to 50% in peak flows can be expected as a result of implementing these types of programs.

Smoke testing is a relatively simple process, which consists of blowing smoke mixed with larger volumes of air into the sanitary sewer line, usually induced through the manhole.

The smoke travels the path of least resistance and quickly shows up at sites that allow surface water inflow. Smoke will identify broken manholes, illegal connections (including roof drains, sump pumps, yard drains and more), uncapped lines, and will even shows cracked mains and laterals providing there is a passageway for the smoke to travel to the surface.

Although video inspection and other techniques are certainly important components of an I&I survey, research has shown that approximately 65% of all extraneous stormwater inflow enters the system from somewhere other than the main line (see private sector diagram). Smoke testing is an excellent method of inspecting both the mainlines, laterals and more. Smoke travels throughout the system, identifying problems in all connected lines, even sections of line that were not known to exist, or thought to be independent or unconnected. Best results are obtained during dry weather, which allows smoke better opportunity to travel to the surface.

Necessary Equipment

Blowers; Most engineering specifications for smoke testing identify the use of a blower able to provide 1750 cfm (cubic feet of air per minute), however in today's world it seems to be the mindset that bigger is better. New smoke blowers on the market can deliver over 3000 cfm, but is this really needed? Once the manhole area is filled, the smoke only needs to travel sections of generally 8 or 10-inch pipe.

Moving the air very quickly is useless if the blower does not have the static pressure to push that air/smoke through the lines. If you've used high CFM blowers and found that smoke frequently backs up to the surface, this may be your problem.

Blowers

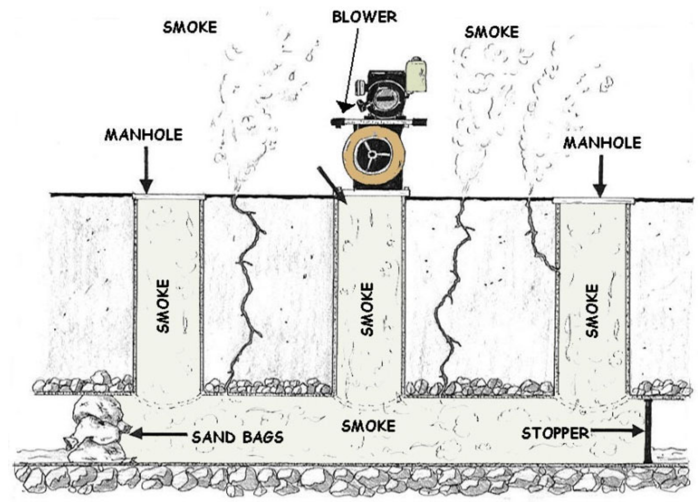
There are two types of blowers available for smoke testing sewers: squirrel cage and direct drive propeller. In general, squirrel cage blowers are usually larger in size, but can provide more static pressure in relation to CFM.

The output of the squirrel cage type is usually adjustable by alternating pulleys and belts to meet the demands of the job. Propeller style blowers are usually more compact and generally offer approx. 3,200 CFM.

Other than reducing the engine throttle, the output is not adjustable since the fan blade is attached directly to the engine shaft. If purchasing a smoke blower you should ask the manufacturer if the CFM and static pressure output they are quoting is the specification of the propeller itself (uninstalled/free air), or if it is the actual performance when installed in the blower assembly. These two numbers can vary significantly.

Smoke Types

There are two types of smoke currently offered for smoke testing sewers, classic smoke candles and smoke fluids.



Smoke candles were first used for testing sewers when the process began its popularity back in 1961, and continue to be the most widely used. They are used by simply placing a smoke candle on the fresh air intake side of the blower. Once ignited, the exiting smoke is drawn in with the fresh air and blown down into the manhole and throughout the system. Smoke candles are available in various sizes that can be used singularly or in combination to meet any need. This type of smoke is formed by a chemical reaction, creating a smoke which contains a high content of atmospheric moisture. It is very visible even at low concentrations, and extremely effective at finding leaks.

Another available source of smoke is a smoke fluid system. Although they have just recently been more aggressively marketed, smoke fluids became available for sewer testing shortly after smoke candles, some 30 years ago. They can certainly be used effectively, but it is important to understand how they work. This system involves injecting a smoke fluid (usually a petroleum based product) into the hot exhaust stream of the engine where it is heated within the muffler (or heating chamber) and exhausted into the air intake side of the blower. One gallon of smoke fluid is generally less expensive than one dozen smoke candles; however smoke fluids do not consistently provide the same quality of smoke.

When using smoke fluid, it is important to understand that as fluid is injected into the heating chamber (or muffler) it immediately begins to cool the unit. The heating chamber will eventually reach a point where it is not hot enough to completely convert all the fluid to smoke, thus creating thin/wet smoke. This can actually happen quickly, depending on the rate of fluid flow. If the smoke has become thin it can be especially difficult to see at greater distances.

Blocking off sections of line is usually a good idea with any type of smoke, but becomes almost a necessity when using smoke fluid. Some manufactures have taken steps to address this issue, and now offer better flow control, fluid distribution, and most importantly *insulated heating chambers* to help maintain necessary temperatures.

Safety

Maybe one of the more talked about, yet least understood aspects of smoke testing is the use and safety of these products.

As manufacturers have become more competitive, some marketing programs and advertisements have implied danger in the use of competitive types of smoke products. Laboratory reports, scientific studies, and even Material Safety Data Sheets can be quite confusing to most of us who are not trained or qualified to make scientific judgments on this data. Having this information delivered to us in the form of advertising can be dangerous, as most of us tend to believe what we read.

An author of an associated industry publication once stated… "*Do not use smoke bombs, as they give off a toxic gas*". Although the author quotes no scientific literature to support this statement, competitive propaganda has made such implications. It is interesting to note that the same exact statement could be made for smoke fluids. Smoke from fluid is created in the exhaust system of the engine, which contains carbon monoxide. Is carbon monoxide not a toxic gas?

Other statements that have been made include warnings to wear a respirator while smoke testing. While certain manufacturers have issued this warning about competitive products, they do not qualify the statement, nor do they mention the fact that the same thing could be said of their own product. The fact is that a respirator should be worn whenever a person would be exposed to <u>ANY</u> substance in quantities that exceeded OSHA limits. The bottom line on safety is that it is important to use common sense.

All smokes, candles, and fluids can be used safely and effectively when used as directed. When planning to smoke test, it is important to develop a proactive public notice program. Ads in local papers, door hangers, mailers, as well as door to door inquiries are recommended. It is helpful to educate the public as to why the test is being performed and the positive benefits to the community. In addition, it should instruct residents on what to do and who to call if smoke should enter their homes.

It is also important to notify local police and fire departments daily, as to where and when smoke testing will be taking place. Reducing stormwater inflow into collection systems means reduced chances of overflows, less emergency maintenance and less money spent on treatment. If these are goals of your organization, consider smoke testing as a fairly easy, inexpensive, and effective way of achieving your objectives.

Paul Tashian is employed by Superior Signal Company Inc., a manufacturer of all types of smoke testing equipment, and a major contributor to the original development of smoke testing practices. Paul can be reached at (732) 251-0800, or ptashian@superiorsignal.com. *Also, thanks to Wade & Associates (a company specializing in sanitary sewer evaluation surveys) for offering reference material, and providing artwork and photographs used in this article. For information on Wade's services call (785) 841-1774, or visit www.wadeinc.com.*

Operation and Maintenance Summary

Maintaining wastewater collection infrastructure – pump stations, force mains, and sewers – is an integral component of the proper management of a treatment system and critical to preventing illegal wastewater releases. Effective preventive maintenance programs have been shown to significantly reduce the frequency and volume of untreated sewage discharges, help communities plan for the future and save money on emergency response.

The compelling reason to perform a condition assessment of your collection system is to preserve the existing valuable infrastructure, minimize O&M and avoid emergencies and unexpected costs. Condition assessment of your collection system is an investment in managing risk. Knowing the structural condition of your underground assets will allow you to avoid emergencies, prioritize repair and replacement projects, and plan for the future. In a condition assessment, data and information are gathered through observation, direct inspection, investigation, and monitoring.

Written Protocol

An analysis of the data and information helps determine the structural, operational, and performance status of capital infrastructure assets. A good written protocol, consistently applied, will help define the assessment. Use new data collection techniques to get the most out of your program. Implementing a pro-active program based on information and systematic assessment removes some of the politics and second-guessing from decision-making.

Performing a condition assessment has a cost, but prioritizing work by focusing on critical assets and the maintenance and replacement needs for your collection system is an essential step toward better management.

Condition Assessments

Maintenance issues are the leading cause of backups and overflows of collection systems. Condition assessment helps utilities discover maintenance and capacity issues before they become maintenance problems. Knowing how your collection system really works will identify Trouble Spots and lead to preventive maintenance decisions, rather than being reactive to the consequences of emergency incidents.

Implementing a pro-active program based on information and systematic assessment provides a manager with the tools to improve decision-making and solid information on which to base staffing and funding decisions.

- grease
- roots
- debris

Record Keeping

Record keeping of sewer maintenance, inspections and repairs meets several needs of the sewer system. Records help simplify and improve work planning and scheduling, including integrating recurring and on-demand work. Measuring and tracking of workforce productivity and developing units costs for various activities are a few of the record keeping benefits. Records of sewer maintenance, service line maintenance, and sewer main and service line repairs should be kept and maintained. Examples of record forms are found herein.

Operations and Maintenance Post Quiz

1. The system's goal should be a minimum of cleaning between _______________% of the sewers every year.

Sewer Cleaning and Inspection

2. As sewer system networks age, the risk of deterioration, this _________________________, and collapses becomes a major concern.

3. __________________ are essential to maintaining a properly functioning system; these activities further a community's reinvestment into its wastewater infrastructure.

Identify the Cleaning Method

4. Directs high velocities of water against pipe walls. Removes debris and grease build-up, clears blockages, and cuts roots within small diameter pipes. Efficient for routine cleaning of small diameter, low flow sewers.

5. Round, rubber-rimmed, hinged metal shield that is mounted on a steel framework on small wheels. The shield works as a plug to build a head of water. Scours the inner walls of the pipe lines. Effective in removing heavy debris and cleaning grease from line.

6. Similar in function to the ball. Rigid rims on bag and kite induce a scouring action. Effective in moving accumulations of decayed debris and grease downstream.

7. Most effective in lines up to 12 inches in diameter. Uses an engine and a drive unit with continuous rods or sectional rods. As blades rotate, they break up grease deposits, cut roots, and loosen debris.

8. Partially removes large deposits of silt, sand, gravel, and some types of solid waste. Cylindrical device, closed on one end with 2 opposing hinged jaws at the other. Jaws open and scrape off the material and deposit it in the bucket.

9. A threaded rubber cleaning ball that spins and scrubs the pipe interior as flow increases in the sewer line. Removes deposits of settled inorganic material and grease build-up. Most effective in sewers ranging in size from 5-24 inches.

10. Introduces a heavy flow of water into the line at a manhole. Removes floatables and some sand and grit. Most effective when used in combination with other mechanical operations, such as rodding or bucket machine cleaning.

More on Sewer Cleaning Procedures
A maintenance plan attempts to develop a strategy and priority for maintaining pipes based on several of the following factors:

11. ________________- frequency and location; 80 percent of problems occur in 25 percent of the system.

12. Force main vs. gravity-force mains have a higher priority than gravity, size for size, due to the complexity of the ______________________.

13. ________________ - Hydrogen Sulfide (H_2S) is responsible for corroding sewers, structures, and equipment used in wastewater collection systems. The interior conditions of the pipes need to be monitored and treatment needs to be implemented to prevent the growth of slime bacteria and the production of H_2S gases.

14. ________________- pipes that carry larger volumes take precedence over pipes that carry a smaller volume.

Limitations of Cleaning Methods
15. __________________ will normally utilize a variety of cleaning methods including jetting, high velocity cleaning, rodding, bucket machining, and using stop trucks.

16. The cleaning and inspection crews will usually consist of two members to operate each of the?

Detailed Cleaning Methods
The purpose of sewer cleaning is to remove foreign material from the sewer and generally is undertaken to alleviate one of the following conditions:

17. _____________________ is caused by either the premature operation of combined wastewater overflows because of downstream restrictions to hydraulic capacity or pollution caused by the washing through and discharge of debris from overflows during storms.

18. ______________________ is caused by the retention of solids in the system for long periods resulting in, among other things, wastewater turning septic and producing hydrogen sulfide.

Answers
1. 20-30, 2. Blockages, 3. Cleaning and inspecting sewer lines,4. Jetting, 5. Scooter, 6. Kites, Bags, and Poly Pigs, 7. Mechanical Rodding, 8. Bucket Machine, 9. Hydraulic Balling, 10. Flushing, 11. Problems, 12. Cleaning and repairs, 13. Corrosion potential, 14. Pipe diameter/volume conveyed, 15. The collection system, 16 Combination trucks and TV trucks, 17. Pollution, 18. Odor

Chapter 11- CMOM - "Capacity, Management, Operation and Maintenance"

Section Focus: You will learn the basics of the Capacity, Management, Operation and Maintenance program. At the end of this section, you will be able to describe the basics of the Capacity, Management, Operation and Maintenance program. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Sanitary sewage overflows that reach waters of the U.S. are point source discharges. Like other point source discharges from municipal sanitary sewer systems, sanitary sewage overflows are prohibited unless authorized by a NPDES permit. Moreover, SSOs, including those that do not reach waters of the U.S., may be indicative of improper operation and maintenance of the sewer systems, and may violate NPDES permit conditions.

What are Sanitary Sewer Overflows?
Sanitary Sewer Overflows (SSOs) are discharges of raw sewage from municipal sanitary sewer systems. SSOs can release untreated sewage into basements or out of manholes and onto city streets, playgrounds, and into streams before it can reach a treatment facility. SSOs are often caused by blockages and breaks in the sewer lines.

Why do Sewers Overflow?
SSOs occasionally occur in almost every sewer system, even though systems are intended to collect and contain all the sewage that flows into them. When SSOs happen frequently, it means something is wrong with the system.

Problems that Can Cause Chronic SSOs Include:

Infiltration and Inflow (I&I): Too much rainfall or snowmelt infiltrating through the ground into leaky sanitary sewers not designed to hold rainfall or to drain property, and excess water inflowing through roof drains connected to sewers, broken pipes, and badly connected sewer service lines.

Undersized Systems: Sewers and pumps are too small to carry sewage from newly-developed subdivisions or commercial areas.

Pipe Failures: blocked, broken or cracked pipes, tree roots grow into the sewer, sections of pipe settle or shift so that pipe joints no longer match, and sediment and other material builds up causing pipes to break or collapse.

Equipment Failures: Pump failures, power failures.

Sewer Service Connections: Discharges occur at sewer service connections to houses and other buildings; some cities estimate that as much as 60% of overflows comes from the service lines.

Deteriorating Sewer System: Improper installation, improper maintenance; widespread problems that can be expensive to fix develop over time, some municipalities have found severe problems necessitating billion-dollar correction programs, often communities have to curtail new development until problems are corrected or system capacity is increased.

Why are SSOs a Problem?
The EPA has found that SSOs caused by poor sewer collection system management pose a substantial health and environmental challenge. The response to this challenge varies considerably from state to state. Many municipalities have asked for national consistency in the way permits are considered for wastewater discharges, including SSOs, and in enforcement of the law prohibiting unpermitted discharges. In response, the EPA has convened representatives of states, municipalities, health agencies, and environmental advocacy groups to advise the Agency on how to best meet this challenge.

How Big is the SSO Problem?
The total number of SSOs that occur nationwide each year is not known. In some areas, they might not be reported or are underreported to the EPA and state environmental agencies. Two surveys, however, help to define the size of the problem:

- In a 1994 survey of 79 members of the Association of Metropolitan Sewerage Agencies, 65 percent of the respondents reported wet weather SSOs. They reported that between 15 and 35 percent of their sewers were filled above capacity and/or overflowed during wet weather. However, municipal respondents with SSOs had only limited information about them. Only 60 percent had estimated the annual number. Half of those had estimated the amount of sewerage discharged, and 17 percent had determined what pollutants were in their overflows.
- A 1981 survey conducted by the National Urban Institute indicated an average of 827 backups and 143 breaks per 1,000 miles of sewer pipe (about 1,000 miles of sewer pipe are needed to serve 250,000 people.) per year. Breaks occurred most often in the young, growing cities of the South and West.

Downstream of a nonfunctional Combined Sewer Overflow (CSO) Control Facility.

Combined Sewer Overflows

Combined sewer systems are sewers that are designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. Most of the time, combined sewer systems transport all of their wastewater to a sewage treatment plant, where it is treated and then discharged to a water body. During periods of heavy rainfall or snowmelt, however, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess wastewater directly to nearby streams, rivers, or other water bodies.

These overflows, called combined sewer overflows (CSOs), contain not only storm water but also untreated human and industrial waste, toxic materials, and debris. They are a major water pollution concern for the approximately 772 cities in the U.S. that have combined sewer systems. CSOs may be thought of as a type of "urban wet weather" discharge. This means that, like sanitary sewer overflows (SSOs) and storm water discharges, they are discharges from a municipality's wastewater conveyance infrastructure that are caused by precipitation events such as rainfall or heavy snowmelt. The EPA's CSO Control Policy, published April 19, 1994, is the national framework for control of CSOs.

The Policy provides guidance on how communities with combined sewer systems can meet Clean Water Act goals in as flexible and cost-effective a manner as possible. EPA's Report to Congress on implementation of the CSO Control Policy assesses the progress made by EPA, states, and municipalities in implementing and enforcing the CSO Control Policy.

Proper function of sanitary sewer systems is vital to protect public health, property, and waterways in the surrounding area. Most utilities have a management, operation, and maintenance (MOM) plan to ensure their system is in working order. However, more than 40,000 sanitary sewage overflows SSOs occur every year, causing huge monetary losses, damage to fish/shellfish beds, polluting groundwater, and decreased tourism. Sanitary sewage overflows (SSOs) release raw sewage from the collection system before it can reach a treatment facility. Sewage may flow out of manholes, into businesses and homes, and eventually ends up in local waterways.

Many factors are involved in SSOs. Many municipalities started constructing sewer systems over 100 years ago. Some of these have not been adequately maintained, improved, or repaired over the last century.

Cities have used a wide variety of building materials, designs, and installation techniques, which aren't durable enough to withstand heavy, continuous use. Problems can be especially bad where an older system is attached to a new system or an older system has fallen into disrepair.

EPA believes that every sanitary sewer system has the capacity to have a sanitary sewer overflows (SSO). This may be due to a number of factors including, but not limited to:

- Blockages
- Structural, mechanical, or electrical failures
- Collapsed or broken sewer pipes • Insufficient conveyance capacity
- Vandalism

Additionally, high levels of inflow and infiltration (I/I) during wet weather can cause SSOs. Many collection SSOs include untreated discharges from sanitary sewer systems that reach waters of the United States systems that were designed according to industry standards experience wet weather SSOs because levels of I/I may exceed levels originally expected; prevention of I/I has proven more difficult and costly than anticipated; or the capacity of the system has become inadequate due to an increase in service population without corresponding system upgrades (EPA 2004).

The Management, Operation and Maintenance (MOM) Programs Project is a pilot enforcement approach developed by EPA Region 4 to bring municipal sewer systems into full compliance with the Clean Water Act by eliminating sanitary sewer overflows (SSOs) from municipal sewer systems. A SSO is a release of untreated wastewater before the flow reaches a treatment plant. SSOs pose a significant threat to public health and water quality.

Treatment Balance and the Effects of Undesirable Solids

For any wastewater treatment plant to operate properly, the operator has to maintain a skillfully balanced mixture of microorganisms which contact and digest the organics in the wastewater, and bacteria then grows on this media to treat the wastewater. When a plant is properly maintained these bacteria or bugs eat the dissolved organics in the water, thus removing BOD, Ammonia, Nitrates, and Phosphorus.

All of these constituents must be treated and removed from the water. When this is accomplished you achieve a low turbidity and clean decantible water which is then filtered and chlorinated to kill all the remaining bacteria. This incredible process leaves extremely clean and reusable water that can be injected back into the ground, sent to ponds or used for irrigation.

Certain compounds and undesirable solids, like grease and grass clippings, can disturb this delicate balance and necessary process at the wastewater treatment facility. There are compounds and mixtures that should never be introduced into a sanitary sewer system. These destructive compounds include but are not limited to: cleaning solvents, grease (both household and commercial), oils (both household and commercial), pesticides, herbicides, antifreeze and other automotive products.

The solids include but are not limited to: plastics, rubber goods, grass clippings, metal products such as aluminum foil, beer or soda cans, wood products, glass, paper products such as disposable diapers and sanitary napkins. Items such as these disturb or even kill the delicate balance of microorganisms and bacteria that are needed to treat the wastewater. These will also clog the sanitary sewer causing back-ups and sewer overflows. First, we will examine the damage to equipment and we will finish with resolution methods.

Costly Maintenance
These harmful compounds and solids can also cause equipment damage and create costly and unnecessary repairs, as well as frequent and costly maintenance. Repairs include but are not limited to: SBR Motive Pumps--these should last at least 5 years but are failing after only 2 or 3 years because of material that was placed in the sewer system. In a recent 2007 study, the cost of repairing these pumps was around $30,000.00. The replacement of the influent grinder or, “Muffin Monster” after only 3 years of service was nearly $7,000.00. The cost of frequent maintenance consists of, but is not limited to: the extensive amounts of damaging solids that clog lift stations and damage lift station pumps. These costs have almost doubled in today’s costs.

To properly clean a lift station may cost around $3,0000 -10,000 for each time that common problems occur like grass clippings from a golf course, overflowing grease from improperly maintained grease traps from a casino, hotel or golf course and improperly maintained grease and oil interceptors.

These costs do not touch the cost of cleaning the sewer mains and manholes. In most cases, no serious damage will occur to the sewer main or manhole, but the chance of overflowing sewage or untreated wastewater getting to the street is greatly increased and does happen in most communities. Most of us know about it and accept it as part of our jobs. But time and rules have changed. We must work harder and be smarter to stop these problems before the damage and overflow occurs.

Municipality Self-Assessment
Under the MOM Programs Project, municipalities are encourages to undertake a detailed self-assessment of their MOM programs. The municipalities submit this self-assessment along with recommendations for improvements to the MOM programs and/or remedial measures to correct sewer infrastructure problems.

In consideration for undertaking the self-assessment, the municipality is able to establish its own reasonable goals and schedules, which could result to significantly reduced penalties related to SSOs. Where an enforcement action is necessary, the regulator works with the municipality to identify necessary remedial measures and to establish schedules. The Regulator will likely defer any penalty decision until after the completion of the necessary improvements.

Project Initiation
In 1998, Region 4 began the MOM Programs Project by identifying priority watersheds and geographical areas in each of the eight States in the Region. These included areas where SSOs could cause significant public health concerns, such as beaches, shellfish harvesting areas and drinking water supplies. In addition, watersheds already listed as impaired by collection system overflows or bacterial contamination were identified.

Region 4, working with the States, selected a watershed (or geographical area) in each State. All municipal sewer systems in each watershed were identified and invited to participate in the Project and to attend a kickoff meeting held at a location in the watershed.

Those municipalities wanting to participate in the MOM Project undertake the self-assessment using the guidance materials provided and submit the self-assessment to the Region within seven months of the kickoff. Municipalities that don’t participate are inspected by the Region and/or State and are subject to traditional enforcement actions, including penalties where appropriate. Improper management and maintenance cause a majority of avoidable SSOs.

Leading Causes of SSOs

Problem/Cause	% of SSOs	Description
Blockages	43%	Blockages may be caused by tree roots or a build-up of sediment and other materials (i.e., grease, grit, debris). Structural defects and a flat slope can also cause excessive deposits of material. Build-ups can cause pipes to break or collapse.
Infiltration and Inflow (I/I)	27%	Infiltration and inflow occurs when rain or snowmelt enters the ground and seeps into leaky sanitation sewers, which were not designed to carry rainfall or drain property. Inflow can also occur when excess waters from roof drains, broken pipes and bad connections at sewer service lines infiltrates the sanitary sewer.
Structural Failures	12%	Line/main breaks are a major result of structural failure. Undersized systems do not have large enough pumps or lines to carry all the sewage generated by the buildings attached to them. This is especially true for new subdivisions or commercial areas. SSOs can occur at sewer service connections to houses or buildings. Some cities estimate that up to 60% of SSOs come from service lines.
Power Failure	11%	Stops pump operation, interrupting sewage flow
Other	7%	Scheduling, vandalism

Above, a cracked sewer main, a SSO waiting to happen.

Purpose of CMOM Programs

CMOM programs incorporate many of the standard operation and maintenance activities that are routinely implemented by the owner or operator with a new set of information management requirements in order to:

- Better manage, operate, and maintain collection systems
- Investigate capacity constrained areas of the collection system
- Proactively prevent SSOs
- Respond to SSO events

The CMOM approach helps the owner or operator provide a high level of service to customers and reduce regulatory noncompliance. CMOM can help utilities optimize use of human and material resources by shifting maintenance activities from "reactive" to "proactive"–often leading to savings through avoided costs due to overtime, reduced emergency construction costs, lower insurance premiums, changes in financial performance goals, and fewer lawsuits.

CMOM programs can also help improve communication relations with the public, other municipal works and regional planning organizations, and regulators. It is important to note that the collection system board members or equivalent entity should ensure that the CMOM program is established as a matter of policy. The program should not be micro-managed, but an understanding of the resources required of the operating staff to implement and maintain the program is necessary. In CMOM planning, the owner or operator selects performance goal targets, and designs CMOM activities to meet the goals.

The CMOM planning framework covers operation and maintenance (O&M) planning, capacity assessment and assurance, capital improvement planning, and financial management planning. Information collection and management practices are used to track how the elements of the CMOM program are meeting performance goals, and whether overall system efficiency is improving. On a periodic basis, utility activities should be reviewed and adjusted to better meet the performance goals. Once the long-term goal of the CMOM program is established, interim goals may be set. For instance, an initial goal may be to develop a geographic information system (GIS) of the system.

Once the GIS is complete, a new goal might be to use the GIS to track emergency calls and use the information to improve maintenance planning. An important component of a successful CMOM program is periodically collecting information on current systems and activities to develop a "snapshot-in-time" analysis. From this analysis, the owner or operator evaluates its performance and plans its CMOM program activities. Maintaining the value of the investment is also important. Collection systems represent major capital investments for communities and are one of the communities' major capital assets.

Equipment and facilities will deteriorate through normal use and age. Maintaining value of the capital asset is a major goal of the CMOM program. The infrastructure is what produces sales and service. Proper reinvestment in capital facilities maintains the ability to provide service and generate sales at the least cost possible and helps ensure compliance with environmental requirements.

The performance of wastewater collection systems is directly linked to the effectiveness of its CMOM program. Performance characteristics of a system with an inadequate CMOM program include frequent blockages resulting in overflows and backups. Other major performance indicators include pump station reliability, equipment availability, and avoidance of catastrophic system failures such as a collapsed pipe.

A CMOM program is what an owner or operator should use to manage its assets; in this case, the collection system itself. The CMOM program consists of a set of best management practices that have been developed by the industry and are applied over the entire life cycle of the collection system and treatment plant.

These practices include:

- Designing and constructing for O&M
- Knowing what comprises the system (inventory and physical attributes)
- Knowing where the system is (maps and location)
- Knowing the condition of the system (assessment)
- Planning and scheduling work based on condition and performance
- Repairing, replacing, and rehabilitating system components based on condition and performance
- Managing timely, relevant information to establish and prioritize appropriate CMOM activities

EPA and state NPDES inspectors evaluate collection systems and treatment plants to determine compliance with permit conditions including proper O&M. Among others, these permit conditions are based on regulation in 40 CFR 122.41(e): "The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit."

The Elements of a Proper CMOM Program

Utility Specific
The complexity and expense associated with a utility's CMOM or MOM programs is specific to the size and complexity of the Publicly Owned Treatment Works (POTW) and related infrastructure. Factors such as population growth rate and soil/groundwater conditions also dictate the level of investment which should be made.

Purposeful
When MOM programs are present and properly maintained, they support customer service and protect system assets, public health, and water quality.

Goal-Oriented
Proper MOM programs have goals directed toward their individual purposes. Progress toward these goals is measurable, and the goals are attainable.

Uses Performance Measures
Performance measures should be established for each MOM program in conjunction with the program goal. These measures are quantifiable, and used in determining progress to, or beyond, the program goal.

Periodically Evaluated
An evaluation of the progress toward reaching the goals, or a reassessment of the goals, should be made periodically and based upon the quantified performance measures.

Available In Writing
The effectiveness of a MOM program quickly breaks down unless it is available in writing. Personnel turnover and lapses in communication between staff and management can change otherwise proper MOM programs to improper ones. Written MOM programs are useful only if they are made readily available to all personnel and clearly documented.

Implemented by Trained Personnel
Appropriate safety, equipment, technical, and program training is essential for implementing MOM programs properly.

What MOM programs should be audited?
MOM activity at a utility involves its entire wastewater infrastructure. Common utility management activities and operations and maintenance activities associated with sewer systems and pretreatment are listed in the Self-Audit Review Document.

If a utility owns treatment works or a pond system, then activities associated with the management, operation, and maintenance of these facilities should also be included in the audit. A helpful guide for this part is the NPDES Compliance Inspection Manual. Instruction for obtaining this manual is provided in a list of references.

What are the elements of a proper Self-Audit?
Initial Assessment
Begin by performing a general assessment of the utility, and prioritizing the order of programs to be audited. The NPDES Compliance Inspection Manual and Guidance may be useful references in making this assessment.

Develop the Audit Plan
Identify the MOM programs present and/or needed at the utility, establish performance measures, and develop a schedule for auditing the programs.

Conduct the Audit
Evaluate each MOM program against the defined elements of a proper program. This can be accomplished by reviewing the program's records and resources, conducting a field evaluation, and comparing the program understanding of both personnel and management.

Identify Deficiencies
Define any programs needed, or improvements to programs needed, and any infrastructure deficiencies found. Identify any unpermitted discharges that have occurred in the past five years.

Develop Improvement Plan
Define the utility's plan/schedule to remediate the necessary improvements. This plan should include any short-term or long-term program improvements, and any short-term or long-term capital improvements that need addressing.

Prepare the Self-Audit Report
Generate a report of the audit results, including any deficiencies found and the corresponding improvement plan, which is useful for the utility. This report should be capable of serving the utility as a reference when conducting any needed remedial measures, and as a reference to compare current performance with future self-audit results.

Are there federal grants or other compliance assistance resources available to conduct a Self-Audit?
Currently, there are no funds available for the specific purpose of conducting a MOM Programs Self-Audit. However, the Office of Wastewater Management offers a number of financial resources to assist qualified utilities in making improvements to their programs.

Small publicly-owned wastewater treatment plants which discharge less than 5 million gallons per day are also eligible for the Wastewater Treatment Plant Operator On-Site Assistance Training Program. The program provides on-site operator training, financial management, troubleshooting, and other operation and maintenance assistance.

A network of operator training personnel, EPA Regional Office Coordinators and States and State Training Centers work in the field with small under-served communities to help solve their operation and maintenance problems. There is no cost incurred by the facility in need of assistance. The only requirement of the program is the willingness to work with a trainer to correct the facility's problems.

What Health Risks do SSOs present?
Because SSOs contain raw sewage they can carry bacteria, viruses, protozoa (parasitic organisms), helminths (intestinal worms), and borroughs (inhaled molds and fungi). The diseases they may cause range in severity from mild gastroenteritis (causing stomach cramps and diarrhea) to life-threatening ailments such as cholera, dysentery, infectious hepatitis, and severe gastroenteritis.

People can be Exposed Through:

- Sewage in drinking water sources.
- Direct contact in areas of high public access such as basements, lawns or streets, or waters used for recreation. At least one study has estimated a direct relationship between gastrointestinal illness contracted while swimming and bacteria levels in the water.
- Shellfish harvested from areas contaminated by raw sewage. One study indicates that an average of nearly 700 cases of illness per year were reported in the 1980s from eating shellfish contaminated by sewage and other sources. The number of unreported cases is estimated to be 20 times that.
- Some cases of disease contracted through inhalation and skin absorption have also been documented.

What other Damage can SSOs do?

SSOs also damage property and the environment. When basements flood, the damaged area must be thoroughly cleaned and disinfected to reduce the risk of disease. Cleanup can be expensive for homeowners and municipalities. Rugs, curtains, flooring, wallboard panels, and upholstered furniture usually must be replaced. A key concern with SSOs that enter oceans, bays, estuaries, rivers, lakes, streams, or brackish waters is their effect on water quality. When bodies of water cannot be used for drinking water, fishing, or recreation, society experiences an economic loss. Tourism and waterfront home values may fall. Fishing and shellfish harvesting may be restricted or halted. SSOs can also close beaches. One 1994 study claims that SSOs closed beaches across the nation that year for a total of more than 300 days.

How can SSOs be Reduced or Eliminated?

Many avoidable SSOs are caused by inadequate or negligent operation or maintenance, inadequate system capacity, and improper system design and construction. These SSOs can be reduced or eliminated by:

- Sewer system cleaning and maintenance
- Reducing infiltration and inflow through system rehabilitation and repairing broken or leaking service lines.
- Enlarging or upgrading sewer, pump station, or sewage treatment plant capacity and/or reliability.
- Construction of wet weather storage and treatment facilities to treat excess flows.

Communities also should address SSOs during sewer system master planning and facilities planning, or while extending the sewer system into previously unsewered areas. A few SSOs may be unavoidable. Unavoidable SSOs include those occurring from unpreventable vandalism, some types of blockages, extreme rainstorms, and acts of nature such as earthquakes or floods.

What Costs are Involved with Reducing or Eliminating SSOs?

Sanitary sewer collection systems are a valuable part of the nation's infrastructure. The EPA estimates that our nation's sewers are worth a total of more than $1 trillion. The collection system of a single large municipality is an asset worth billions of dollars and that of a smaller city could cost many millions to replace.

Sewer rehabilitation to reduce or eliminate SSOs can be expensive, but the cost must be weighed against the value of the collection system asset and the added costs if this asset is allowed to further deteriorate. Ongoing maintenance and rehabilitation adds value to the original investment by maintaining the system's capacity and extending its life.

The costs of rehabilitation and other measures to correct SSOs can vary widely by community size and sewer system type. Those being equal, however, costs will be highest and ratepayers will pay more in communities that have not put together regular preventive maintenance or asset protection programs.

Assistance is available through the Clean Water Act State Revolving Fund for capital projects to control SSOs. State Revolving Funds in each state and Puerto Rico can help arrange low-interest loans. For the name of your State Revolving Fund contact, please call the EPA Office of Water Resource Center, (202) 566-1729.

To reduce sanitary sewer overflows (SSOs), the EPA is proposing to clarify and expand permit regulations that are already in force under the Clean Water Act. This will affect over 19,000 municipal sanitary sewer systems, including 4800 satellite collection systems that will be regulated for the first time. It will allow streamlined CMOM requirements for small communities, and permit them to skip self-audits and annual reports if an SSO hasn't occurred.

More Specifically, CMOM will Require Facilities to:

- Establish general performance standards.
- Have a management program.
- Create an overflow response plan.
- Ensure system evaluations.
- Verify capacity assurance.
- Submit to periodic audits of the CMOM program.
- Notify the public and regulatory agencies of SSOs.

General Performance Standards

A CMOM program will ensure:

- There is enough capacity to handle base and peek flows.
- The use of all reasonable measure to stop SSOs.
- Proper collection, management, operation and maintenance of the system.
- Prompt notification of all parties that may be exposed to an SSO.

Management Programs

Management program documents must include:

- The goals of the CMOM program (may differ depending on the facility.)
- Legal authorities that will help implement CMOM.
- The "chain of command" for implementing CMOM and reporting SSOs.
- Design and performance requirements.
- Measures that will be taken to help implement CMOM.
- Monitoring/performance measures to how effective the CMOM program is.
- Communication plan.

Overflow Response Plan

The overflow response plan should be designed provide a quick response to SSOs. Rapid response to an SSO can mitigate structural damage, pollution of waterways, and the public health risk. The plan must include the following:

- SSO response procedures.
- Immediate notification of health officials.
- Public notification.
- Plan made available to the public.
- Distribution to all appropriate personnel.
- Revision and maintenance of the plan by appropriate personnel.

Collection System Management

Collection system management activities form the backbone for operation and effective maintenance activities. The goals of a management program should include:

- Protection of public health and prevention of unnecessary property damage
- Minimization of infiltration, inflow and exfiltration, and maximum conveyance of wastewater to the wastewater treatment plant
- Provision of prompt response to
- Staffing plans–Number of people and service interruptions
- Efficient use of allocated funds
- Sewer use ordinance
- Identification of and remedy solutions to design, construction, and operational deficiencies
- Performance of all activities in a safe manner to avoid injuries

Without the proper procedures, management and training systems, O&M activities may lack organization and precision, resulting in a potential risk to human health and environmental contamination of surrounding water bodies, lands, dwellings, or groundwater. The following sections discuss the common elements of a robust collection system management program.

Organizational Structure
Well-established organizational structure, which delineates responsibilities and authority for each position, is an important component of a CMOM program for a collection system. This information may take the form of an organizational chart or narrative description of roles and responsibilities, or both. The organizational chart should show the overall personnel structure, including operation and maintenance staff. Additionally, up-to-date job descriptions should be available.

Job descriptions should include the nature of the work performed, the minimum requirements for the position, the necessary special qualifications or certifications, examples of the types work, lists of licenses required for the position, performance measures or promotion potential. Other items to note in regard to the organizational structure are the percent of staff positions currently vacant, on average, the length of time positions remain vacant, and the percent of collection system work that is contracted out.

Reviewer - Point to Note
The reviewer may want to note the turnover rate and current levels of staffing (i.e., how many vacant positions exist and for how long they have been vacant). This may provide some indication of potential understaffing, which can create response problems. Reviewers should evaluate specific qualifications of personnel and determine if the tasks designated to individuals, crews, or teams match the job descriptions and training requirements spelled out in the organizational structure.

From an evaluation standpoint, the reviewer might try to determine what type of work is performed by outside contractors and what specific work is reserved for collection system personnel. If much of the work is contracted, it is appropriate to review the contract and to look at the contractor's capabilities. If the contractor handles emergency response, the reviewer should examine the contract with the owner or operator to determine if the emergency response procedures and requirements are outlined. The inclusion of job descriptions in the organizational structure ensures that all employees know their specific job responsibilities and have the proper credentials.

Additionally, it is useful in the course of interviews to discuss staff management. The reviewer should note whether staff receive a satisfactory explanation of their job descriptions and responsibilities. In addition, when evaluating the CMOM program, job descriptions will help a reviewer determine who should be interviewed.

Reviewer - Point to Note
A reviewer should look for indications that responsibilities are understood by employees. Such indications may include training programs, meetings between management and staff, or policies and procedures.

When evaluating the organizational structure, the reviewer should look for the following:

- Except in very small systems, operation and maintenance personnel ideally should report to the same supervisor or director. The supervisor or director should have overall responsibility for the collection system. Guide for Evaluating CMOM Programs at Sanitary Sewer Collection Systems

- In some systems, maintenance may be carried out by a citywide maintenance organization, which may also be responsible for such diverse activities as road repair and maintenance of the water distribution system. This can be an effective approach, but only if adequate lines of responsibility and communication are established.

- In general, one supervisor should manage a team of individuals small enough that is safe and effective. However, the individuals on the team may have additional employees reporting to them. This prevents the top supervisors from having to track too many individuals. The employee-supervisor ratio at individual collection systems will vary depending on their need for supervisors. In a utility with well-established organizational structure, staff and management should be able to articulate their job and position responsibilities.

Personnel should be trained to deal with constantly changing situations and requirements, both regulatory and operational. The system's personnel requirements vary in relation to the overall size and complexity of the collection system. In very small systems, these responsibilities may include operation of the treatment plant as well as the collection system.

In many systems, collection system personnel are responsible for the stormwater as well as wastewater collection system. References providing staff guidelines or recommendations are available to help the reviewer determine if staffing is adequate for the collection system being reviewed.

Potential Performance Indicators

Input measures	Per capita costs Number of employee hours
Output measures	Length of pipe maintained Number of service calls completed Percentage of length maintained repaired this year Percentage of length maintained needing repair Length of new sewer constructed Number of new services connected
Outcomes	Number of stoppages per 100 miles of pipe Average service response time Number of complaints
Ecological/Human health/ Resource use	Shellfish bed closures Benthic Organism index Biological diversity index Beach closures Recreational activities Commercial activities

CMOM Audits
CMOM will require regular, comprehensive audits, done by each facility. These audits will help identify non-conformance to CMOM regulations so problems can be addressed quickly. All findings, proposed corrective actions and upcoming improvements should be documented in the audit report.

Communication/Notification
If an SSO occurs, sanitary sewer facilities will be required to immediately notify the NPDES permit authority, appropriate health agencies, state authorities, drinking water suppliers, and, if necessary, the general public in the risk area. This rule will also require an annual report of all overflows, including minor SSOs such as building backups. Facilities must post locations of recurrent SSOs and let the public know that the annual report is available to them. The record keeping provisions mandate that facilities must maintain records for three years about all overflows, complaints, work orders on the system, and implementation measures.

According to the EPA, an effective CMOM program would help NPDES permitees to:

- Develop/revise routine preventive maintenance activities that prevent service interruption and protect capital investments.
- Create an inspection schedule and respond to the inspection results.
- Investigate the causes of SSOs and take corrective measures.
- Respond quickly to SSOs to minimize impacts to human health and the environment.
- Identify and evaluate SSO trends.
- Develop budgets and identify staffing needs.
- Plan for future growth to ensure adequate capacity is available when it’s needed.
- Identify hydraulic (capacity) and physical deficiencies and prioritize responses, including capital investments.
- Identify and develop appropriate responses to program deficiencies (e.g., lack of legal authority, inadequate funding, and inadequate preventive maintenance).
- Keep parts and tools inventories updated and equipment in working order.
- Report and investigate safety incidents and take steps to prevent their recurrence.

Implementation
The EPA estimates that implementing this rule will impose an additional $93.5 to $126.5 million every year on municipalities (includes planning and permitting costs). A system serving 7,500 people may need to spend an average of $6,000 every year to comply with the rule.

CMOM regulations will be added to the permit when facilities need to have a permit re-issued. Although a compliance deadline has not been set, the EPA recommends that facilities begin to implement "SSO Standard Conditions" right after the proposed rule is published. Considering the time and costs associated with compliance, this may be good advice.

Continuous Training
Procedures for emergency response plans should be understood and practiced by all personnel in order to ensure safety of the public and the collection system personnel responding. Procedures should be specific to the type of emergency that could occur.

It is important to keep detailed records of all past emergencies in order to constantly improve response training, as well as the method and timing of future responses.

The ability to deal with emergencies depends on the knowledge and skill of the responding crews, in addition to availability of equipment. The crew should be able to rapidly diagnose problems in the field under stress and select the right equipment needed to correct the problem.

If resources are limited, consideration should be given to contracting other departments or private industries to respond to some emergencies, for example, those rare emergencies that would exceed the capacity of staff.

System Evaluation and Capacity Assurance Plan
These two activities work hand-in-hand to detect and address deficiencies and scheduling. These will provide:

- An evaluation of parts of the collection system that have substandard performance.
- Capacity assurance measures to address substandard performance.
- Explanation of prioritization and scheduling.

Performance measures and indicators are important in evaluating collection system performance and implementing capacity management, operation and maintenance programs.

Hydrogen Sulfide Monitoring and Control Sub-Section

The collection system owner or operator should have a program under which they monitor areas of the collection system that may be vulnerable to the adverse effects of hydrogen sulfide. It may be possible to perform visual inspections of these areas. The records should note such items as the condition of metal components, the presence of exposed rebar (metal reinforcement in concrete), copper sulfate coating on copper pipes and electrical components, and loss of concrete from the pipe crown or walls.

Areas Subject to Generation of Hydrogen Sulfide:

- Sewers with low velocity conditions and/or long detention times
- Sewers subject to solids deposition
- Pump stations
- Turbulent areas, such as drop manholes or force main discharge points
- Inverted siphon discharges

The collection system owner or operator should be carrying out routine manhole inspections. The hydrogen sulfide readings generated as a result of these inspections should be added to the records of potential areas of corrosion. A quick check of the pH of the pipe crown or structure enables early indication of potential hydrogen sulfide corrosion. A pH of less than four indicates further investigation is warranted. “Coupons” may be installed in structures or pipelines believed to be potentially subject to corrosion. Coupons are small pieces of steel inserted into the area and measured periodically to determine whether corrosion is occurring.

Reviewer - Point to Note

The reviewer should be aware that a system in which infiltration and inflow (I/I) has successfully been reduced may actually face an increased risk of corrosion. The reviewer should pay particular attention to the hydrogen sulfide monitoring program in these systems. The reduction of flow through the pipes allows room for hydrogen sulfide gases to rise into the airway portion of the sewer pipe and react with the bacteria and moisture on the pipe walls to form sulfuric acid. Sulfuric acid corrodes ferrous metals and concrete. There are several methods to prevent or control hydrogen sulfide corrosion. The first is proper design. Design considerations are beyond the scope of this manual but may be found in the Design Manual: Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants (EPA 1985).

The level of dissolved sulfide in the wastewater may also be reduced by chemical or physical means such as aeration, or the addition of chlorine, hydrogen peroxide, potassium permanganate, iron salts, or sodium hydroxide. Whenever chemical control agents are used, the owner or operator should have procedures for their application and maintain records of the dosages of the various chemicals.

Alternatively, sewer cleaning to remove deposited solids reduces hydrogen sulfide generation. Also, air relief valves may be installed at the high points of the force main system. The valve allows air to exit thus avoiding air space at the crown of the pipe where acid can form. The reviewer should examine the records to see that these valves are receiving periodic maintenance.

Collection systems vary widely in their vulnerability to hydrogen sulfide corrosion. Vitrified clay and plastic pipes are very resistant to hydrogen sulfide corrosion while concrete, steel, and iron pipes are more susceptible. The physical aspects of the collection system are also important. Sewage in pipes on a decline that moves the wastewater at a higher velocity will have less hydrogen sulfide than sewage in pipes where the wastewater may experience longer detention times. Therefore, some systems may need a more comprehensive corrosion control program while some might limit observations to vulnerable points.

Safety
The reasons for development of a safety program should be obvious for any collection system owner or operator. The purpose of the program is to define the principles under which the work is to be accomplished, to make the employees aware of safe working procedures, and to establish and enforce specific regulations and procedures. The program should be in writing (e.g., procedures, policies, and training courses) and training should be well documented. The purpose of safety training is to stress the importance of safety to employees. Safety training can be accomplished through the use of manuals, meetings, posters, and a safety suggestion program.

One of the most common reasons for injury and fatalities in wastewater collection systems is the failure of victims to recognize hazards. Safety training cuts across all job descriptions and should emphasize the need to recognize and address hazardous situations.

Safety programs should be in place for the following areas:
- Confined spaces
- Chemical handling
- Trenching and excavations
- Safety Data Sheets (SDS)
- Biological hazards in wastewater
- Traffic control and work site safety
- Lockout/Tagout
- Electrical and mechanical safety
- Pneumatic or hydraulic systems safety

The collection system owner or operator should have written procedures that address all of the above issues and are made available to employees. In addition to training, safety programs should incorporate procedures to enforce the program. For example, this could include periodic tests or "pop" quizzes to monitor performance and/or compliance and follow-up on safety related incidents. The owner or operator should maintain all of the safety equipment necessary for system staff to perform their daily activities and undertake any emergency repairs.

This equipment should include, at minimum:
- Atmospheric gas testing equipment
- Respirators and/or self-contained breathing apparatus
- Full body harness
- Tripods or non-entry rescue equipment
- Hard hats
- Safety glasses
- Rubber boots
- Rubber and/or disposable gloves
- Antibacterial soap
- First aid kit
- Protective clothing
- Confined space ventilation equipment
- Traffic and/or public access control equipment
- Hazardous gas meter

Reviewer - Point to Note
The reviewer should, in the course of interviewing personnel, determine their familiarity with health and safety procedures according to their job description. Each field crew vehicle should have adequate health and safety supplies. If the reviewer has access to the municipal vehicle storage area, he or she might choose to check actual vehicle stocks, not just supplies in storage.

Confined Space Safety
Collection system operators typically assist with manhole cover removal and other physical activities. The inspector should refrain from entering confined spaces. A confined space is defined by the Occupational Safety and Health Administration (OSHA) as a space that:
(1) is large enough and so configured that an employee can bodily enter and perform assigned work; and
(2) has limited or restricted means for entry or exit; and
(3) is not designed for continuous employee occupancy

[29 CFR 1910.146(b)].
A "permit-required confined space (permit space)" is a confined space that has one or more of the following characteristics:
(1) contains or has a potential to contain a hazardous atmosphere;
(2) contains a material that has the potential for engulfing an entrant;
(3) has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
(4) contains any other recognized serious safety or health hazard [29 CFR 1910.146(b)].

Though OSHA has promulgated standards for confined spaces, those standards do not apply directly to municipalities, except in those states that have approved plans and have asserted jurisdiction under Section 18 of the OSHA Act.

Contract operators and private facilities do have to comply with the OSHA requirements and the inspector may find that some municipalities elect to do so voluntarily. In sewer collection systems, the two most common confined spaces are the underground pumping station and manholes.

The underground pumping station is typically entered through a relatively narrow metal or concrete shaft via a fixed ladder. Inspectors conducting the field evaluation component of the CMOM audit should be able to identify and avoid permit-required confined spaces.

Although most confined spaces are unmarked, confined spaces that may have signage posted near their entry containing the following language:

DANGER–PERMIT REQUIRED–CONFINED SPACE AUTHORIZED PERSONNEL ONLY

If confined space entry is absolutely necessary, inspectors should consult with the collection system owner or operator first, have appropriate training on confined space entry, and use the proper hazard detection and personal safety equipment.

CMOM Summary

Sewers deteriorate over time and develop cracks, breaks and blockages if not properly maintained. Aging, out-of-sight, out-of-mind sewer systems can be neglected and thus not be inspected or maintained on a regular basis. A CMOM Program is an effective, holistic management tool that owners of collection systems (primarily municipalities) create to operate and manage a collection system to significantly reduce, if not eliminate, sanitary sewer overflows and basement backups. It assures sewage collection system owners proactively operate and maintain this significant and valuable community infrastructure through planned ongoing maintenance and prioritizing rehabilitation and replacement projects.

For EPA and state inspectors or other reviewers, conducting an evaluation of collection system CMOM programs shares many similarities with other types of compliance reviews. Overall, the reviewer would examine records, interview staff and conduct field investigations, generally in that order although tailored, if necessary, to meet site-specific needs.

Prior to performing the onsite interviews and evaluations, preliminary information may be requested that will provide an overall understanding of the organization to allow for a more focused approach for the review. This information also provides a basis for more detailed data gathering during on site activities. The information typically requested prior to the review should include a schematic map of the collection system (could be as-built drawings) and any written operations or maintenance procedures. Depending on the volume of information, the collection system owner or operator may need ample lead time to gather and copy these documents.

Alternatively, the reviewer may offer to examine the documents and bring them back when doing the on-site review so that extra copies are not necessary. No matter which method is used, the importance of up-front preparation cannot be overemphasized. With the exception of pump stations and manholes, much of the collection system is not visible. Therefore, the more complete the reviewer's understanding of the system is prior to the review, the more successful the assessment will be. The reviewer would then proceed with the on-site activities.

Guidance for conducting compliance reviews is provided in the NPDES Compliance Inspection Manual (EPA 2004). The manual provides the general procedures for performing compliance reviews and is a valuable source of information on such topics as entry, legal authority, and responsibilities of the reviewer. Although CMOM evaluations are not specifically addressed in the manual, the general review procedures can be applied to CMOM reviews. Another good reference for general review information is the Multi-Media Investigations Manual, NEIC (EPA 1992). Some issues with entry are specific to CMOM reviews.

Some facilities may be on private property and the reviewer may need property owner consent for entry.

Documents to Review On-site Include:

- Organization chart(s)
- Staffing plans
- Job descriptions
- Sewer use ordinance
- Overall map of system showing facilities such as pump stations, treatment plants, major gravity sewers, and force mains
- O&M budget with cost centers for wastewater collection
- Performance measures for inspections, cleaning, repair, and rehabilitation
- Recent annual report, if available

• Routine reports regarding system O&M activities
• Collection system master plan
• Capital improvement projects (CIP) plan
• Flow records or monitoring
• Safety manual
• Emergency response plan
• Management policies and procedures
• Detailed maps/schematics of the collection system and pump stations
• Work order management system
• O&M manuals
• Materials management program
• Vehicle management and maintenance records
• Procurement process
• Training plan for employees
• Employee work schedules
• Public complaint log
• Rate ordinance or resolution
• Financial report ("notes" section)
• As built plans
• Discharge monitoring reports (DMRs)

Field reviews are typically conducted after interviews. The following is a list of typical field sites the team should visit:
• Mechanical and electrical maintenance shop(s)
• Fleet maintenance facilities (vehicles and other rolling stock)
• Materials management facilities (warehouse, outside storage yards)
• Field maintenance equipment storage locations (i.e., crew trucks, mechanical and hydraulic cleaning equipment, construction and repair equipment, and television inspection equipment)
• Safety equipment storage locations
• Pump stations
• Dispatch and supervisory control and data acquisition (SCADA) systems
• Crew and training facilities
• Chemical application equipment and chemical storage areas (use of chemicals for root and grease control, hydrogen sulfide control [odors, corrosion])
• Site of SSOs, if applicable
• A small, but representative, selection of manholes

CMOM Section Post Quiz

Purpose of CMOM Programs

1. The CMOM approach helps the owner or operator provide a high level of service to customers and reduce ________________________.

2. Once the GIS is complete, a new goal might be to use the GIS to track emergency calls and use the information to improve ______________.

3. In CMOM planning, the owner or operator selects ___________ targets, and designs CMOM activities to meet the goals.

4. Information collection and management practices are used to track how the elements of the CMOM program are meeting _________________, and whether overall system efficiency is improving.

5. An important component of a ______________________is periodically collecting information on current systems and activities to develop a "snapshot-in-time" analysis. From this analysis, the owner or operator evaluates its performance and plans its CMOM program activities.

6. Performance characteristics of a system with an inadequate CMOM program include frequent blockages resulting in ________________________.

7. Other major performance indicators include pump station reliability, equipment availability, and avoidance of _________________ such as a collapsed pipe.

The Elements of a Proper CMOM Program
Purposeful

8. ____________________ when present and properly maintained, they support customer service and protect system assets, public health, and water quality.

Goal-Oriented

9. _____________________ have goals directed toward their individual purposes. Progress toward these goals is measurable, and the goals are attainable.

Uses Performance Measures

10. Performance measures should be established for each of this _________________________ in conjunction with the program goal.

Periodically Evaluated

11. An evaluation of the progress toward reaching the goals, or ________________________, should be made periodically and based upon the quantified performance measures.

Available In Writing

12. The effectiveness of a MOM program quickly breaks down unless it is available in writing. Personnel turnover and lapses in communication between staff and management can change otherwise proper MOM programs to improper ones.

A. True B. False

Implemented by Trained Personnel

13. Appropriate safety, equipment, technical, and program training is essential for implementing?

What MOM programs should be audited?

14_____________________ at a utility involves its entire wastewater infrastructure. Common utility management activities and operations and maintenance activities associated with sewer systems and pretreatment are listed in the Self-Audit Review Document?

15. If a utility owns treatment works or a pond system, then activities associated with the management, operation, and maintenance of these facilities should be included in the audit.

A. True B. False

Identify Deficiencies

16. Identify any permitted discharges that have occurred in the past seven years.

A. True B. False

Develop Improvement Plan

17. Define the utility's plan/schedule to remediate the?

Prepare the Self-Audit Report

18. ___________________ including any deficiencies found and the corresponding improvement plan, which is useful for the utility?

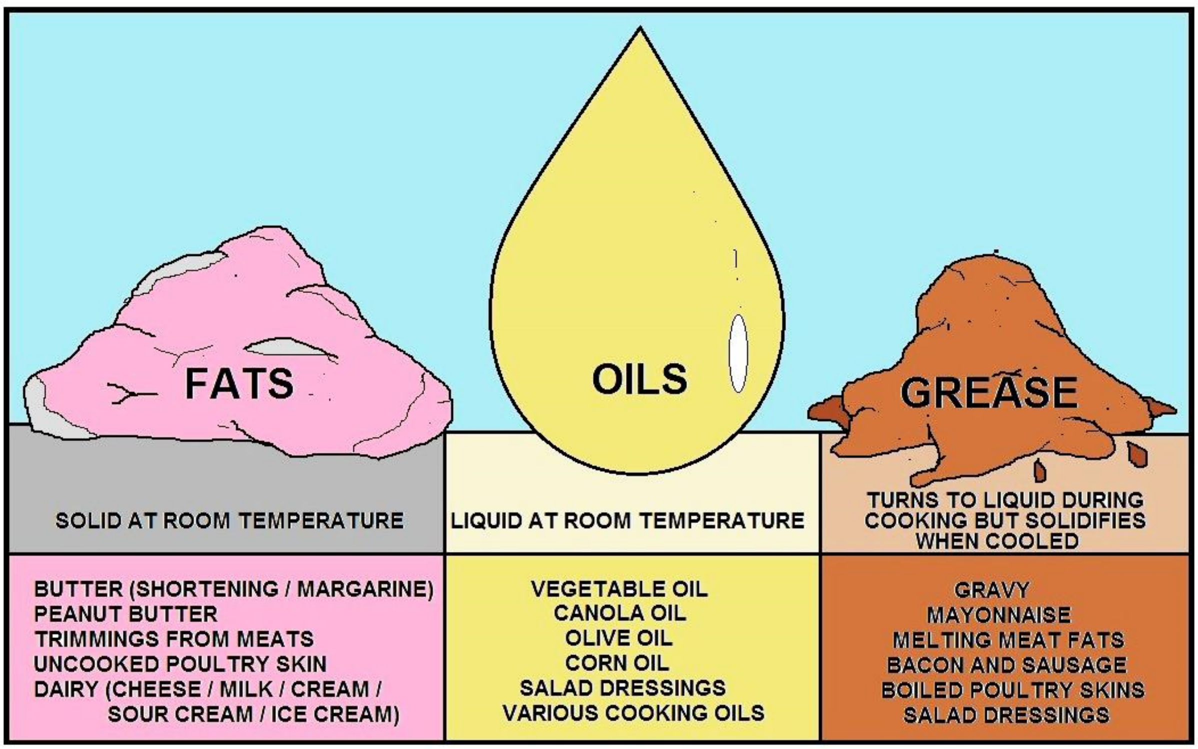
Answers

1. Regulatory noncompliance, 2. Maintenance planning, 3. Performance goal, 4. Performance goals, 5. Successful CMOM program, 6. Overflows and backups, 7. Catastrophic system failures, 8. MOM programs, 9. Proper MOM programs, 10. MOM program, 11. A reassessment of the goals, 12. True, 13. MOM program(s), 14. MOM activity, 15. True, 16. False, 17. Necessary improvements, 18. Audit results

Chapter 12- Fats, Oils and Grease (FOG) Section

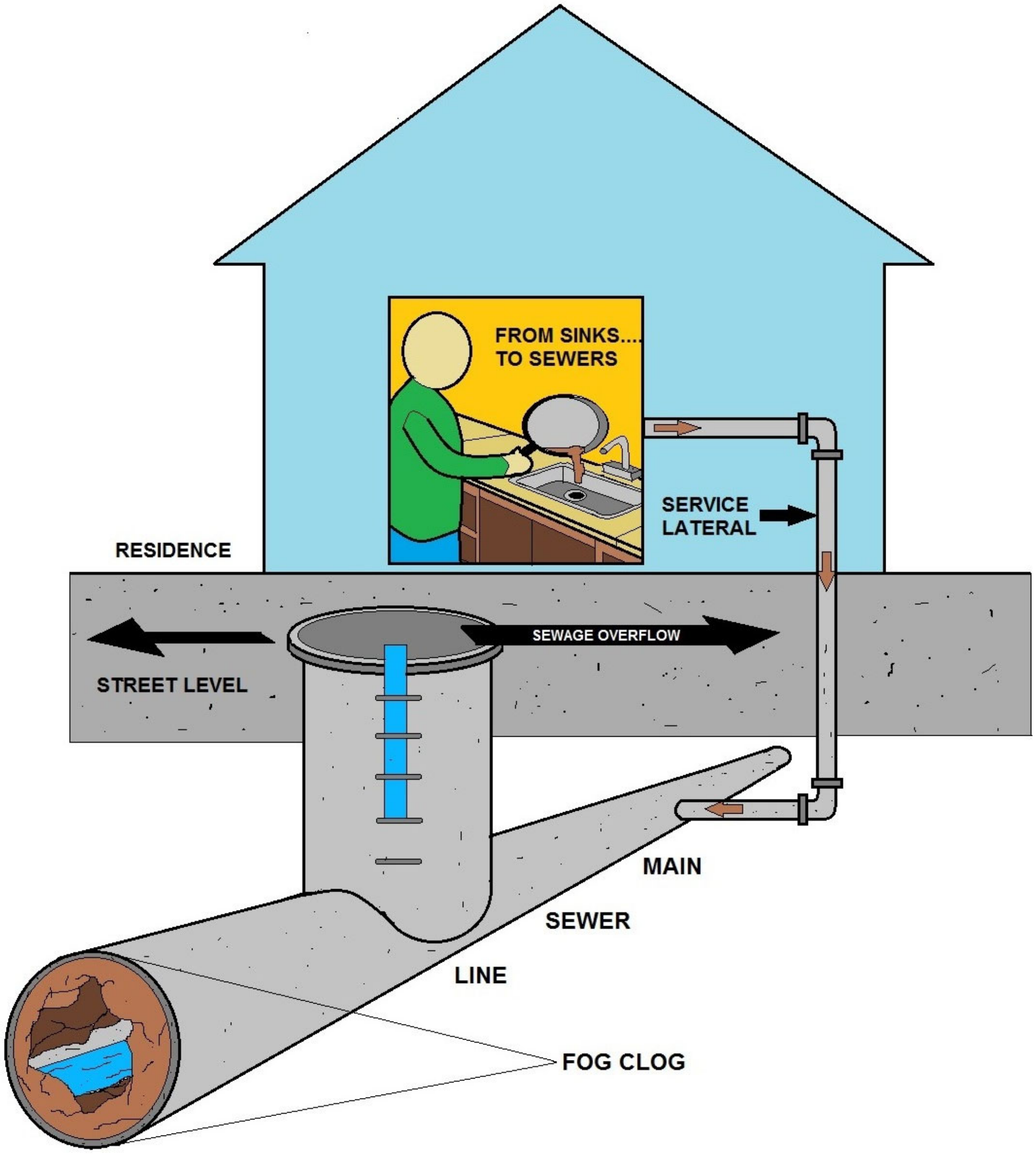
Section Focus: You will learn the basics of the Clean Water Act, the need for FOG fats, oils and grease regulation and enforcement. At the end of this section, you will be able to describe the need for fats, oils and grease regulation, enforcement and public education. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: The CWA made it unlawful to discharge any pollutant (FOG) from a point source into navigable waters, unless a permit was obtained. EPA's National Pollutant Discharge Elimination System (NPDES) permit program controls discharges. Food service establishments deal with large volumes of FOG on a daily basis. FOG can have a very negative impact if not handled properly. It can cause serious damage to the sewer system, your property and that of your neighbors, as well as, damage the environment and public health concerns. Cleanup of sewer overflows can be very costly and this expense translates to higher bills for sewer customers. By being aware of what FOG can do to your surroundings, it is easier to take that extra minute to do your part and prevent FOG from ending up in the sewer.



FOG (FATS/OILS/GREASE) CONTRIBUTORS

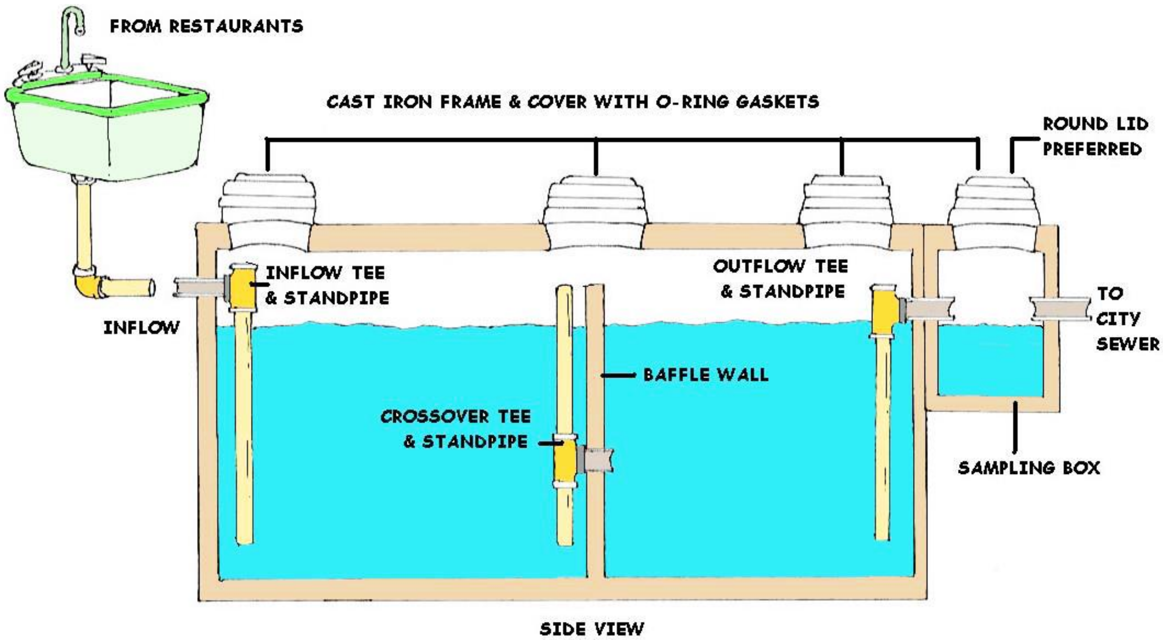
Most stoppages in the sewer system are caused by grease. It is best to have a strong FOG Ordinance that prevents restaurants from dumping grease into the system. You as the regulator will need a process of back charging the restaurants that do clog the sewers as payment for cleaning. As a pretreatment inspector, you will visit many restaurants for grease violations.



HOW SEWERS ARE CLOGGED BY GREASE DIAGRAM

Keeping Fats, Oils, and Grease out of the Sewer System
Fats, oils, and grease—FOG—comes from meat fats in food scraps, cooking oil, shortening, lard, butter and margarine, gravy, and food products such as mayonnaise, salad dressings, and sour cream.

FOG poured down kitchen drains accumulates inside sewer pipes and cause damage to the collection system. As the FOG builds up, it restricts the flow in the pipe and can cause untreated wastewater to back-up into homes and businesses, resulting in high costs for cleanup and restoration.



Cooking grease coats pipelines much like fatty foods clog human arteries. The grease clings to the insides of the pipe, eventually causing blockage and potential sewer spills. By following a few simple steps, customers can help prevent costly sewer spills in the future.

- All cooking oil (this includes salad oil, frying oil and bacon fat) should be poured into an old milk carton, frozen juice container, or other non-recyclable package, and disposed of in the garbage.
- Dishes and pots that are coated with greasy leftovers should be wiped clean with a disposable towel prior to washing or placing in the dishwasher.
- Instead of placing fat trimmings from meat down the garbage disposal, place them in a trash can.

Vactor

FOG Problems
Manholes can overflow into parks, yards, streets, and storm drains, allowing FOG to contaminate local waters, including drinking water. Exposure to untreated wastewater is a public-health hazard and is an EPA violation. FOG discharged into septic systems and drain fields can cause malfunctions, resulting in more frequent tank pump-outs and other expenses.

Restaurants, cafeterias, and fast-food establishments spend tens of thousands of dollars on plumbing emergencies each year to deal with grease blockages and pump out grease traps and interceptors. Some cities also charge businesses for the repair of sewer pipes and spill cleanup if they can attribute the blockage to a particular business.

Some cities also add a surcharge to wastewater bills if a business exceeds a specified discharge limit. These expenses can be a significant.

Communities spend billions of dollars every year unplugging or replacing grease-blocked pipes, repairing pump stations, and cleaning up costly and illegal wastewater spills. Excessive FOG in the sewer system can affect local wastewater rates. So, keeping FOG out of the sewer system helps everyone in the community.

Controlling Fats, Oils, and Grease Discharges from Food Service Establishments
FOG gets into our sewer collection system mainly from residential customers pouring the substances down their drains and from commercial food preparation establishments with inadequate grease controls. Fats, oils and grease are a byproduct of cooking and are mostly found in the following:

- ✓ Meats
- ✓ Cooking oil
- ✓ Lard or shortening
- ✓ Butter or margarine

Our sewer system is not designed to handle or treat these substances in excess. Over time, without proper disposal of fats, oils and grease, they build up in the sewer system and eventually block collection pipes and sewer lines, resulting in sewer backups and overflows on streets, properties and even in customers' homes and/or businesses. Overflows may also impact the environment negatively and can result in contamination of ponds, streams or rivers.

Food Service Establishments (FSEs)
Food Service Establishments (FSEs) are a significant source of fats, oil and grease (FOG) because of the amount of grease used in cooking. POTW Commercial FOG Programs are generally developed to assist restaurants and other FSEs with proper handling and disposal of their FOG. Through implementation of Best Management Practices (BMPs), these establishments should be able to significantly reduce the amount of FOG that goes down their drains. This will minimize back-ups and help business owners comply with the POTW's requirements.

To work effectively, sewer systems need to be properly maintained, from the drain to the treatment plant. If wastes are disposed of correctly, the POTW's sewer system can handle them without any problem.

The POTW needs businesses and individuals to do their part to maintain the system because repeated repairs are disruptive to residences and businesses alike. Furthermore, proper disposal by commercial establishments is required by law.

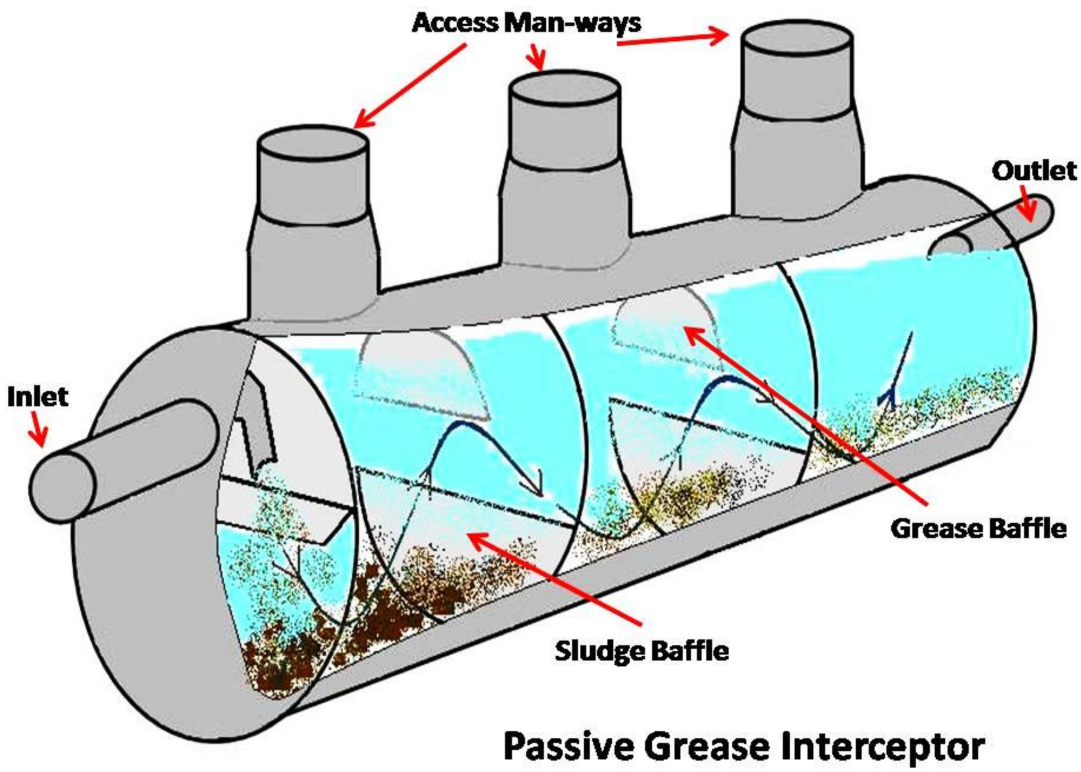
Grease Trap

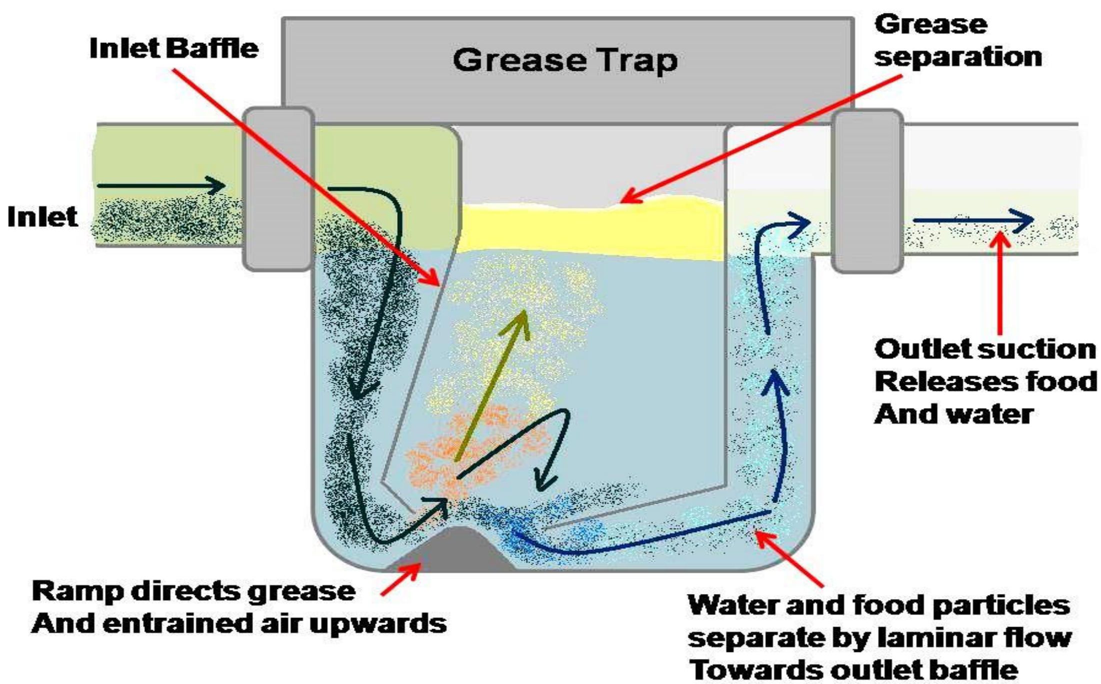
The trap prevents excess grease from getting into the sewer system from existing plumbing lines within facilities. Traps are small and are usually installed inside a facility. Generally, they range in size from 20 gallons per minute (gpm) to 50 gpm.

Infloor grease trap being removed and replaced with a grease interceptor.

Looking down into a grease interceptor commonly used in a commercial food service operations.

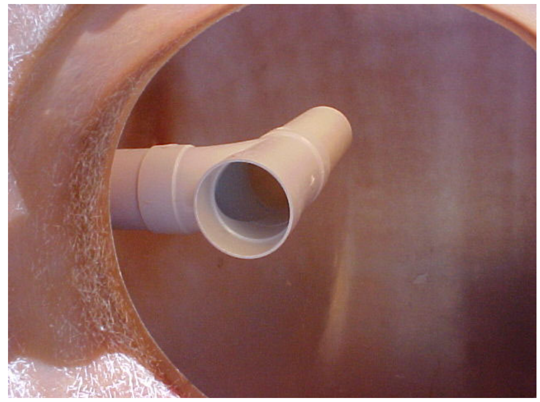
Grease Interceptor Diagrams





Grease Interceptor Sub-Section

High-volume or new establishments use grease interceptors that are larger than the traps and are installed underground, outside of a facility. Grease is actually "intercepted" in these concrete or fiberglass tanks before it reaches the sewer main. Grease interceptors should be accessible by three manhole covers, and a sample box. Interceptors and traps cause the flow of water to slow down, allowing the grease to naturally float to the top of the tank for easy removal.



New fiberglass three compartment grease interceptor. You will need to fill the interceptor with water before connecting it to the sewer main.

Plan Checks and Inspections
All plans for new commercial food establishments (including new construction remodels and retrofits) should receive a plan review from the POTW. This review assures that appropriate grease-removal equipment is installed during construction.

Grease Blockages
Shortly after sewer-spills caused by grease are reported or discovered, POTW inspectors investigate facilities within the immediate area. A determination is made as to which commercial facilities contributed to the blockage, and more in-depth inspections are conducted at those facilities.

Where appropriate, additional requirements and/or procedures are put in place. When requirements are made for additional grease-removal equipment, the facility is given a due date to comply.

A Notice of Violation, with an administrative fee, is issued once a facility has passed its final due date. Administrative hearings, permit revocation, and ultimately, termination of sewer service may occur for those facilities that remain out of compliance.

Regular Grease Inspection
Regular inspection and maintenance is essential to the proper operation of a grease removal device. The local ordinance should require a minimum cleaning frequency of once every six months.

However, that frequency will increase depending on the capacity of the device, the amount of grease in the wastewater, and the degree to which the facility has contributed to blockages in the past.

Regular cleaning at the appropriate interval is necessary to maintain the rated efficiency of the device. Equipment that is not regularly maintained puts the food service facility at risk of violating the sewer use ordinance, and this may not be known until an overflow and violation have occurred.

Most POTWs suggest businesses start with quarterly cleanings and should be done when 75 percent of the retention capacity of the unit is 75 percent full of accumulated grease. A large measuring stick and/or a clear piece of conduit may be used to determine the depth of the grease accumulation. You should require that restaurants contract with a licensed grease hauler to remove it from the premises for appropriate disposal.

Choosing a Grease Hauler
When you speak to a restaurant owner, inform them that while selecting a grease hauler, be aware that services and prices can vary. Minimum services should include:

- Complete pumping and cleaning of the interceptor and sample box, rather than just skimming the grease layer.
- Deodorizing and thorough cleaning of affected areas, as necessary.
- Disposal/reclamation at an approved location.
- Notes concerning the condition of the interceptor
- Complete pumping and cleaning record.

The restaurant owner and grease hauler should agree on an adequate cleaning frequency to avoid blockage of the line. Waste grease from a kitchen is recyclable for use in making soap, animal feed, etc. Grease from a grease trap or interceptor may not be reused in this way. For recyclable grease, some POTWs recommend that all facilities have waste grease containers with tight fitting lids that are either secondarily contained or kept in a bermed area to protect floor drains and storm drain inlets from spills.

Keeping up-to-date Records
Careful record keeping is one of the best ways to ensure that the grease removal device is being cleaned and maintained on a regular basis. City codes and ordnances require records be maintained for a minimum of three to five years.

Other Types of Devices
A grease trap may be approved in lieu of an interceptor for full service food service facilities only in very limited circumstances when space is not available. Grease traps may also be approved by the Industrial Pretreatment Program for facilities such as delicatessens and small bakeries that produce small quantities of oil, grease, or fat. Refer to the International Plumbing Code for requirements related to grease traps such as installation of flow-control devices, flow rates, and other structural requirements.

Please Note: Flow restrictors are required for grease traps because they increase retention time and efficiency.

Automatic grease skimming devices collect small volumes of water and remove grease into a side container at preset times each day. Usually, special approval from the Industrial Pretreatment Staff or the POTW is required to install one of these devices in lieu of a grease interceptor.

Magic Grease "Bugs" and Bacterial Additives
Manufacturers of bacterial additives claim that their products remove grease and enhance the performance of grease traps and interceptors. Such additives cannot be substituted for a grease removal device and regular inspection and maintenance. If a customer decides to use an additive, they need to make sure the product you select is not an emulsifier, which simply keeps grease in suspension temporarily and allows it to flow to the sewer system.

Obtaining necessary permits

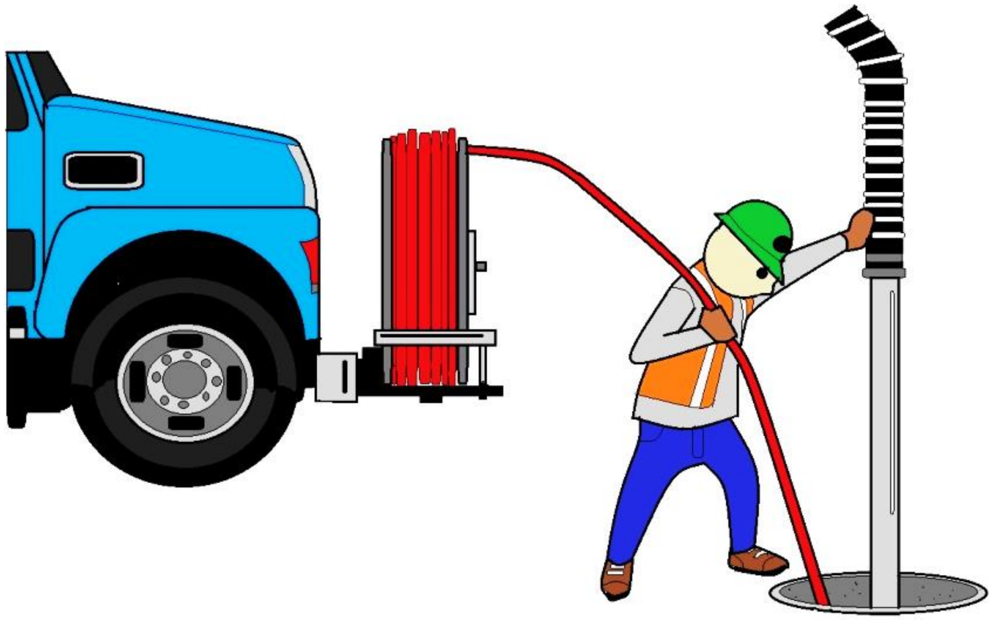
• Building departments prefer in-ground installations that drain by gravity to the sanitary sewer. Avoid pumps and other mechanical devices in your connection to the sewer if possible.

• The interceptor or grease trap needs to be properly sized in accordance with the International Plumbing Code, IAPMO, or local ordinance.

Chain Cutter

This tool is attached to the flush truck. When water pressure is applied, the 3 chains at the head spin at tremendous speeds. These spinning chains will cut roots, grease build-up, and even a protruding tap.

This is a sewer line that has a large amount of grease buildup that will be cut out. Grease gets into the sewer line by pouring grease left over from cooking, down the kitchen sink.



USING A VACUUM TRUCK TO CLEAN SEWER

Often the Vactor is called out to clean out the above concerns.

Interceptors and Traps- Plan Checks and Inspections

As a pretreatment inspector, you will need knowledge of many different concerns in order to properly identify the problem.

All plans for new commercial food establishments (including new construction remodels and retrofits) should receive a plan review from the POTW. This review assures that appropriate grease-removal equipment is installed during construction.

Grease Blockages
Shortly after sewer-spills caused by grease are reported or discovered, POTW inspectors or Collection Inspectors investigate facilities within the immediate area. A determination needs to be made as to which commercial facilities contributed to the blockage, and more in-depth inspections are conducted at those facilities. Where appropriate, additional requirements and/or procedures are put into place. When requirements are made for additional grease-removal equipment, the facility is given a due date to comply. A Notice of Violation (NOV), with an administrative fee, is issued once a facility has passed its final due date. Administrative hearings, permit revocation, and ultimately, termination of sewer service may occur for those facilities that remain out of compliance.

Regular Grease Inspection
Regular inspection and maintenance is essential to the proper operation of a grease removal device. The local ordinance should require a minimum cleaning frequency of once every six months. However, that frequency will increase depending on the capacity of the device, the amount of grease in the wastewater, and the degree to which the facility has contributed to blockages in the past.

Regular cleaning at the appropriate interval is necessary to maintain the rated efficiency of the device. Equipment that is not regularly maintained puts the food service facility at risk of violating the sewer use ordinance, and this may not be known until an overflow and violation have occurred.

Most POTWs suggest businesses start with quarterly cleanings that should be done when 75 percent of the retention capacity of the unit is full of accumulated grease. A large measuring stick and/or a clear piece of conduit may be used to determine the depth of the grease accumulation.

You should contract with a licensed grease hauler to remove it from the premises for appropriate disposal.

Choosing a Grease Hauler
When the customer needs to select a grease hauler, they should be aware that services and prices can vary.

Minimum services should include:
• Complete pumping and cleaning of the interceptor and sample box, rather than just skimming the grease layer.

• Deodorizing and thorough cleaning of affected areas, as necessary.

• Disposal/reclamation at an approved location.

• Notes concerning the condition of the interceptor.

• Complete pumping and cleaning record.

The Customer and the hauler should agree on an adequate cleaning frequency to avoid blockage of the line.

Recyclable grease storage
Waste grease from a kitchen is recyclable for use in making soap, animal feed, etc. Grease from a grease trap or interceptor may not be reused in this way.

For recyclable grease, some POTWs recommend that all facilities have waste grease containers, with tight fitting lids, that are either secondarily contained or kept in a bermed area to protect floor drains and storm drain inlets from spills.

Keeping up-to-date Records
Careful record keeping is one of the best ways to ensure that your grease removal device is being cleaned and maintained on a regular basis. City codes and ordnances require records be maintained for a minimum of three to five years.

Other Types of Devices
Often but not always, a grease trap or several traps may be approved in lieu of an interceptor for full service food service facilities only in very limited circumstances when space is not available.

Grease traps may also be approved by the Industrial Pretreatment Program for facilities such as delicatessens and small bakeries that produce small quantities of oil, grease, or fat. Refer to the Plumbing Code for requirements related to grease traps such as installation of flow-control devices, flow rates, and other structural requirements.

Please Note: flow restrictors are required for grease traps because they increase retention time and efficiency. Automatic grease skimming devices collect small volumes of water and remove grease into a side container at preset times each day.

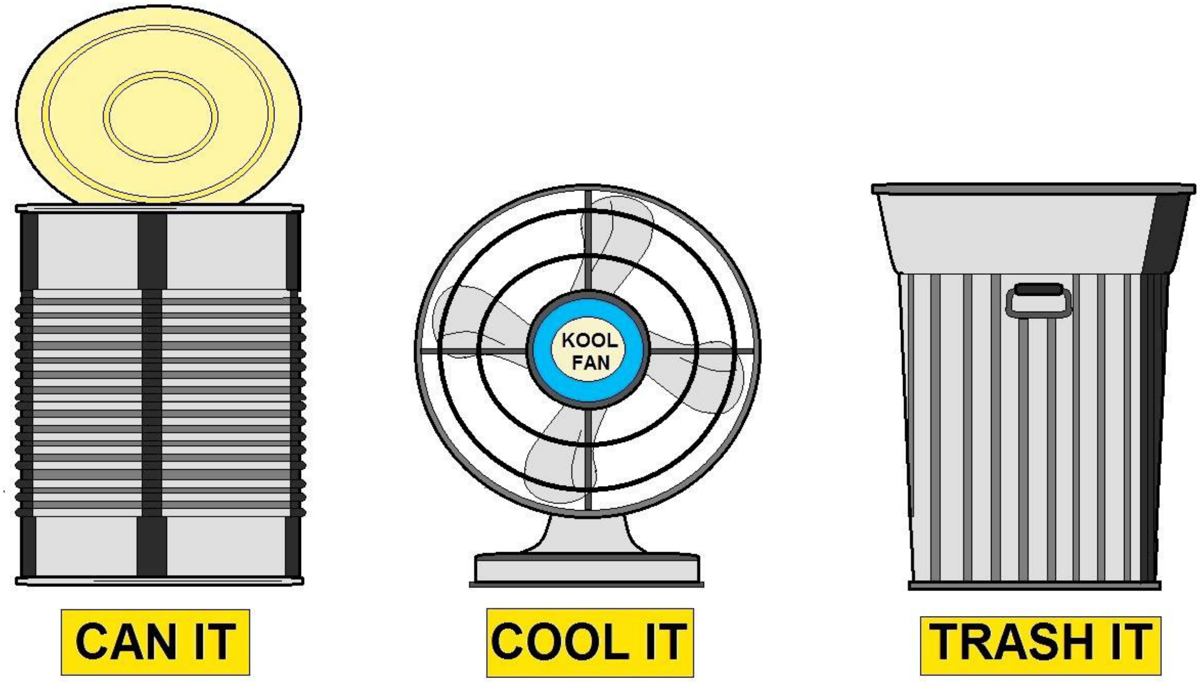
Usually, special approval from the Industrial Pretreatment Staff or the POTW is required to install one of these devices in lieu of a grease interceptor.

Magic Grease Eating "Bugs" and Bacterial Additives
Manufacturers of bacterial additives claim that their products remove grease and enhance the performance of grease traps and interceptors. Such additives cannot be substituted for a grease removal device, cleaning, regular inspection and maintenance.

If a customer decides to use an additive, they need to make sure the product you select is not an emulsifier, which simply keeps grease in suspension temporarily and allows it to flow to the sewer system.

Obtaining Necessary Permits - Fixture Unit Loading Calculation
- Building departments prefer in-ground installations that drain by gravity to the sanitary sewer. Avoid pumps and other mechanical devices in your connection to the sewer if possible.
- The interceptor or grease trap needs to be properly sized (fixture unit loading) in accordance with the International Plumbing Code, IAPMO, or local ordinance.

Controlling FOG Discharges



METHODS OF PROPER GREASE DISPOSAL

FOG wastes are generated at FSEs as byproducts from food preparation activities. FOG captured on-site is generally classified into two broad categories: yellow grease and grease trap waste. Yellow grease is derived from used cooking oil and waste greases that are separated and collected at the point of use by the food service establishment.

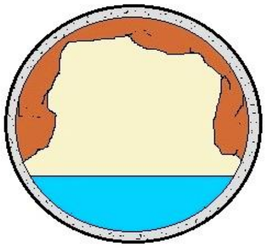
The annual production of collected grease trap waste and uncollected grease entering sewage treatment plants can be significant and ranges from 800 to 17,000 pounds/year per restaurant.

The National Pretreatment Program already provides the necessary regulatory tools and authority to local pretreatment programs for controlling interference problems. Under the provisions of Part 403.5(c)(1) & (2), in defined circumstances, a POTW must establish specific local limits for industrial users to guard against interference with the operation of the municipal treatment works.

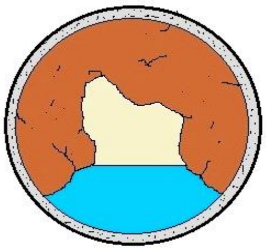
Consequently, pretreatment oversight programs should include activities designed to identify and control sources of potential interference and, in the event of actual interference, enforcement against the violator.

Food service establishments can adopt a variety of best management practices or install interceptor/collector devices to control and capture the FOG material before discharge to the collection system.

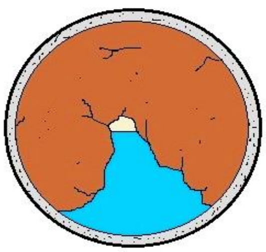
For example, instead of discharging yellow grease to POTWs, food service establishments usually accumulate this material for pick up by consolidation service companies for re-sale or re-use in the manufacture of tallow, animal feed supplements, bio-fuels, or other products. Additionally, food service establishments can install interceptor/collector devices (e.g., grease traps) in order to accumulate grease on-site and prevent it from entering the POTW collection system.



THE START OF BLOCKED PIPE BEGINS WITH SOLIDS AND GREASE COLLECTING ON TOP AND SIDES OF PIPE INTERIOR.



OVER TIME, THE BUILD-UP INCREASES WHEN GREASE AND DEBRIS ARE WASHED DOWN A DRAIN.



EXCESSIVE ACCUMULATION RESTRICTS THE FLOW OF WASTEWATER THAT CAN RESULT IN AN OVERFLOW OF SANITARY SEWER

HOW SEWER BLOCKAGES FORM

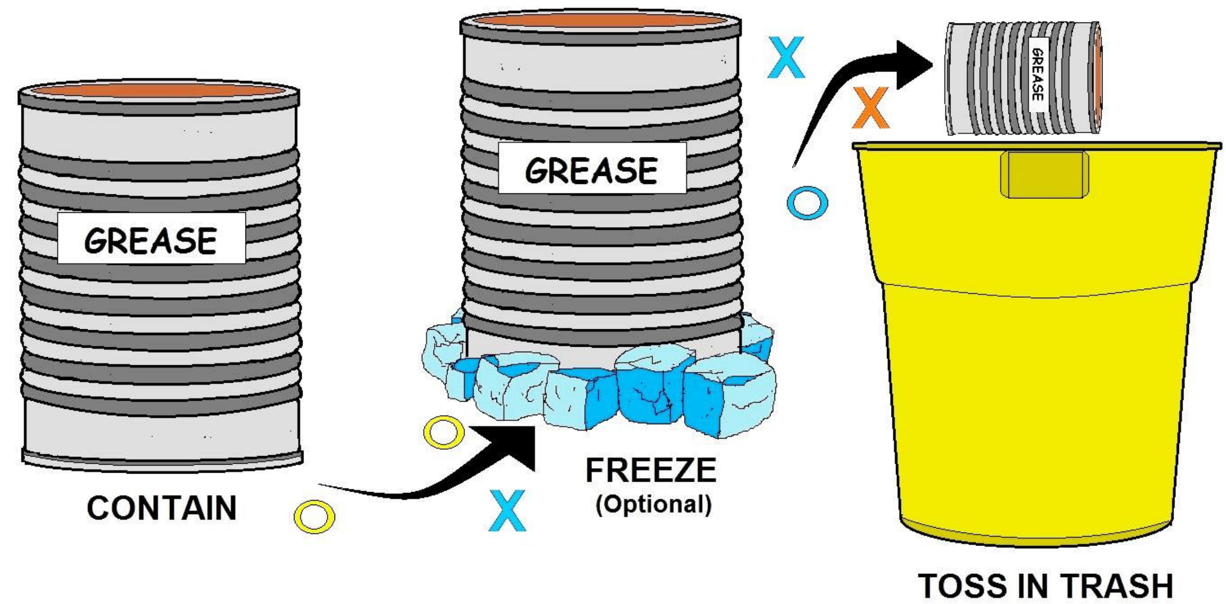
POTWs control methods for FOG discharges from FSEs

Proper design, installation, and maintenance procedures are critical for these devices to control and capture the FOG.

For example,

- ✓ Interceptor/collector devices must be designed and sized appropriately to allow FOG to cool and separate in a non-turbulent environment.
- ✓ FSE must be diligent in having their interceptor/ collector devices serviced at regular intervals.

Methods of Recycling FOG



THE SINK SHOULD NEVER BE USED TO DISPOSE OF:
OILS , FATS OR GREASE

FOG Customers and Violators Should be Encouraged or Written Up to…

Rendering FOG
Liquid fats and solid meat products can be used as raw materials in the rendering industry, which converts them into animal food, cosmetics, soap, and other products. Many companies will provide storage barrels and free pick-up service.

Converting FOG to Biodiesel
FOG are collected and converted by a local manufacturer into environmentally friendly biodiesel fuel. Biodiesel is an alternative fuel produced from renewable resources such as virgin oils (soybean, canola, palm), waste cooking oil, or other bio-waste feedstock.

Biodiesel significantly reduces greenhouse gases, sulfur dioxide in air emissions, and asthma-causing soot. Along with creating less pollution, biodiesel is simple to use, biodegradable and nontoxic.

Inspection Checklists
Pretreatment programs are developing and using inspection checklists for both food service establishments and municipal pretreatment inspectors to control FOG discharges.

Additionally, EPA identified typical numeric local limits controlling oil and grease in the range of 50 mg/L to 450 mg/L with 100 mg/L as the most common reported numeric pretreatment limit.

EPA expects that blockages from FOG discharges will decrease as POTWs incorporate FOG reduction activities into their Capacity, Management, Operations, and Maintenance (CMOM) program and daily practices.

CMOM programs are comprehensive, dynamic, utility specific programs for better managing, operating and maintaining sanitary sewer collection systems, investigating capacity constrained areas of the collection system, and responding to SSOs.

Collection system owners or operators who adopt FOG reduction activities as part of their CMOM program activities are likely to reduce the occurrence of sewer overflows and improve their operations and customer service.

Industrial Uses (Fats, Oils, and Grease)

Fats, Oils, and Grease Resources
Liquid fats and solid meat products are materials that should not be sent to landfills or disposed of in the sanitary sewer system. Fats, oils, and grease (FOG) can clog pipes and pumps both in the public sewer lines as well as in wastewater treatment facilities. This prevents combined sewer overflows, which protects water quality and lowers bills. FOG should be sent to the rendering industry to be made into another product, converted to biofuels, or sent to an anaerobic digester.

Proper Disposal Methods
Ways in which you as a customer can reduce the amounts of FOG that enters the sewer system is by doing the following:

- ✓ Have grease interceptors or traps inspected, maintained and cleaned regularly. (Usually every 6 months they should be pumped out).
- ✓ Scrape grease and food residue from dishes and pans into a garbage bag before placing them into your dishwasher or sink.
- ✓ Allow grease to cool to a safe temperature after cooking before disposal.
- ✓ Only dispose of fat and grease in an approved container or by an approved method.
- ✓ Recycle used cooking or motor oil at a recycling center.
- ✓ First freeze the grease or oil and then throw the hardened oil away on trash day.
- ✓ Mix oils with unscented kitty litter, sawdust or sand to solidify the oil (Avoid scented or disinfectant types of kitty litter as they can react with the oil and cause a fire).
- ✓ Use a paper towel to wipe small amounts of cooking oil, such as meat drippings, and throw the paper towel in the trash.
- ✓ Install “No Grease” signs around sinks to remind employees to avoid dumping fry grease and other fat products down the drain.
- ✓ Frying oils can generally be stored for up to six months and also can be reused for up to six hours of frying time. Store oil in the original container after cooling and strain for foreign materials as it is being poured back into the container.

Methods that should be avoided:

- ✓ Pouring household grease into sinks, garbage disposals or other drains. This is one of the major contributors to sewer stoppages.
- ✓ Flushing grease, diapers, sanitary napkins, newspapers, soiled rags, and/or paper towels down toilets.
- ✓ Pouring oil or grease into a storm drain; it is the same as pouring it directly into a lake.
- ✓ Ignoring your grease trap maintenance schedule.

National Pretreatment Program's Tools

The National Pretreatment Program provides regulatory tools and authority to state and local POTW pretreatment programs for eliminating pollutant discharges that cause interference at POTWs, including interference caused by the discharge of Fats, Oils, and Grease (FOG) from food service establishments (FSE).

More specifically, the Pretreatment Program regulations at 40 CFR 403.5(b)(3) prohibit "solid or viscous pollutants in amounts which will cause obstruction" in the POTW and its collection system.

EPA's Report to Congress on combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) identified that "grease from restaurants, homes, and industrial sources are the most common cause (47%) of reported blockages.

Grease is problematic because it solidifies, reduces conveyance capacity, and blocks flow."

Controlling FOG discharges will help POTWs prevent blockages that impact CSOs and SSOs, which cause public health and water quality problems.

Controlling FOG discharges from FSEs is an essential element in controlling CSOs and SSOs and ensuring the proper operations for many POTWs. The interference incidents identified in CSO/SSO report to Congress may indicate the need for additional oversight and enforcement of existing regulations and controls.

Best Management Practices (BMPs)

The required maintenance frequency for interceptor/collector devices depends greatly on the amount of FOG a facility generates as well as any best management practices (BMPs) that the establishment implements to reduce the FOG discharged into its sanitary sewer system. In many cases, an establishment that implements BMPs will realize financial benefit through a reduction in their required grease interceptor and trap maintenance frequency.

A growing number of control authorities are using their existing authority (e.g., general pretreatment standards in Part 403 or local authority) to establish and enforce more FOG regulatory controls (e.g., numeric pretreatment limits, best management practices including the use of interceptor/collector devices) for food service establishments to reduce interferences with POTW operations (e.g., blockages from fats, oils, and greases discharges, POTW treatment interference from Nocardia filamentous foaming, damage to collection system from hydrogen sulfide generation).

Non-Compliance Rate Example

For example, since identifying a 73% non-compliance rate with its grease trap ordinance among restaurants, New York POTW has instituted a $1,000-per-day fine for FOG violations. Likewise, more and more municipal wastewater authorities are addressing FOG discharges by imposing mandatory measures of assorted kinds, including inspections, periodic grease pumping, stiff penalties, and even criminal citations for violators, along with 'strong waste' monthly surcharges added to restaurant sewer bills. Surcharges are reportedly ranging from $100 to as high as $700 and more, the fees being deemed necessary to cover the cost of inspections and upgraded infrastructure.

FOG Customers Using Best Management Practices Can:

- Lessen the likelihood of customer's losing revenue to emergency shutdowns caused by sewage backups and expensive bills for plumbing and property repairs.
- Lessen the likelihood of customer's lawsuits by nearby businesses over sewer problems caused by negligence.
- Lessen the likelihood of customer's lawsuits from workers or the public exposed to raw sewage during a backup.
- Reduce the number of times customers have to pump and clean your grease interceptors or traps.
- Lessen the likelihood of surcharges from the local sewer authority, or chargebacks for repairs to sewer pipes attributable customer's FOG.
- Reduce testing customer's requirements imposed due to a history of violations.
- Lessen the likelihood of customer's enforcement action by POTW authorities due to violations of ordinances.

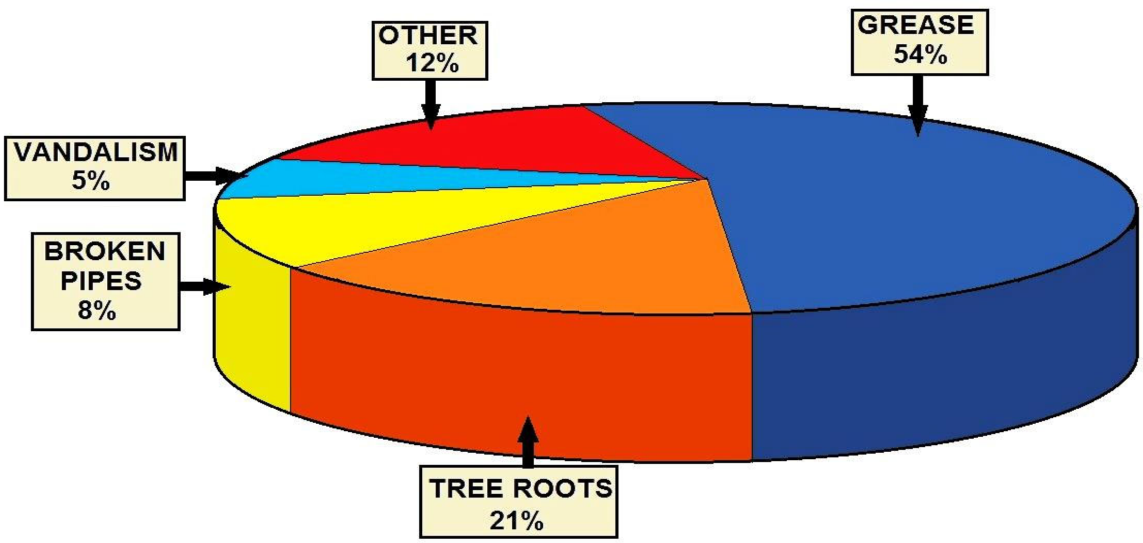
FOG Summary

Reducing Fats, Oils, and Grease in Your Commercial Kitchen
Any business or institution with a commercial kitchen has to deal with fats, oils, and grease (FOG). Commercial kitchens are found in restaurants, hospitals, churches, hotels, nursing homes, mobile food preparation facilities, etc.

Environmental problem with FOG sewers
FOG that enters the sewer system eventually solidifies and forms grease balls. These grease balls can range in size from marbles to the size of cantaloupes and must be removed periodically. Since the sewer system is unable to handle or treat these substances effectively, this incurs greater expenditures on the maintenance of the collection systems and/or treatment plants which in turn can lead to higher customer rates.

Sewer backups can also cost customers thousands of dollars for the repair or replacement of their damaged property.

Controlling FOG Discharges



CAUSES OF SANITARY SEWER OVERFLOWS

FOG wastes are generated at FSEs as by-products from food preparation activities. FOG captured on-site is generally classified into two broad categories: yellow grease and grease trap waste. Yellow grease is derived from used cooking oil and waste greases that are separated and collected at the point of use by the food service establishment.

The annual production of collected grease trap waste and uncollected grease entering sewage treatment plants can be significant and ranges from 800 to 17,000 pounds/year per restaurant.

The National Pretreatment Program already provides the necessary regulatory tools and authority to local pretreatment programs for controlling interference problems. Under the provisions of Part 403.5(c)(1) & (2), in defined circumstances, a POTW must establish specific local limits for industrial users to guard against interference with the operation of the municipal treatment works.

Consequently, pretreatment oversight programs should include activities designed to identify and control sources of potential interference and, in the event of actual interference, enforcement against the violator.

Food service establishments can adopt a variety of best management practices or install interceptor/collector devices to control and capture the FOG material before discharge to the collection system. For example, instead of discharging yellow grease to POTWs, food service establishments usually accumulate this material for pick up by consolidation service companies for re-sale or re-use in the manufacture of tallow, animal feed supplements, bio-fuels, or other products.

Additionally, food service establishments can install interceptor/collector devices (e.g., grease traps) in order to accumulate grease on-site and prevent it from entering the POTW collection system.

Residential and Commercial Guidelines
The fats, oil and grease (FOG) found in food ingredients such as meat, cooking oil, shortening, butter, margarine, baked goods, sauces and dairy products is a major concern for POTW's sewers. When not disposed of properly, FOG builds up in the sewer system constricting flow, which can cause sewer back-ups into homes and overflow discharges onto streets. It can also interfere with sewage treatment processes at the POTW's Wastewater Treatment Plants.

To remediate this problem, many control authorities have developed an outreach program aimed at eliminating FOG from the sewer system. FOG buildup in sewer lines has many harmful and costly effects.

Sewer backups into homes create a health hazard as well as an unpleasant mess that can cost hundreds and sometimes thousands of dollars to clean up. In certain parts of the POTW, FOG can enter storm drains and flow directly into water bodies and onto beaches creating serious environmental and health conditions.

In addition to problems caused by cooking oils, petroleum-based oils can also cause sewer-related problems. POTW residents or customers may not be aware of or understand their role in these sewer-related problems or pollution, but they can do a lot to help eliminate FOG and other contaminants from the sewer system.

For example:

- Car washing can result in soap and oil residue entering the storm sewers.
- Run-off from your sprinkler, watering hose, or from the rain can carry yard waste and fertilizer into storm sewers.
- Littering can cause trash and debris to clog catch basins and storm drains.
- A gallon of oil poured down a storm drain could contaminate up to one million gallons of water.

FOG Section Post Quiz

Food Service Establishments (FSEs)

1. Because of the amount of grease used in cooking, __________________are a significant source of fats, oil and grease (FOG).

2. To assist improper handling and disposal of their FOG _______________ are generally developed to assist restaurants and other FSEs with instruction and compliance.

3. The __________________ can handle properly disposed wastes, but to work effectively, sewer systems need to be properly maintained, from the drain to the treatment plant.

4. Proper sewer disposal by commercial establishments is required by __________________.

Environmental problem with FOG sewers

5. The various sizes of grease balls can range in size from cantaloupes to the size of marble and must be removed periodically.

A. True B. False

6. The repair or replacement of their damaged property caused by FOG creating _____________ can also cost customers thousands of dollars for the repair or replacement of their damaged property.

Controlling FOG discharges

7. FOG wastes are generated at FSEs as byproducts from food preparation activities. FOG captured on-site is generally classified into two broad categories: yellow grease and grease trap waste.

A. True B. False

8. The POTW collection system(s) will require that certain food service establishments install interceptor/collector devices (e.g., grease traps) in order to accumulate grease on-site and prevent it from entering the?

Keeping Fats, Oils, and Grease out of the Sewer System

9. Manholes can overflow into parks, yards, streets, and storm drains, allowing FOG to contaminate local waters, including drinking water. Exposure to untreated wastewater is a public-health hazard and is an EPA violation. FOG discharged into septic systems and drain fields can cause malfunctions, resulting in more frequent tank pump-outs and other expenses.

A. True B. False

10. _________________ will back up into homes and businesses, resulting in high costs for cleanup and restoration?

POTWs control methods for FOG discharges from FSEs

11. FOG must be able to cool and separate in a non-turbulent environment, therefore. _________________ must be designed and sized appropriately.

12. Grease interceptor/ collector devices shall be serviced at regular intervals and ___________ must be diligent in providing proper maintenance and records.

Best Management Practices (BMPs)

13. The amount of FOG a facility generates as well as any best management practices (BMPs) that the establishment implements to reduce the *FOG* discharged into its sanitary sewer system.
A. True B. False

Answers

1. Food Service Establishments (FSEs), 2. POTW Commercial FOG Program, 3. POTW's sewer system, 4. Law, 5. True, 6. Sewer backup(s), 7.True, 8. POTW collection system(s), 9. True, 10. Untreated wastewater, 11. Interceptor/collector device(s), 12. FSE, 13. True

Chapter 13 - Non-Point Discharge Section

Section Focus: You will learn the basics of the Clean Water Act, the need for wastewater treatment and common wastewater constituents. At the end of this section, you will be able to describe the need for wastewater treatment and the composition/components of wastewater. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.

As a pretreatment inspector or similar inspector, you will spend time determining sewage discharges and sometimes those discharges are from storm drains and sometimes from illegal industrial discharges into storm drains. Some POTWs combine stormwater and pretreatment inspection into one position, either way, you will need stormwater knowledge.

Nonpoint source (**NPS**) pollution is water pollution that consists of contaminated runoff associated with agricultural, urban, and other sources. The term "nonpoint source pollution" was created under the federal Clean Water Act to distinguish it from "point source" discharges such as industrial waste water from pipes.

Nonpoint sources include many varied small sources of pollutants from activities.
Every time it rains or the snow melts, pollutants such as dirt, nutrients, bacteria, oils and heavy metals are swept off from land surfaces and carried by runoff water into surface and groundwater.

When people speak about "stormwater quality control", they are talking about reducing the pollutants from nonpoint sources that are carried by stormwater into our lakes, streams, groundwater, and coastal areas.

The Clean Water Act of 1972 (passed by the United States Congress and amended by the Water Quality Act of 1987) set in motion requirements and policy measures for the Environmental Protection Agency (EPA). The EPA therewith established regulatory components for Storm Water Discharges which were levied upon associated industries and municipalities with populations over 100,000.

The goal of NPDES, through permits and plans, is to reduce to the maximum extent practical, the amount of pollution discharges from the municipal storm drainage systems. These municipal permits have several components, one being management programs. A term frequently used in this subject matter is - Best Management Practices (BMP).

BMP's are schedules of activities, prohibition of practices, maintenance procedures, and other recommended management practices that may be employed for a particular purpose - Storm Water Pollution Prevention and Reduction.

Although the EPA / NPDES regulations seem complex, their goal is simple - *"Improve water quality in waters of the United States".*

Evidence of illegal paint and chemical dumping.

What is Nonpoint Source Pollution?

Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water.

These pollutants include:
- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas;
- Oil, grease, and toxic chemicals from urban runoff and energy production;
- Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks;
- Salt from irrigation practices and acid drainage from abandoned mines;
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems;

Atmospheric deposition and hydromodification are also sources of nonpoint source pollution.

What are the effects of these pollutants on our waters?
States report that nonpoint source pollution is the leading remaining cause of water quality problems. The effects of nonpoint source pollutants on specific waters vary and may not always be fully assessed. However, we know that these pollutants have harmful effects on drinking water supplies, recreation, fisheries, and wildlife.

What causes nonpoint source pollution?
Nonpoint source pollution results from a wide variety of human activities on the land. Each of us can contribute to the problem without even realizing it.

Leachate from a landfill, a strange green colored water.

Leachates
Leachates are liquids that have dripped through the landfill and carry dissolved substances from the waste materials, containing such substances as heavy metals and organic decomposition products; salt; bacteria; and viruses.

Summary

Non-point source pollution is a diffuse source that is difficult to measure and is highly variable due to different rain patterns and other climatic conditions. In many areas, however, non-point source pollution is the greatest source of water quality degradation.

Presently, states and tribes identify non-point source pollution from cropland and livestock, urban runoff, and storm sewers as the greatest water quality threat to the Nation's surface waters. Other non-point sources of pollution to surface water include runoff from roads, construction sites, mining, and logging; drainage from waste disposal sites and landfills; and airborne pollutants that settle in the water.

(1) Urban Stormwater. Stormwater carries a wide variety of pollutants from nutrients to toxic chemicals. Siltation and turbidity associated with construction activities can also be a major problem. Problem areas are concentrated around urban centers and mimic, quite well, the population map of the state. Current stormwater rules and growth management laws address this problem for new sources, but are difficult to monitor and enforce.

(2) Agricultural runoff. The major pollutants involved include nutrients, turbidity, BOD, bacteria, and herbicides/pesticides. These pollutants generally have the greatest adverse impacts in lakes and slow moving rivers and canals, and sometimes, the receiving estuary.

Stormwater Program Sub-Section

Introduction

Stormwater runoff is rainwater or melted snow that flows across the ground and eventually into lakes, streams, wetlands, underground water supplies, and the ocean.

The construction of pavement and buildings, and the clearing and flattening of fields increase the volume and speed of stormwater runoff. This contributes to flooding and damage to property and habitat (stormwater quantity impacts). It also contributes to lowering of water quality by increasing the flow of human pollutants such as oil, fertilizers and pesticides, and the flow of natural elements such as phosphorus, into the water (stormwater quality impacts).

Degradation of lakes, streams and wetlands has economic effects: it reduces property values, raises bills from public water utilities, raises local property tax rates, and reduces tourism and related business income. The U.S. Environmental Protection Agency (EPA) estimates that 60% of the water quality problems in the nation are caused by nonpoint sources.

Stormwater runoff has quantity and quality impacts. When impervious or disturbed areas are created by construction activities and stormwater is not adequately managed, the environment may be adversely affected by: (1) changes in volume, timing, and location of the stormwater discharges, and (2) the movement of pollutants from the site to waterbodies. Stormwater runoff can cause flooding, undermine stream banks, and damage property and habitat, as well as carry contaminants that contribute to lower water quality.

Regulation: 40 CFR 122.26

Applicability

The EPA's National Pollutant Discharge Elimination System (NPDES) stormwater discharge permit program was developed to regulate the runoff of stormwater from various types of facilities. Covered facilities are required to obtain NPDES permits, submit management plans to reduce runoff, and disconnect illegal connections to storm drains.

A permittee is required to develop a pollution prevention plan that details the best management practices the facility will use to ensure that the stormwater from its site does not impact surface waters.

The permittee must also develop a training program that covers such topics as spill prevention and response, good housekeeping, and material management practices so that employees are aware of the goals of the stormwater pollution prevention plan (SWPPP) and have an overall understanding of its provisions.

Phase I of the NPDES stormwater discharge permit program regulates:

- Operators of medium and large municipal separate storm sewer systems that generally serve or are located in incorporated places and counties with populations of 100,000 or more.
- Operators of 11 categories of industrial activity—one of which is construction activity disturbing five or more acres of land—that discharge stormwater runoff to waters of the United States or into municipal separate storm sewer systems.

Phase II of the NPDES stormwater discharge permit program regulates two classes of stormwater dischargers on a nationwide basis:

- Operators of small municipal separate storm sewer systems located in urbanized areas.
- Operators of construction activities that disturb equal to or greater than one acre of land but less than five acres.

Training Requirements

An employee training program must inform personnel at all levels of the responsibility of the components and goals of the facility stormwater pollution prevention plan (SWPPP).

The training program should be an ongoing, yearly process. Facilities are required to specify a schedule for periodic training activities in the SWPPP.

Best Management Practices

As a pretreatment inspector, you will need knowledge of many different concerns in order to properly identify the problem. Knowledge of BMPs will assist you in writing of compliance or notices of non-compliance or violations. Sometimes, an inspector will write the customer suggestions in maintenance issues, like in maintaining a grease interceptor.

Good Housekeeping
Good housekeeping practices are designed to maintain a clean and orderly work environment. Often, the most effective first step towards preventing pollution in stormwater from industrial sites simply involves using good common sense to improve the facility's basic housekeeping methods. Poor housekeeping can result in more waste being generated than necessary and an increased potential for stormwater contamination.

A clean and orderly work area reduces the possibility of accidental spills caused by mishandling of chemicals and equipment and should reduce safety hazards to plant personnel. Well-maintained material and chemical storage will reduce the possibility of stormwater mixing with pollutants.

Good housekeeping procedures may include:

- Improving operation and maintenance of machinery and processes.
- Implementing careful storage practices.
- Keeping an up-to-date inventory and labeling all containers.
- Scheduling routine cleanup operations.
- Training employees on good housekeeping techniques.

Preventive Maintenance
Preventive maintenance includes the regular inspection and testing of plant equipment and operational systems.

These inspections should uncover conditions, such as cracks or slow leaks, that could cause breakdowns or failures that result in discharges of chemicals to storm sewers and surface waters. The program should prevent breakdowns and failures through adjustment, repair, or replacement of equipment. An effective preventive maintenance program should include:

- Identification of equipment, systems, and facility areas that should be inspected.
- Schedule for periodic inspections or tests of such equipment and systems.
- Appropriate and timely adjustment, repair, or replacement of equipment and systems.
- Maintenance of complete records on inspections, equipment, and systems.

Examples of equipment to be inspected at a facility can include:

- Pipes
- Pumps
- Storage tanks and bins
- Pressure vessels
- Pressure release valves
- Process and material handling equipment
- Stormwater management devices (oil/water separators, catch basins, or other structural or treatment BMPs)

Spill Prevention and Response
Spills and leaks together account for one of the largest industrial sources of stormwater pollutants and are avoidable in most cases.

Establishing standard operating procedures, such as safety and spill prevention procedures, along with proper employee training can reduce these accidental releases.

The steps to take for spill prevention and response usually involve:

- Identify potential spill areas (such as loading and unloading areas, storage areas, process activities, dust or particulate generating processes, and waste disposal activities).
- Specify material handling procedures and storage requirements.
- Identify spill response procedures and equipment (such as spill response team; safety measures; notification of authorities; spill containment, diversion, isolation, and cleanup; and spill response equipment).

Visual Inspections
Regular visual inspections are the means to ensure that all of the elements of the SWPPP are in place and working properly. They are routine look-overs of the facility to identify conditions that may give rise to contamination of stormwater runoff with pollutants from the facility.

Areas to be inspected should include:

- Areas around all equipment listed in the preventive maintenance box
- Areas where spills and leaks have occurred in the past
- Material storage areas
- Outdoor material processing areas
- Material handling areas
- Waste generation, storage, treatment, and disposal areas

All inspections must be documented, and the records must be kept with the SWPPP.

Sediment and Erosion Control
There may be certain areas on your site that, due to construction activities, steep slopes, sandy soils, or other reasons, are prone to soil erosion.

Construction activities typically remove grass and other protective ground covers, resulting in the exposure of underlying soil to wind and rain. Similarly, steep slopes or sandy soils may not be capable of supporting plant life, leaving soils exposed.

Because the soil surface is unprotected, dirt and sand particles are easily picked up by wind and/or washed away by rain. This process is called erosion. Erosion can be controlled or prevented with the use of certain BMPs.

It is important to:

- Identify areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion.
- Identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

Management of Runoff

As a pretreatment inspector, you will need to know of inflitration and exfliration. Most collection system operators understand this concern.

Traditional stormwater management practices can be used to direct stormwater away from areas of exposed materials or potential pollutants. These management practices can also be used to direct stormwater that contains pollutants to natural or other types of treatment locations. The potential of various sources at the facility to contribute pollutants to stormwater discharges associated with industrial activity must be considered when determining reasonable and appropriate measures.

Appropriate measures include:

- ✓ Vegetative swales and practices
- ✓ Reuse of collected stormwater
- ✓ Inlet controls (such as oil/water separators)
- ✓ Snow management activities
- ✓ Infiltration devices
- ✓ Wet detention/retention devices

Monitoring and Sampling

In addition to instituting BMPs, facilities may be required to implement a program of sampling and monitoring of their stormwater discharges. The terms of the permit will indicate the levels of sampling and monitoring required at a facility.

Stormwater Management Practices

A watershed manager needs to make careful choices about what stormwater management practices should be installed in the subwatershed to compensate for the hydrological changes caused by new and existing development. Stormwater management practices are used to delay, capture, store, treat, or infiltrate stormwater runoff. A key choice is to determine the primary stormwater objectives for a subwatershed that will govern the selection, design, and location of stormwater management practices at individual sites. While specific design objectives for stormwater management practices are often unique to each subwatershed, the general goals for stormwater management practices are often the same, and include:

- ✓ maintaining groundwater quality and recharge;
- ✓ reducing stormwater pollutant loads;
- ✓ protecting stream channels;
- ✓ preventing increased overbank flooding; and
- ✓ safely conveying extreme floods.

There are numerous structural stormwater management techniques for controlling stormwater quantity and quality. These five practices can be categorized into five broad groups, including:

- ✓ ponds
- ✓ wetlands
- ✓ infiltration
- ✓ filtering systems and
- ✓ grassed channels

While many advances have been made recently in innovative stormwater management designs, their ability to maintain resource quality in the absence of other watershed protection tools is limited. In fact, stormwater management practices designed or located improperly can sometimes cause more severe secondary environmental impacts than if they were not installed at all.

Basic Program Requirements

Stormwater Monitoring Program
Objective: To obtain a baseline measurement of current water quality, discover and eliminate illicit connections to the system and, the development of watershed drainage runoff data to assist in engineering studies for future developments.

Industrial Monitoring Program
Objective: To evaluate industrial storm water runoff locations and to perform physical site inspections and develop future pollution prevention plans.

Illicit Connection Program
Objective: To discover and eliminate illicit connections to the storm sewer system.

In-Stream Monitoring Program
Objective: To improve data collection and interpretation. Analysis of the monitoring sites with a full scan of pollutants as required by the NPDES permit.

Household Hazardous Waste Program
Objective: To eliminate household hazardous waste from contaminating the storm water.

Public Educational Program
Objective: Create a public awareness of the pollutional risk of misusing and improper disposal of chemicals. Recycling techniques and water conservation are also parts of an overall program.

Recycling Program

As a pretreatment inspector, you will need to know of recycling because it is part of a pollution prevention program (P2 or P3). These programs are normally part of the pretreatment or pollution control departments.

Objective: To reduce the amount of household hazardous waste disposed of improperly as well as to recover recyclable materials from the waste stream thereby reducing the demand on the landfills and improving the environment.

Electronic recycling event

Spill Response Program
Objective: To prevent pollutants from entering the Storm Drainage System.

Storm Sewer Maintenance
Objective: To prevent failure of the Storm Drainage System by performing preventative maintenance and repairs in a timely, cost-effective manner.

Street Cleaning Program
Objective: To remove debris that has collected on the streets before it can enter the drainage system and contaminate the Storm water.

Overflow Elimination Program
Objective: To reduce the amount of overflows to the storm drain system, and increase the efficiency of expenditures by planning and coordinating all infrastructure type projects.

Clearing and Grading Permit Administration
Objective: To allow local inspectors from the City to review construction drawings and field check compliance with such.

New and Redevelopment Program
Objective: To reduce the discharge of pollutants to the Municipal Separate Storm Sewer System; minimize potential short and long term water quality impacts; establish inspection and enforcement procedures and appropriate control measures; develop appropriate education and training measures; and notification process for applicants of their potential responsibilities under the NPDES permitting program.

Animal Feeding Operations (AFOs) and Concentrated Animal Feeding Operations (CAFOs)

Any facility which stables, confines, feeds, or maintains animals for at least 45 days in a 12 month period, and does not sustain crops or vegetation forage growth over any portion of the facility is an animal feeding operation (AFO). AFOs which meet certain size and location criteria are defined as concentrated animal feeding operations (CAFOs). By criteria listed at 40 CFR 122 Appendix B, a CAFO is a facility which has:

more than 1,000 animal units;
between 301 and 1,000 animal units and that may or does discharge pollutants into navigable waters through a manmade conveyance, or discharges pollutants directly into waters of the United States; or
been designated a CAFO by the permitting authority on a case-by-case basis.

An animal unit (AU) is a unit of measure based on manure production of various types of livestock. One animal unit is equal to one slaughter cow, and numbers for other types of livestock are converted to AU using coefficients set forth at 40 CFR 122 Appendix B (e.g., 1 horse = 2.0 AU, 1 dairy cow = 1.4 AU, 1 swine = 0.4 AU, 1 sheep = 0.1 AU).

Facilities which are CAFOs are regulated under the point source program, and require NPDES permits. Effluent limitations guidelines for CAFOs are found at 40 CFR 412. For regulatory resources, visit the Library of EPA resources on CAFOs, which includes a downloadable *"Final Guidance on NPDES Regulations for Concentrated Animal Feeding Operations," December 1995.*

Livestock Area

The EPA and the United States Department of Agriculture have recently partnered to address water quality impacts from all animal feeding operations. On March 9, 1999 the EPA and the USDA issued the Draft Unified National Strategy for Animal Feeding Operations.

BEST MANAGEMENT PRACTICES SUB-SECTION

<u>Background</u>: The definition of Significant Industrial User (SIU) was added to the General Pretreatment Regulation, *40 CFR § 403* on July 24, 1990 and became effective 30 days later. This definition states that;

(1) Except as provided in paragraph (t)(2) of this section, the term Significant Industrial User means:

(i) All industrial users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; and

(ii) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process wastestream which makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

(2) Upon a finding that an industrial user meeting the criteria in paragraph (t)(1)(ii) of this section has no reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement, the Control Authority (as defined in 40 CFR 403.12(a)) may at any time, on its own initiative or in response to a petition received from an industrial user or POTW, and in accordance with 40 CFR 403.8(f)(6), determine that such industrial user is not a significant industrial user.

As stated in (1) (ii), above, any other industrial user that has a reasonable potential for violating a pretreatment standard or requirement should be designated as an SIU by the Control Authority, either as per the potential to violate pretreatment standards or by a determination of the potential to cause an adverse effect.

With the implementation of more stringent water quality based effluent limits many municipalities are confronted with the need to include small volume/quantity industrial users in the community of regulated users. This is most apparent when the Publicly Owned Treatment Works (POTW) develops Technically Based Local Limits (TBLLs) and determines the background or unregulated contribution exceeds or approaches the Maximum Allowable Headworks Loading (MAHL).

In these situations the POTW has little choice but to expand the universe of regulated users and begin to address small volume/quantity dischargers, usually grouped by pollutants discharged or by activity. The problem arises when the POTW determines that these small volume/quantity dischargers are a substantial contribution of the target pollutant and controls are necessary to meet NPDES permit limitations or to allow the establishment of equitable TBLLs for the larger volume dischargers.

Typically the small volume/quantity dischargers include; photodevelopers, printing and publishing facilities and medical facilities for silver; radiator and maintenance shops for lead, copper, zinc and cadmium; septic waste haulers for a multitude of pollutants; etc.

Most POTWs are concerned about the reasonableness of issuing permits and expecting these small volume/quantity dischargers to purchase and maintain the pretreatment equipment necessary to comply with TBLLs.

To avoid an adverse situation many POTWs are developing and implementing Best Management Practices (BMPs) for these facilities; the rationale being that the control and reduction of the target pollutant at many facilities will have a significant impact on the total contribution through the sheer number of facilities involved. This scenario is similar to that implemented in Palo Alto, California for silver reduction.

ACTION: The region must therefore establish guidelines, where a POTW determines it is necessary to regulate traditionally non-significant users, to allow for the implementation of BMPs and also demonstrate compliance with the General Pretreatment Regulations. To accomplish this goal the following **minimum** procedures are proposed:
* All small volume/quantity users within the specified grouping must either be regulated by the BMP guidelines or be permitted.
* Small volume/quantity users that are permitted are expected to comply with all of the pretreatment regulations pertaining to large volume and categorical SIUs.
* A list of small volume/quantity users being regulated under the BMP guidelines shall be maintained by the Control Authority and the Control Authority shall issue Letters of Authorization to each facility indicating the facilities intent to comply with the BMP guidelines.
* The Control Authority must require at least annual reporting by the small volume/quantity users, demonstrating compliance with the BMP guidelines, such as copies of maintenance records for silver recovery equipment or manifests/receipts for septic waste haulers .
* The BMP guidelines must be incorporated into the Approved Pretreatment Program and established as a pretreatment standard/requirement in an ordinance, thus allowing the intent of the SIU definition to be met (however the BMP regulated users shall not be considered significant industrial users).
* The POTW must conduct inspections to determine independent of the information supplied by the industrial user compliance with the pretreatment standards. These inspections could be a reduced number from the entire universe, such as a percentage of facilities regulated by the guidelines (the facilities inspected need to change year to year to eventually allow for full coverage).

PRETREATMENT PROGRAM EVALUATION EXAMPLE

1. Has a change in contributing jurisdictions occurred since the last Annual Report?

   Yes No

   If yes, identify the jurisdictions that have been added or removed: _______________

   ____

   ____

2. Has the Control Authority updated its Industrial Waste Survey (IWS) to identify new Industrial Users (IUs) or changes in wastewater discharges at existing IUs? [(403.8(f)(2)(i)]

   Yes No

   If yes:

   a. Are any of these IUs located in new service areas (describe)? _______________

   ____

   ____

   b. Have any IUs located in contributing jurisdictions where the POTW has no inter-jurisdictional agreements or IU contracts? Yes No

   c. If yes, specify: ____

   ____

3. For any <u>new</u> Categorical Industrial Users:

   a. Baseline Monitoring Report (BMR) Submitted? Yes No

   b. Final (90-day) Compliance Report (FCR) Submitted? Yes No

4. How many IUs are currently identified by the Control Authority in each of the following groups?

___________ TOTAL SIUs (as defined by Control Authority)

_____________Categorical Industrial Users (CIUs)

_____________Significant Non-categorical IUs

_____________NDCIUs subject to zero discharge limits

___________ Other regulated non-categorical IUs (Describe):

___________ NDCIUs that are not subject zero discharge categorical limits

5. Is the Control Authority's definition of "**Significant Industrial User**" the same as EPA's? [403.3(t)(1)(i-ii)] Yes No

   If not, the Control Authority has defined "**Significant Industrial User**" to mean: ____
   ____
   ____
   ____
   ____
   ____

6. How many SIUs are required to be covered by an individual control mechanism? ___
   ____

   How many SIUs are not covered by an existing, unexpired permit or other control mechanism? ____

   Explain: ____
   ____
   ____
   ____

7. Were individual control mechanisms issued/reissued for 90% of the SIUs within 180 days of the expiration date? Yes No

   How many control mechanisms were not issued within 180 days of the expiration date?
   ____

   Explain: ____
   ____
   ____
   ____

8. Does the Control Authority have a control mechanism for regulating IUs whose wastes are trucked to the treatment plant? Yes No N/A

   If yes, does control mechanism designate a discharge point? Yes No

9. Are all applicable categorical standards and local limits applied to IUs whose wastes are trucked into the POTW? Yes No N/A

If not, why: ____
____
____
____
____
____

10. Has the Control Authority evaluated the need for SIUs to develop slug discharge control plans? [403.8(f)(2)(v)] Yes No

If yes, when was the evaluation last conducted and what criteria were used to identify the IUs for slug plans? ______________________________
____
____
____
____
____

How many slug control plans were: Required? ________
Received? ________
Approved? ________

11. Are TTO standards or alternatives (solvent management plans or oil & grease monitoring) being implemented for IUs subject to TTO limitations? Yes No N/A

If not, why? ____
____
____
____
____
____

Are TTO standards being applied to other IUs? Yes No

12. How many times were the following monitored during the past year?

	Influent	Effluent	Sludge	Ambient (Receiving Water)
Metals				
Priority Poll.				
Biomonitoring				
TCLP				
EP Tox				
Other:				

13. How many, and what percentage of SIUs were (a) not sampled at least twice, or (b) not inspected at least once during the reporting period? [403.8(f)(2)(vi)]
    a. Number and % not sampled: ______ (_____%)
    b. Number and % not inspected: ______ (_____%)

14. Does the Control Authority routinely split samples with industrial personnel?
    a. If requested: ρ Yes ρ No ρ N/A
    b. To verify IU self-monitoring results: ρ Yes ρ No ρ N/A

15. Provide the following analytical information regarding pollutant analyses:

	Analytical Method	Name of Laboratory
Metals		
Cyanide		
Organics		
Other:		

16. Does the Control Authority use QA/QC for sampling and analysis? Yes No

    If yes, describe: ____
    ____
    ____

17. How much time normally elapses between sample collection and obtaining analytical results? ____

18. Is there an established protocol clearly detailing sampling location and procedures?

    Yes No

19. Has the Control Authority had any problems performing compliance monitoring?

    Scheduled Unscheduled Demand

    If yes, explain: ____
    ____
    ____
    ____
    ____
    ____
    ____

20. How frequently does the Control Authority use the closed cup flashpoint test, specified in 40 CFR Part 261.21, to monitor SIUs? [403.5(b)(1)]

    ______Once per year
    ______Prior to each sampling
    ______Other: ____

    Did the Control Authority find any problems? Yes No

    If yes, explain: ____
    ____
    ____
    ____
    ____
    ____

21. Does the Control Authority compare all monitoring data to applicable pretreatment standards and requirements contained in the control mechanism within 15 days of its receipt? [403.8(f)(2)(iv)] Yes No

22. Does the Control Authority use EPA's definition of Significant Noncompliance (SNC)? [403.8(f)(2)(vii)] Yes No

23. Are SIUs required to notify the Control Authority within 24 hours of becoming aware of a violation and to submit additional monitoring within 30 days after the violation is identified [403.12(g)(2)] Yes No N/A

    If the Control Authority conducts monitoring in lieu of the user, does the Control Authority resample and obtain results within 30 days of identifying a violation?
    Yes No N/A

24. Has the Control Authority developed an Enforcement Response Plan? Yes No

25. For each of the listed enforcement actions, identify the following for the ones the Control Authority has used during the reporting period:

	Total # of Actions	# of Industries Affected
Written notice or letter of violation		
Administrative orders		
Administrative fines		
Show cause hearings		
Compliance orders		
Permit revocation		
Civil action		
Criminal action		
Termination of service		
Other (specify):		

26. Indicate the number and percent of SIUs that were identified as being in SNC (as defined by EPA) with the following <u>during the reporting period</u>:

	# of SNC SIUs	% of SNC SIUs
Applicable pretreatment standards [PSNC]*		
Self-monitoring requirements [MSNC]		
Reporting requirements [PSNC]*		
Pretreatment compliance schedule [SSNC]		
Other:		

27. Did the Control Authority publish all SIUS in SNC in the largest daily newspaper? [403.8(f)(2)(vii)] Yes No

If yes, attach copy, or attach copy of affidavit of publication.

28. Indicate the number of SIUs that are currently in SNC with self-monitoring and were not inspected or sampled: ____________________

29. Has the Control Authority experienced any of the following?

	Yes	No	Unknown	Explain:
Interference				
Pass through				
Fire or explosions (including flash point violations)				
Corrosive structural damage (including pH<5.0)				
Flow obstructions				
Excessive flow or pollutant concentrations				
Heat problems				
Interference due to oil or grease				
Toxic fumes				
Illicit dumping of hauled waste				

30. How many SIUs are currently on compliance schedules in order to meet new or revised national pretreatment standards or requirements?____________________

Have any <u>CIUs</u> been allowed more than 3 years from the effective date of a categorical standard to achieve compliance? [403.6(b)] Yes No

31. Indicate the number of SIUs from which penalties have been collected by the Control Authority during the past year:

	Number	Amount ($)
Civil		
Administrative		
Total		

32. Have IUs requested that data be held confidential? Yes No

33. Have any requests been made by the public to review files? Yes No

34. Has public comment been solicited during revisions to the SUO and/or local limits since the last PCI or audit? [403.5(c)(3)] Yes No N/A

35. Are there significant public or community issues impacting the POTW's pretreatment program? Yes No

If yes, explain:____

____

____

____

____

.____

____

____

36. Are all records maintained for at least 3 years? Yes No N/A

37. Have any problems in program implementation been observed which appear to be related to inadequate funding, resources or staff? Yes No

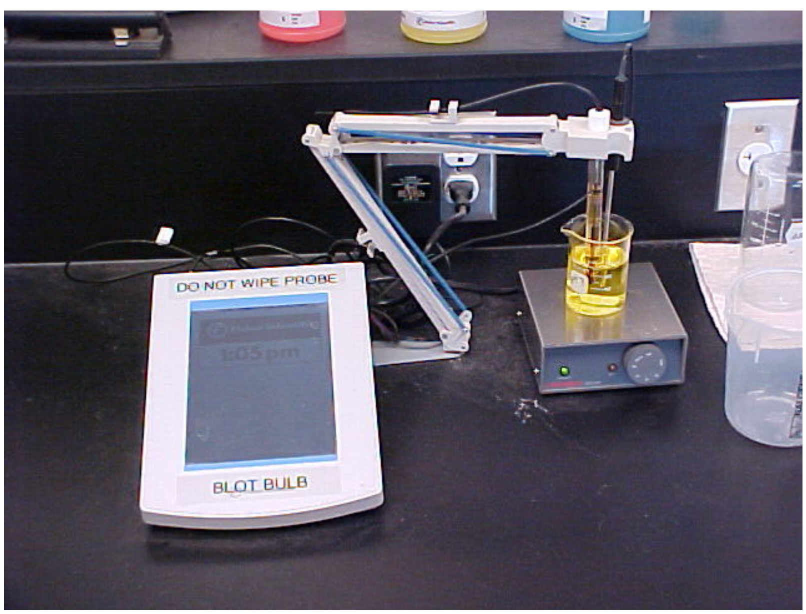
If yes, explain:____

38. Does the Control Authority have the technical documents necessary for implementing its pretreatment program? Yes No

39. Does the Control Authority have access to adequate:

	Yes	No	Explain:
Sampling equipment			
Safety equipment			
Vehicles			
Analytical equipment			

Normal pretreatment equipment found in a regulated industry. pH, ORP and Temperature measuring equipment. Notice the different pH buffers in the upper right of the top photo, and center of the bottom photo. Yellow, red and blue are the normal pH buffers. You are required to calibrate your pH probe at least daily and record your values in a log book. Many States will require a written pH procedure and may require both your log book and procedure in court.



PERMIT COVER SHEET EXAMPLE

Control Authority Name: ____

Treatment Plant Name(s): Permit Number(s):

____ ____________

____ ____________

____ ____________

____ ____________

____ ____________

Pretreatment Contact: ______________________________

Title: ______________________________

Address: ______________________________

____

____

City, State, Zip Code: ______________________________

Telephone: ______________________________

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

______________________________ ____________

POTW Authorized Signatory Date

____

Title

1. Approval Date of Original Pretreatment Program:

2. Program Materials Under Development (Date Planned for Submission):

3. Program Materials Submitted for Review/Approval (Date Submitted):

4. Program Materials Approved (Date Approved/Date Incorporated into NPDES Permit):

5. Additional Noteworthy Pretreatment Activities/Accomplishments:

LIST OF REGULATED USERS

Name of User	SIU (Y/N)	CIU (Y/N)	40 CFR Part No.	NDCIU (Y/N)	SIC Code	Permit Issued (Y/N)

INDUSTRIAL SURVEY UPDATE

Name of Industry	Survey Returned (Y/N)	Permit Application Required (Y/N)	Permit Application Returned (Y/N)	Permit Issued (Y/N)	Comments

COMPLIANCE/OVERSIGHT SUMMARY
(SIUs ONLY)

Name of SIU	Permit Expiration Date	Number of Documented Inspections	POTW Sampling (All Regulated Pollutants)	SIU Self-Monitoring (All Regulated Pollutants)	SNC for Quarter[1]			
					1	2	3	4

B – SNC with Self-Monitoring Requirements
C – SNC with Reporting Requirements
D – SNC with Compliance Schedule

NONCOMPLIANCE/ENFORCEMENT SUMMARY
(SIUs ONLY)

Name of SIU	Nature of Violation	Date of Violation	POTW Enforcement Response	Date of POTW Response	Date of Return to Compliance	Comments

Examples of Regulatory and Compliance Letters

January 13, 2021

Mr. D. Robert Kelly
Ajax Well Repair, Inc.
8111 East Montebello Drive
Phoenix, Az. 85777

Dear Mr. Kelly:

RE: DISCHARGE OF WELL MONITORING WATER AT ACME'S PEORIA AVENUE FACILITY

I am in receipt of your letter dated December 4, 2020, in which you requested to discharge approximately 3000 gallons of groundwater generated during the sampling operations of MW-1a thru MW-9 located at, and in the immediate vicinity of, the Acme Peoria Avenue facility, 2250 West Peoria Avenue. The groundwater withdrawn from monitoring wells located at this site is part of a Remedial Investigation / Feasibility Study required by the Arizona Department of Environmental Quality.

Approval is hereby granted for the discharge of approximately 3000 gallons of well purge water. This discharge is anticipated to occur sometime during the period of December 11, through December 16, 2020, to City of Sunflower manholes 124 and 125 in Quarter Section 30-24, and manholes 302 and 403 in Quarter Section 29-23. This discharge shall not exceed a flow rate of 50 gallons per minute, in order to avoid hydraulic overloading of the sewer mains in the area.

This approval is based on a thorough review of the historic analytical data submitted in your letter of September 27, 2020 and 2nd Quarter water quality results submitted with the December 4, 2014 letter. Our review indicates, the Toxic Organics were analyzed using EPA methods 601. All VOC concentrations were found to be less than the Sunflower City Code Instantaneous Effluent Limitations.

It is the opinion of the City of Sunflower Water Quality Division that the wastewater meets all requirements under Chapter 28. The wastewater is also determined not to be in sufficient quantity to injure or interfere with any sewage treatment process, cause corrosive structural damage, constitute a hazard to humans, or create any hazard to the sewer system, or in the receiving waters of the sewage treatment plant.

Please submit your final status report within ten (10) days of the date of discharge. This report shall include the date(s) of discharge, time of day this discharge occurred, and the total gallonage.

Please review the permit thoroughly. Should you have any questions, please contact me at 534-1362. Our office hours are 8:00 a.m. to 5:00 p.m., Monday through Friday.

Sincerely,

MANHOLE ENTRY PERMIT Example

The City of Sunflower, acting through the Water and Wastewater Department, hereby issues a manhole permit to:

Ajax Well Repair, Inc
8111 East Montebello Drive
Suite 116
Tempe, AZ. 85281

hereinafter called Permittee, for the purpose of entering City of Sunflower manhole nos. 124 and 125 in Quarter Section 30-24 and manhole nos. 302 and 403 in Quarter Section 29-23 to dispose groundwater brought to the surface during monitor well pumping test operations at and in the immediate vicinity of:

Acme's Peoria Avenue Facility
7574 West Culver Avenue
Sunflower, Arizona

Prior results from laboratory chemical analyses, from December, 2019 to June, 2020, indicate that concentrations of volatile organic compounds are less than 1000 micrograms per liter. Monitor well water will be sampled and analyzed for volatile organic compounds using EPA methods 601/602 and method 624 for purgeable volatiles. Discharge to the sewer must not exceed 50 gallons per minute, in order to avoid hydraulic overloading of the sewer mains in the area.

The manhole entry permit is issued subject to the following conditions:

1. That the only activities authorized by the permit are for the purposes of removal of the contained wastewater, and that the Permittee conduct no other activity while entering upon the public property authorized by this permit.

2. That the Permittee's activities be conducted only within the time period of December 11, through December 16, 2015, unless authorized in writing by the Water and Wastewater Director for an extension of time, or unless revoked earlier, and that the Permittee notify the Water and Wastewater Department in advance of each separate entry.

3. Permittee shall submit analytical results as established in Section 3 of this permit within 10 days of completing discharge of development and purge waters.

4. Permittee shall incur costs of $1.0255 per one hundred cubic feet (or current rate as established by water accounting) of ground water discharged.

5. That the Permittee, when finished with the removal and discharge activities, replace to the satisfaction of the Water and Wastewater Director, any manhole covers or other disturbances to the City of Sunflower sewer lines that he caused during the course of his activities.

6. That the Permittee agrees to save and hold harmless, the City, any of its departments, agencies, officers or employees from all costs and damages occurred by any of the above from any damage to any person or property whatsoever which is caused by the activity, condition or event arising out of the

negligent performance or nonperformance of any of the provisions of this permit by the Permittee any of the Permittee's agents, or any of the Permittee's independent contractors. The above costs incurred by the City, any of its departments, agencies, officers or employees shall include in the event of any action, court cost, expensive litigation and reasonable attorney fees. When any of the above costs and/or damages occur as aforesaid, the Permittee assumes the burden of proof that the negligent activity, condition or event did not cause such cost damage or other expense the City may incur.

The Permittee agrees to the condition set forth in this permit, and understands that all activities done under the conditions of this permit should conform to the laws of the City of Sunflower and the State of Arizona.

Dated this _______ day of _________________, 2021.

____
Permittee

Dated this _______ day of _________________, 2021.

CITY OF SUNFLOWER,
a municipal corporation

By: _______________________________
Chris Binder
Chief Water Quality Inspector
Water Services Department

MANHOLE NO.	QUARTER SECTION	DESCRIPTION OF LOCATION
MH 124	30-24	5 feet west of center line in 21st Avenue approximately 150 feet north of center line of Fred Street. For monitor well MW-6.
MH 125	30-24	1 foot of center line in 23rd Avenue and approximately 140 feet south of center line in Frank Street. For monitor well MW-5.

September 15, 2021

Mr. Dewey Hopkins, President
Acme Technical Casting, Inc.
8111 East Montebello Street
Sunflower, Arizona 85040

Certified Mail
Return Receipt Requested

Re: Confirmation of Wastewater Discharge Permit Reclassification From Class A to Class B

Dear Mr. Myers:

I am writing this letter to acknowledge your meeting on August 29, 2020 with Chris Binder, Chief Water Quality Inspector, and to confirm the City of Sunflower' (City) decision to reclassify the permit status of Acme Technical Casting, Inc. (Acme) from "***Class A***" to "***Class B***." While the reasons forming the basis for this decision were briefly discussed at the meeting, I believe it necessary to recite them here so that Acme thoroughly understands why the City made this decision.

BACKGROUND INFORMATION

The information contained in this portion of my letter is based upon documentation contained in our file, observations made by City Water Quality Inspectors during on-site inspections and various meetings with Acme representatives.

Acme manufactures investment castings for commercial and aerospace applications using ferrous and non-ferrous metals. Pretreatment consists of a closed loop recirculating filtration system. There is no categorical discharge to the sanitary sewer. Any sludge resulting from the manufacturing process is disposed of accordingly.

There are no floor drains in the production area. The floor is bermed and sloped to a sump in the pretreatment area. All categorical process discharge lines have been cut and plugged. This has been verified by on-site inspections performed by City Water Quality Inspectors. The wastewater discharge of approximately 4000 gallons per day (gpd) consists of non-federally regulated penetrant and X-ray rinses, in addition to sanitary wastes.

Even though the manufacturing operation is regulated by the 40 CFR 464.15(f) and 40 CFR 464.36(e)(2), metal molding and casting category, there is no discharge of this process wastewater to the sanitary sewer. Therefore, Acme does not conduct any activities that are regulated by the federal categorical standards contained in 40 CFR Chapter I, Subchapter N (parts 405-471). However, Acme is required to comply with 40 CFR 403 and Chapter 28 of the Sunflower City Code. Acme has been permitted as a Significant Industrial User (**SIU**) since June 24, 1991.

Acme has had two effluent violations in the past four years. Both were for exceeding the silver limitation, and the last violation occurred on September 5,

2020. Acme received the Mayor's Award recognizing full compliance with pretreatment requirements for the year 2006.

The total daily poundage from the biological oxygen demand (BOD) and suspended solids (SS) concentrations of the process wastewater is approximately 9.5 pounds. This is substantially less than the equivalent strength of 25,000 gpd of domestic waste when measured by BOD and SS (approximately 75 pounds).

PERMITTING STRUCTURE

As you know, the wastewater discharge permitting requirements are contained in Chapter 28 of the Sunflower City Code. When Acme was first issued a permit, the City only issued permits to SIU's. Due to its federal categorical discharge flows, Acme was designated in 1997 as a SIU. The City has since revised its permitting structure to allow for the issuance of non-SIU permits to other industrial users. The SIU permits are designated as Class A, with the non-SIU permits falling into the Class B category.

DECLASSIFICATION ANALYSIS

When a SIU permit is up for renewal, or when the City is made aware of changes made by the SIU that could change the status of the existing Class A permit, the City reviews all relevant information to determine (1) whether the SIU should continue to be classified as a SIU and therefore be issued a Class A permit; or (2) whether the industrial user qualifies for a Class B Permit. A Class B permit generally contains less restrictive requirements than a Class A permit.

Section 10-45.1 of the City Code allows industrial users to be issued a Class B permit if they: (1) are a zero process discharge user; (2) discharge the equivalent strength of 25,000 gallons per day of domestic waste as measured by BOD (Biological Oxygen Demand) and SS (Suspended Solids); (3) discharge polluted groundwater; or (4) discharge any of the substances identified in Sections 28-9 and 28-45(b) of the City Code.

Eligibility for a B permit is for those users discharging less than 25,000 gpd of process wastewater and there are no discharges of any federal categorical process wastewater. It is evident from the Background Section of this letter that Acme met this threshold requirement.

Our next step was to gather and evaluate additional information to determine whether Acme discharges causes or has the reasonable potential to cause harm or damage to the City's wastewater treatment plants, worker safety, public safety or to the environment. Without going into detail over everything that was considered, we did ask ourselves the following questions:

1. What is the average annual water consumption at the facility?

2. What are the process wastewater biological demand and suspended solids concentrations?

3. What types of activities are conducted on the site?

4. Is there a reasonable potential for adversely affecting the City's wastewater treatment plant operation or for violating any pretreatment standard or requirement?

5. Does the discharge pose a health and safety concern to Water Services personnel?

6. What is the compliance history of the facility?

7. What is the existence and effectiveness of pretreatment used by the facility?

8. Has there been any receipt of any environmental awards (e.g., Mayor's Recognition of Achievement for Full Compliance With Pretreatment Requirements)?

9. Does the facility have a written policy or philosophy pertaining to environmental matters and is it being followed?

10. Has the facility always exhibited good faith efforts in complying with Chapter 28 requirements?

11. Is this a special discharge under Section 28-45.1 of the Sunflower City Code?

Based upon all of the foregoing considerations, the City has reclassified the permit status of Acme from a Class A permit to a Class B permit.

<u>WHAT RECLASSIFICATION MEANS TO YOU</u>

1) Effective July 1, 2020, Wastewater Discharge Permit No. 9405-2910 is rescinded. Acme is no longer designated as a Significant Industrial User under Section 28-45 of the Sunflower City Code.

2) On or before September 15, 2020, Acme will be issued a Class B Wastewater Discharge Permit.

3) Effective July 1, 2016, Acme will not be subject to the annual permitting fee contained in Section 28-39(h) of the City Code. This information will be provided to the City's Customer Service Division of the Water Services Department and any adjustments will be made on a future billing statement.

4) Acme will no longer be eligible for the Mayor's Recognition of Achievement Award for Full Compliance with Pretreatment Requirements since the award is only given to Class A permittees. However, the City is considering

whether to have some type of award for Class B Permit holders.

5) Please be aware that even though Acme is not a SIU based upon the facts as they exist today, this designation can change if the basis for our decision to issue a Class B Permit is no longer valid. For example, changes in your zero discharge of categorical process wastewater status so that Acme now has categorical process wastewater flow to the sanitary sewer will require a reclassification and return to SIU status. The City will review your permit classification status on an annual basis, or more frequently if warranted under the circumstances.

CONCLUSION

Acme will receive a Class B wastewater discharge permit under our new permitting structure. We are confident that Acme will continue to be responsible and use sound and prudent judgment in the handling of its wastewater discharges.

Chris Binder, Senior Water Quality Inspector, is the inspector that has been assigned to your facility. Please feel free to contact him at 474-8888 should you have any questions pertaining to your new permit.

Sincerely,

Bill Fields
Water Quality Supervisor

HIGH STRENGTH DISCHARGE PERMIT EXAMPLE

Facility Name:	ACME Services Group of Sunflower
Facility Address:	8111 West Montebello Street Sunflower, Arizona 85297
Mail Address:	8111 West Montebello Street Sunflower, Arizona 85297

PERMIT EFFECTIVE DATE: **January 1, 2020**

PERMIT EXPIRATION DATE: **December 31, 2019**

In accordance with the Permit Application filed by **ACME Services Group (ACME)** on **01/02/20** with the City of Sunflower Pollution Control Division, this High Strength Discharge Permit (Permit) is granted to the above facility (i.e., Permittee) to discharge process wastewater to the City of Sunflower (City) Sanitary Sewer Collection System in accordance with the terms and conditions of this Permit.

The Permittee shall comply with Chapter 10 of the Sunflower City Code, all federal and state laws and regulations pertaining to the Permittee's discharge and all provisions of this Permit.

This Permit replaces all previously issued Permits. If you believe that the City should reconsider the conditions and limitations of this Permit you have the right to file a Petition for Review within twenty (20) days of your receipt of this Permit. A copy of Section 10-46.1 governing the Permit Appeals Process is attached.

Date of Issue: December 30, 2019
Modified on **January 13, 2020**

Chris Binder
Water Quality Supervisor

I. SPECIFIC REQUIREMENTS

A. Discharge Limitations

1. The Permittee is authorized to discharge previously collected human wastes from portable toilets through a private manhole on their property, and truck/toilet washing/maintenance operation discharges to the compliance sampling point described as a **three inch Parshall flume vault located at the northwest corner of the property approximately 20 feet west of the driveway.**
2. The compliance sampling point is illustrated in Attachment A of this Permit.

2. Flow volume through the compliance sampling point averages 4,500 gallons per day but in no event shall exceed 7,000 gallons during any single day.

3. During the term of this Permit, all discharges shall comply with the general user requirements contained in Section 10-8 of the Sunflower City Code.

B. Sampling Requirements and Procedures

1. Permittee shall sample once per month (starting the month of January 2001) for arsenic, copper, lead, and mercury by the taking of a composite sample, and pH, total petroleum hydrocarbons (TPH) and total sulfides, by the taking of grab samples at the compliance sampling point. The pH shall be within the instantaneous limits of 5.0 - 10.5 s.u. (standard units). The TPH shall be 100 mg/l or less. There is no numerical limit at this time associated with the metals, or sulfide samples.

2. All samples shall be taken at the compliance sampling point specified in this Permit and, unless otherwise specified, before the wastewater joins or is diluted by any other wastestream, body of water or substance. All equipment used for sampling and analysis must be routinely calibrated and inspected and maintained to ensure accuracy. The sampling point shall not be changed without written approval of the City.

3. Sampling and analysis of these samples shall be performed in accordance with the techniques prescribed in 40 CFR Part 136, as may be amended. For TPH analysis, use EPA method 418.1.

4. If required, appropriate flow measurement devices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. Devices shall not be installed without prior written approval from the City.

C. Periodic Monitoring Report Required

1. All reporting (including written notifications, oral notifications and discharge sampling reports) required by this Permit shall, unless otherwise specified, be addressed to:

City of Sunflower
Water Services Department
Pollution Control Division
1534 West Montebello
Sunflower, Arizona 85297

2. Each submitted discharge sampling report, written notification, or any other report required by this Permit, must be signed (see Part II. N of this Permit for signatory requirements).

3. Sampling results shall be summarized and reported on a High Strength Discharge Monitoring Report Form provided by the City. This report is due on the last day of each month and is to include all results of monitoring performed during that calendar month as well as information required for the prior calendar month that has not been previously submitted. The report must be received at the above address no later than the due date so as not to be considered late. The first report is due no later than January 31, 2001. Each report should indicate the results of all sampling as set forth in Part I (B) and (G) of this Permit. Reports must also be submitted during months in which no wastewater discharge occurred and include a zero discharge certification statement on a form provided by the City.

4. If Permittee samples more frequently at the compliance sampling point than required by this Permit, using test procedures approved under 40 CFR Part 136 or as specified in this Permit, the results of such sampling shall be reported in the monthly report.

D. pH Log Book

Permittee is required to maintain a log book of pH measurements showing date and time of measurement, name of the person performing the measurement, and pH meter calibration data for all samples collected at the compliance sampling location.

E. Maintenance of Compliance Monitoring Point

1. Permittee shall maintain the compliance sampling point, illustrated in Attachment A, in continuously efficient operations at all times.

2. Permittee is required to keep written documentation of maintenance which includes at least the following:

   a. Date of service;
   b. Who performed the service (contractor name or Permittee employee name and title);
   c. Nature of service (repaired - nature of repair, inspection, cleaned, etc.).

F. Maintenance of Pretreatment Interceptors

1. Permittee is required to maintain the two stage seven hundred fifty gallon sand/oil interceptor located approximately 6 feet west of the toilet cleaning pad and the three stage, two thousand gallon interceptor located 25 feet west of the northwest corner of the maintenance shop building which receives wastewater from the truck/toilet washing/maintenance operation in continuously efficient operations at all times.

2. Permittee is required to maintain written documentation of both of the interceptor's maintenance which includes at least the following:

   a. Date of service;

   b. Who performed the service (contractor name or Permittee name and title).

   c. Nature of service (pumped, repaired -- nature of repair, inspection, etc.)

G. Access Restrictions/Security /Special Sampling Requirements

1. Beginning February 1, 2001, permittee will perform screening tests on samples collected from individual trucks prior to discharge to the compliance sampling point, on a random basis picked by a computer system, for the following parameters and according to the following schedule:

   a. The following will be tested on every truck:

PARAMETER	ACCEPTABLE CRITERIA
PH	5.0 - 10.5 s.u.
ORP	-500 to +500 mv
Temperature	150° F or less

   b. From February 1, 2015 through July 31, 2001, a minimum of one truck per day will be tested for the following:

PARAMETER	ACCEPTABLE CRITERIA
Colorimetric analysis:	
Cyanide (filtered sample)	2.0 mg/L
Chromate (filtered sample)	0.5 mg/L
Copper (filtered sample)	10.0 mg/L
Test Paper:	
Lead	5.0 mg/L
Organic Solvent/Petroleum Hydrocarbons	10 mg/L gasoline
Oxidizer	3.0 mg/L as H_2O_2
Fluoride	20 mg/L
Iodine, Bromine, Chlorine	1 mg/L

   c. After the expiration of the time period in part b above, for the remaining term of this permit, a minimum of three trucks per week will be tested for those parameters identified in part b.

   d. In addition, a minimum of one sample every month will be collected from a truck and analyzed by a licensed laboratory for arsenic, copper, lead and mercury.

e. If any of the parameters identified above exceed the Acceptable Criteria, then the load will be temporarily stored in the 1,000 gallon above ground holding tank and handled as set forth in subparagraph 6 of this paragraph G.

f. The City anticipates that the sampling frequencies and Acceptable Criteria contained in this paragraph G may need to be changed based upon the sampling generated from February 1, 2001 through July 31, 2015, and in such event this Permit will be amended accordingly. However, until this Permit is amended, the sampling frequencies and Acceptable Criteria contained in this paragraph G will remain in effect.

Permittee will include all results of individual truck testing with monthly reports as required in Part I. C . of this Permit.

2. Prior to February 1, 2015, Permittee will purchase, install and maintain a locked manhole cover over the truck discharge point, with access being limited to a select number of Permittee's employees having keys.

3. Prior to March 1, 2015, Permittee will issue a form letter to all existing customers (and thereafter on an annual basis) and to each new customer at time of initial service, placing that customer on notice that any discharge of foreign material into portable toilets is prohibited.

4. Prior to March 1, 2015, Permittee will conspicuously label all portable toilets with a warning that any disposal of foreign substance into portable toilets is unlawful and may lead to fines and/or prosecution.

5. Permittee will provide all current service drivers and employees (prior to March 1, 2015) and future portable service drivers (within 15 days of hiring) with training to detect the presence of foreign material in the portable toilets. In addition to acknowledging the training provided by Permittee, all drivers will sign a separate Acknowledgement of Training Form stating their understanding of the following procedures:

a. All drivers will perform visual and olfactory inspections of each toilet for foreign material prior to and while pumping portable toilets;

b. In the event foreign material is detected during these inspections, the driver will notify Permittee's Facility Operations via mobile radio or telephone immediately;

c. The driver will tag the unit with a Bypass Ticket notifying the customer of the nature of the problem. The driver shall also attempt to contact a responsible party on the job site and advise that party to contact Permittee's office;

d. The driver will turn in the route card or route sheet with a copy of the Bypass Ticket to operations at the end of the route;

e. ACME Operations will then remove that unit from the route and forward the Bypass Ticket to the sales department for customer contact and resolution;

f. The ACME Sales Department will notify the customer of their responsibility to legally dispose of the foreign material. The customer will be advised to contact the ACME Sales Department when the foreign material has been removed;

g. Upon notification of removal by the customer, the sales department will notify ACME Operations. ACME Operations will conduct a field inspection of the unit and reinsert the unit into the route for service;

h. Any unit containing foreign material will not be removed from a particular job site until the customer has appropriately addressed the removal of the foreign material.

All signed Acknowledgement Training Forms will be placed in each employee's personnel file and be made available to City personnel during inspections. This employee training will be incorporated into Permittee's general monthly employee meetings, a record of which shall be maintained at the facility.

6. Prior to March 1, 2020, the Permittee will install and maintain a one thousand (1000) gallon above ground tank at the facility. If a questionable wastestream is determined while testing, that particular waste load will be temporarily stored in this tank. The contents will be retested by a licensed laboratory for a complete list of parameters as determined by the City. Should the retest confirm the wastestream is not suitable for discharge to the compliance point, the contents will be disposed of in a manner as required by state and federal law. At no time will Permittee discharge a questionable load to the sanitary sewer.

II. **HIGH STRENGTH DISCHARGE PERMIT STANDARD CONDITIONS**

A. Permittee Shall Provide Notice of Changes

Any changes, permanent or temporary, to the premises or operations that significantly change the quality or volume of the wastewater discharge or other changes that have occurred which differ from what was stated in the Permit application shall be reported by the Permittee 90 days prior to making the changes.

B. Permittee Shall Provide Notification of Noncompliance

Permittee shall notify the City within 24 hours of becoming aware of a discharge which is known or suspected to be in violation with any limitation or provision of this Permit, including an accidental spill of substances prohibited by Section 10 of the Sunflower City Code.

C. Permittee Shall Provide Information

The Permittee shall furnish to the Pollution Control Division, by the date requested, any information to determine whether cause exists for modifying or revoking this Permit, or to determine compliance with this Permit. The Permittee shall also furnish to the Pollution Control Division, upon request, copies of records required by this Permit to be kept by the Permittee.

D. Inspection and Entry of Facility

The Permittee shall provide free access to all areas of the facility to an authorized representative of the Pollution Control Division, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter at any time during normal hours of operation upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this Permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit and any production, or storage area where discharge regulated under this Permit, could originate or may be subject to regulation; and

4. Sample or monitor, for the purposes of assuring Permit compliance, any substances or parameters at any location.

E. Permittee Shall Retain Records

1. The Permittee shall retain on site, copies of all reports required by this Permit, including all emergency response procedures and incident documentation and records of all data used to complete the application for this Permit, for a period of at least three years from the date of the document preparation.

2. All records which pertain to matters that are the subject of special orders or any other enforcement or litigation activities brought by the Pollution Control Division shall be retained and preserved by the Permittee until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired.

3. The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, for a period of at least three years from the date of the sample or measurement.

4. Sampling records shall contain the following:

    a. The date, exact place, time, and methods of sampling or measurements, and sample preservation techniques or procedures;

    b. Who performed the sampling or measurements;

    c. The date(s) analyses were performed;

    d. Who performed the analyses;

    e. The analytical techniques or methods used; and

    f. The results of such analyses.

5. Additional Sampling by the Permittee

    If the Permittee samples more frequently than required by this Permit, using approved test procedures or as specified in this Permit, the results of this monitoring shall be maintained as a part of Permittee's records for a period of at least three years from the date of the sampling.

F. Emergency Response Procedures and Incident Documentation Reports

1. Permittee shall have emergency response procedures which, at a minimum, identify how to document the incident(s) or other event(s) that does or may result in a discharge in excess of the Permit

limitations to the sanitary sewer and identifies the agency(s) and official(s) to notify in case of a spill or need to discharge this process wastewater to the sanitary sewer.

2. Emergency incident documentation requirements shall at a minimum include:

   a. date, time of emergency
   b. description of emergency including discharge constituents and quantity
   c. documentation of agency and agency official notification
   d. cause of emergency
   e. corrective actions taken or to be taken to correct the incident
   f. corrective action plan to prevent a future incident
   g. report on compliance with corrective action schedule(s)

3. Any emergency incident causing a wastewater discharge to the sanitary sewer does not relieve the Permittee from the requirements set forth in 40 CFR Part 403, Chapter 10 of the City Code and this Permit.

G. Duty to Reapply; Automatic Extension of Permit

If Permittee wishes to continue an activity regulated by this Permit after the expiration date of this Permit, Permittee must apply for and obtain a new Permit. The application must be submitted at least 60 calendar days before the expiration date of this Permit. Subject to the City's right to amend, or, revoke this Permit, or to deny a new Permit, this Permit shall automatically continue to remain in full force and effect after the expiration date if Permittee has timely filed the Permit application and a new Permit is not issued prior to the Permit expiration date.

H. Permit Modification

This Permit may be modified by the City:

1. To incorporate any new or revised federal, state, or local pretreatment standards or requirements;

2. To make changes due to material or substantial alterations or additions to the Permittee's operation which were not covered in the issued Permit;

3. To correct any errors;

4. To make changes that are deemed reasonably necessary to prevent pass through or interference, protect the quality of the water body receiving the treatment plant's effluent, protect worker health and safety, facilitate sludge management and disposal, protect against damage to the POTW and to ensure user compliance with Chapter

10 of the Sunflower City Code or state and federal laws, rules and regulation.

I. Permit Revocation

This Permit may be revoked for good cause, including but not limited to:

1. failure to notify the City of significant changes to the wastewater prior to the changed discharge;
2. failure to provide prior notification to the City of changed conditions pursuant to Section 10-44(f) of the Sunflower City Code;
3. misrepresentation or failure to fully disclose all relevant facts in the wastewater discharge Permit application;
4. falsifying self-monitoring reports;
5. tampering with monitoring equipment;
6. refusing to allow the City timely access to the facility premises and records;
7. failure to meet effluent limitations;
8. failure to pay fines and penalties;
9. failure to pay sewer charges;
10. failure to meet compliance schedules;
11. failure to complete a wastewater survey or the Permit application;
12. failure to provide advance notice of the transfer of business ownership of a Permitted facility; or
13. violation of any pretreatment standard or requirement, or any terms of the Permit or requirement of Chapter 10 of the Sunflower City Code; or
14. when the City has determined that a Permit reclassification is required.

J. Permit Not a Property Right

The issuance of this Permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

K. Non-Transferability of Permit

This Permit is not transferable to any person. In the event of sale or change of ownership the Permittee shall provide written notice to the Pollution Control Division thirty (30) days prior to the effective date of sale or change of ownership.

L. Severability

The provisions of this Permit are severable. If any provision of this Permit, or the application of any provision of this Permit to any circumstances is held invalid, the application of such provision to other circumstances, and the remainder of this Permit, shall not be affected thereby.

M. Civil and Criminal Penalties

Any violation of this Permit can result in both civil and criminal penalties that are in addition to all remedies available to the City set forth in Chapter 10 of the Sunflower City Code. Civil Penalties can be $25,000 per day per violation. Criminal misdemeanors can result in fines of $2500.00 per day per violation in addition to imprisonment of 6 months.

N. Signatory Requirements

Permit applications, correspondence and all reports shall be signed by the appropriate signatory:

1. For a corporation: by a corporate officer or other persons performing a similar policy or decision-making function for the corporation;

2. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively;

3. All applications, correspondence, reports, and self-monitoring reports may be signed by a duly authorized representative of the person described above. A person is a duly authorized representative only if:

    a. the authorization is made in writing by a person described above; and

    b. the authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, superintendent, or position of equivalent responsibility. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

4. Any person signing a document required under this Permit shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

GAS METER CALIBRATION LOG

Meter # ______________________________

DATE	COMB (58) (52-64)	0_2 (15%) (13-17%)	CO (300) (290-310)	H_2S (10ppm) (9-12 ppm)	COMMENTS (SENSORS & BATTERIES)	INIT

Post Quiz

Stormwater Introduction

1. Stormwater precipitation is caused by some type of runoff.
A. True B. False

2. Stormwater problems can contribute to raising of water quality of water sources, this is by decreasing the flow of human pollutants such as oil, fertilizers and pesticides, and the flow of natural elements such as phosphorus, into the water (stormwater quality impacts).
A. True B. False

3. Degradation of lakes, streams and wetlands has economic effects: it reduces property values, raises bills from public water utilities, raises local property tax rates, and reduces tourism and related business income.
A. True B. False

4. The U.S. Environmental Protection Agency (EPA) estimates that 6% of the water quality problems in the nation are caused by nonpoint sources.
A. True B. False

5. Stormwater runoff has no quantity and quality impacts.
A. True B. False

6. Nonpoint source (NPS) pollution is water pollution that consists of contaminated runoff associated with agricultural, urban, and other sources.
A. True B. False

7. The term “nonpoint source pollution” was created under the federal Clean Water Act to distinguish it from “point source” discharges such as industrial wastewater from pipes.
A. True B. False

8. Nonpoint sources include many varied small sources of pollutants from activities.
A. True B. False

9. Every time it rains or the snow melts, pollutants such as dirt, nutrients, bacteria, oils and heavy metals, are swept off from land surfaces and are not carried by runoff water into surface and groundwater.
A. True B. False

10. Stormwater runoff cannot cause flooding, undermine stream banks, and damage property and habitat, as well as carry contaminants that contribute to lower water quality. A. True B. False

11. When people speak about “stormwater quality control”, they are talking about reducing the pollutants from nonpoint sources that are carried by stormwater into our lakes, streams, groundwater, and coastal areas.
A. True B. False

12. The Clean Water Act of 1776 passed by the United States Congress and amended by the Water Quality Act of 1812, set in motion requirements and policy measures for the Environmental Protection Agency (EPA).
A. True B. False

13. The EPA has established regulatory components for Storm Water Discharges that were levied upon associated industries and municipalities with populations over 1,000,000.
A. True B. False

14. The goal of NPDES, through permits and plans, is to reduce to the maximum extent practical, the amount of pollution discharges from the municipal storm drainage systems.
A. True B. False

15. NPDES municipal permits have several components, one being management programs. A term frequently used in this subject matter is - Best Management Practices (BMP).
A. True B. False

16. RMP's are schedules of activities, prohibition of practices, maintenance procedures, and other recommended management practices that may be employed for a particular purpose - Storm Water Pollution Prevention and Reduction.
A. True B. False

17. Although the OSHA regulations seem complex, their goal is simple - "Improve water quality in waters of the United States".
A. True B. False

Basic Program Requirements

18. ____________________ is obtaining a baseline measurement of current water quality, discover and eliminate illicit connections to the system.

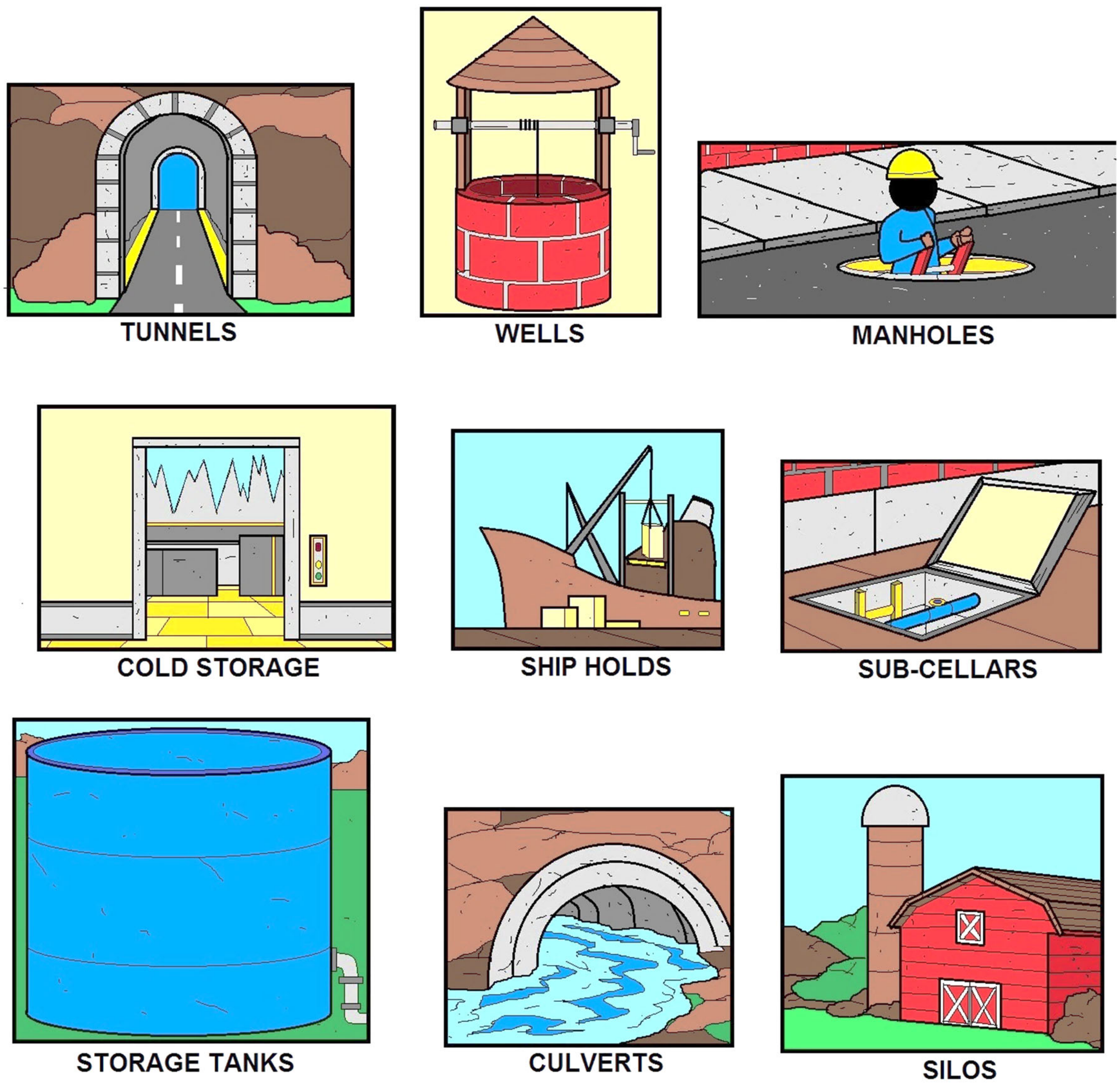
Answers

1. False, 2. False, 3. True, 4. False, 5. False, 6. True, 7. True, 8. True, 9. False, 10. True, 11. True, 12. False, 13. False, 14. True, 15. False, 16. False, 17. False, 18. Stormwater Monitoring Program

Chapter 14- Confined Space Section

Section Focus: You will learn the basics of proper confined space entry. At the end of this section, you will be able to understand and describe confined space and permit required confined spaces. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: The Confined Space Entry Program is provided to protect authorized employees that will enter confined spaces and may be exposed to hazardous atmospheres, engulfment in materials, conditions which may trap or asphyxiate due to converging or sloping walls, or contains any other safety or health hazards.
Reference: OSHA-Permit-Required Confined Spaces (**29 CFR 1910.146**).



EXAMPLES OF CONFINED SPACES

Scenario. A fixed ladder drops deep inside a permit required or type II confined space. One man goes inside and passes out from hazardous fumes. A second man goes in and dies within seconds trying to help his buddy.

A third man goes in to save the others and dies on the spot. Only the first man survives, that is if you can say that being brain dead is surviving. Never try to rescue your buddies unless you are trained and have proper equipment. Never! Call 911 first. This scenario actually happened inside a sewer system. ***Don't be the next victim.***

Confined Spaces are

-large enough to allow entry of any body part, and
-limited or restricted entry or exit, and
-not designed for continuous employee occupancy

Permit Required Confined Spaces are confined spaces that have any of the following
-potential hazardous atmosphere
-material inside that may engulf or trap you
-internal design that could trap or asphyxiate you
-any other serious safety or health hazard

Entry Permits are required before you enter any
"**Permit Required Confined Space**"

Hazards include

- Fire & Explosion
- Engulfment
- Asphyxiation
- Entrapment
- Slips & Falls
- Electric Shock
- Noise & Vibration
- Chemical Exposure
- Toxic Atmospheres
- Thermal / Chemical Burns

Engineering Controls

- ❑ Ventilation
- ❑ Locked Access
- ❑ Lighting

Administrative Controls

- ❑ Controlled Access
- ❑ Hazard Assessments
- ❑ Entry Permits & Procedures
- ❑ Signs & Lockout Tagout
- ❑ Training

Smart Safety Rules

Know what you are getting into.

Know how to get out in an emergency.

Know the hazards & how they are controlled.

Only authorized & trained personnel may enter a Confined Space or act as an attendant.

No smoking in Confined Space or near entrance or exit area.

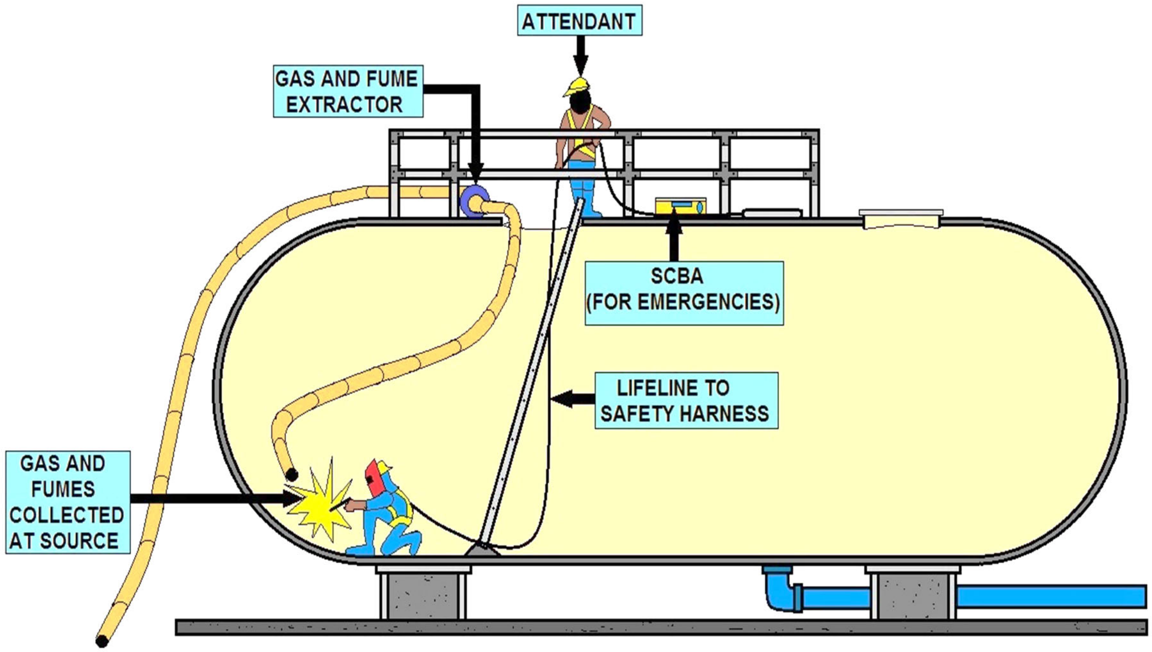
Attendant must be present at all times.

Constant visual or voice communication must be maintained between the attendant and entrants.

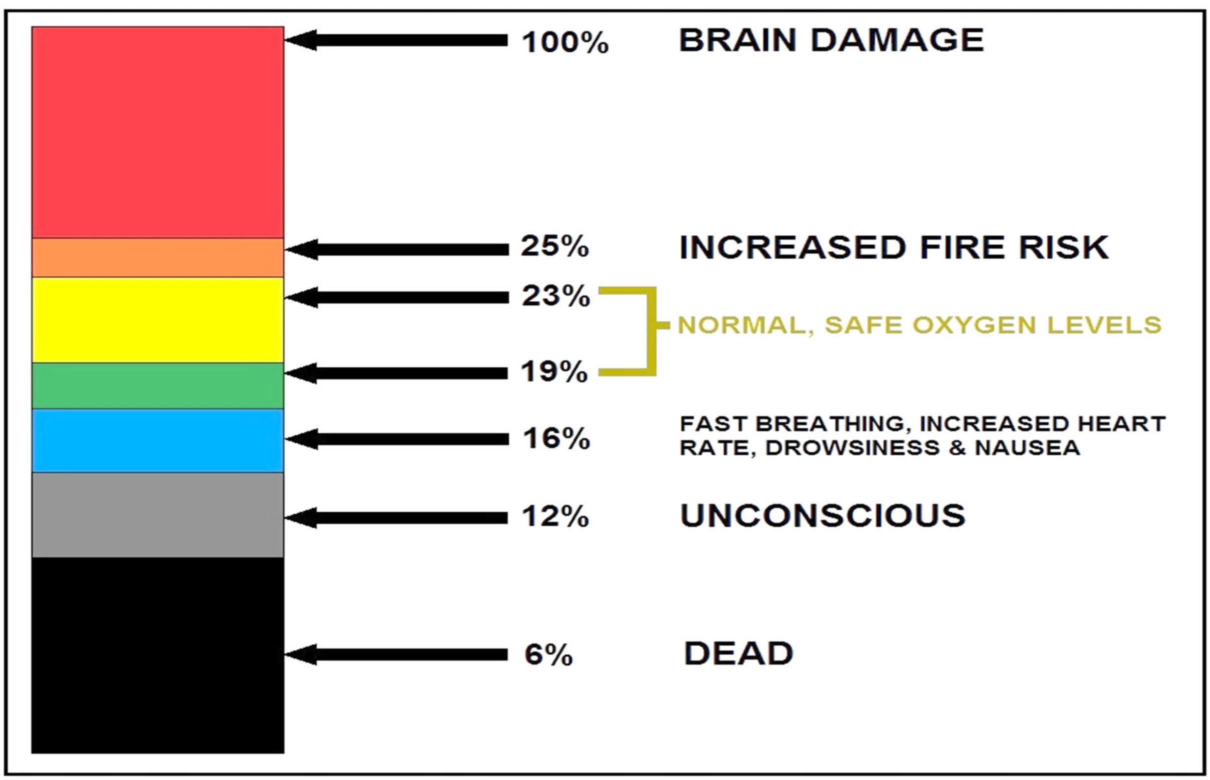
No bottom or side entry will be made, or work conducted below the level any hanging material or material which could cause engulfment.

Air and oxygen monitoring is required before entering a Permit-Required Confined Space.

Ventilation & oxygen monitoring is required when welding is performed.



CONFINED SPACE DIAGRAM



RESULTS OF OXYGEN LEVELS IN CONFINED SPACES

Confined Space Terms

"Acceptable entry conditions" means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.

"Attendant" means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

"Authorized entrant" means an employee who is authorized by the employer to enter a permit space.

"Blanking or blinding" means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

"Confined space" means a space that:
(1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and

(2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and

(3) Is not designed for continuous employee occupancy.

"Double block and bleed" means the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

"Emergency" means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

"Engulfment" means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

"Entry" means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

"Entry permit (permit)" means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.

"Entry supervisor" means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.

NOTE: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

"Hazardous atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);

(2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.

(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;

(4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;

NOTE: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

(5) Any other atmospheric condition that is immediately dangerous to life or health.

NOTE: For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets that comply with the Hazard Communication Standard, section 1910.1200 of this Part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

"Hot work permit" means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

"Immediately dangerous to life or health (IDLH)" means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

NOTE: Some materials -- hydrogen fluoride gas and cadmium vapor, for example -- may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

"Inerting" means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

NOTE: This procedure produces an IDLH oxygen-deficient atmosphere.

"Isolation" means the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

"Line breaking" means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

"Non-permit confined space" means a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

"Oxygen deficient atmosphere" means an atmosphere containing less than 19.5 percent oxygen by volume.

"Oxygen enriched atmosphere" means an atmosphere containing more than 23.5 percent oxygen by volume.

"Permit-required confined space (permit space)" means a confined space that has one or more of the following characteristics:

(1) Contains or has a potential to contain a hazardous atmosphere;

(2) Contains a material that has the potential for engulfing an entrant;

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

(4) Contains any other recognized serious safety or health hazard.

"Permit-required confined space program (permit space program)" means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

"Permit system" means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

"Prohibited condition" means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

"Rescue service" means the personnel designated to rescue employees from permit spaces.

"Retrieval system" means the equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

"Testing" means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

Would you consider this a confined space? How about a permit required?
Think about the various chemicals that we use inside confined spaces.

Confined Space Entry Program - Introduction

Purpose

The Confined Space Entry Program is provided to protect authorized employees that will enter confined spaces and may be exposed to hazardous atmospheres, engulfment in materials, conditions which may trap or asphyxiate due to converging or sloping walls, or contains any other safety or health hazards.
Reference: OSHA-Permit-Required Confined Spaces (**29 CFR 1910.146**).

Scope

You are required to recognize the dangers and hazards associated with confined spaces, and this program is designed to assist you in the safety of and compliance with the OSHA standards associated with such.

Most communities will utilize the Fire Department for all rescues and additional assistance dealing with confined spaces, understanding that most Fire Department operations utilize additional in house SOG's/SOP's pertaining to such operations.

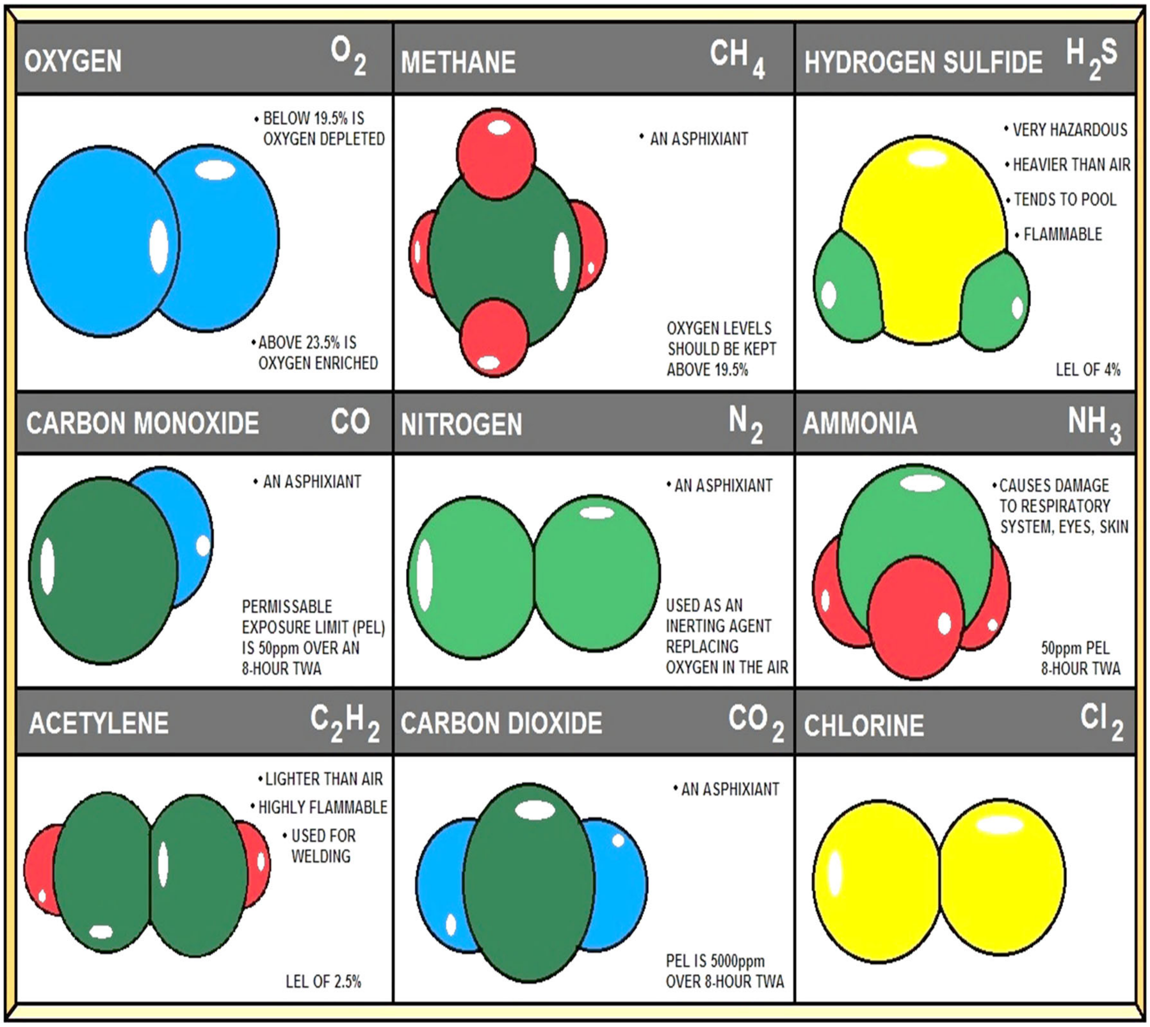
Definitions

Confined space:

- ✓ Is large enough or so configured that an employee can bodily enter and perform work.
- ✓ Has limited or restricted means for entry or exit (i.e. tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- ✓ Is not designed for continuous employee occupancy.
- ✓ Permit required confined space (permit space), is a confined space that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere.
2. Contains a material that has the potential for engulfing an entrant.
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly covering walls or by a floor that slopes downward and tapers to a smaller cross-section.
4. Contains any other recognized serious safety or health hazard.

Each Permit-Required Confined Space will be marked
"***Confined Space - Entry Permit Required***".



COMMON GASES THAT CAN BE FOUND IN CONFINED SPACE

Confined Space Hazards

Fatalities and injuries constantly occur among construction workers who, during the course of their jobs, are required to enter confined spaces. In some circumstances, these workers are exposed to multiple hazards, any of which may cause bodily injury, illness, or death.

Newspaper and magazine articles abound with stories of workers injured and killed from a variety of atmospheric factors and physical agents. Throughout the construction jobsite, contractors and workers encounter both inherent and induced hazards within confined workspaces.

Inherent Hazards
Inherent hazards, such as electrical, thermal, chemical, mechanical, etc., are associated with specific types of equipment and the interactions among them.

Examples include high voltage (shock or corona discharge and the resulting burns), radiation generated by equipment, defective design, omission of protective features (no provision for grounding non-current-carrying conductive parts), high or low temperatures, high noise levels, and high-pressure vessels and lines (rupturing with resultant release of fragments, fluids, gases, etc.).

Inherent hazards usually cannot be eliminated without degrading the system or equipment, or without making them inoperative. Therefore, emphasis must be placed on hazard control methods.

Induced Hazards
Induced hazards arise, and are induced from, a multitude of incorrect decisions and actions that occur during the actual construction process. Some examples are: omission of protective features, physical arrangements that may cause unintentional worker contact with electrical energy sources, oxygen-deficient atmospheres created at the bottom of pits or shafts, lack of safety factors in structural strength, and flammable atmospheres.

Typical Examples of Confined Workspaces
Following are typical examples of confined workspaces in construction which contain both inherent and induced hazards.

Vaults
A variety of vaults are found on the construction jobsite. On various occasions, workers must enter these vaults to perform a number of functions.

The restricted nature of vaults and their frequently below-grade location can create an assortment of safety and health problems.

Oxygen-Deficient Atmosphere
One of the major problems confronting construction workers while working in vaults is the ever-present possibility of an oxygen-deficient atmosphere.

Explosive or Toxic Gases, Vapors, or Fumes
While working in an electrical vault, workers may be exposed to the build-up of explosive gases such as those used for heating (propane). Welding and soldering produce toxic fumes which are confined in the limited atmosphere.

Electrical Shock
Electrical shock is often encountered from power tools, line cords, etc. In many instances, such electrical shock results from the fact that the contractor has not provided an approved grounding system or the protection afforded by ground-fault circuit interrupters or low-voltage systems.

Purging
In some instances, purging agents such as nitrogen and argon may enter the vault from areas adjacent to it. These agents may displace the oxygen in the vault to the extent that it will asphyxiate workers almost immediately.

Materials Falling In and On
A hazard normally considered a problem associated with confined spaces is material or equipment which may fall into the vault or onto workers as they enter and leave the vault.

Vibration could cause the materials on top of the vault to roll off and strike workers. If the manhole covers were removed, or if they were not installed in the first place, materials could fall into the vault, causing injury to the workers inside.

Condenser Pits
A common confined space found in the construction of nuclear power plants is the condenser pit. Because of their large size, they are often overlooked as potentially hazardous confined spaces.

These below-grade areas create large containment areas for the accumulation of toxic fumes, gases, and so forth, or for the creation of oxygen-deficient atmospheres when purging with argon, Freon, and other inert gases.

Other hazards will be created by workers above dropping equipment, tools, and materials into the pit.

Manholes
Throughout the construction site, manholes are commonplace. As means of entry into and exit from vaults, tanks, pits, and so forth, manholes perform a necessary function. However, these confined spaces may present serious hazards which could cause injuries and fatalities.

A variety of hazards are associated with manholes. To begin with, the manhole could be a dangerous trap into which the worker could fall. Often covers are removed and not replaced, or else they are not provided in the first place.

Pipe Assemblies

One of the most frequently unrecognized types of confined spaces encountered throughout the construction site is the pipe assembly. Piping of sixteen to thirty-six inches in diameter is commonly used for a variety of purposes.

For any number of reasons, workers will enter the pipe. Once inside, they are faced with potential oxygen-deficient atmospheres, often caused by purging with argon or another inert gas. Welding fumes generated by the worker in the pipe, or by other workers operating outside the pipe at either end, subject the worker to toxic atmospheres.

The generally restricted dimensions of the pipe provide little room for the workers to move about and gain any degree of comfort while performing their tasks. Once inside the pipe, communication is extremely difficult. In situations where the pipe bends, communication and extrication become even more difficult. Electrical shock is another problem to which the worker is exposed.

Ungrounded tools and equipment or inadequate line cords are some of the causes. As well, heat within the pipe run may cause the worker to suffer heat prostration.

Ventilation Ducts

Ventilation ducts, like pipe runs, are very common at the construction site. These sheet metal enclosures create a complex network which moves heated and cooled air and exhaust fumes to desired locations in the plant.

Ventilation ducts may require that workers enter them to cut out access holes, install essential parts of the duct, etc. Depending on where these ducts are located, oxygen deficiency could exist. They usually possess many bends, which create difficult entry and exit and which also make it difficult for workers inside the duct to communicate with those outside it. Electrical shock hazards and heat stress are other problems associated with work inside ventilation ducts.

Tanks

Tanks are another type of confined workspace commonly found in construction. They are used for a variety of purposes, including the storage of water, chemicals, etc.

Tanks require entry for cleaning and repairs. Ventilation is always a problem. Oxygen-deficient atmospheres, along with toxic and explosive atmospheres created by the substances stored in the tanks, present hazards to workers. Heat, another problem in tanks, may cause heat prostration, particularly on a hot day.

Since electrical line cords are often taken into the tank, the hazard of electrical shock is always present. The nature of the tank's structure often dictates that workers must climb ladders to reach high places on the walls of the tank.

Sumps

Sumps are commonplace. They are used as collection places for water and other liquids. Workers entering sumps may encounter an oxygen-deficient atmosphere.

Also, because of the wet nature of the sump, electrical shock hazards are present when power tools are used inside. Sumps are often poorly illuminated. Inadequate lighting may create an accident situation.

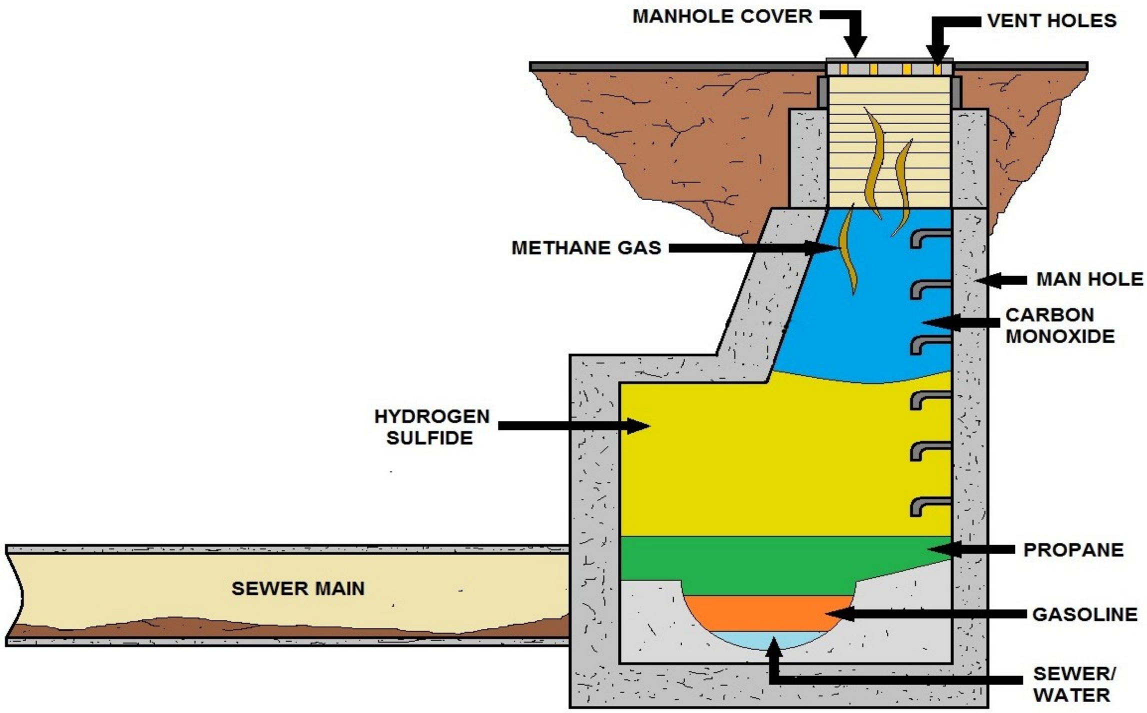
Containment Cavities
These large below-grade areas are characterized by little or no air movement. Ventilation is always a problem. In addition, the possibility of oxygen deficiency exists. As well, welding and other gases may easily collect in these areas, creating toxic atmospheres. As these structures near completion, more confined spaces will exist as rooms are built off the existing structure.

Electrical Transformers
Electrical transformers are located on the jobsite. They often contain a nitrogen purge or dry air. Before they are opened, they must be well vented by having air pumped in. Workers, particularly electricians and power plant operators, will enter these transformers through hatches on top for various work-related reasons. Testing for oxygen deficiency and for toxic atmospheres is mandatory.

Heat Sinks
These larger pit areas hold cooling water in the event that there is a problem with the pumps located at the water supply to the plant--normally a river or lake--which would prevent cooling water from reaching the reactor core.

When in the pits, workers are exposed to welding fumes and electrical hazards, particularly because water accumulates in the bottom of the sink.

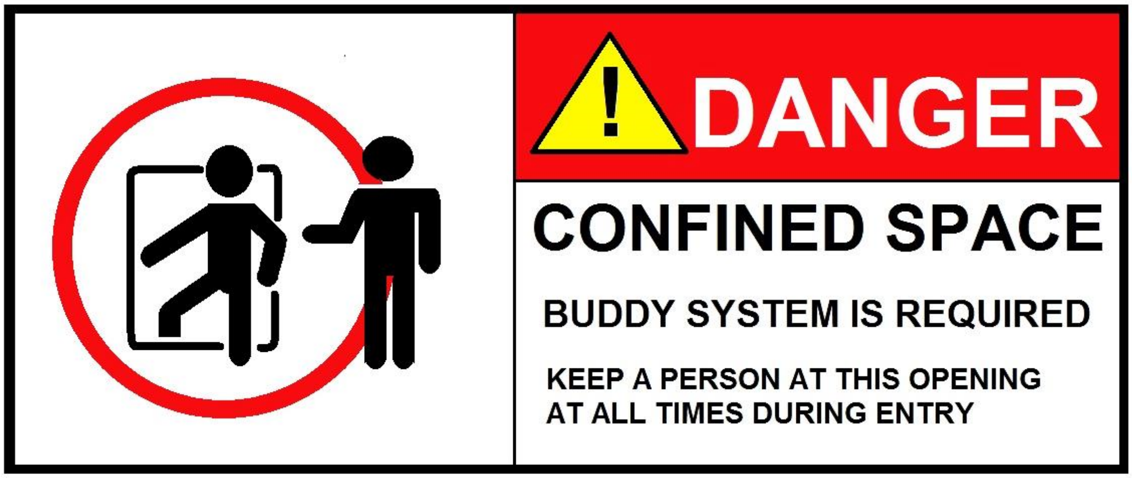
Generally, it is difficult to communicate with workers in the heat sink, because the rebar in the walls of the structure deaden radio signals.



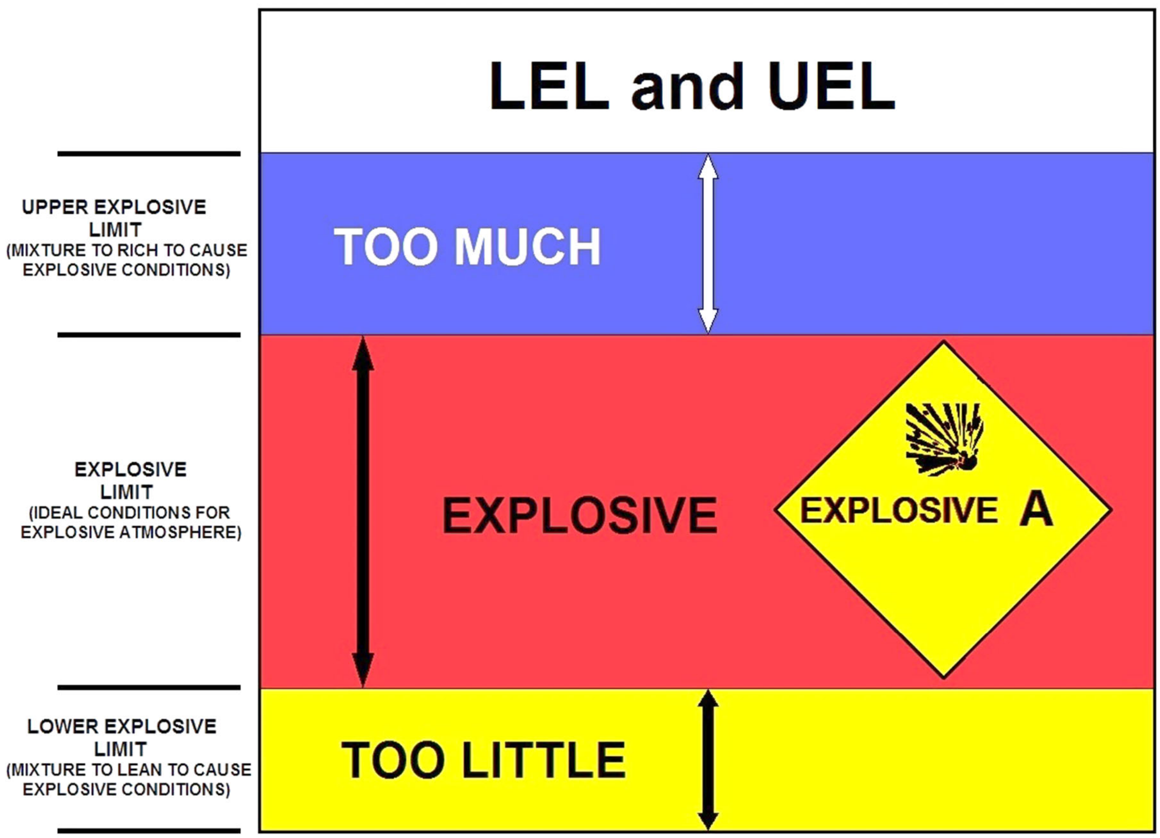
POSSIBLE HAZARDOUS ATMOSPHERES PRESENT IN A CONFINED SPACE (EXAMPLE IS OF A SEWER MAIN)

COMMON HAZARDOUS GASES THAT MAY BE PRESENT IN CONFINED SPACE					
SUBSTANCE *	8-HOUR TIME-WEIGHTED AVERAGE (TWA)	15-MINUTE SHORT-TERM EXPOSURE LIMIT (STEL)	CEILING LIMIT (Never To Be Exceeded)	IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH)	RECOMMENDED ALARM SETTINGS (Low / High)
AMMONIA	25 ppm	35 ppm	—	300 ppm	13 ppm / 25 ppm
CARBON MONOXIDE	25 ppm	100 ppm	—	1200 ppm	13 ppm / 25 ppm
CHLORINE	0.5 ppm	1 ppm	—	10 ppm	0.25 ppm / 0.5 ppm
HYDROGEN SULFIDE	—	—	10 ppm	100 ppm	5 ppm / 10 ppm
METHANE	1000 ppm	—	—	—	500 ppm / 1000 ppm
NITROGEN DIOXIDE	—	—	1 ppm	20 ppm	0.5 ppm / 1 ppm
SULFUR DIOXIDE	2 ppm	5 ppm	—	100 ppm	1 ppm / 2 ppm
OXYGEN	—	—	—	—	20.5 % of Atmosphere
LOWER EXPLOSIVE LIMIT (LEL)	—	—	—	—	5 % LEL

EXAMPLE OF A CHART OF CONFINED SPACE GASES



EXAMPLE OF A CONFINED SPACE ENTRY DANGER SIGN



UNDERSTANDING UPPER (UEL) & LOWER (LEL) EXPLOSIVE LIMITS

Unusual Conditions

Confined Space within a Confined Space
By the very nature of construction, situations are created which illustrate one of the most hazardous confined spaces of all--a confined space within a confined space.

This situation appears as tanks within pits, pipe assemblies or vessels within pits, etc. In this situation, not only do the potential hazards associated with the outer confined space require testing, monitoring, and control, but those of the inner space also require similar procedures.

Often, only the outer space is evaluated. When workers enter the inner space, they are faced with potentially hazardous conditions.

A good example of a confined space within a confined space is a vessel with a nitrogen purge inside a filtering water access pit. Workers entering the pit and/or the vessel should do so only after both spaces have been evaluated and proper control measures established.

Hazards in One Space Entering another Space
During an examination of confined spaces in construction, one often encounters situations which are not always easy to evaluate or control. For instance, a room or area which classifies as a confined space may be relatively safe for work.

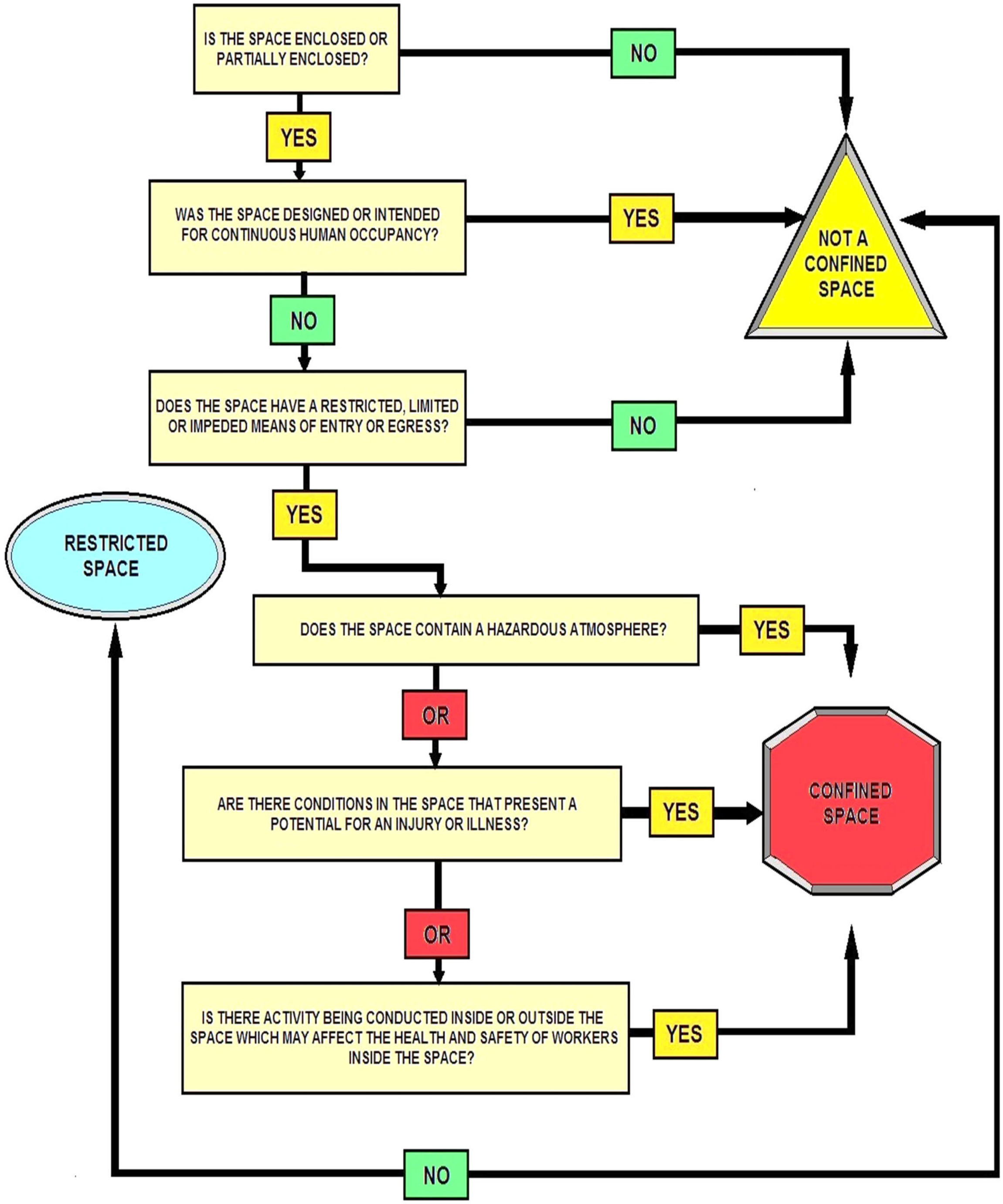
However, access passages from other areas outside or adjacent to the room could, at some point, allow the transfer of hazardous agents into the "***safe***" one. One such instance would be a pipe coming through a wall into a containment room.

Welding fumes and other toxic materials generated in one room may easily travel through the pipe into another area, causing it to change from a safe to an unsafe workplace.

A serious problem with a situation such as this is that workers working in the "**safe**" area are not aware of the hazards leaking into their area. Thus, they are not prepared to take action to avoid or control it.

Session Conclusion
In this discussion, we have defined inherent and induced hazards in confined spaces. We have examined typical confined spaces on construction sites and we have described representative hazards within these confined spaces.

Most of this text is credited to OSHA.



HOW TO DETERMINE CONFINED SPACES

Most of this text is credited to OSHA.

Permitted Confined Space Entry Program

Definition of Confined Spaces Requiring an Entry Permit
Confined space:

- ✓ Is large enough or so configured that an employee can bodily enter and perform work.
- ✓ Has limited or restricted means for entry or exit (i.e. tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- ✓ Is not designed for continuous employee occupancy.

Purpose
The Permit Required Space (PRCS) Program is provided to protect authorized employees that will enter confined spaces and may be exposed to hazardous atmospheres, engulfment in materials, conditions which may trap or asphyxiate due to converging or sloping walls, or contains any other safety or health hazards.

Many workplaces contain confined spaces not designed for human occupancy which due to their configuration hinder employee activities including entry, work and exit. Asphyxiation is the leading cause of death in confined spaces.

Subpart P applies to all open excavations in the earth's surface.

- ✓ All trenches are excavations.
- ✓ All excavations are not trenches.

Permit Required Confined Space Entry General Rules

During all confined space entries, the following safety rules must be strictly enforced:

1. Only authorized and trained employees may enter a confined space or act as safety watchmen/attendants.

2. No smoking is permitted in a confined space or near entrance/exit area.

3. During confined space entries, a watchmen or attendant must be present at all times.

4. Constant visual or voice communication will be maintained between the safety watchmen and employees entering a confined space.

5. No bottom or side entry will be made or work conducted below the level any hanging material or material which could cause engulfment.

6. Air and oxygen monitoring is required before entering any permit-required confined space. Oxygen levels in a confined space must be between 19.5 and 23.5 percent. Levels above or below will require the use of an SCBA or other approved air supplied respirator. Additional ventilation and oxygen level monitoring is required when welding is performed. The monitoring will check oxygen levels, explosive gas levels and carbon monoxide levels. Entry will not be permitted if explosive gas is detected above one-half the Lower Explosive Limit (LEL).

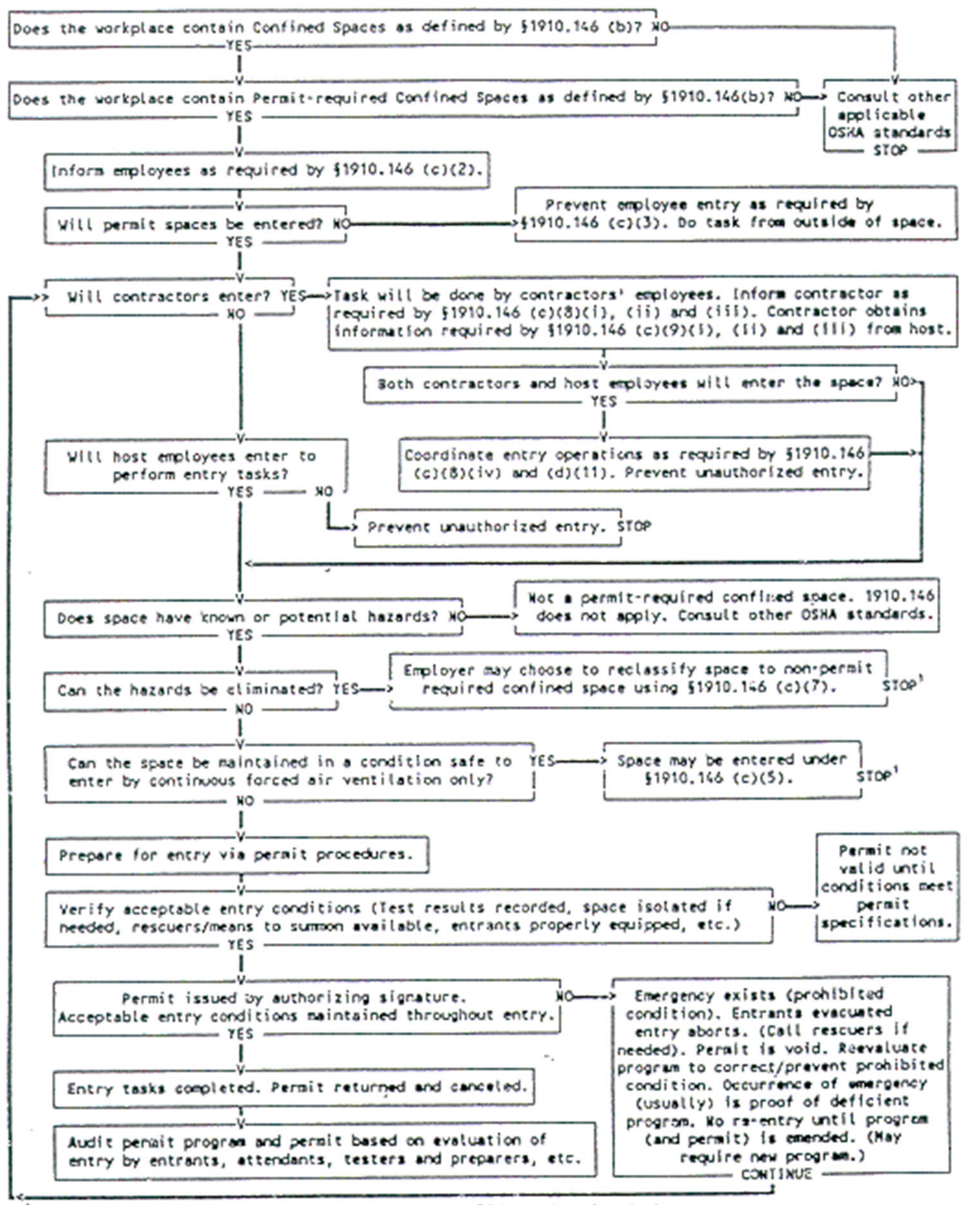
7. To prevent injuries to others, all openings to confined spaces will be protected by a barricade when covers are removed.

Appendix A to §1910.146

Permit-Required Confined Space Decision Flow Chart

Note: Appendices A through F serve to provide information and non-mandatory guidelines to assist employers and employees in complying with the appropriate requirements of this section.

APPENDIX A TO §1910.146—PERMIT-REQUIRED CONFINED SPACE DECISION FLOW CHART



[1] Spaces may have to be evacuated and re-evaluated if hazards arise during entry

[58 FR 4549, Jan. 14, 1993; 58 FR 34846, June 29, 1993; 63 FR 66039, Dec. 1, 1998]

Confined Space Entry Permit *Example*

Date & Time Issued		Date & time Expires	
Space I.D.		Supervisor	
Equipment Affected		Task	
Standby Team			
Pre-Entry Atmospheric Checks	Time (am - pm)		
	Oxygen		
	Explosive (% LEL)		
	Toxic (PPM)		
	Testers Signature		

Pre-entry Fluid System Isolation	Yes	No
Pumps /lines blinded, blocked, disconnected		
Ventilation Source Established		
Mechanical Forced Air		
Natural Ventilation		
Post Ventilation Pre-Entry Atmospheric Checks		
Time		
Oxygen (%)		
Explosive (% LEL		
Toxic (PPM)		
Tester Signature		
Communication Procedures Established per specific Confined Space SOP		
Rescue Procedures established per specific Confined Space SOP		

Training Verification - for the following persons & space to be entered	YES	NO
All persons entering Confined Space		
All persons acting as Supervisor for the Entry		
All persons assigned backup positions		
All persons assigned to monitor access and interior activities		
All persons assigned to emergency rescue team		

Equipment on Scene	YES	NO	NA		YES	NO	NA
Gas Monitor				Life Line			
Safety Harness				Hoisting Equipment			
Fall Arrest Gear				Powered Comm Eq.			
SCBAs				Air Line Respirators			

Protective Clothing				Elect Gear Properly Rated			

Periodic Atmospheric Checks				
Time (am - pm)				
Oxygen				
Explosive (% LEL)				
Toxic (PPM)				
Testers Signature				

A review of the work authorized by this permit and the information contained on this Entry Permit. Written instructions and safety procedures have been received and are understood. Entry cannot be approved if any squares are marked in the "**No**" column. This permit is not valid unless all appropriate items are completed.

Permit Prepared By: (Supervisor) ________________________________

Approved By: (Unit Supervisor) __________________________________

This permit to be kept at job site.
Return job site copy to Safety Office following job completion.

Copies: Safety Office, Unit Supervisor, Job site

Confined Space Duties & Responsibilities

Examples of Assignments
Employees

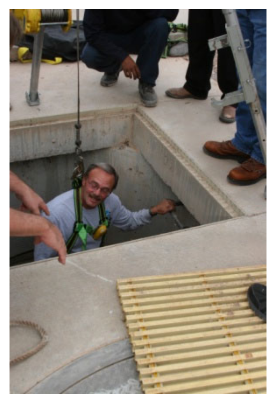
- Follow program requirements.
- Report any previously un-identified hazards associated with confined spaces.
- Do not enter any confined spaces that have not been evaluated for safety concerns.

Management

- Provide annual Confined Space training to all employees that may need confined space training.
- Ensure confined space assessments have been conducted.
- Annually review this program and all Entry Permits.

Rescue or Training Department

- Ensure proper training for entry & rescue teams.
- Provide proper equipment for entry & rescue teams.
- Ensure all permit required confined spaces are posted.
- Evaluate rescue teams and service to ensure they are adequately trained and prepared.
- Ensure rescue team at access during entry into spaces with Immediately Dangerous to Life or Health (IDLH) atmospheres.
- Provide annual confined space awareness training to all employees that may need confined space awareness training.



Entry Supervisor
Entry supervisors are responsible for the overall permit space entry and must coordinate all entry procedures, tests, permits, equipment and other relevant activities.

The following entry supervisor duties are required:
Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

- Verify by checking that the appropriate entries have been made on the permit, all tests specified by the permit have been conducted, and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.
- Terminate the entry and cancel the permit when the entry is complete or there is a need for terminating the permit.
- Verify that rescue services are available and that the means for summoning them are operable.

- Remove unauthorized persons who enter or attempt to enter the space during entry operations.

Determine whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space that entry operations remain consistent with the permit terms and that acceptable entry conditions are maintained.

Entry Attendants
At least one attendant is required outside the permit space into which entry is authorized for the duration of the entry operation.

Responsibilities include:

- To know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
- To be aware of possible behavioral effects of hazard exposure on entrants.
- To continuously maintain an accurate count of entrants in the permit space and ensures a means to accurately identify authorized entrants.
- To remain outside the permit space during entry operations until relieved by another attendant (once properly relieved, they may participate in other permit space activities, including rescue if they are properly trained and equipped).
- To communicate with entrants as necessary to monitor entrant status and alert entrants of the need to evacuate.
- To monitor activities inside and outside the space to determine if it is safe for entrants to remain in the space; orders the entrants to immediately evacuate if: the attendant detects a prohibited condition, detects entrant behavioral effects of hazard exposure, detects a situation outside the space that could endanger the entrants; or if the attendant cannot effectively and safely perform all the attendant duties.
- To summon rescue and other emergency services as soon as the attendant determines the entrants need assistance to escape the permit space hazards.
- To perform non-entry rescues as specified by that rescue procedure and entry supervisor and not to perform duties that might interfere with the attendants' primary duty to monitor and protect the entrants.

Most of this text is credited to OSHA.

Is Entry Necessary?

Can the task be accomplished from the outside? For example, measures that eliminate the need for employees to enter confined spaces should be carefully evaluated and implemented if at all possible before considering human entry into confined spaces to perform non-emergency tasks.

CONFINED SPACE ENTRY CHECKLIST EXAMPLE

Entering a Confined Space Procedures

This space requires an emergency retrieval system, continuous air monitoring, and safety watch or two-way communication for safe entry.

Donning the personal protective equipment (PPE) necessary for confined space entry.

The full-body harness provides fully adjustable leg and shoulder straps for worker comfort and proper fit. Stamped steel sliding back D-ring and sub-pelvic strap provide optimum force distribution.

Example of a "***D-Ring***" and fall protection harness used when entering a confined space. The D-Ring provides a compatible anchor point for connecting devices such as lanyards or retractable lifelines. The shock absorbing lanyard provides a deceleration distance during a fall to reduce fall arrest forces for extra protection against injury.

Tripod-retrieval assembly in use for an entry into one of the many confined spaces.

Checking the cable tension and inertial locking mechanism of the retrieval assembly.

Correct use of this device prevents free-falls greater than 2 feet.

The entrant descends into the space as the attendant critiques the operation.

Dramatic rescue simulation using the tripod-retrieval system.

The entrant is now safely out of the space and is ready to return to his many other projects after this simulated exercise.

Duties of the Person Authorizing or in Charge of the Entry

The person who authorizes or is in charge of the permit entry confined space must comply with the following:

1. Make certain that all pre-entry requirements as outlined on the permit have been completed before any worker is allowed to enter the confined space.
2. Make certain that any required pre-entry conditions are present.
3. If an in-plant/facility rescue team is to be used in the event of an emergency, make sure they would be available. If your Employer does not maintain an in-plant rescue team, dial 911 on any telephone for the Rescue Squad.
4. Make sure that any communication equipment which would be used to summon either the in-plant rescue team or other emergency assistance is operating correctly.
5. Terminate the entry upon becoming aware of a condition or set of conditions whose hazard potential exceeds the limits authorized by the entry permit.

If the person who would otherwise issue an entry permit is in charge of the entry and present during the entire entry, then a written permit is not required if that person uses a checklist as provided in the section on "***Permits***".

This person may also serve as the attendant at the site.

Special Considerations During A Permit Required Entry

Certain work being performed in a permit entry confined space could cause the atmosphere in the space to change.

Examples of this are welding, drilling, or sludge removal. In these situations, air monitoring of the confined space should be conducted on a continuous basis throughout the time of the entry.

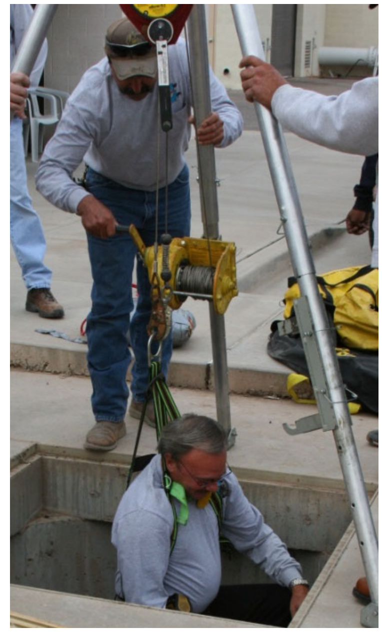
If the workers leave the confined space for any significant period of time, such as for a lunch or other break, the atmosphere of the confined space must be retested before the workers reenter the confined space.

Unauthorized Persons

Take the following actions when unauthorized persons approach or enter a permit space while entry is under way:

1. Warn the unauthorized persons that they must stay away from the permit space,
2. Advise unauthorized persons that they must exit immediately if they have entered the space, and
3. Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.

Entrants



All entrants must be authorized by the entry supervisor to enter permit spaces, have received the required training, have used the proper equipment, and observed the entry procedures and permit requirements.

The following entrant duties are required:
Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

Properly use the equipment required for safe entry;
Communicate with the attendant as necessary to enable the attendant to monitor the status of the entrants and to enable the attendant to alert the entrants of the need to evacuate the space if necessary;

Alert the attendant whenever; the entrant recognizes any warning signs or symptoms of exposure to a dangerous situation, or any prohibited condition is detected; and Exit the permit space as quickly as possible whenever the attendant or entry supervisor gives an order to evacuate the permit space, the entrant recognizes any warning signs or symptoms of exposure to a dangerous situation, the entrant detects a prohibited condition, or an evacuation alarm is activated.

Hazards

- ✓ **Explosive / Flammable Atmospheres**
- ✓ **Toxic Atmospheres**
- ✓ **Engulfment**
- ✓ **Asphyxiation**
- ✓ **Entrapment**
- ✓ **Slips & falls**
- ✓ **Chemical Exposure**
- ✓ **Electric Shock**
- ✓ **Thermal / Chemical Burns**
- ✓ **Noise & Vibration**

Hazard Control

Engineering Controls

- ➢ Locked entry points
- ➢ Temporary ventilation
- ➢ Temporary Lighting

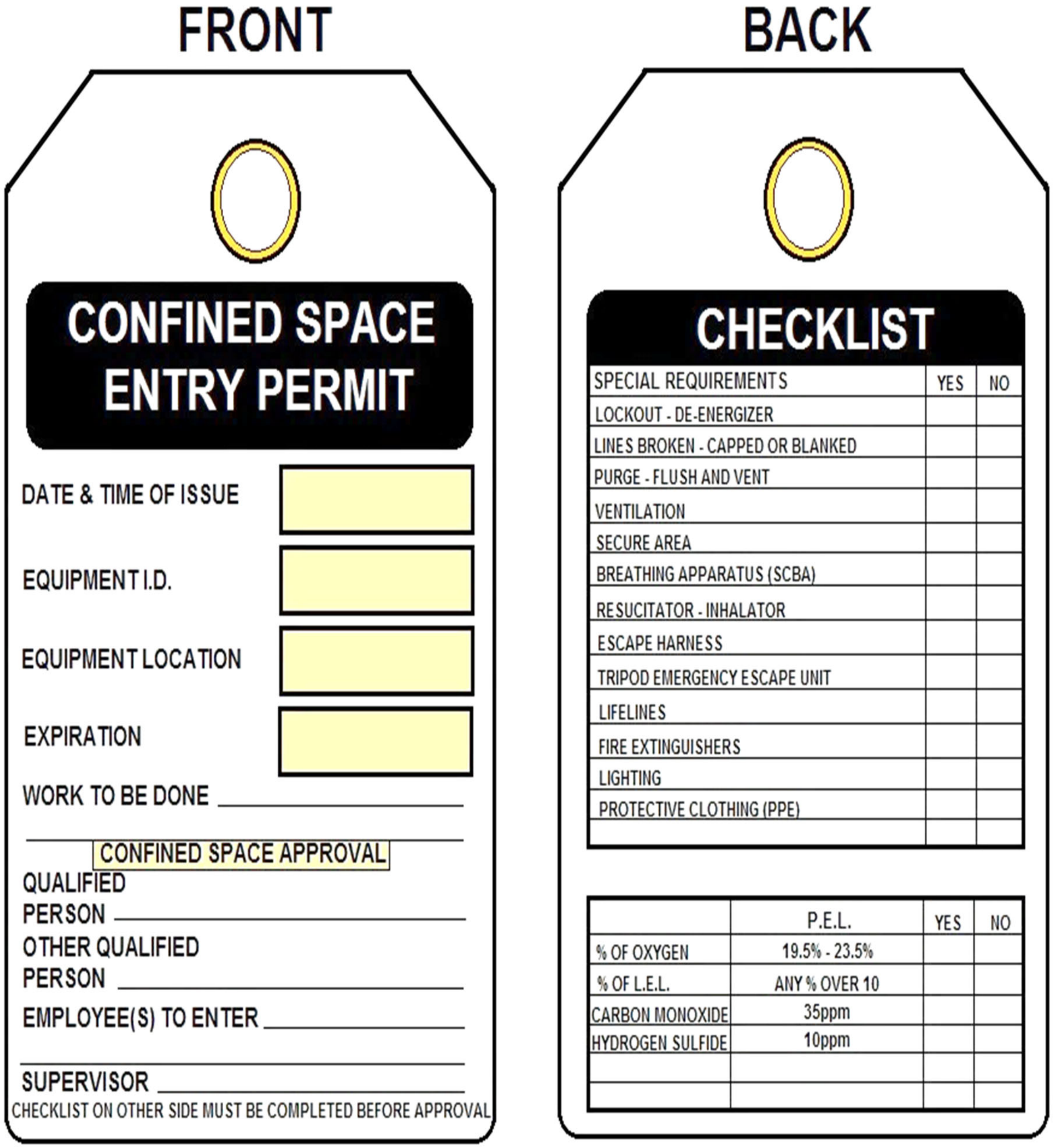
Administrative Controls

- ➢ Signs
- ➢ Employee training
- ➢ Entry procedures
- ➢ Atmospheric Monitoring
- ➢ Rescue procedures
- ➢ Use of prescribed Personal Protective Equipment

Entry Standard Operating Procedures

This program outlines:

- ➢ Hazards
- ➢ Hazard Control & Abatement
- ➢ Acceptable Entry Conditions
- ➢ Means of Entry
- ➢ Entry Equipment Required
- ➢ Emergency Procedures



FRONT

CONFINED SPACE ENTRY PERMIT

DATE & TIME OF ISSUE

EQUIPMENT I.D.

EQUIPMENT LOCATION

EXPIRATION

WORK TO BE DONE ____________

CONFINED SPACE APPROVAL

QUALIFIED PERSON ____________

OTHER QUALIFIED PERSON ____________

EMPLOYEE(S) TO ENTER ____________

SUPERVISOR ____________

CHECKLIST ON OTHER SIDE MUST BE COMPLETED BEFORE APPROVAL

BACK

CHECKLIST

SPECIAL REQUIREMENTS	YES	NO
LOCKOUT - DE-ENERGIZER		
LINES BROKEN - CAPPED OR BLANKED		
PURGE - FLUSH AND VENT		
VENTILATION		
SECURE AREA		
BREATHING APPARATUS (SCBA)		
RESUCITATOR - INHALATOR		
ESCAPE HARNESS		
TRIPOD EMERGENCY ESCAPE UNIT		
LIFELINES		
FIRE EXTINGUISHERS		
LIGHTING		
PROTECTIVE CLOTHING (PPE)		

	P.E.L.	YES	NO
% OF OXYGEN	19.5% - 23.5%		
% OF L.E.L.	ANY % OVER 10		
CARBON MONOXIDE	35ppm		
HYDROGEN SULFIDE	10ppm		

EXAMPLE OF A CONFINED SPACE ENTRY TAG

Permit Required Confined Space Entry General Rules

During all confined space entries, the following safety rules must be strictly enforced:
1. Only authorized and trained employees may enter a confined space or act as safety watchman/attendant.

2. No smoking is permitted in a confined space or near entrance/exit area.

3. During confined space entries, a watchman must be present at all times.

4. Constant visual or voice communication will be maintained between the safety watchman/attendant and employees entering a confined space.

5. No bottom or side entry will be made or work conducted below the level of any hanging material or material which could cause engulfment.

6. Air and oxygen monitoring is required before entering any permit-required confined space. Oxygen levels in a confined space must be between 19.5 and 23.5 percent. Levels above or below will require the use of an SCBA or other approved air supplied respirator.

Additional ventilation and oxygen level monitoring is required when welding is performed.

The monitoring will check oxygen levels, explosive gas levels and carbon monoxide levels. Entry will not be permitted if explosive gas is detected above one-half the Lower Explosive Limit (LEL), or 10% of a specific gas explosive limit.

7. To prevent injuries to others, all openings to confined spaces will be protected by a barricade when covers are removed.

Confined Space Entry Procedures
Each employee who enters or is involved in the entry must:
1. Understand the procedures for confined space entry

2. Know the Hazards of the specific space

3. Review the specific procedures for each entry

4. Understand how to use entry and rescue equipment

Confined Space Entry Permits
- ✓ Confined Space Entry Permits must be completed before any employee enters a permit-required confined space. The permit must be completed and signed by an authorized member of management before entry.

- ✓ Permits will expire before the completion of the shift or if any pre-entry conditions change.

- ✓ Permits will be maintained on file for 12 months.

Contractor Entry

All work by non-company employees that involves the entry into confined spaces will follow the procedures of this program. The information of this program and specific hazards of the confined spaces to be entered will be provided to contractor management prior to commencing entry or work.

Important Rescue Service Questions

What is the availability of the rescue service?

Is it unavailable at certain times of the day or in certain situations?

What is the likelihood that key personnel of the rescue service might be unavailable at times?

If the rescue service becomes unavailable while an entry is underway, does it have the capability of notifying the employer so that the employer can instruct the attendant to abort the entry immediately?

Confined Space Training Sub-Section

***Training for Confined Space Entry includes*:**

1. Duties of entry supervisor, entrant and attendants
2. Confined space entry permits
3. Hazards of confined spaces
4. Use of air monitoring equipment
5. First aid and CPR training
6. Emergency action & rescue procedures
7. Confined space entry & rescue equipment
8. Rescue training, including entry and removal from representative spaces

Confined Space Training and Education

OSHA's General Industry Regulation, §1910.146 Permit-required confined spaces, contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. This regulation does not apply to construction.

On May 4, 2015, OSHA issued a new standard for construction work in confined spaces, which became effective August 3, 2015. Confined spaces can present physical and atmospheric hazards that can be avoided if they are recognized and addressed prior to entering these spaces to perform work. The new standard, Subpart AA of 29 CFR 1926 will help prevent construction workers from being hurt or killed by eliminating and isolating hazards in confined spaces at construction sites similar to the way workers in other industries are already protected. These requirements are shown below.

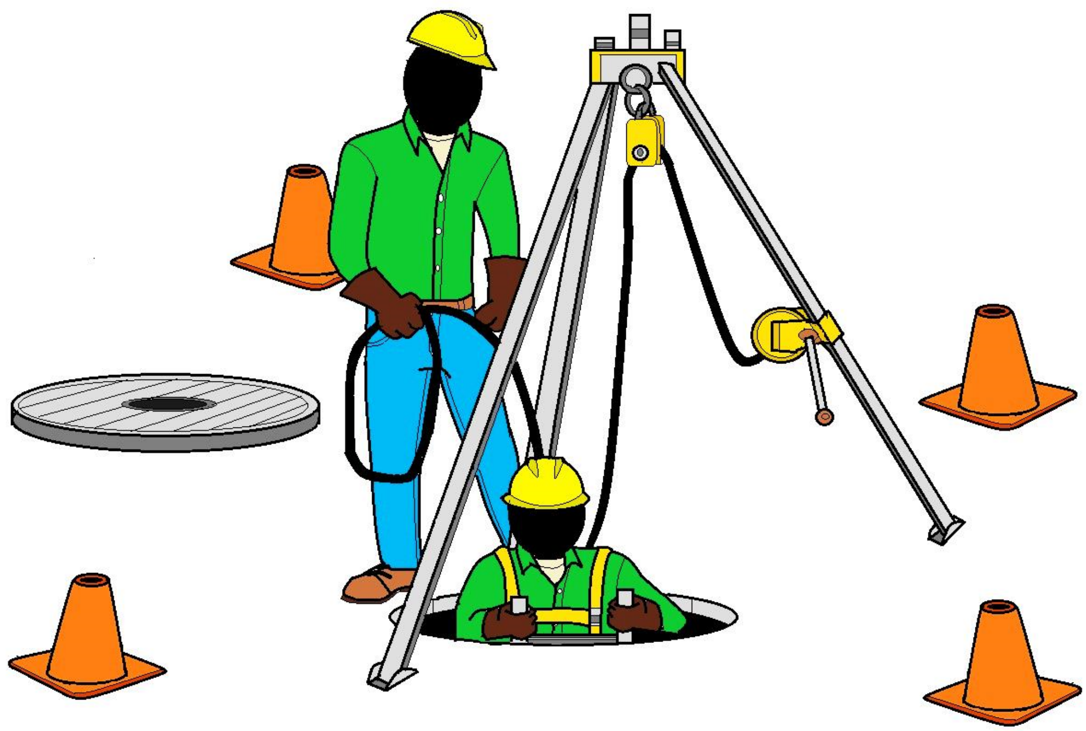
§1926.21 Safety Training and Education. (Partial)

(b)(6)(i) All employees required to enter into confined or enclosed spaces shall be instructed as to the nature of the hazards involved, the necessary precautions to be taken, and in the use of protective and emergency equipment required. The employer shall comply with any specific regulations that apply to work in dangerous or potentially dangerous areas.

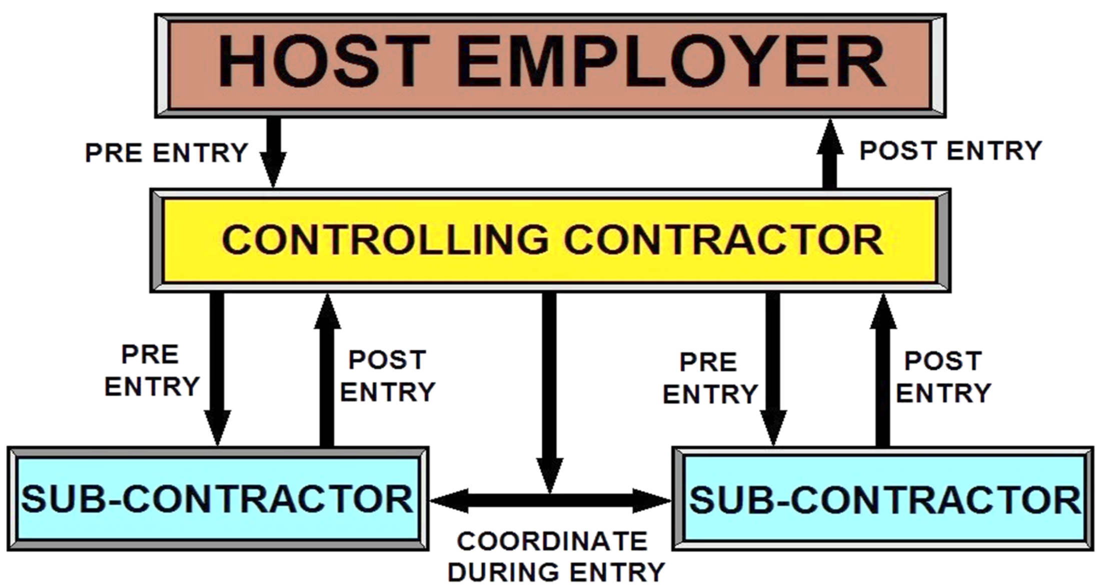
(ii) For purposes of paragraph (b)(6)(i) of this section, "***confined or enclosed space***" means any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined or enclosed spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels pipelines, and open top spaces more than 4 feet in depth such as pits, tubs, vaults, and vessels.

OSHA's Construction Regulations also contain requirements dealing with confined space hazards in underground construction (Subpart S), underground electric transmission and distribution work (§1926.956), excavations (Subpart P), and welding and cutting (Subpart J).

Further guidance may be obtained from American National Standard ANSI Z117.1-1989, Safety Requirements for Confined Spaces. This standard provides minimum safety requirements to be followed while entering, exiting and working in confined spaces at normal atmospheric pressure. This standard does not pertain to underground mining, tunneling, caisson work or other similar tasks that have established national consensus standards.



ENTERING A CONFINED SPACE



COORDINATING CONFINED SPACE ENTRY ON JOBSITES

Your Employer is Responsible for Certain Training Requirements
These are as follows:

1. **GENERAL:** As an employer, your employer must ensure that all workers who must enter a permit entry confined space in the course of their work are informed of appropriate procedures and controls for entry into such spaces. These workers must be made aware of the fact that an unauthorized entry could be fatal, and that their senses are unable to detect and evaluate the severity of atmospheric hazards.

2. **TRAINING FOR AUTHORIZED ENTRANTS:** Your employer must ensure that all authorized entrants know the emergency action plan and have received training covering the following subjects prior to entering any permit entry confined space:

a**. Hazard Recognition**: Each worker must understand the nature of the hazard before entering and the need to perform appropriate testing to determine if it is safe to enter.

b. **Use of Personal Protective Equipment**: Each employee must be taught the proper use of all personal protective equipment required for entry or rescue, and the proper use of protective barriers and shields.

c. **Self-Rescue**: Each worker must be trained to get out of the confined space as rapidly as possible without help whenever an order to evacuate is given by the attendant, whenever an automatic evacuation alarm is activated, or whenever workers recognize the warning signs of exposure to substances that could be found in the confined space.

They must also be made aware of the toxic effects or symptoms of exposure to hazardous materials he could encounter in the confined space. This includes anything that could be absorbed through the skin or which could be carried through the skin by any solvents that are used. They must be trained to relay an alarm to the attendant and to attempt self- rescue immediately upon becoming aware of these effects.

d. **Special Work Practices or Procedures**: Each worker must be trained in any modifications of normal work practices that are necessary for permit entry confined space work.

3. **TRAINING FOR PERSONS AUTHORIZING OR IN CHARGE OF ENTRY:** In addition to other requirements already covered, the person authorizing or in charge of entry shall be trained to recognize the effects of exposure to hazards that could be in the confined space. They must also carry out all duties that the permit assigns to them.

Rescue practice training. This photo is showing a sand bag being utilized as a dummy.

4. **TRAINING FOR ATTENDANT** Any worker functioning as an attendant at a permit entry confined space must be trained in the company's emergency action plan, the duties of the attendant, and in;

a. Proper use of the communications equipment furnished for communicating with authorized workers entering the confined space or for summoning emergency or rescue services.

b. Authorized procedures for summoning rescue or other emergency services.

c. Recognition of the unusual actions of a worker which could indicate that they could be experiencing a toxic reaction to contaminants that could be present in the space.

d. Any training for rescuers, if the attendant will function as a rescuer also.

e. Any training for workers who enter the confined space, if the permit specifies that the duty of the attendant will rotate among the workers authorized to enter the confined space.

CONFINED SPACE AUTHORIZED ENTRANT'S LOG EXAMPLE

CONFINED SPACE: **DATE:**

TIME:

ENTRANT'S NAME (PRINT)	TIME IN	TIME OUT

ENTRY Attendant:

ENTRY Supervisor Review:

Confined Space Entry Procedure

Space _________________ Date Last Modified _____________

Place check mark in all applicable areas

	Hazards		**Personal Protective Equipment**
	Explosive / Combustion Hazard		Air supplied Respirator
	Exposed Electrical Circuits		Air Purifying Respirator
	Unguarded Machine Parts		Welding Protection
	Atmospheric Hazard		Gloves
	Potential Atmospheric Hazard		Hard Hat
	Thermal Hazard		**Ventilation Requirements**
	Chemical Hazard		Continuous ___cu.ft/min Note*: See Ventilation Guidelines for Confined Spaces for typical ventilation configurations and formulas.*
	Fall Hazard		
	Engulfment hazard		Note: *Additional ventilation may be required for hot work, grinding or other operations that would produce airborne fumes, mist or dust. Entry Supervisor must assess additional ventilation requirements base on tasks to be performed in the space*
	Converging Walls		
	Floors slope-small cross-section		
	Slip Hazard		
	Entry Path		Vent Exhaust Point:
	Side entry		Vent Supply Point:
	Bottom entry		Space Volume
	Door		**Initial Purge Time=** 7.5 X ______(space volume) Effective Blower Capacity
	Top open entry		
	Top manhole entry		**20 Air Changes per Hour (ACH) for duration of entry**
	Hinged hatch		**Minimum initial Purge Time= 20 Minutes**
	Entry & Rescue Equipment		**Adequate Blower Capacity (ABC) = ________** ABC = Space Volume x 20 ACH 60 minutes
	Life Line		
	Floor level opening barrier		**Acceptable Entry Conditions**
	Body Harness		Confined Space Entry permit posted
	Tripod		Oxygen 19.5 23.5%
	Man Winch		Lower Explosive Level %
	Fall Arrest Unit		Toxic fumes/vapors Less than PEL
	Emergency Retrieval Line		No engulfing material in space
	Atmospheric Monitor		No hazardous chemicals or material
	Blower /Saddle / Trunks		Drained - Flushed
	Drop Light		Rescue Team Available on Site
	Communication Gear		Ventilation Established & Maintained
	Ladder		LOTO Electrical components in space
	Hand held radios		LOTO Mechanical Components in space
	Portable Lighting		LOTO All pipes to and from space

Other Hazards

Flammable Atmospheres
A flammable atmosphere generally arises from enriched oxygen atmospheres, vaporization of flammable liquids, byproducts of work, chemical reactions, concentrations of combustible dusts, and desorption of chemical from inner surfaces of the confined space.

An atmosphere becomes flammable when the ratio of oxygen to combustible material in the air is neither too rich nor too lean for combustion to occur. Combustible gases or vapors will accumulate when there is inadequate ventilation in areas such as a confined space.

Flammable gases such as acetylene, butane, propane, hydrogen, methane, natural or manufactured gases or vapors from liquid hydrocarbons can be trapped in confined spaces, and since many gases are heavier than air, they will seek lower levels as in pits, sewers, and various types of storage tanks and vessels. In a closed top tank, it should also be noted that lighter than air gases may rise and develop a flammable concentration if trapped above the opening.

The byproducts of work procedures can generate flammable or explosive conditions within a confined space. Specific kinds of work such as spray painting can result in the release of explosive gases or vapors. Welding in a confined space is a major cause of explosions in areas that contain combustible gas.

Chemical reactions forming flammable atmospheres occur when surfaces are initially exposed to the atmosphere, or when chemicals combine to form flammable gases. This condition arises when dilute sulfuric acid reacts with iron to form hydrogen or when calcium carbide makes contact with water to form acetylene.

Other examples of spontaneous chemical reactions that may produce explosions from small amounts of unstable compounds are acetylene-metal compounds, peroxides, and nitrates. In a dry state, these compounds have the potential to explode upon percussion or exposure to increased temperature.

Another class of chemical reactions that form flammable atmospheres arise from deposits of pyrophoric substances (carbon, ferrous oxide, ferrous sulfate, iron, etc.) that can be found in tanks used by the chemical and petroleum industry. These tanks containing flammable deposits will spontaneously ignite upon exposure to air.

Combustible dust concentrations are usually found during the process of loading, unloading, and conveying grain products, nitrated fertilizers, finely ground chemical products, and any other combustible material.

High charges of static electricity, which rapidly accumulate during periods of relatively low humidity (below 50%) can cause certain substances to accumulate electrostatic charges of sufficient energy to produce sparks and ignite a flammable atmosphere.

These sparks may also cause explosions when the right air or oxygen to dust or gas mixture is present.

Toxic Atmospheres

The substances to be regarded as toxic in a confined space can cover the entire spectrum of gases, vapors, and finely-divided airborne dust in industry. The sources of toxic atmospheres encountered may arise from the following:
1. The manufacturing process (for example, in producing polyvinyl chloride, hydrogen chloride is used as well as vinyl chloride monomer, which is carcinogenic).
2. The product stored [removing decomposed organic material from a tank can liberate toxic substances, such as hydrogen sulfide (H_2S)].
3. The operation performed in the confined space (for example, welding or brazing with metals capable of producing toxic fumes).
During loading, unloading, formulation, and production, mechanical and/or human error may also produce toxic gases which are not part of the planned operation.

Carbon monoxide (CO) is a hazardous gas that may build up in a confined space. This odorless, colorless gas that has approximately the same density as air is formed from incomplete combustion of organic materials such as wood, coal, gas, oil, and gasoline; it can be formed from microbial decomposition of organic matter in sewers, silos, and fermentation tanks.

CO is an insidious toxic gas because of its poor warning properties. Early stages of CO intoxication are nausea and headache. CO may be fatal at as little as 1000 ppm or 10% in air, and is considered dangerous at 200 ppm or 2%, because it forms Carboxyhemoglobin in the blood which prevents the distribution of oxygen in the body.

CO is a relatively abundant colorless, odorless gas. Therefore, any untested atmosphere must be suspect. It must also be noted that a safe reading on a combustible gas indicator does not ensure that CO is not present. CO must be tested for specifically.

The formation of CO may result from chemical reactions or work activities, therefore fatalities due to CO poisoning are not confined to any particular industry. There have been fatal accidents in sewage treatment plants due to decomposition products and lack of ventilation in confined spaces.

In another area, the paint industry, varnish is manufactured by introducing the various ingredients into a kettle, and heating them in an inert atmosphere, usually town gas, which is a mixture of carbon dioxide and nitrogen.

In welding operations, oxides of nitrogen and ozone are gases of major toxicological importance, and incomplete oxidation may occur and carbon monoxide can form as a byproduct.

Another poor work practice, which has led to fatalities, is the recirculation of diesel exhaust emissions. Increased CO levels can be prevented by strict control of the ventilation and the use of catalytic converters.

Procedures for Atmospheric Testing. - 1910.146 App B
OSHA Requirement

Sub-Part Title: General Environmental Controls

Atmospheric testing is required for two distinct purposes:
evaluation of the hazards of the permit space and verification that acceptable entry conditions for entry into that space exist.

(1) Evaluation testing. The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space.

Evaluation and interpretation of these data, and development of the entry procedure, should be done by, or reviewed by, a technically qualified professional (e.g., OSHA consultation service, or certified industrial hygienist, registered safety engineer, certified safety professional, certified marine chemist, etc.) based on evaluation of all serious hazards.

(2) Verification testing. The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions.

Results of testing (i.e., actual concentration, etc.) should be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition.

(3) Duration of testing. Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.

(4) Testing stratified atmospheres. When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.

(5) Order of testing. A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere.

Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gases and vapors. If tests for toxic gases and vapors are necessary, they are performed last.

This is a ten-minute escape air pack or emergency air supply. The plastic bag with go over your head during an emergency and provide enough air to get out of the hole. There are smaller versions of this system.

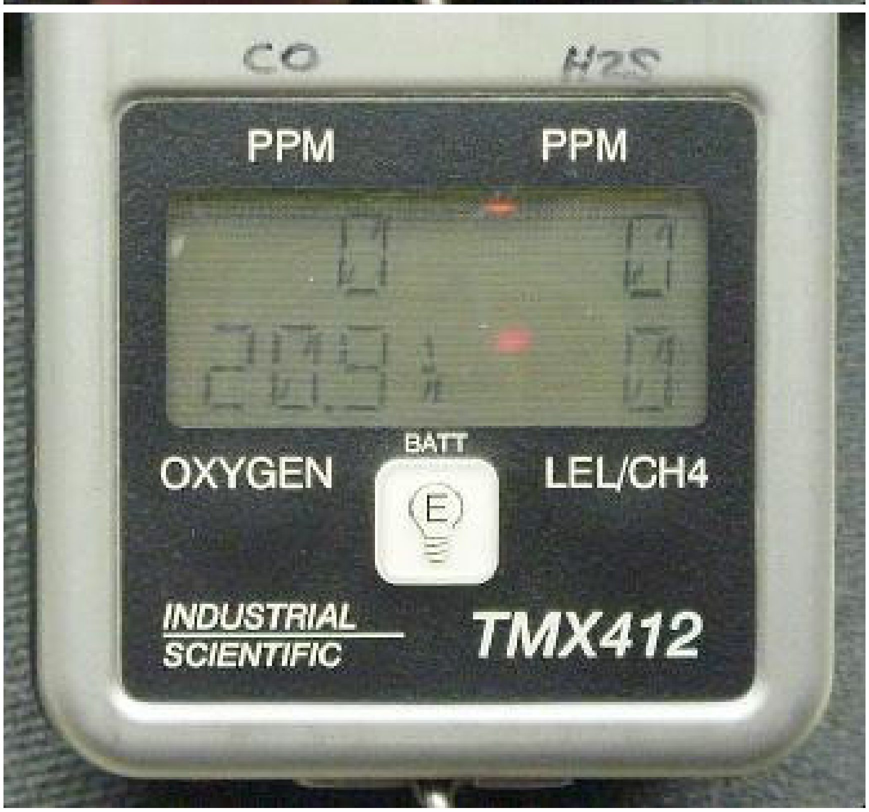
Functional Buttons:

On/Off	Press black button and hold until display tells you to RELEASE. Turn on in a clean-air environment.
Mode	Press "mode" button at display prompt.
E Button	Press (E) button at display prompt.
Alarm Mode	Red lights flash and unit beeps. Beeps are more frequent at higher contaminant levels, or lower oxygen level.

Forced air ventilation with a disposable air shaft.

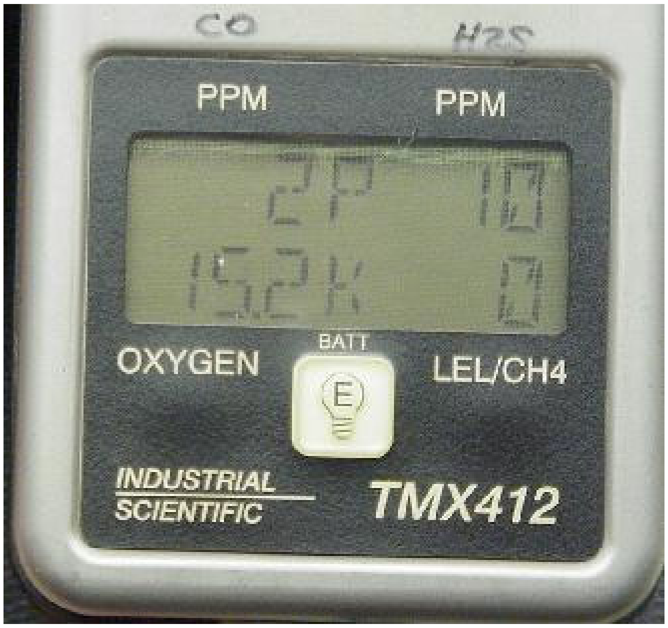
Typical Display of the TMX412

Location of gases on display.



Example of a clean air display. Carbon monoxide (**CO**) and hydrogen sulfide (**H_2S**) are in ppm; oxygen (**O_2**) and lower explosive limit (**LEL**) readings are percentage values. The battery-life indicator is just right of the oxygen display (i.e., 20.9); each line represents about one hour of service remaining.

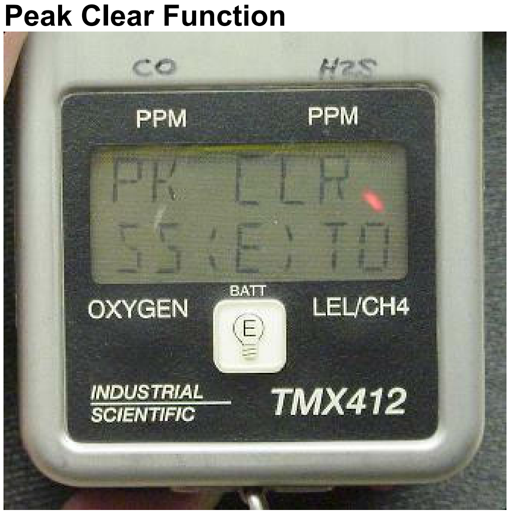
Peak Display Function



Example Display for Peak Mode: The display reads 2 ppm peak value for CO and 10 ppm peak value for H_2S (top line);
15.2 % for oxygen and 0 % for LEL (bottom line).

- Use the PEAK function to display highest recorded readings for CO, H2S, and LEL, and the lowest reading for O2.
- Readings are not erased when you turn the unit off. You must use the PEAK CLEAR function to erase the memory.
- Make sure you check the peak readings have been cleared before you start your monitoring session.
- Press mode button until display reads "P" (top line), and "K" (bottom line) (see photo).

Peak Clear Function



- Use the **PEAK CLEAR** function to clear peak readings from the internal memory. Readings are not erased when you turn the unit off. You must use the **PEAK CLEAR** function to erase the memory.
- Press mode button until display reads "**PK CLR PRESS (E) TO RESET**". After you press the (E) button, press mode button again until peak reading appears. Unit

should now read 0,0 (top line), and 21, 0 (bottom line) assuming this was performed in a clean-air environment.

Zero Function and Calibration Function:

- Zero and Calibration Functions are performed by Attendant or as specified by the Supervisor or manufacturer.
- Special equipment and experience is necessary to properly perform these functions.

Documentation and Training:

- Make sure you are familiar with all of our confined space entry equipment, including the multi-gas monitor, before use.
- Make sure to document your air monitoring data (e.g., peak values and other relevant data) on the Confined Space Air Monitoring Data Form.

You need continued atmospheric monitoring during the entry in any confined space. Most entrants will carry two gas monitors for increased safety.

Atmospheric Testing Policy *Example*

Before entry, it is necessary to test the atmosphere in the confined space for oxygen levels, flammability, and/or any contaminants that have a potential to be present in that confined space. This testing must be done by a qualified person using equipment which has been approved for use in such areas.

The testing equipment itself should be checked to make sure it is working properly before using it. Follow the manufacturer's recommended procedures.

Testing of the confined spaces should be conducted throughout the entire portion of the space that workers will occupy during the entry. This testing shall be done without the use of ventilation systems.

Where the entry is vertical into the confined space, it is recommended that remote probes be used to measure the atmosphere at various levels. This is necessary because some gases and vapors are lighter or heavier than air and can accumulate at different levels in the confined space. Test outside the confined space to make sure the surrounding air is not contaminated.

Atmospheric conditions are considered unacceptable if oxygen levels are less than 19.5% or greater than 23.5%. Regulations define the following unacceptable levels of other hazards monitored:

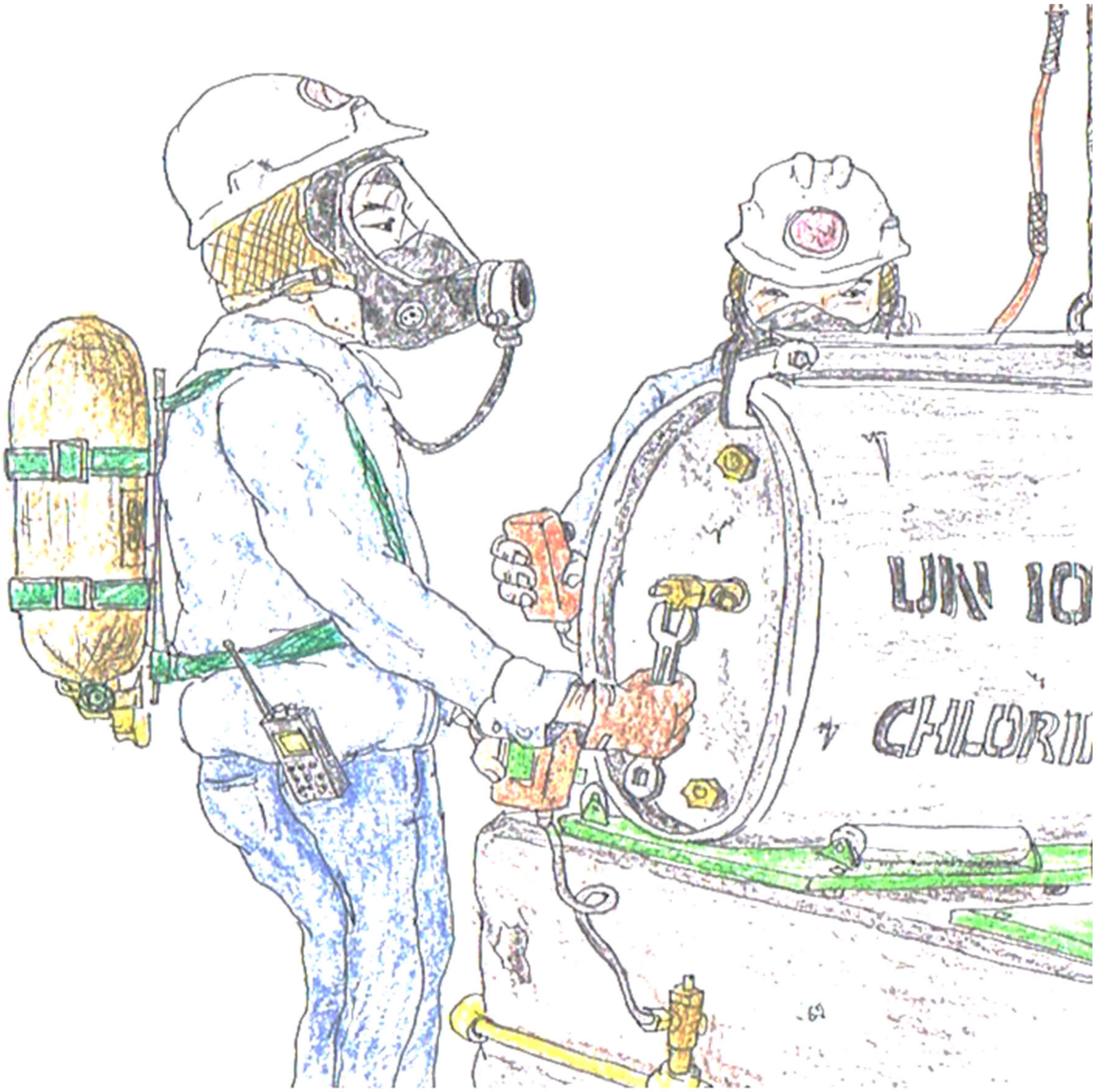
1. A flammable gas, vapor or mist greater than 10% of its lower flammable limit (**LFL**). LFL means the minimum concentration of the flammable material which will ignite if an ignition source is present.

2. An airborne combustible dust at a concentration that obscures vision at a distance of five feet or less.

3. An atmospheric concentration of a substance greater than the allowed limit in the Material Safety Data Sheet for that substance.

If test results conclude that the atmospheric condition of the confined space is unacceptable, entry is prohibited until such conditions are brought into acceptable limits. This may be done by purging, cleaning and/or ventilating the space.
Purging refers to the method by which gases, vapors, or other airborne impurities are displaced from a confined space.

The confined space may also be made non-flammable, non-explosive or otherwise chemically non-reactive by displacing or diluting the original atmosphere with steam or gas that is non-reactive with respect to that space, a process referred to as "***inerting***".



Fire, Explosion, and Reactivity Hazards

Some chemicals present physical hazards such as the potential for fire, explosion, and reactivity. The SDS formerly called the MSDS explains these physical hazards.

Flammable chemicals—catch fire easily. The SDS will tell if it's flammable.

Flash point—the minimum temperature at which a liquid gives off enough vapors to burn. The lower the flash point, the more flammable the substance.

Flammable limits—the range of concentration of a substance in the air within which a substance can readily catch fire. Concentrations below or above the limits are less likely to ignite or burn.

Irritant (Corrosive) Atmospheres

Irritant or corrosive atmospheres can be divided into primary and secondary groups. The primary irritants exert no systemic toxic effects (effects on the entire body).

Examples of primary irritants are chlorine, ozone, hydrochloric acid, hydrofluoric acid, sulfuric acid, nitrogen dioxide, ammonia, and sulfur dioxide. A secondary irritant is one that may produce systemic toxic effects in addition to surface irritation. Examples of secondary irritants include benzene, carbon tetrachloride, ethyl chloride, trichloroethane, trichloroethylene, and chloropropene.

Irritant gases vary widely among all areas of industrial activity. They can be found in plastics plants, chemical plants, the petroleum industry, tanneries, refrigeration industries, paint manufacturing, and mining operations.

Prolonged exposure at irritant or corrosive concentrations in a confined space may produce little or no evidence of irritation. This may result in a general weakening of the defense reflexes from changes in sensitivity. The danger in this situation is that the worker is usually not aware of any increase in his/her exposure to toxic substances.

Asphyxiating Atmospheres
The normal atmosphere is composed approximately of 20.9% oxygen and 78.1% nitrogen, and 1% argon with small amounts of various other gases. Reduction of oxygen in a confined space may be the result of either consumption or displacement.

The consumption of oxygen takes place during combustion of flammable substances, as in welding, heating, cutting, and brazing. A more subtle consumption of oxygen occurs during bacterial action, as in the fermentation process.

Oxygen may also be consumed during chemical reactions as in the formation of rust on the exposed surface of the confined space (iron oxide). The number of people working in a confined space and the amount of their physical activity will also influence the oxygen consumption rate.

A second factor in oxygen deficiency is displacement by another gas. Examples of gases that are used to displace air, and therefore reduce the oxygen level are helium, argon, and nitrogen.

Carbon dioxide may also be used to displace air and can occur naturally in sewers, storage bins, wells, tunnels, wine vats, and grain elevators.

Aside from the natural development of these gases, or their use in the chemical process, certain gases are also used as inerting agents to displace flammable substances and retard pyrophoric reactions.

Gases such as nitrogen, argon, helium, and carbon dioxide, are frequently referred to as non-toxic inert gases but have claimed many lives. The use of nitrogen to inert a confined space has claimed more lives than carbon dioxide.

The total displacement of oxygen by nitrogen will cause immediate collapse and death.

Carbon Dioxide
Carbon dioxide and argon, with specific gravities greater than air, may lie in a tank or manhole for hours or days after opening. Since these gases are colorless and odorless, they pose an immediate hazard to health unless appropriate oxygen measurements and ventilation are adequately carried out.

Oxygen Deprivation
Oxygen deprivation is one form of asphyxiation. While it is desirable to maintain the atmospheric oxygen level at 21% by volume, the body can tolerate deviation from this ideal. When the oxygen level falls to 17%, the first sign of hypoxia is deterioration to night vision, which is not noticeable until a normal oxygen concentration is restored.

Physiologic effects are increased breathing volume and accelerated heartbeat.

Between 14-16% physiologic effects are increased breathing volume, accelerated heartbeat, very poor muscular coordination, rapid fatigue, and intermittent respiration.

Between 6-10% the effects are nausea, vomiting, inability to perform, and unconsciousness. Less than 6%, the effects are spasmodic breathing, convulsive movements, and death in minutes.

Mechanical Hazards
If activation of electrical or mechanical equipment would cause injury, each piece of equipment should be manually isolated to prevent inadvertent activation before workers enter or while they work in a confined space. The interplay of hazards associated with a confined space, such as the potential of flammable vapors or gases being present, and the build-up of static charge due to mechanical cleaning, such as abrasive blasting, all influence the precautions which must be taken.

To prevent vapor leaks, flashbacks, and other hazards, workers should completely isolate the space. To completely isolate a confined space, the closing of valves is not sufficient.

All pipes must be physically disconnected or isolation blanks bolted in place. Other special precautions must be taken in cases where flammable liquids or vapors may re-contaminate the confined space.

The pipes blanked or disconnected should be inspected and tested for leakage to check the effectiveness of the procedure. Other areas of concern are steam valves, pressure lines, and chemical transfer pipes. A less apparent hazard is the space referred to as a void, such as double walled vessels, which must be given special consideration in blanking off and inerting.

Thermal Effects
Four factors influence the interchange of heat between people and their environment. They are:
(1) air temperature,
(2) air velocity,
(3) moisture contained in the air, and
(4) radiant heat. Because of the nature and design of most confined spaces, moisture content and radiant heat are difficult to control.

As the body temperature rises progressively, workers will continue to function until the body temperature reaches approximately 102°F.

When this body temperature is exceeded, the workers are less efficient, and are prone to heat exhaustion, heat cramps, or heat stroke. In a cold environment, certain physiologic mechanisms come into play, which tend to limit heat loss and increase heat production.

The most severe strain in cold conditions is chilling of the extremities so that activity is restricted. Special precautions must be taken in cold environments to prevent frostbite, trench foot, and general hypothermia.

Proper signage is essential.

Abbreviations

PEL - permissible exposure limit: Average concentration that must not be exceeded during 8-hour work shift of a 40-hour workweek.

STEL - Short-term exposure limit: 15-minute exposure limit that must not be exceeded during the workday.

REL - Recommended exposure limit: Average concentration limit recommended for up to a 10-hour workday during a 40-hour workweek.

IDLH - Immediately dangerous to life or health: Maximum concentration from which person could escape (in event of respiratory failure) without permanent or escape-impairing effects within 30 minutes.

SCBA Storage Box

Required Confined Space Equipment Policy *Example*

Air Testing Equipment
All air-testing equipment should be calibrated in accordance with the manufacturer's instruction.

Oxygen Meters and Monitors
The oxygen content of the air in a confined space is the first and most important constituent to measure before entry is made. The acceptable range of oxygen is between 19.5 and 23.5 percent. This content is measured before flammability is tested because rich mixtures of flammable gases or vapors give erroneous measurement results.

For example, a mixture of 90 percent methane and 10 percent air will test nonflammable because there is not enough oxygen to support the combustion process in the flammability meters. This mixture will not support life and will soon become explosive if ventilation is provided to the space. Before entry, spaces must be ventilated until both oxygen content and flammability are acceptable.

Flammability Meters
Flammability meters are used to measure the amount of flammable vapors or gases in the atmosphere as a percent of the LEL/LFL. The oxygen content must be near 21 percent for results to be meaningful.

Toxic Air Contamination Testers
Tests for toxic contaminants must be specific for the target toxin. The instrument manufacturer should be consulted for interferences. Therefore, it is important to know the history of the confined space so proper tests can be performed. Part of hazard assessment is to identify all possible contaminants that could be in the confined space.

Protective Devices
Fall-Protection Equipment
Fall-protection equipment for confined spaces should be the chest-waist harness type to minimize injuries from uncontrolled movements when it arrests a worker's fall. This type of harness also permits easier retrieval from a confined space than a waist belt. Adjustable lanyards should be used to limit free fall to two feet before arrest.

Respirators
An industrial hygienist should select respirators on the basis of his or her evaluation of possible confined-space hazards. NIOSH-approved respirators should be identified in the approved procedure required by the confined-space entry permit. It is important to note that air-purifying respirators cannot be used in an oxygen deficient atmosphere.

Lockout/Tagout Devices
Lockout/tagout devices permit employees to work safely on de-energized equipment without fear that the devices will be accidentally removed. Lock and tag devices are required to withstand a 50-pound pull without failure.

Devices used to block or restrain stored mechanical energy devices must be engineered for safety.

Safety Barriers
Safety barriers separate workers from hazards that cannot reasonably be eliminated by other engineering controls.

Required barriers will be identified in the approved confined-space entry procedure.

Ground Fault Circuit Interrupters
Ground fault circuit interrupter must be used for all portable electrical tools and equipment in confined spaces because most workers will be in contact with grounded surroundings.

Emergency Response Equipment

Fire Extinguishers
"***Hot work***" inside a confined space requires that an approved fire extinguisher and a person trained in its use be stationed in the confined space or in a suitable vantage point where he or she could effectively suppress any fire that might result from the work.

First Aid Equipment
Blankets, first-aid kit, Stokes stretchers, and any other equipment that may be needed for first-response treatment must be available just outside the confined space. Medical and safety professionals should select equipment on the basis of their evaluations of the potential hazards in the confined space.

Retrieval Equipment
A tripod or another suitable anchorage, hoisting device, harnesses, wristlets, ropes, and any other equipment that may be needed to make a rescue must be identified in the confined-space safe-entry procedures.

It is important that this equipment be available for immediate use. Harnesses and retrieval ropes must be worn by entrants unless they would increase hazards to the entrants or impede their rescue.

Summary
A Confined Space Entry Program

Should Include the Following:

- Written confined space entry procedures
- Evaluation to determine whether entry is necessary
- Issuance of a confined space entry permit
- Evaluation of the confined space by a qualified person
- Testing and monitoring the air quality in the confined space to ensure:
- Oxygen level is at least 19.5%
- Flammable range is less than 10% of the LFL (lower flammable limit)
- Training of workers and supervisors in the selection and use of:
    - *safe entry procedures*
    - *respiratory protection*
    - *lifelines and retrieval systems*
    - *protective clothing*
- Training of employees in safe work procedures in and around confined spaces
- Training of employees in confined space rescue procedures
- Conducting safety meetings to discuss confined space safety
- Availability and use of proper ventilation equipment
- Monitoring the air quality while workers are in the confined space.

Recommendation #2: Employers should identify the types of confined spaces within their jurisdiction and develop and implement confined space entry and rescue programs.

Discussion: Employers may be required to enter confined spaces to perform either non-emergency tasks or emergency rescue.

Therefore, employers should identify the types of confined spaces within their jurisdiction and develop and implement confined space entry and rescue programs that include written emergency rescue guidelines and procedures for entering confined spaces. A confined space program, as outlined in NIOSH Publications 80-106 and 87-113, should be implemented. At a minimum, the following should be addressed:

1. Is entry necessary? Can the task be accomplished from the outside? For example, measures that eliminate the need for employees to enter confined spaces should be carefully evaluated and implemented if at all possible before considering human entry into confined spaces to perform non-emergency tasks.

2. If entry is to be made, has the air quality in the confined space been tested for safety based on the following:

- oxygen supply at least 19.5%
- flammable range for all explosive gases less than 10% of the lower flammable limit
- absence of toxic air contaminants?

3. Is ventilation equipment available and/or used?

4. Is appropriate rescue equipment available?

5. Are supervisors being continuously trained in the selection and use of appropriate rescue equipment such as:
- SCBA's
- lifelines
- human hoist systems offering mechanical advantage
- protective clothing
- ventilation systems

6. Are employees being properly trained in confined space entry procedures?

7.Are confined space safe work practices discussed in safety meetings?

8. Are employees trained in confined space rescue procedures?

9. Is the air quality monitored when the ventilation equipment is operating?

The American National Standards Institute (ANSI) Standard Z117.1-1989 (Safety Requirements for Confined Spaces), 3.2 and 3.2.1 state, "*Hazards shall be identified for each confined space. The hazard identification process shall include, ... the past and current uses of the confined space which may adversely affect the atmosphere of the confined space; ... The hazard identification process should consider items such as ... the operation of gasoline engine powered equipment in or around the confined space*."

D-Ring on the rear of the harness is necessary for the entrant to be retrieved from the confined space.

Confined Space Post Quiz

Confined space:
1. A confined space is large enough or so configured that an employee can ____________.

2. A confined space is not designed for ______________________.

3. A permit required confined space (permit space) contains a material that has __________________.

Confined Space Hazards
4. Fatalities and injuries constantly occur among construction workers who are required to enter __________________.

5. ______________ are associated with specific types of equipment and the interactions among them. These hazards can be electrical, thermal, chemical, mechanical, etc.

Typical Examples of Confined Workspaces
6. Confined workspaces in construction contain _____________________.

7. Workers must enter ________________ found on the construction jobsite to perform a number of functions.

8. The ever-present possibility of ______________________ is one of the major problems confronting construction workers while working in vaults.

9. According to the text, a _______________ normally considered a problem associated with confined spaces is material or equipment which may fall into the vault.

10. Manholes are necessary to provide a means of entry into and exit from vaults, tanks, and pits, but these confined spaces may present _________________ which could cause injuries and fatalities.

11. The pipe assembly is one of the _____________________ encountered throughout the construction site,

12. Once inside a pipe assembly, workers are faced with ___________________, often caused by purging with argon or another inert gas.

13. _____________ is another problem to which the worker is exposed when inside a pipe assembly.

14. The worker may suffer _______________ caused by heat within the pipe run.

15. Tanks are ______________________ that are used for a variety of purposes, including the storage of water and chemicals.

16. According to the text, oxygen-deficient atmospheres, along with toxic and explosive atmospheres created by the substances stored in the tanks, present hazards to workers.
A. True B. False

17. Heat in tanks may cause _________________, particularly on a hot day.

18. Entry supervisors must coordinate all entry procedures, tests, ___________, equipment, and other activities related to the permit space entry.

19. Before endorsing the permit and allowing entry to begin, the ________________ must check that all appropriate entries have been made on the permit, all tests specified by the permit have been conducted, and that all procedures and equipment specified by the permit are in place.

20. A responsibility of the entry attendant is to know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
A. True B. False

Confined Space Chapter Answers
1. Bodily enter and perform work, 2. Continuous employee occupancy, 3. The potential for engulfing an entrant, 4. Confined spaces, 5. Inherent hazards, 6. Both inherent and induced hazards, 7. A variety of vaults,8. An oxygen-deficient atmosphere, 9. Hazard, 10. Serious hazards, 11. Most frequently unrecognized types of confined spaces, 12. Potential oxygen-deficient atmospheres, 13. Electrical shock, 14. Heat prostration, 15. Another type of confined workspace, 16. True, 17. Heat prostration, 18. Permits, 19. Entry supervisor, 20. True

Chapter 15 - Respiratory Protection

Section Focus: You will learn the basics of respiratory protection. At the end of this section, you will be able to understand and describe the need and rules regarding respiratory protection. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: OSHA 1910.134 – Respiratory Protection
(c) - Respiratory protection program. This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator.

General
In the Respiratory Protection program, hazard assessment and selection of proper respiratory PPE is conducted in the same manner as for other types of PPE. In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination.

This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used. **References**: OSHA Standards *Respiratory Protection* (**29 CFR 1910.134**)

Why Respirators Are Needed
Respirators protect against the inhalation of dangerous substances (vapors, fumes, dust, gases). They can also provide a separate air supply in a very hazardous situation.

Some of the health hazards that respirators prevent include

- *Lung damage*
- *Respiratory diseases*
- *Cancer and other illnesses.*

Respiratory Protection Responsibilities
The employer is responsible for:
- Providing training in the use and care of respirators.
- Ensuring that equipment is adequate, sanitary, and reliable.
- Allowing employees to leave area if ill, for breaks, and to obtain parts.
- Fit testing.
- Providing annual medical evaluations.
- Providing a powered air-purifying respirator (**PAPR**) if an employee cannot wear a tight-fitting respirator.

The employee is responsible for:
- Properly using respirators.
- Maintaining respirator properly.
- Reporting malfunctions.
- Reporting medical changes.

Selection of Respiratory Protection
When choosing the correct respiratory protection for your work environment, it is important to consider:
- Identification of the substance or substances for which respiratory protection is necessary
- A substance's safety data sheet (SDS) (it will state which type of respirator is most effective for the substance)
- Activities of the workers
- Hazards of each substance and its properties
- Maximum levels of air contamination expected
- Probability of oxygen deficiency
- Period of time workers will need to use the respiratory protection devices
- Capabilities and physical limitations of the device used

Types of Respirators The following is a description of different types of respirators.
Commonly Used Respirators (*Air Purifying*)
- **Disposable Dust** masks are worn over the nose and mouth to protect the respiratory system from certain nuisance dusts, mists, etc. They can only provide protection against particular contaminants as specified by the manufacturer (e.g., general dust, fiberglass, etc.). These dust masks cannot be fit tested, and are generally single use. They are not generally recognized as proper respiratory protection and may not be worn if a potential for overexposure exists. They are not included in most companies' Respiratory Protection Programs.
- **Half-Face Respirators** with interchangeable filter cartridges can protect the respiratory system from hazardous dusts, fumes, mists, etc. They can only provide protection against certain contaminants up to limited concentrations specified by the manufacturer for the particular cartridge type used (e.g., toluene, acetone). These generally operate under negative pressure within the respirator which is created by the wearer's breathing through the filter cartridges. As the protection is only gained if there is a proper seal of the respirator face piece, this type requires fit testing prior to respirator assignment and a fit check prior to each use.
- **Full-Face Respirators** operate under the same principle and requirements as the half-face type, however, they offer a better facepiece fit and also protect the wearer's eyes from particularly irritating gases or vapors.

- **Full-face, helmet or hood type powered air purifying respirators** (**PAPRs**) operate under positive pressure inside the facepiece using a battery operated motor blower assembly to force air through a filter cartridge into the wearer's breathing zone. Use of these respirators is also subject to the manufacturers' guidelines.

Less Commonly Used Types Respirators (Air Supplying)

- **Air-Line Respirators** supply clean air through a small diameter hose from a compressor or compressed air cylinders. The wearer must be attached to the hose at all times, which limits mobility. Use of these respirators is subject to the manufacturers' guidelines.
- **Self-Contained Breathing Apparatus** (**SCBA**) respirators supply clean air from a compressed air tank carried on the back of the wearer. These types of respirators are highly mobile and are used primarily for emergency response or rescue work, since only a limited amount of air can be supplied by a single tank, generally 20-60 minutes. Units must be thoroughly inspected on a monthly basis and written records must be kept of all inspections, operator training, etc. Use of these respirators is subject to the manufacturer's guidelines

Basic Types of Respirators

Air-purifying or filtering respirators. Such respirators are used when there is enough oxygen (at least 19.5 percent) and contaminants are present below IDLH level. The respirator filters out or chemically "**scrubs**" contaminants, usually with a replaceable filter. Use color-coded filter cartridges or canisters for different types of contaminants. It's important to select the right filter for the situation.

Air-supplying respirators. These respirators are required when air-purifying respirators aren't effective. Air-purifying respirators are not sufficient in the following settings:

- When there is not enough oxygen.
- Confined spaces.
- When contaminants cannot be filtered out.
- When contaminants are at or above IDLH level.

Different kinds of air-supplying respirators include

- Those connected by hose to stationary air supply (airline)
- Portable tank self-contained breathing apparatus (**SCBA**).

The Importance of Correct Fit

Even a tiny gap between the respirator and the face can allow contaminants to enter. Respirators should be comfortable and properly fitted. Proper fit includes:

- **Secure but not too tight**
- **No slipping or pinching**
- **Allowance for head movement and speech**

An OSHA-accepted qualitative fit test or quantitative fit test must be performed prior to an employee using any tight-fitting respirator. Tight-fitting respirators must be seal checked before each use by using positive- or negative-pressure check procedures or the manufacturer's instructions.

Respirator Filters/Cartridges
For protection against gases and vapors, the cartridges used for air-purifying respirators must be either equipped with an end-of-service-life indicator (ESLI), certified by NIOSH for the contaminant, or a cartridge change schedule has to be established.

For protection against particulates, there are nine classes of filters (three levels of filter efficiency, each with three categories of resistance to filter efficiency degradation). Levels of filter efficiency are 95 percent, 99 percent, and 99.97 percent.

Categories of resistance to filter efficiency degradation are labeled N, R, and P.

Protection Factors
The protection factor of a respirator is an expression of performance based on the ratio of two concentrations: The contaminant concentration outside the respirator to the contaminant concentration inside the respirator.

Each class of respirator is also given an assigned protection factor (APF). The APF is a measure of the minimum anticipated level of respiratory protection that a properly functioning respirator or class of respirators would provide to a percentage of properly fitted and trained users.

When a contaminant concentration is known, the APF can be used to estimate the concentration inside a particular type of respirator worn by a user.

Who Cannot Wear a Respirator?

Respirator fit is essential. Employees must have a medical checkup to make sure they can wear respirators safely. Generally, respirators cannot be worn when a person:

- Wears glasses or personal protective equipment that interferes with the seal of the face piece to the face of the user.
- Has facial hair that comes between the sealing surface of the face piece and the face or interferes with valve function.
- Has a breathing problem, such as asthma.
- Has a heart condition.
- Is heat sensitive.

Sometimes a person's facial features will not permit a good fit. Check with the supervisor or medical department if the fit is a problem.

Checking for Damage
Before each use, make sure there are no holes, tears, etc., in the respirator. Rubber parts can wear out and should be checked very carefully every time a respirator is used. Replace worn and damaged parts when necessary. Make sure air and oxygen cylinders are fully charged.

Staying Prepared for Respirator Use
Respirators are bulky and awkward, so getting used to them takes practice. Possible problems with wearing respirators may include heat exhaustion or heat stroke. Be alert for symptoms, use the "*buddy system*," and wear a lifeline or harness when necessary. Drink plenty of fluids and take frequent breaks.

Poor maneuverability
Practice with respirators in narrow passages, on ladders, etc., if your use of respirators may be in these types of conditions.

Using up the air supply
When a SCBA is in use, keep checking the gauges and listening for alarms; be ready to leave the area immediately if there is a problem.

Panic
Remember the importance of staying calm in a hot, stressful, or awkward situation.

Cleaning Respirators
Respirators should be cleaned and disinfected after every use. Check the respirator for damage before putting it away; look for holes, cracks, deterioration, dented cartridges, etc. If any damage is found, it should be reported to a supervisor.

Respirators stored for emergency use must be inspected monthly when not in use, as well as after each use. Respirators should be stored away from light, heat, cold, chemicals, and dust. Store respirators in a "*normal*" (natural, undistorted) position to hold their shape. Do not allow respirators to get crushed, folded, or twisted.

OSHA Overview

OSHA requires that supervisors consult with employees and encourage their participation in the process safety management plan. In fact, managers must have a written plan of action for employee participation in process safety management. Employee participation is critical because…

- **Employees know a lot about the process which they work upon**
- **They play key roles in making sure that process operation is conducted safely.**

Operating Procedures
Managers must furnish written operating procedures that clearly explain how to perform each covered process safely. The procedures must be accurate and must be written in language that people can understand. Avoid technical jargon and, if necessary, supply translations.

Operating procedures must include at least the following:

- Operating steps for initial startup, normal and temporary operations, emergency shutdown (including when it's called for and who does it), emergency operations, normal shutdown, and startup after a turnaround or an emergency shutdown
- Operating limits, including what happens if workers don't conform to operating limits and how to avoid or correct such problems
- Safety and health considerations, such as chemical or other hazards, precautions to prevent exposure, quality and inventory control for chemicals, and what to do if an employee is exposed to a hazardous substance
- Safety systems and their functions, including up-to-date operating procedures and safe work practices.

Contractor Employees
Sometimes, the municipality will hire contractors to preform special sampling or other programs. Process safety training and safety programs are also required for contractors who work on-site. Managers must check out the safety performance and programs of any contractors being considered for maintenance, repair, turnaround, major renovation, or specialty work on or around a process covered by the regulation.

When a contractor is hired, the manager must provide the contractor with information on the hazards of the process the contractor will work on. To further ensure contractor safety, managers must also

- Provide the contractor with information on safe work practices for the process they're involved with and tell them what to do in an emergency.
- Keep a log of contractor employees' injuries or illnesses related to their work in process areas.
- Evaluate the contractor's performance to make sure they're living up to their safety obligations set by the standard.

The Contractor has Responsibilities, too

- Document that employees are trained to recognize hazards and to follow safe work practices on the job
- Make sure that the contractor's employees understand potential job-related hazards, are trained to work safely, and follow the safety rules of the facility in which they're working.

Written Respiratory Protection Program

This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator.

The Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide will be available on or about April 8, 1998 from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202-219-4667).

(c)(1) In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

(c)(1)(i) Procedures for selecting respirators for use in the workplace;

(c)(1)(ii) Medical evaluations of employees required to use respirators;

(c)(1)(iii) Fit testing procedures for tight-fitting respirators;

(c)(1)(iv) Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;

(c)(1)(v) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;

(c)(1)(vi) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;

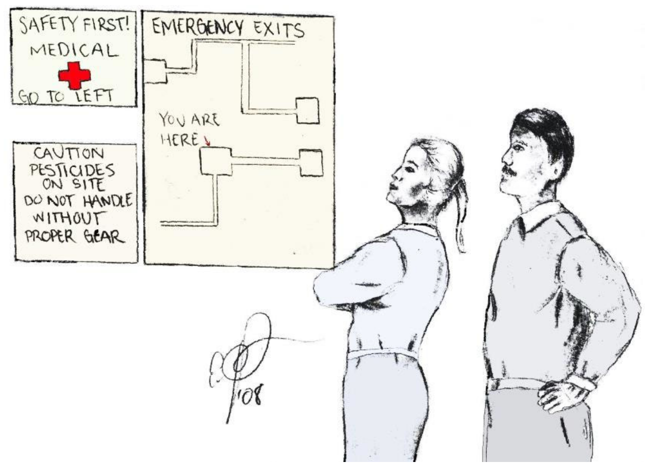
(c)(1)(vii) Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;

Example of RP Employee Responsibilities

All Employees shall follow the requirements of the Respiratory Protection Program.

Management
- Implement the requirements of this program.
- Provide a selection of respirators as required.
- Enforce all provisions of this program.
- Appoint a ***Specific Designated*** individual to conduct the respiratory protection program.

Administrative Department
- Review sanitation/storage procedures.
- Ensure respirators are properly stored, inspected and maintained.
- Monitor compliance for this program.
- Provide training for affected Employees.
- Review compliance and ensure monthly inspection of all respirators.
- Provide respirator fit testing.



Designated-Occupational Health Care Provider
- Conducts medical aspects of program.

Program Administrator
Each Department will designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

Voluntary Use of Respirators is Prohibited
OSHA requires that voluntary use of respirators, when not required by the Employer, must be controlled as strictly as under required circumstances. To prevent violations of the Respiratory Protection Standard, Employees are not allowed voluntary use of their own or Employer supplied respirators of any type.

Exception: Employees whose only use of respirators involves the voluntary use of filtering (non-sealing) face pieces (dust masks).

Respiratory Protection Program Statement *Example*

Facility ___________________________________

Policy Statement

A respiratory protection program is hereby established so as to coordinate the use and maintenance or respiratory protective equipment as determined necessary to:

1. Reduce Personnel exposure to toxic chemical agents, harmful dusts, mist and fumes and
2. Allow trained personnel to work safely in hazardous environments like sewers and vaults, such as oxygen deficient atmospheres, toxic atmospheres, etc.

Designation of Program Administrator

Management has designated ______________________________________
to be responsible for the respiratory protection program at this facility. He/she has been delegated authority by Management to make decisions and implement changes in the respirator program anywhere in this facility.

The following responsibilities apply:

1. Supervision of respirator selection process and procedures
2. Establishment of respiratory protection training sessions
3. Establishment of a continuing program of cleaning and inspections
4. Establishment of medical screening program
5. Establishment of issuing procedures
6. Establishment of periodic inspections
7. Continuing evaluation of all aspects of the respiratory protection program to assure continued effectiveness
8. Establishment of annual fit tests procedures

Any questions or problems concerning respirators or their use should be directed to the Program Administrator

____ ______________

Facility Manager Date

Respiratory Protection Program
Training Certificate *Example*

Name:____

Department:__________________________ Date:___________

I have received Training on the Respiratory Protection Program. The Training included the following:

Classroom Training

- ✓ Overview of the Company Respiratory Protection Program
- ✓ Respiratory Protection Safety Procedures
- ✓ Respirator Selection
- ✓ Respirator Operation and Use
- ✓ Why the respirator is necessary
- ✓ How improper fit, usage, or maintenance can compromise the protective effect.
- ✓ Limitations and capabilities of the respirator.
- ✓ How to use the respirator effectively in emergency situations, including respirator malfunctions
- ✓ How to inspect, put on and remove, use, and check the seals of the respirator.
- ✓ Procedures for maintenance and storage of the respirator.
- ✓ How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators.
- ✓ Respirator filter & cartridge change out schedule
- ✓ The general requirements of this program

Hands-on Training

- ✓ Respirator Inspection
- ✓ Respirator cleaning and sanitizing
- ✓ Fit Check
- ✓ Record Keeping
- ✓ Respirator Storage
- ✓ Emergencies

____

Employee Signature

____

Trainer's Signature

Program Evaluation
Evaluations of the workplace are necessary to ensure that the written respiratory protection program is being properly implemented; this includes consulting with employees to ensure that they are using the respirators properly. Evaluations shall be conducted as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

Program evaluation will include discussions with employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems.

Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:
- Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the employee is exposed;
- Proper respirator use under the workplace conditions the employee encounters; and
- Proper respirator maintenance.

RP Recordkeeping

The employer will retain written information regarding medical evaluations, fit testing, and the respiratory protection program. This information will facilitate employee involvement in the respiratory protection program, assist the Employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

Training and Information

Effective training for employees who are required to use respirators is essential. The training must be comprehensive, understandable, and recur annually and more often if necessary. Training will be provided prior to requiring the employee to use a respirator in the workplace.

The training shall ensure that each employee can demonstrate knowledge of at least the following:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator
- Limitations and capabilities of the respirator
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions
- How to inspect, put on and remove, use, and check the seals of the respirator
- Procedures for maintenance and storage of the respirator
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators
- The general requirements of this program

Retraining shall be conducted annually and when:

- changes in the workplace or the type of respirator render previous training obsolete
- inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill
- other situation arises in which retraining appears necessary to ensure safe respirator use

Training is divided into the following sections:

Classroom Instruction

1. Overview of the Employer’s Respiratory Protection Program & OSHA Standard.
2. Respiratory Protection Safety Procedures.
3. Respirator Selection.
4. Respirator Operation and Use.
5. Why the respirator is necessary.
6. How improper fit, usage, or maintenance can compromise the protective effect.
7. Limitations and capabilities of the respirator.
8. How to use the respirator effectively in emergency situations, including respirator malfunctions.
9. How to inspect, put on and remove, use, and check the seals of the respirator.
10. Procedures for maintenance and storage of the respirator.
11. How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators.
12. Change out schedule and procedure for air purifying respirators.

RESPIRATORY PROTECTION PROGRAM CHECKLIST				PAGE 1 OF 1 PAGES
DIVISION:	SECTION:	SUPERVISOR:	DATE:	

		YES	NO	NA
1	Is respiratory protection (RP) being worn in the section?			
2	Has air sampling been accomplished that mandates using RP?			
3	Where air sampling results greater than Occupational Exposure Limits? (If NO, why are you using a respirator?)			
4	Has a Hazard Assessment been generated concerning the task or process that placed the section on the RP Program?			
5	Have all processes that may warrant the use of RP been evaluated? (If NO, request an assessment from the Department Safety Analyst /Personnel Safety, unless the operation is emergency response).			
6	Have workers received physicals and been found medically qualified to wear RP?			
7	Is there documentation that workers were formally briefed on air sampling results and why RP is required?			
8	Is respiratory protection training and fit-testing documentation available on everyone who wears a respirator?			
9	Are RP wearers being fit-tested at least annually?			
10	Are section employees wearing RP voluntarily when conditions have not mandated their use?			
11	Are employees wearing contacts in hazardous atmospheres or using eye-wear that negates face to face piece seal?			
12	Do RP users have facial hair that negates face to face piece seal?			
13	Has a respirator inventory been compiled that list the type of respirator(s) used in the workplace? (Use Respirator Inventory Worksheet attach to this checklist)			
14	Has the Section Supervisor received formal RP training on OSHA, City Personnel Safety and Respiratory Protection Program requirements and his or her responsibilities?			
15	Does the section have written standard operating instructions governing the selection, fit-testing, use, cleaning, storage and maintenance of respirators?			
16	Is the Fire Department the only source being used to charge SCBA's with compressed air?			
17	Are SCBA's being inspected at least every 30 days?			
18	Does the section have on hand, applicable OSHA, CITY, and Section Respiratory Protection Program guidance documents?			
19	Are periodic audits of the section's RP program conducted with discrepancies tracked until closed out?			
20	Have program deficiencies been elevated to the Director and Department Safety Analyst?			

SURVEYED BY:	REVIEWED BY:

Summary

CLEANING AN SCBA MASK

Following the training session, employees should:

- Wear the respirator assigned to him or her
- Always check for fit before wearing
- Always check for damage and deterioration before wearing
- Know when to replace canisters and cartridges
- Practice maneuvering with a respirator
- Store carefully in the proper location.

Respiratory Protection Chapter Post Quiz

True or False Questions

1. The Employee is required to retain written information regarding medical evaluations, fit testing, and the respirator program.

2. Training will be provided prior to requiring the employee to use a respirator in the workplace.

The training shall ensure that each employee can demonstrate knowledge of at least the following:
#3-7

3. Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator.

4. How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions.

5. How to inspect, put on and remove, use, and check the seals of a transmission.

6. What the procedures are for maintenance and storage of the respirator.

7. How not to recognize medical signs and symptoms that may not limit or prevent the effective use of respirators

Retraining shall be conducted annually and when:

8. Changes in the workplace or the type of respirator render previous training obsolete.

9. Adequacies in the employee's knowledge or use of the respirator indicate that the employee has retained the requisite understanding or skill.

10. Other situation arises in which retraining appears necessary to ensure safe respirator use.

11. A pre-authorization and annual certification by a qualified physician will be required and maintained. Any changes in an Employees health or physical characteristics will be reported to the Occupational Health Department and will be evaluated by a qualified physician.

12. Only the proper prescribed dust mask or OSHA may be used for the job or work environment.

13. Employees working in environments where a sudden release of a hazardous substance is likely will wear an appropriate respirator for that hazardous substance (example: Employees working in an ammonia compressor room will have an ammonia APR respirator on their person.).

14. Only SCBAs will be used in oxygen deficient environments, environments with an unknown hazardous substance or unknown quantity of a known hazardous substance or any environment that is determined "Immediately Dangerous to Life or Health" (IDLH).

15. Employees will follow the established Emergency Response Program and/or Confined Space Entry Program when applicable.

16. Management will establish and maintain surveillance of jobs and work place conditions and degree of Employee exposure or stress to maintain the proper procedures and to provide the necessary RPE.

17. The Employer is responsible and need to have evaluated the respiratory hazard(s) in each workplace, identified relevant workplace and user factors and has based respirator selection on these factors. Also included are estimates of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form.

18. Respirators provided only for escape from PEL atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

19. The respirators selected shall be adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

20. The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

Respirator Protection Post Quiz Answers

1. False, 2. True, 3. True, 4. True, 5. False, 6. True, 7. False, 8. True, 9. False, 10. True, 11. True, 12. False, 13. True, 14. True, 15. True, 16. True, 17. True, 18. False, 19. True, 20. True

Math Conversion Factors

1 PSI = 2.31 Feet of Water
1 Foot of Water = .433 PSI
1.13 Feet of Water = 1 Inch of Mercury
454 Grams = 1 Pound
2.54 CM =Inch
1 Gallon of Water = 8.34 Pounds
1 mg/L = 1 PPM
17.1 mg/L = 1 Grain/Gallon
1% = 10,000 mg/L
694 Gallons per Minute = MGD
1.55 Cubic Feet per Second = 1 MGD
60 Seconds = 1 Minute
1440 Minutes = 1 Day
.746 kW = 1 Horsepower

<u>LENGTH</u>
12 Inches = 1 Foot
3 Feet = 1 Yard
5280 Feet = 1 Mile

<u>AREA</u>
144 Square Inches = 1 Square Foot
43,560 Square Feet =1 Acre

<u>VOLUME</u>
1000 Milliliters = 1 Liter
3.785 Liters = 1 Gallon
231 Cubic Inches = 1 Gallon
7.48 Gallons = 1 Cubic Foot of water
62.38 Pounds = 1 Cubic Foot of water

Dimensions

SQUARE: Area (sq.ft.) = Length X Width
Volume (cu.ft.) = Length (ft) X Width (ft) X Height (ft)

CIRCLE: Area (sq.ft.) = 3.14 X Radius (ft) X Radius (ft)

CYLINDER: Volume (Cu. ft) = 3.14 X Radius (ft) X Radius (ft) X Depth (ft)

PIPE VOLUME: .785 X Diameter ^{2} X Length = ? To obtain gallons multiply by 7.48

SPHERE: $\frac{(3.14)\ (\text{Diameter})^3}{(6)}$

Circumference = 3.14 X Diameter

General Conversions

Flowrate

Multiply	**—>**	**to get**
to get	**<—**	**Divide**
cc/min	1	mL/min
cfm (ft^3/min)	28.31	L/min
cfm (ft^3/min)	1.699	m^3/hr
cfh (ft^3/hr)	472	mL/min
cfh (ft^3/hr)	0.125	GPM
GPH	63.1	mL/min
GPH	0.134	cfh
GPM	0.227	m^3/hr
GPM	3.785	L/min
oz/min	29.57	mL/min

POUNDS PER DAY= Concentration (mg/L) X Flow (MG) X 8.34
***A.K.A.* Solids Applied Formula** = Flow X Dose X 8.34

PERCENT EFFICIENCY = $\frac{\text{In – Out}}{\text{In}}$ X 100

TEMPERATURE: $^0F = (^0C \times 9/5) + 32$ 9/5 =1.8
$^0C = (^0F - 32) \times 5/9$ 5/9 = .555

CONCENTRATION: Conc. (A) X Volume (A) = Conc. (B) X Volume (B)

FLOW RATE (Q): Q = A X V (**Q**uantity = **A**rea X **V**elocity)

FLOW RATE (gpm): Flow Rate (gpm) = $\frac{2.83 \text{ (Diameter, in)}^2 \text{ (Distance, in)}}{\text{Height, in}}$

% SLOPE = $\frac{\text{Rise (feet)}}{\text{Run (feet)}}$ X 100

ACTUAL LEAKAGE = $\frac{\text{Leak Rate (GPD)}}{\text{Length (mi.) X Diameter (in)}}$

VELOCITY = $\frac{\text{Distance (ft)}}{\text{Time (Sec)}}$

N = Manning's Coefficient of Roughness
R = Hydraulic Radius (ft.)
S = Slope of Sewer (ft/ft.)

HYDRAULIC RADIUS (ft) = $\frac{\text{Cross Sectional Area of Flow (ft)}}{\text{Wetted pipe Perimeter (ft)}}$

WATER HORSEPOWER = $\frac{\text{Flow (gpm) X Head (ft)}}{3960}$

BRAKE HORSEPOWER = $\frac{\text{Flow (gpm) X Head (ft)}}{\text{3960 X Pump Efficiency}}$

MOTOR HORSEPOWER = $\frac{\text{Flow (gpm) X Head (ft)}}{\text{3960 X Pump Eff. X Motor Eff.}}$

MEAN OR AVERAGE = $\frac{\text{Sum of the Values}}{\text{Number of Values}}$

TOTAL HEAD (ft) = Suction Lift (ft) X Discharge Head (ft)

SURFACE LOADING RATE (gal/min/sq.ft) = $\frac{\text{Flow Rate (gpm)}}{\text{Surface Area (sq. ft)}}$

MIXTURE STRENGTH (%) = $\frac{\text{(Volume 1, gal) (Strength 1, \%) + (Volume 2, gal) (Strength 2,\%)}}{\text{(Volume 1, gal) + (Volume 2, gal)}}$

INJURY FREQUENCY RATE = $\frac{\text{(Number of Injuries) 1,000,000}}{\text{Number of hours worked per year}}$

DETENTION TIME (hrs) = $\frac{\text{Volume of Basin (gals) X 24 hrs}}{\text{Flow (GPD)}}$

SLOPE = $\frac{\text{Rise (ft)}}{\text{Run (ft)}}$ **SLOPE (%)** = $\frac{\text{Rise (ft) X 100}}{\text{Run (ft)}}$

POPULATION EQUIVALENT (PE):

1 PE = .17 Pounds of BOD per Day
1 PE = .20 Pounds of Solids per Day
1 PE = 100 Gallons per Day

LEAKAGE (GPD/inch) = $\frac{\text{Leakage of Water per Day (GPD)}}{\text{Sewer Diameter (inch)}}$

CHLORINE DEMAND (mg/L) = Chlorine Dose (mg/L) – Chlorine Residual (mg/L)

MANNING FORMULA

τQ = Allowable time for decrease in pressure from 3.5 PSI to 2.5 PSI
τq = As below

$\tau Q = (0.022)\,(d_1^2 L_1)/Q$ $\tau q = \frac{[\,0.085]}{q}\,[(d_1^2 L1)/(d_1 L_1)]$

Q = 2.0 cfm air loss
θ = .0030 cfm air loss per square foot of internal pipe surface
δ = Pipe diameter (inches)
L = Pipe Length (feet)

$V = \frac{1.486}{\nu} R^{2/3} S^{1/2}$

V = Velocity (ft./sec.)
ν = Pipe Roughness
R = Hydraulic Radius (ft)
S= Slope (ft/ft)

HYDRAULIC RADIUS (ft) = $\frac{\text{Flow Area (ft.}^2)}{\text{Wetted Perimeter (ft.)}}$

WIDTH OF TRENCH (ft) = Base (ft) + (2 Sides) X $\frac{\text{Depth (ft}^2)}{\text{Slope}}$

.

Conversion Factors

1 acre = 43,560 square feet
1 cubic foot = 7.48 gallons
1 foot = 0.305 meters
1 gallon = 3.785 liters
1 gallon = 8.34 pounds
1 grain per gallon = 17.1 mg/L
1 horsepower = 0.746 kilowatts
1 million gallons per day = 694.45 gallons per minute
1 pound = 0.454 kilograms
1 pound per square inch = 2.31 feet of water
1% = 10,000 mg/L
Degrees Celsius = (Degrees Fahrenheit - 32) (5/9)
Degrees Fahrenheit = (Degrees Celsius * 9/5) + 32
64.7 grains = 1 cubic foot
1,000 meters = 1 kilometer
1,000 grams = 1 kilogram

Formula/Conversion Table

Acid Feed Rate = $\frac{\text{(Waste Flow) (Waste Normality)}}{\text{Acid Normality}}$

Alkalinity = $\frac{\text{(mL of Titrant) (Acid Normality) (50,000)}}{\text{mL of Sample}}$

Amperage = Voltage ÷ Ohms

Area of Circle = (0.785)(Diameter^2) OR (π)(Radius^2)

Area of Rectangle = (Length)(Width)

Area of Triangle = $\frac{\text{(Base) (Height)}}{2}$

C Factor Slope = Energy loss, ft. ÷ Distance, ft.

C Factor Calculation = Flow, GPM ÷ [193.75 (Diameter, ft.)2.63(Slope)0.54]

Chemical Feed Pump Setting, % Stroke = $\frac{\text{(Desired Flow) (100\%)}}{\text{Maximum Flow}}$

Chemical Feed Pump Setting, mL/min =
$\frac{\text{(Flow, MGD) Dose, mg/L) (3.785L/gal) (1,000,000 gal/MG)}}{\text{(Liquid, mg/mL) (24 hr. / day) (60 min/hr.)}}$

Chlorine Demand (mg/L) = Chlorine dose (mg/L) – Chlorine residual (mg/L)

Circumference of Circle = (3.141) (Diameter)

Composite Sample Single Portion = $\frac{\text{(Instantaneous Flow) (Total Sample Volume)}}{\text{(Number of Portions) (Average Flow)}}$

Detention Time = $\frac{\text{Volume}}{\text{Flow}}$

Digested Sludge Remaining, % = $\frac{\text{(Raw Dry Solids) (Ash Solids) (100\%)}}{\text{(Digested Dry Solids) (Digested Ash Solids)}}$

Discharge = $\frac{\text{Volume}}{\text{Time}}$

Dosage, lbs/day = (mg/L)(8.34)(MGD)

$$\text{Dry Polymer (lbs.)} = (\text{gal. of solution})(8.34\ \text{lbs/gal})(\%\ \text{polymer solution})$$

$$\text{Efficiency, \%} = \frac{(\text{In} - \text{Out})(100\%)}{\text{In}}$$

$$\text{Feed rate, lbs/day} = \frac{(\text{Dosage, mg/L})(\text{Capacity, MGD})(8.34\ \text{lbs/gals})}{(\text{Available fluoride ion})(\text{Purity})}$$

$$\text{Feed rate, gal/min (Saturator)} = \frac{(\text{Plant capacity, gal/min.})(\text{Dosage, mg/L})}{18{,}000\ \text{mg/L}}$$

$$\text{Filter Backwash Rate} = \frac{\text{Flow}}{\text{Filter Area}}$$

$$\text{Filter Yield, lbs/hr./sq. ft} = \frac{(\text{Solids Loading, lbs/day})(\text{Recovery, \% / 100\%})}{(\text{Filter operation, hr./day})(\text{Area, ft}^2)}$$

$$\text{Flow, cu. ft./sec.} = (\text{Area, Sq. Ft.})(\text{Velocity, ft./sec.})$$

$$\text{Gallons/Capita/Day} = \frac{\text{Gallons / day}}{\text{Population}}$$

$$\text{Hardness} = \frac{(\text{mL of Titrant})(1{,}000)}{\text{mL of Sample}}$$

$$\text{Horsepower (brake)} = \frac{(\text{Flow, gpm})(\text{Head, ft})}{(3{,}960)(\text{Efficiency})}$$

$$\text{Horsepower (motor)} = \frac{(\text{Flow, gpm})(\text{Head, ft})}{(3960)(\text{Pump, Eff})(\text{Motor, Eff})}$$

$$\text{Horsepower (water)} = \frac{(\text{Flow, gpm})(\text{Head, ft})}{(3960)}$$

$$\text{Hydraulic Loading Rate} = \frac{\text{Flow}}{\text{Area}}$$

Leakage (actual) = Leak rate (GPD) ÷ [Length (mi.) x Diameter (in.)]

Mean = Sum of values ÷ total number of values

$$\text{Mean Cell Residence Time (MCRT)} = \frac{\text{Suspended Solids in Aeration System, lbs}}{\text{SS Wasted, lbs / day} + \text{SS lost, lbs / day}}$$

$$\text{Organic Loading Rate} = \frac{\text{Organic Load, lbs BOD / day}}{\text{Volume}}$$

$$\text{Oxygen Uptake} = \frac{\text{Oxygen Usage}}{\text{Time}}$$

Pounds per day = (Flow, MGD) (Dose, mg/L) (8.34)

$$\text{Population Equivalent} = \frac{(\text{Flow MGD}) (\text{BOD, mg/L}) (8.34 \text{ lbs / gal})}{\text{Lbs BOD / day / person}}$$

$$\text{RAS Suspended Solids, mg/l} = \frac{1{,}000{,}000}{\text{SVI}}$$

$$\text{RAS Flow, MGD} = \frac{(\text{Infl. Flow, MGD}) (\text{MLSS, mg/l})}{\text{RAS Susp. Sol., mg/l} - \text{MLSS, mg/l}}$$

$$\text{RAS Flow \%} = \frac{(\text{RAS Flow, MGD}) (100 \%)}{\text{Infl. Flow, MGD}}$$

$$\text{Reduction in Flow, \%} = \frac{(\text{Original Flow} - \text{Reduced Flow}) (100\%)}{\text{Original Flow}}$$

$$\text{Slope} = \frac{\text{Drop or Rise}}{\text{Run or Distance}}$$

$$\text{Sludge Age} = \frac{\text{Mixed Liquor Solids, lbs}}{\text{Primary Effluent Solids, lbs / day}}$$

$$\text{Sludge Index} = \frac{\text{\% Settleable Solids}}{\text{\% Suspended Solids}}$$

$$\text{Sludge Volume Index} = \frac{(\text{Settleable Solids, \%}) (10{,}000)}{\text{MLSS, mg/L}}$$

$$\text{Solids, mg/L} = \frac{(\text{Dry Solids, grams}) (1{,}000{,}000)}{\text{mL of Sample}}$$

Solids Applied, lbs/day = (Flow, MGD)(Concentration, mg/L)(8.34 lbs/gal)

$$\text{Solids Concentration} = \frac{\text{Weight}}{\text{Volume}}$$

Solids Loading, lbs/day/sq. ft = $\frac{\text{Solids Applied, lbs / day}}{\text{Surface Area, sq. ft}}$

Surface Loading Rate = $\frac{\text{Flow}}{\text{Rate}}$

Total suspended solids (TSS), mg/L =
(Dry weight, mg)(1,000 mL/L) ÷ (Sample vol., mL)

Velocity = $\frac{\text{Flow}}{\text{Area}}$ O R $\frac{\text{Distance}}{\text{Time}}$

Volatile Solids, % = $\frac{\text{(Dry Solids - Ash Solids) (100\%)}}{\text{Dry Solids}}$

Volume of Cone = (1/3)(0.785)(Diameter^2)(Height)

Volume of Cylinder = (0.785)(Diameter^2)(Height) OR (π)(r^2)(h)

Volume of Rectangle = (Length)(Width)(Height)

Volume of Sphere = [(π)(diameter^3)] ÷ 6

Waste Milliequivalent = (mL) (Normality)

Waste Normality = $\frac{\text{(Titrant Volume) (Titrant Normality)}}{\text{Sample Volume}}$

Weir Overflow Rate = $\frac{\text{Flow}}{\text{Weir Length}}$

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Other Guidance Documents that can help you

Guidance Manual For Implementing Total Toxic Organics (TTO) Pretreatment Standards

Guidance Manual for Preparation and Review of Removal Credit Applications

Guidance Manual for Preventing Interference at POTWs

Guidance Manual for the Identification of Hazardous Wastes Delivered to Publicly Owned Treatment Works by Truck, Rail, or Dedicated Pipe

Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula

Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program

Guidance to Protect POTW Workers From Toxic And Reactive Gases And Vapors

Prelim User's Guide, Documentation for the EPA Computer Program/Model for Developing Local Limits for Industrial Pretreatment Programs at Publicly Owned Treatment Works

Supplemental Manual On the Development And Implementation of Local

Discharge Limitations Under The Pretreatment Program: Residential and Commercial

Toxic Pollutant Loadings And POTW Removal Efficiency Estimation

CERCLA Site Discharges to POTWs Guidance Manual

Control of Slug Loadings To POTWs: Guidance Manual

Guidance For Developing Control Authority Enforcement Response Plans

Guidance Manual for POTWs to Calculate the Economic Benefit of Noncompliance

Industrial User Inspection and Sampling Manual For POTWs

Industrial User Permitting Guidance Manual

Model Pretreatment Ordinance

Multijurisdictional Pretreatment Programs: Guidance Manual

NPDES Compliance Inspection Manual

POTW Sludge Sampling and Analysis Guidance Document

Pretreatment Compliance Monitoring and Enforcement Guidance

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