CWA
WASTEWATER TREATMENT

CONTINUING EDUCATION
PROFESSIONAL DEVELOPMENT COURSE

Technical Learning College

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Professional Engineers; Most states will accept our courses for credit but we do not officially list the States or Agencies acceptance or approvals.

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http://www.abctlc.com/downloads/PDF/CEU%20State%20Approvals.pdf

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Do not solely depend on TLC's Approval list for it may be outdated.

A second certificate of completion for a second State Agency $50 processing fee.

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 / pretreatment regulations that may be more stringent than EPA's or OSHA'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.

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 do finish the material on your leisure. 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.

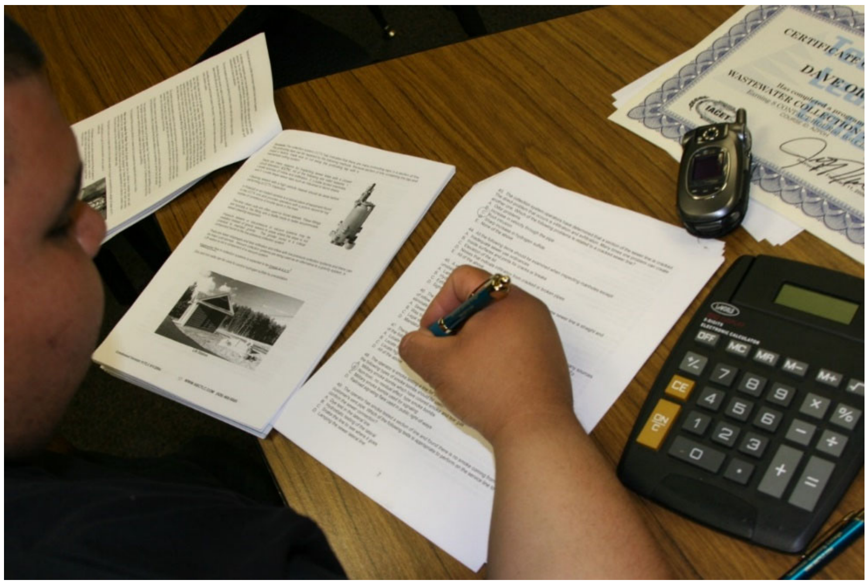
Flexible Learning
At TLC, there are no scheduled online sessions or passwords you need contend with, nor are you required to participate in learning teams or groups designed for the "typical" younger campus based student. You can work at your own pace, completing assignments in time-frames that work 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

No Data Mining Policy
Unlike most online training providers, we do not use passwords or will upload intrusive data mining software onto your computer. We do not use any type of artificial intelligence in our program. Nor will we sell you any other product or sell your data to others as with many of our competitors. Unlike our training competitors, we have a telephone and we humanly answer.

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

CWA - WASTEWATER TREATMENT CEU TRAINING COURSE

This short CEU course (1 hour of regulation) is a review of the Clean Water Act relating to wastewater treatment and compliance. This course is general in nature and not state specific but will contain CWA compliance information. You will not need any other materials for this course.

Intended Audience
Collections Operators, Onsite Installer, 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, wastewater treatment or pretreatment/industrial wastewater facility, 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.

Audience
Attention Pretreatment Operators, Laboratory Technicians, and Wastewater Treatment and Collections Operators. The target audience for this course is the person interested in working in a pretreatment/wastewater treatment or collections / pretreatment facility and wishing to maintain CEUs for certification license, meet education needs for promotion, or to learn how to do the job more safely and effectively.

Course Statement of Need
It is essential that all pretreatment and wastewater operators have Clean Water Act knowledge for this rule is the foundation of maintaining our environment.

General Learning Goals
1. Students will be able to understand, identify and explain the basics of the Clean Water Act's Pollution Control rules.
2. Students will be able to understand, identify and explain some of the pretreatment regulations.

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.

Instructions for Written Assignments
The CWA Wastewater Treatment 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 front of the course assignment 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 CWA – Wastewater Treatment CEU Training course comes 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.

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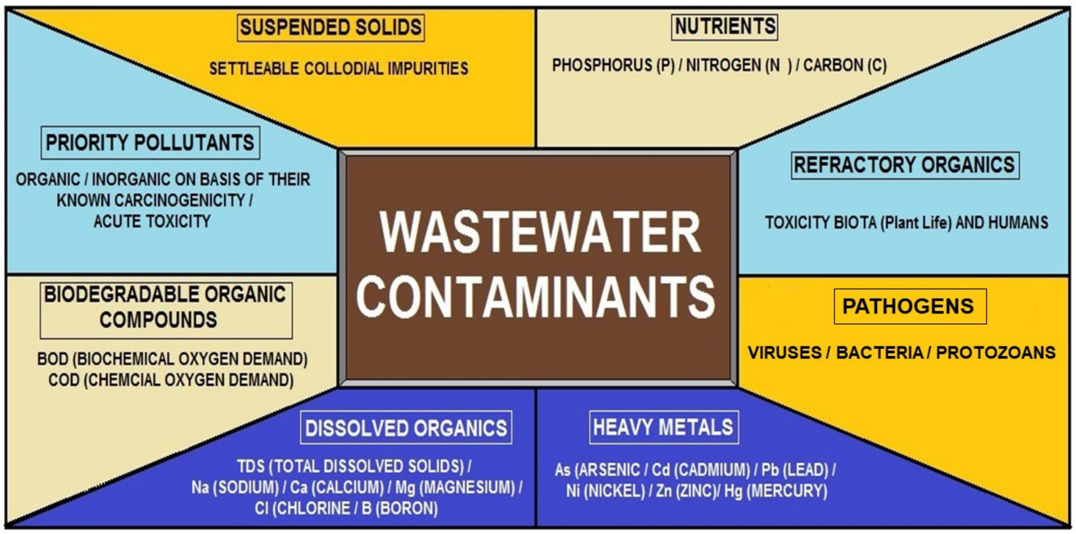
Hyperlink to the Glossary and Appendix
http://www.abctlc.com/downloads/PDF/WWTGlossary.pdf

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.

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



Technical Learning College

TYPES OF WASTEWATER CONTAMINANTS

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 food 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 1,500 POTWs have developed and are implementing local pretreatment programs designed to control discharges from approximately 30,000 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 *Pretreatment Program* 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.

Compliance Acronym Glossary

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

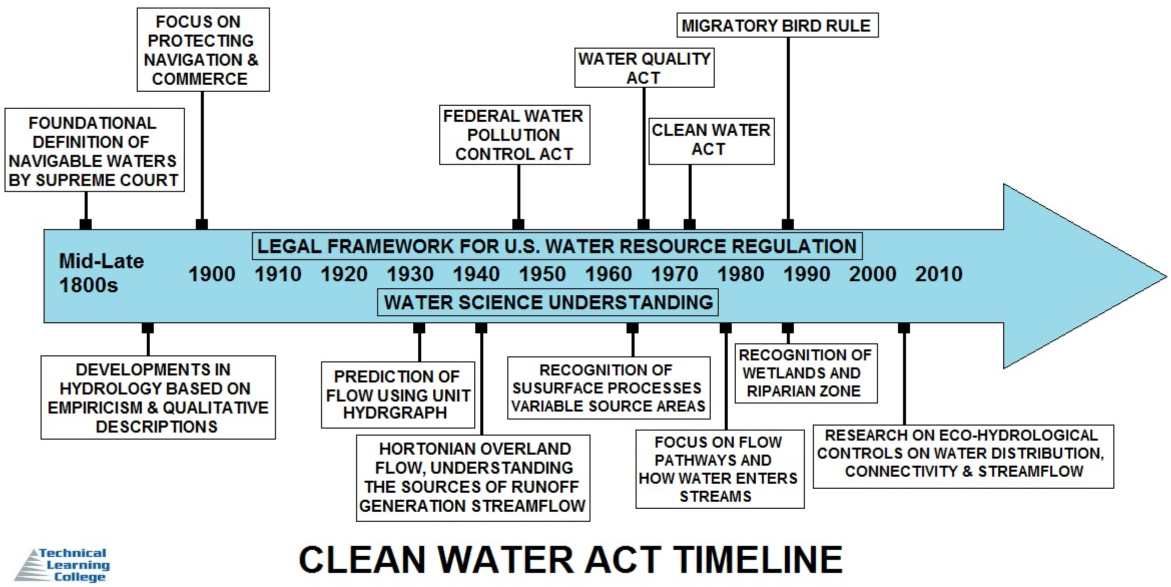
NSPS	New Source Performance Standard
O&G	Oil and Grease
O&M	Operations and Maintenance
OCPSF	Organic Chemicals, Plastics, and Synthetic Fibers
P2	Pollution Prevention
PCA	Federal Water Pollution Control Act
PCI	Pretreatment Compliance Inspection
PCS	Permit Compliance System
PIRT	Pretreatment Implementation 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

Clean Water Act 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.

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.



CLEAN WATER ACT TIMELINE

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 Clean Water Act 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 Clean Water Act.

The Clean Water Act'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 Clean Water Act 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 Act continues to provide a clear path for clean water and a solid foundation for an effective national water program.

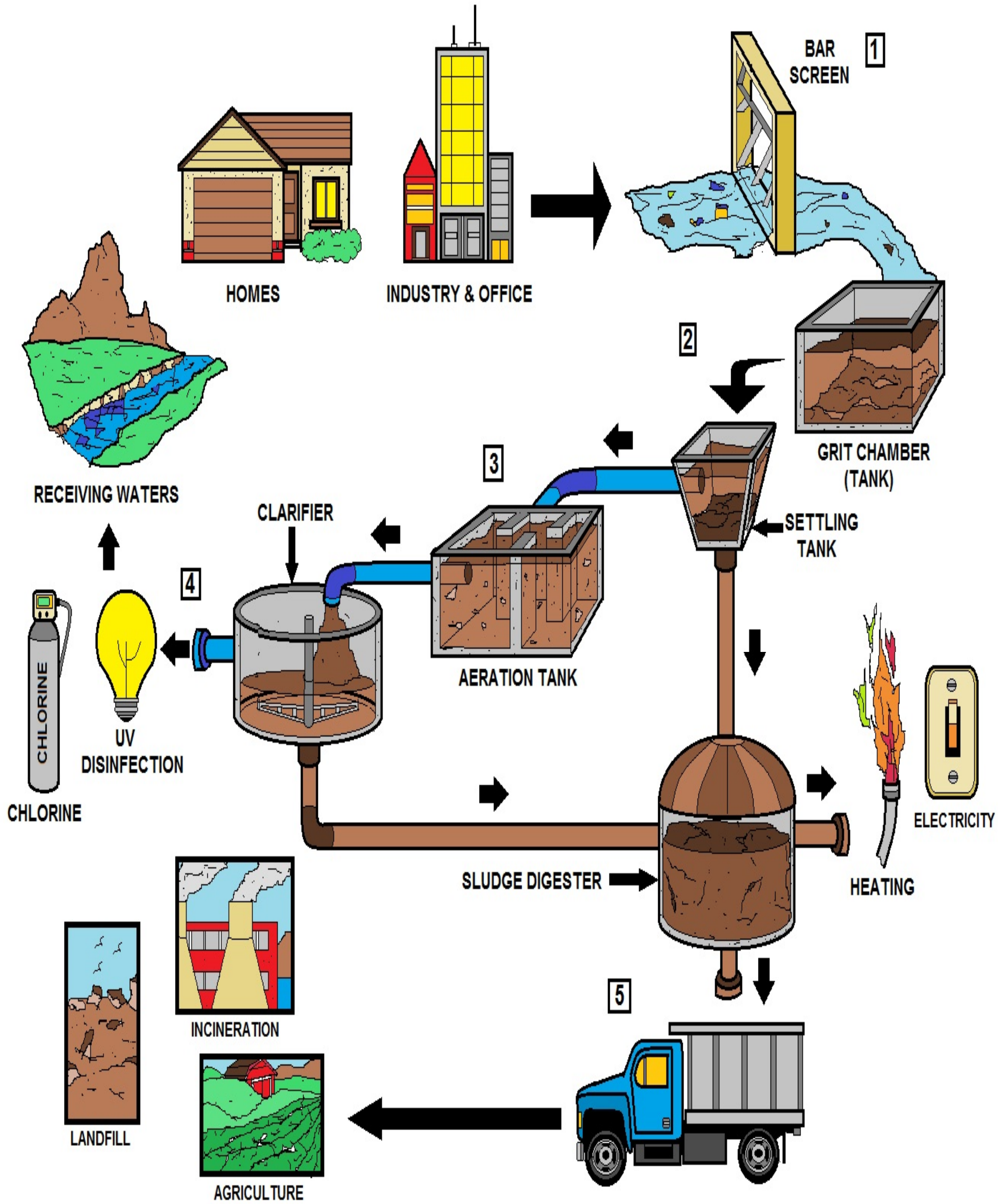
In 1972:
Only a third of the nation's waters were safe for fishing and swimming. Wetlands losses were estimated at about 460,000 acres annually.

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 served only 85 million people.

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

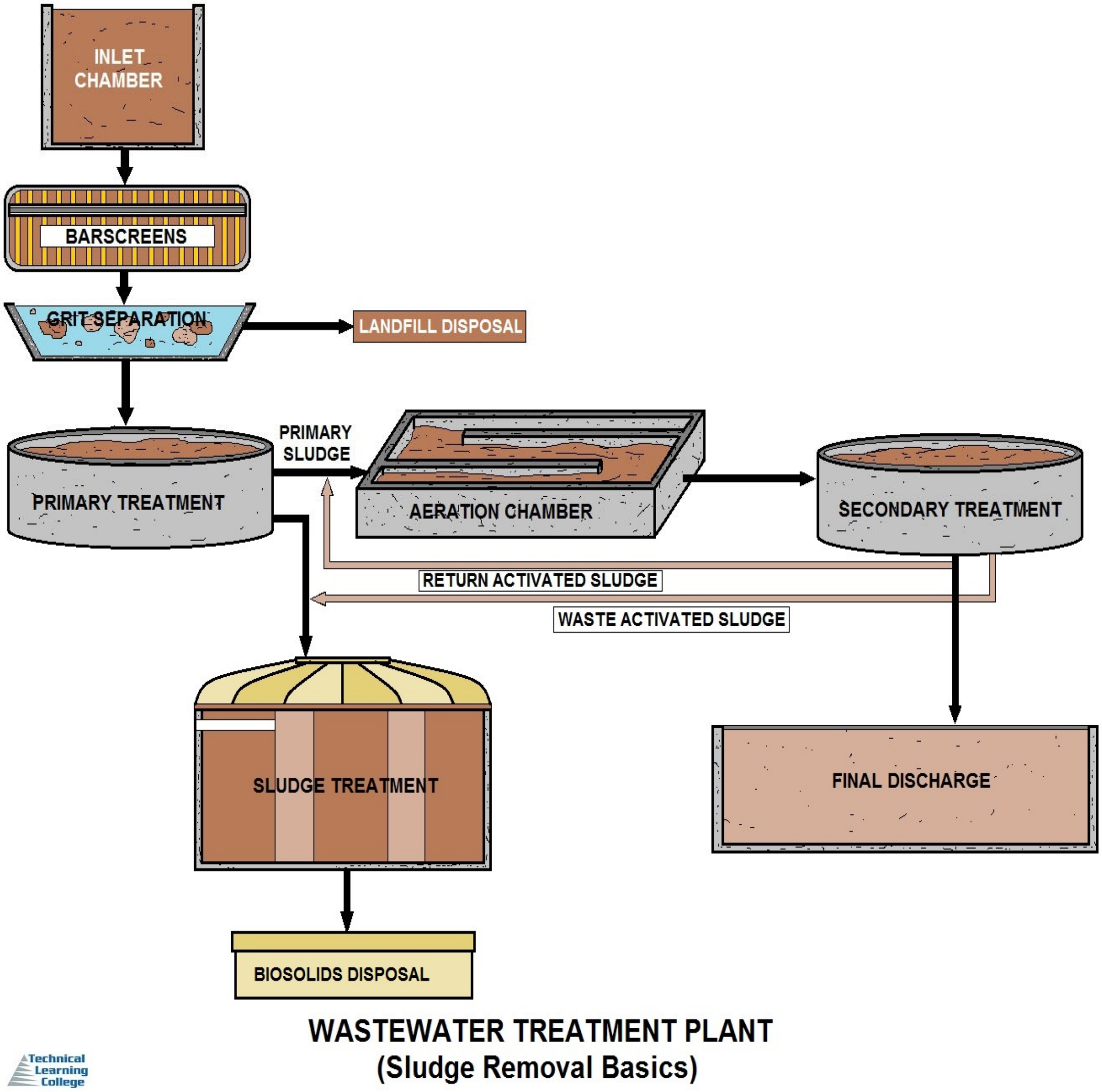
The rate of annual wetlands losses is estimated at about 70,000-90,000 acres according to recent studies. The amount of soil lost due to agricultural runoff has been cut by one billion tons annually, and phosphorus and nitrogen levels in water sources are down.
Modern wastewater treatment facilities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



WASTEWATER TREATMENT PROCESS

As a wastewater operator or pretreatment inspector, you will need knowledge of many different concerns in order to properly identify the problem and sometimes you will need to order the remedy, solution or correction.



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.

Clean Water Act (CWA) Section 101

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.

Pollution Control Act Amendments

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 31 year 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.

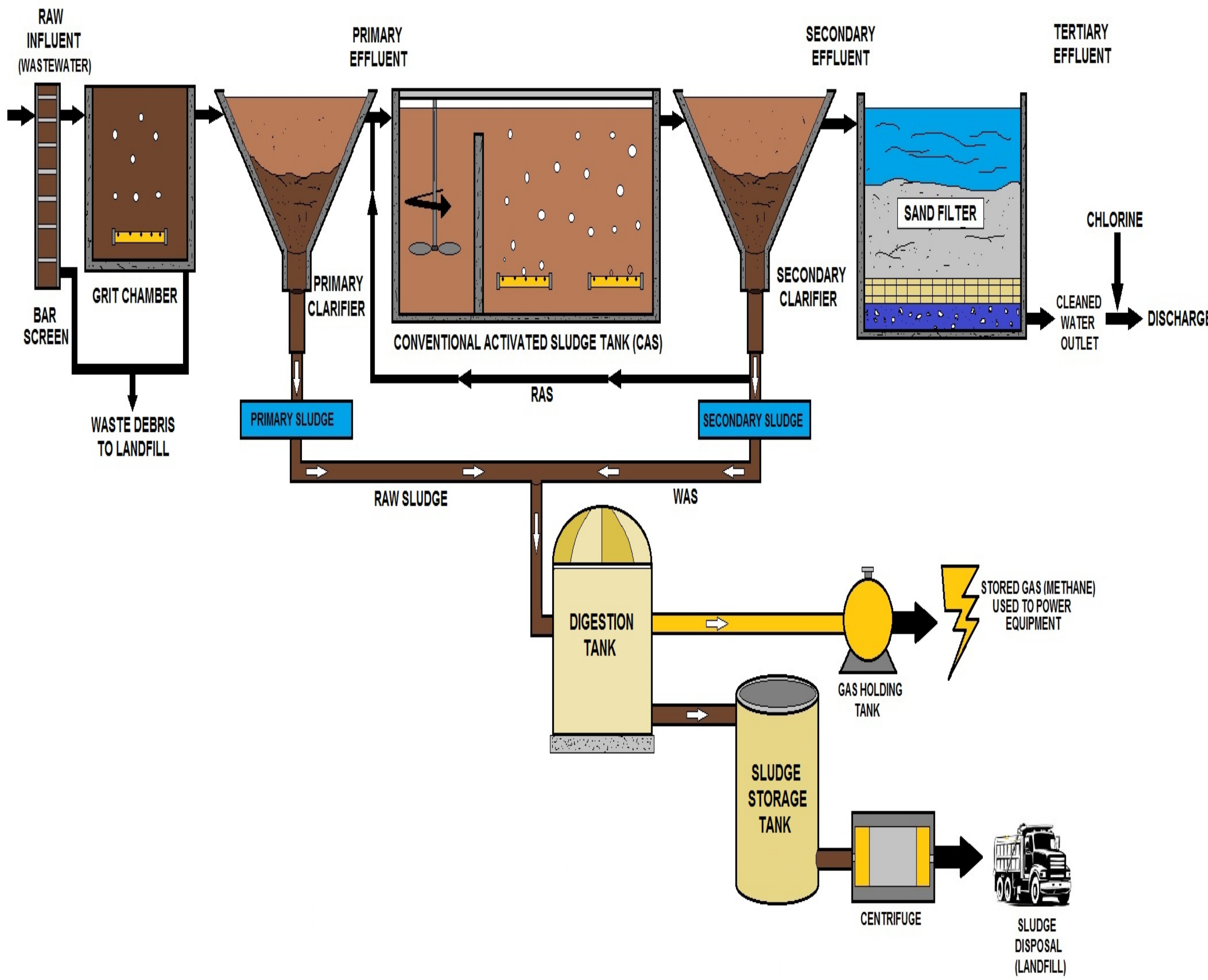
As a result of this litigation, the EPA promulgated the General Pretreatment Regulations at 40 CFR Part 403 on June 26, 1978, replacing the 40 CFR Part 128 requirements. Additionally, as a result of the suit, the EPA agreed to regulate the discharge of 65 categories of pollutants (making up the 126 priority pollutants presented in Figure 4) 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 51 distinct industries.

Modern wastewater treatment plant

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.



Physical, Biological or Chemical Wastewater Treatments

There are two wastewater treatment processes include chemical and/or physical and biological wastewater treatment.

1. Physical waste treatment plants may use chemical reactions as well as physical processes to treat wastewater. 2. Biological treatment systems are ideal for treating wastewater from households and business premises. Biological waste treatment plants use mostly bacteria to break down waste matter.

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?

Wastewater is mostly water by weight. 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 toxic 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 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.

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)

This course contains general EPA’s federal rule requirements. Please be aware that each state implements wastewater/safety/environment regulations that may be more stringent than EPA’s regulations. Check with your permit or state environmental agency for more information.

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.

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.

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.

The bacteria normally present in water must have oxygen to do their part in breaking down the sewage.

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

Anaerobic Digester

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

Any excess microbiological growth can be removed from the wastewater by physical processes. Activated Sludge is a suspended growth process for removing organic matter from sewage by supplying or saturating it with air and microorganisms that can break down the organic matter.

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.

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
Many disease-causing viruses, parasites, and bacteria also are present in wastewater and enter from almost anywhere in the community. These pathogens often originate from people and animals that are infected with or are carriers of a disease.

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.

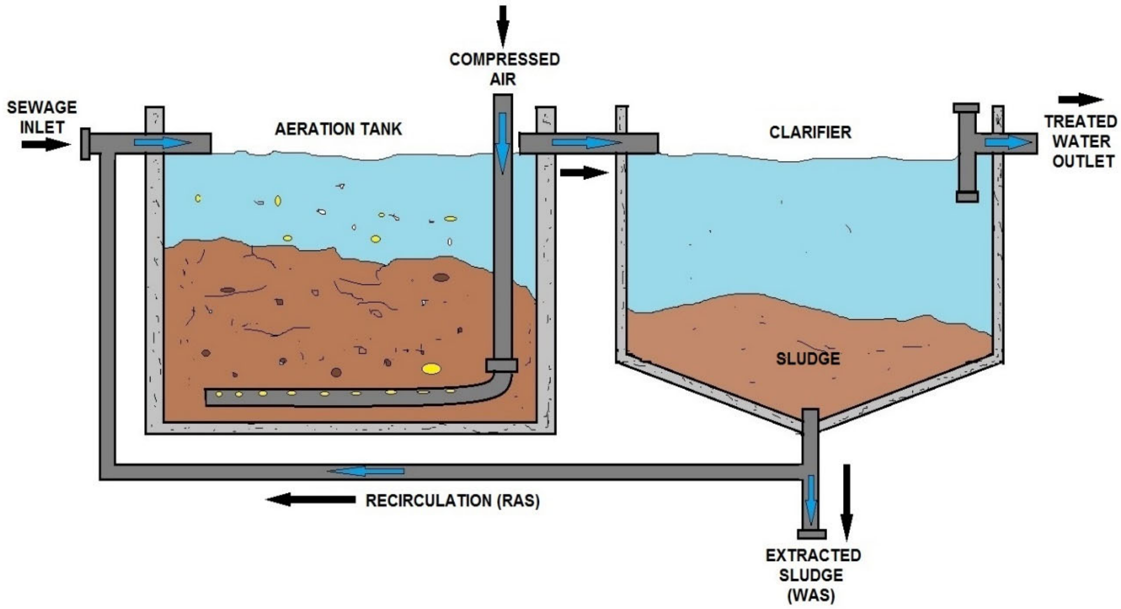
Some illnesses from wastewater-related sources are relatively common. Gastroenteritis can result from a variety of pathogens in wastewater, and cases of this illnesses caused by the parasitic protozoa Giardia lambia and Cryptosporidium are not unusual in the U.S.

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. We will cover this area in greater detail later in the course.

Introduction to Activated Sludge (A/S)



SIMPLIFIED ACTIVIATED SLUDGE DIAGRAM

Quick introduction of some key biological information and we will return to this subject alter in the book.

The Activated Sludge Process is an aerobic biological *wastewater treatment* process that uses microorganisms, including bacteria, fungi, and protozoa, to speed up decomposition of organic matter requiring oxygen for treatment. In activated sludge, microorganisms are thoroughly mixed with wastewater (organics) under conditions that stimulate their growth and waste materials are removed. As the microorganisms (bugs) grow and are mixed by the agitation of the air, the bugs will clump (or *flocculate)* together to form a mass of microbes called ***activated sludge.***

When introduced into a clarifier, the microorganisms in the A/S process takes advantage of aerobic microorganisms or populations that can digest organic matter in wastewater, and clump together by flocculation and settled out. This action produces a liquid that is relatively free from suspended solids and organic material, and flocculated particles that will readily settle out and can be removed. We will cover all these details later in the course manual.

Mixed Liquor
Atmospheric air or sometimes pure oxygen is bubbled through primary treated sewage (or industrial wastewater) and combined with Return Activated Sludge (RAS) organisms to develop a biological floc which reduces the organic content of the sewage. The combination of raw sewage and biological mass is commonly known as Mixed Liquor.

In all activated sludge plants, once the wastewater has received sufficient treatment, the mixed liquor is discharged or flows into settling tanks. The treated supernatant of clarified water often undergoes further treatment before discharge.
Return Activated Sludge

Most of the settled material, the sludge (RAS), is returned to the head of the aeration system to re-seed the new sewage entering the tank. Mixed Liquor is a mixture of raw or settled wastewater and activated sludge within an aeration tank.

Mixed Liquor Suspended Solids (MLSS) is the concentration of suspended solids in the mixed liquor, usually expressed in milligrams per liter (mg/l).

The arrangement of a conventional activated sludge process for removing carbonaceous pollution includes the following items:

- Aeration tank where air (or oxygen) is injected in the mixed liquor.
- Settling tank (usually referred to as "final clarifier" or "secondary settling tank") to allow the biological flocs (the sludge blanket) to settle, thus separating the biological sludge from the clear treated water.

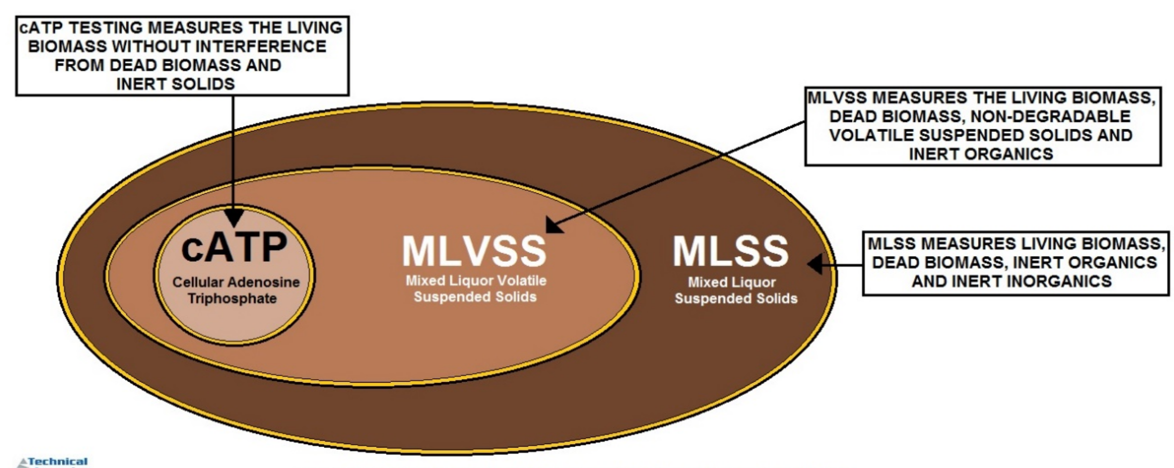
Sometimes activated sludge is used to feed bugs to various tanks, BNR processes, fixed-film filters, lagoons and oxidation ditches. There are times that A/S bugs will be transported to another plant for maintenance or start-ups.

Nitrogenous matter or phosphate treatment involves additional steps where the mixed liquor is left with no residual dissolved oxygen. Again, we will cover this subject later in the course.

Sludge Volume Index (SVI) Introduction

Historically, the Sludge Volume Index (SVI) has been used most commonly as a measure of sludge settleability. It is defined as the volume in milliliters occupied by 1 g of the suspended solids or activated sludge following 30 minutes of unstirred settling of the aeration basin MLSS. The test may be carried out in a 1 or 2 L settling column.

Sludge settleability is central to the health of the biological system. It is important to point out that settleability is influenced by conditions in the activated sludge basin but manifests itself in the clarifier. Poor settling sludge causes lower solids concentration requiring higher RAS rates to maintain a given MLSS in the activated sludge basin. Consequently, measuring sludge settleability is fundamental to the operation and control of the biological system.



COMPARATIVE WASTEWATER TESTING

Primary Wastewater Pollutant Effects

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 lifetime of lakes.
  - 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 susceptible to acids and bases.
- Recommended to have near neutral conditions (6.5 - 8.5).

Effect of Pathogens
May infect:

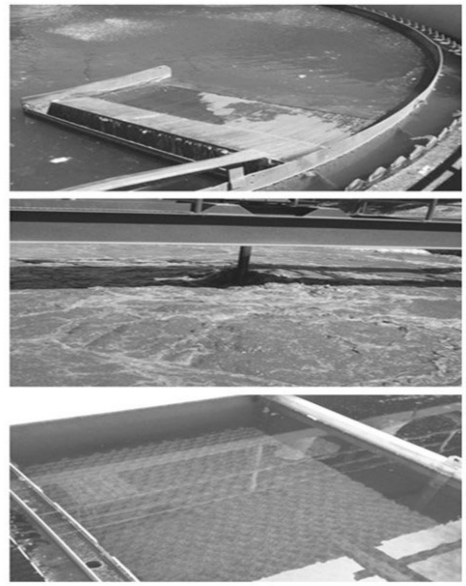
- Humans
- Animals

Domestic waste overflow at a WWTP headworks. Sometimes headworks do overflow, usually due to rags, grease and debris, or operator error. We do not like to see this happening!

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.

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

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

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 Waste Breakdown

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, 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 (Scum)
Fatty organic materials from animals, vegetables, plastics, and petroleum are not quickly broken down by bacteria and can cause pollution in receiving environments. When large amounts of oils and greases are discharged to receiving waters from WWTPS, 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.

FAT AND GREASE REMOVAL

In some larger plants, fat and grease are removed by passing the sewage through a relatively 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.

Wastewater onsite (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 conditions can result in significant costs to homeowners.

Petroleum-based waste oils used for motors and industry are considered hazardous waste and should be collected and disposed of separately from wastewater. They can be toxic to treatment bacteria and often are flammable.

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 relatively new analytical technique provides wastewater treatment plant operators with a much improved means of being able to optimize the operation of the anaerobic 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. Some of these are a natural aspect of drinking water but others 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 *(we will return to this subject in detail later.)*

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.

Excessive nutrients in receiving waters cause algae and other plants to grow quickly depleting oxygen in the water. Water that is deprived of oxygen, fish and other aquatic life die, emitting foul odors as they anaerobically decompose.

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 that a plant or animal 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 are usually acquired from the environment, although some can be manufactured by bacteria, fungus and plants.

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 a more simple mineral form, making them more usable by plant life.

An excess of nutrients, primarily phosphorus but occasionally nitrogen, causes nutrient enrichment that 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.

Because nutrients are very essential to the process, we will cover this subject in several different sections.

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.

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 to manage hydrogen sulfide levels.

Pretreatment Program

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 the 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.

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 (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.

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 sewage only.

However, 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.

National Pretreatment Program
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 after being washed and being allowed to air dry. 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.

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.

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 Local Limits or compliance and the other for the wastewater plant operator to determine plant efficiency.

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.

These same Americans, on average, discharge about the same 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 down the drain, wastes 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.

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.

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

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.

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.

Key Review Notes

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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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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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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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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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.

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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 outcome 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 inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal, and- 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.

As outlined in the EPA's objectives, 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.

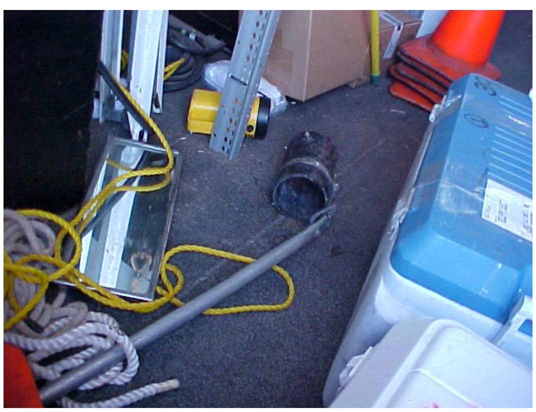
Problems Associated With Toxic Discharges *Figure 3*

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 from contaminated sewage sludge.

Toxic Emissions (*Credit to USEPA)*

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.

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

Volatile Organic Compounds (VOCs)

One more important issues we need to address before we cover the essential 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 3 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.

Other problems associated with toxic discharges were summarized in Figure 3 and further document the urgency of keeping toxics out of collection systems and POTWs.

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 Figure 4).

These pollutants fall into two categories; metals and organics:

- Metals, including lead, mercury, chromium, and cadmium that cannot be destroyed or broken down through treatment or environmental degradation. Toxic metals can cause different 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 be cancer-causing 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.

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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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)

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.

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 1998, 1,578 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.

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 37 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.

NPDES Permit

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.

As of early 1998, of the 1,578 POTWs required to develop pretreatment programs, 97 percent (1,535) have been approved. 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 attachment to grab a sample.

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 (Figure 10).

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.

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.

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