Registration form

Canadian Wastewater Treatment Training Course $200.00
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL $50.00

Start and Finish Dates: ______________*You will have 90 days from this date in order to complete this course*

List number of hours worked on assignment must match State Requirement. ________

Name__________________________________Signature_____________________________
I have read and understood the disclaimer notice on page 2. Digitally sign XXX

Address: ____

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Home (______) _______________________Work (______) __________________________

Operator ID# ____Exp Date_____________

Please circle/check which certification you are applying the course CEU's.

Wastewater Treatment______ Other ________________________

Your certificate will be emailed to you in about two weeks.

Technical Learning College PO Box 3060, Chino Valley, AZ 86323
Toll Free (866) 557-1746 Fax (928) 272-0747 info@tlch2o.com

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DISCLAIMER NOTICE

I understand that it is my responsibility to ensure that this CEU course is either approved or accepted in my Providence for CEU credit. I understand Provencal laws and rules change on a frequent basis and I believe this course is currently accepted in my Provenience for CEU or contact hour credit, if it is not, I will not hold Technical Learning College responsible.

I fully understand that this type of study program deals with dangerous, changing conditions and various laws and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable in any fashion for any errors, omissions, advice, suggestions or neglect contained in this CEU education training course or for any violation or injury, death, neglect, damage or loss of your license or certification caused in any fashion by this CEU education training or course material suggestion or error or my lack of submitting paperwork. It is my responsibility to call or contact TLC if I need help or assistance and double-check to ensure my registration page and assignment has been received and graded. It is my responsibility to ensure all information is correct and to abide with all rules and regulations.

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AFFIDAVIT OF EXAM COMPLETION

I affirm that I personally completed the entire text of the course. I also affirm that I completed the exam without assistance from any outside source. I understand that it is my responsibility to file or maintain my certificate of completion as required by the state or by the designation organization.

Grading Information

In order to maintain the integrity of our courses we do not distribute test scores, percentages or questions missed. Our exams are based upon pass/fail criteria with the benchmark for successful completion set at 70%. Once you pass the exam, your record will reflect a successful completion and a certificate will be issued to you.

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

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Wastewater Treatment WQ CEU Course Answer Key

***Name*___________________________*Telephone #* ____________________**

You are solely responsible that this course is accepted for credit by your Provenience**. Did you check with your Provencal agency to ensure this course is accepted for credit?**

Method of Course acceptance confirmation. Please fill this section

Website __ Telephone Call___ Email____ Spoke to_________________________
Do not solely depend on TLC's Approval list for it may be outdated. No refunds.

What is the course approval number, if applicable? ____________________

Please circle, underline, bold or X only one correct answer

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This course contains general Canadian federal rule requirements. Please be aware that each providence implements wastewater/safety/environmental /building regulations that may be more stringent than Canadian regulations. Check with your environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to be in full-compliance and do not follow this course for proper compliance.

Please fax the answer key to TLC
(928) 272-0747
Always call to confirm that we received your paperwork.

Canadian Wastewater Treatment
CEU Course Assignment

The Assignment is available in Word on the Internet for your Convenience, please visit www.ABCTLC.com, download the assignment, and e-mail it back to TLC.

You will have 90 days from the start of this course to complete in order to receive your Professional Development Hours (**PDHs**) or Continuing Education Unit (**CEU**). A score of 70 % is necessary to pass this course. If you should need any assistance, please email all concerns and the completed manual to info@tlch2o.com.

We would prefer that you utilize the enclosed answer sheet in the front, but if you are unable to do so, type out your own answer key. Please include your name, address on your manual, and make copy for yourself.

Multiple Choice, please select only one answer per question. There are no intentional trick questions.

Organisms

1. Bacteria and other microorganisms are particularly plentiful in wastewater and accomplish most of the treatment. Most _______________systems are designed to rely in large part on biological processes.

A. Wastewater treatment
B. High TSS
C. Settling sediments
D. Total Suspended Solids (TSS)
E. Suspended sediment
F. None of the Above

Nutrients

2. Wastewater often contains large amounts of the __________in the form of nitrate and phosphate, which promote plant growth.

A. Nutrients from wastewater
B. Inorganic materials
C. Inorganic minerals
D. Nutrients nitrogen and phosphorus
E. Nitrogen and phosphorus
F. None of the Above

3. Organisms only require small amounts of ___________in biological treatment, so there normally is an excess available in treated wastewater. In severe cases, excessive nutrients in receiving waters cause algae and other plants to grow quickly depleting oxygen in the water, deprived of oxygen, fish and other aquatic life die, emitting foul Odours.

A. BOD
B. Most inorganic substances
C. Nitrogen and phosphorus
D. Microorganisms
E. Nutrients
F. None of the Above

4. _________________in drinking water may contribute to miscarriages and is the cause of a serious illness in infants called methemoglobinemia or "blue baby syndrome."

A. BOD
B. Most inorganic substances
C. Phosphorus
D. Pesticides and herbicide(s)
E. Nitrogen
F. None of the Above

Solids

5. Solid materials in wastewater can consist of ___________________and organisms.

A. BOD
B. Organic material
C. The solids
D. Microorganisms
E. Organic and/or inorganic materials
F. None of the Above

6. The solids must be significantly reduced by treatment or they can increase _______________when discharged to receiving waters and provide places for microorganisms to escape disinfection. They also can clog soil absorption fields in onsite systems.

A. Suspended solids
B. Organic material
C. BOD
D. Microorganisms
E. Dissolved solids
F. None of the Above

7. Settleable solids: Certain substances, such as sand, grit, and ______________settle out from the rest of the wastewater stream during the preliminary stages of treatment. On the bottom of settling tanks and ponds, organic material makes up a biologically active layer of sludge that aids in treatment.

A. BOD
B. Organic material
C. The solids
D. Heavier organic and inorganic materials
E. Suspended solids in wastewater
F. None of the Above

8. _______________: Materials that resist settling may remain suspended in wastewater.

A. Suspended solids
B. Organic material
C. The solids
D. Microorganisms
E. Dissolved solids
F. None of the Above

9. _____________________ must be treated, or they will clog soil absorption systems or reduce the effectiveness of disinfection systems.

A. BOD
B. Organic material
C. The solids
D. Microorganisms
E. Suspended solids in wastewater
F. None of the Above

10. ____________________**:** Small particles of certain wastewater materials can dissolve, like salt in water.

A. Suspended solids
B. Organic material
C. The solids
D. Microorganisms
E. Dissolved solids
F. None of the Above

11. Some dissolved materials are consumed by ________________ in wastewater, but others, such as heavy metals, are difficult to remove by conventional treatment.

A. BOD
B. Organic material
C. The solids
D. Microorganisms
E. Suspended solids in wastewater
F. None of the Above

Pollutants, Oxygen-Demanding Substances

12. __________________ is a key element in water quality that is necessary to support aquatic life.

A. Dissolved oxygen
B. Oxygen-demanding
C. Magnesium hydroxide
D. Biochemical oxygen demand, or BOD
E. Wastewater odor(s)
F. None of the Above

13. If the effluent, the treated wastewater produced by a treatment plant, has a high content of organic pollutants or ammonia, it will demand more oxygen from the water and leave the water with less _____________ to support fish and other aquatic life.

A. Slime bacteria
B. Wastewater odor(s)
C. Hydrogen sulfide or H_2S problem(s)
D. The lack of oxygen
E. Oxygen
F. None of the Above

14. Organic matter and _____________are "oxygen-demanding" substances.

A. Dissolved oxygen
B. Ammonia
C. Magnesium hydroxide
D. Biochemical oxygen demand, or BOD
E. Wastewater odor(s)
F. None of the Above

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

A. Slime bacteria
B. Wastewater odor(s)
C. Hydrogen sulfide or H_2S problem(s)
D. The lack of oxygen
E. Domestic sewage
F. None of the Above

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

A. Dissolved oxygen
B. Oxygen-demanding
C. Magnesium hydroxide
D. Biochemical oxygen demand, or BOD
E. Bacteria
F. None of the Above

Gases

17. Certain gases in wastewater can cause Odours, affect treatment, or are potentially dangerous. Methane gas, for example, is a byproduct of ________________and is highly combustible. Special precautions need to be taken near septic tanks, manholes, treatment plants, and other areas where wastewater gases can collect.

A. Dissolved oxygen
B. Oxygen-demanding
C. Magnesium hydroxide
D. Biochemical oxygen demand, or BOD
E. Anaerobic biological treatment
F. None of the Above

Hydrogen Sulfide and Ammonia

18. The gases hydrogen sulfide and ____________can be toxic and pose asphyxiation hazards.

A. Ammonia
B. Wastewater odor(s)
C. Hydrogen sulfide or H_2S problem(s)
D. The lack of oxygen
E. Less oxygen
F. None of the Above

19. Unless effectively contained or minimized by design and location, wastewater Odours can affect the mental well-being and_______________. In some cases, Odours can even lower property values and affect the local economy.

A. Dissolved oxygen
B. Oxygen-demanding
C. Quality of life of residents
D. Biochemical oxygen demand, or BOD
E. Wastewater odor(s)
F. None of the Above

20. ___________ are very common in the collection and wastewater system. There are many chemicals used to help or treat this problem.
A. Slime bacteria
B. Wastewater odor(s)
C. Hydrogen sulfide or H_2S problem(s)
D. The lack of oxygen
E. Less oxygen
F. None of the Above

21. Here are a few used in the treatment of hydrogen sulfide problems: Salts of zinc, lime, hydrogen peroxide, ____________and magnesium hydroxide.
A. Dissolved oxygen
B. Oxygen
C. Chlorine
D. Biochemical oxygen demand, or BOD
E. Wastewater odor(s)
F. None of the Above

22. The best method of controlling hydrogen sulfide is to eliminate its habitat or growth area by keeping sewers cleaner, this will harbor_________________.
A. Fewer slime bacteria
B. Wastewater odor(s)
C. Hydrogen sulfide or H_2S problem(s)
D. The lack of oxygen
E. Less oxygen
F. None of the Above

23. Here are some important statements regarding the reduction of hydrogen sulfide: Salts of zinc and iron may precipitate________________, lime treatments can also kill bacteria which produce hydrogen sulfide, but this creates a sludge disposal problem and chlorination is effective at reducing the bacteria which produce hydrogen sulfide.
A. Dissolved oxygen
B. Sulfides
C. Magnesium hydroxide
D. Biochemical oxygen demand, or BOD
E. Wastewater odor(s)
F. None of the Above

24. _____________conditions occur in the sewer system because of the lack of oxygen.
A. Slime bacteria
B. Wastewater odor(s)
C. Hydrogen sulfide
D. The lack of oxygen
E. Less oxygen
F. None of the Above

Other Important Wastewater Characteristics

25. The following are some other important wastewater characteristics that can affect public health and the environment, as well as the design, cost, and______________.
A. Treatment processes
B. Total dissolved solids (TDS)
C. Quality of the water
D. The environment
E. Effectiveness of treatment
F. None of the Above

Temperature

26. The best temperatures for wastewater treatment probably range from 77 to 95 degrees Fahrenheit. In general, biological treatment activity accelerates in warm temperatures and slows in cool temperatures, but ______________can stop treatment processes altogether. Therefore, some systems are less effective during cold weather and some may not be appropriate for very cold climates.
A. Oxygen
B. High TSS
C. Settling sediments
D. Total Suspended Solids (TSS)
E. Extreme hot or cold
F. None of the Above

27. _________________ also affects receiving waters. Hot water, for example, which is a byproduct of many manufacturing processes, can be a pollutant. When discharged in large quantities, it can raise the temperature of receiving streams locally and disrupt the natural balance of aquatic life.

A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness
B. TDS E. Wastewater temperature
C. pH F. None of the Above

pH

28. The acidity or alkalinity of wastewater affects both treatment and the environment. Low pH indicates increasing acidity while a high pH indicates increasing alkalinity (a pH of 7 is neutral). The ___________ of wastewater needs to remain between 6 and 9 to protect organisms.

A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness
B. TDS E. Wastewater temperature
C. pH F. None of the Above

29. Acids and other substances that alter _________ can inactivate treatment processes when they enter wastewater from industrial or commercial sources.

A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness
B. TDS E. Wastewater temperature
C. pH F. None of the Above

Pathogens

30. _______________ also are present in wastewater and enter from almost anywhere in the community. These pathogens often originate from people and animals are infected with or are carriers of a disease.

A. Benzene and toluene D. Wastewater-related source(s)
B. Biodegradable material(s) E. Many disease-causing viruses, parasites, and bacteria
C. Organic material(s) F. None of the Above

31. _______________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.

A. Outbreaks of these diseases D. Graywater and blackwater
B. Organic material(s) E. Food-to-microorganism ratio, F/M
C. Organic compound(s) F. None of the Above

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

A. Allowable concentrations D. Acute (short term) and chronic (long term)
B. Water quality E. Human health
C. Some illnesses F. None of the Above

33. Other important wastewater-related diseases include hepatitis A, typhoid, polio, cholera, and dysentery. ___________________can occur as a result of drinking water from wells polluted by wastewater, eating contaminated fish, or recreational activities in polluted waters.

A. Outbreaks of these diseases D. Acute (short term) and chronic (long term)
B. Water quality E. Human health
C. Some illnesses F. None of the Above

Organic Matter

34. ____________________ are found everywhere in the environment. They are composed of the carbon-based chemicals that are the building blocks of most living things.

A. Outbreaks of these diseases D. Graywater and blackwater
B. Organic material(s) E. Oxygen
C. Organic compound(s) F. None of the Above

35. ________________ 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.

A. Benzene and toluene D. Wastewater-related source(s)
B. Biodegradable material(s) E. Supply of oxygen
C. Organic material(s) F. None of the Above

36. _______________ normally are some combination of carbon, hydrogen, oxygen, nitrogen, and other elements.

A. Outbreaks of these diseases D. Graywater and blackwater
B. Organic material(s) E. Oxygen
C. Organic compound(s) F. None of the Above

37. However, even _________________ can cause pollution. In fact, too much organic matter in wastewater can be devastating to receiving waters.

A. Benzene and toluene D. Wastewater-related source(s)
B. Biodegradable material(s) E. Supply of oxygen
C. Organic material(s) F. None of the Above

38. 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 _______________in the water needed by aquatic life, resulting in fish kills, Odours, and overall degradation of water quality.

A. Outbreaks of these diseases D. Graywater and blackwater
B. Supply of oxygen E. Oxygen
C. Organic compound(s) F None of the Above

39. The amount of oxygen organisms need to break down wastes in wastewater is referred to as the _____________and is one of the measurements used to assess overall wastewater strength.

A. Biochemical oxygen demand (**BOD**) D. Wastewater-related source(s)
B. Biodegradable material(s) E. Oxygen
C. Organic material(s) F. None of the Above

40. 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 _________________ developed for agriculture and industry.

A. Most inorganic substancesD. Graywater and blackwater
B. Organic material(s) E. Many synthetic organic compounds
C. Organic compound(s) F. None of the Above

41. In addition, certain synthetic organics are highly toxic. _____________ are toxic to humans, fish, and aquatic plants and often are disposed of improperly in drains or carried in stormwater.

A. BOD
B. Most inorganic substances
C. Nitrogen and phosphorus
D. Pesticides and herbicide(s)
E. Petroleum-based waste oil(s)
F. None of the Above

Inorganics

42. ________________________, 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.

A. Nutrients from wastewater
B. Inorganic materials
C. Inorganic minerals
D. Excessive grease
E. Pesticides and herbicide(s)
F. None of the Above

43. They can originate from a variety of sources in the community including industrial and commercial sources, stormwater, and inflow and infiltration from cracked pipes and leaky manhole covers. _______________ are relatively stable, and cannot be broken down easily by organisms in wastewater.

A. Metals
B. Most inorganic substances
C. Nitrogen and phosphorus
D. Pesticides and herbicide(s)
E. Petroleum-based waste oil(s)
F. None of the Above

44. Heavy metals which are discharged with many types of industrial wastewaters are difficult to remove by conventional treatment methods.

A. Nutrients from wastewater
B. Inorganic materials
C. Inorganic minerals
D. BOD
E. DON
F. None of the Above

Pathogens

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

A. Pathogen(s)
B. Heavy metals
C. Nutrient enrichment
D. Excessive growth of algae
E. Phosphorus and nitrogen
F. None of the Above

Nutrients

46. __________________are essential to living organisms and are the chief nutrients present in natural water.

A. Oxygen
B. Ecology
C. Nutrient enrichment
D. Carbon, nitrogen, and phosphorus
E. Phosphorus and nitrogen
F. None of the Above

47. ________________do not remove the phosphorus and nitrogen to any substantial extent.

A. Biofilm
B. Some contaminants
C. Secondary treatment
D. Conventional secondary biological treatment processes
E. Oxygen and organic waste
F. None of the Above

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

A. Phosphorus
B. Heavy metals
C. Nutrient enrichment
D. Excessive growth of algae
E. Phosphorus and nitrogen
F. None of the Above

49. Uncontrolled algae growth blocks out sunlight and chokes aquatic plants and animals by depleting ______________in the water at night.

A. Pathogen(s)
B. Dissolved oxygen
C. Nutrient enrichment
D. Excessive growth of algae
E. Phosphorus and nitrogen
F. None of the Above

50. The release of nutrients in quantities that exceed the affected waterbody's ability to assimilate them results in a condition called __________________.

A. Toxic
B. Ecology
C. Nutrient enrichment
D. Eutrophication or cultural enrichment
E. Oxygen and organic waste
F. None of the Above

Inorganic and Synthetic Organic Chemicals

51. A vast array of chemicals is included in this category. Examples include detergents, household cleaning aids, heavy metals, pharmaceuticals, ____________________and herbicides, industrial chemicals, and the wastes from their manufacture.

A. Pathogen(s)
B. Heavy metals
C. Nutrient enrichment
D. Excessive growth of algae
E. Synthetic organic pesticides
F. None of the Above

52. Many of these substances are toxic to fish and aquatic life and many are harmful to humans. Some are known to be highly __________________at very low concentrations. Others can cause taste and odor problems, and many are not effectively removed by conventional wastewater treatment.

A. Toxic
B. Ecology
C. Nutrient enrichment
D. Excessive growth of algae
E. Poisonous
F. None of the Above

Thermal

53. ______________________reduces the capacity of water to retain oxygen. In some areas, water used for cooling is discharged to streams at elevated temperatures from power plants and industries.

A. Heat
B. Heavy metals
C. Nutrient enrichment
D. Excessive growth of algae
E. Phosphorus and nitrogen
F. None of the Above

54. Unchecked discharges of ______________ can seriously alter the ecology of a lake, a stream, or estuary.

A. Toxic
B. Waste heat
C. Nutrient enrichment
D. Eutrophication or cultural enrichment
E. Phosphorus and nitrogen
F. None of the Above

Application Specific Microbiology

55. Each wastewater stream is unique, and so too are the community of microorganisms that process it. This "_______________" is the preferred methodology in wastewater treatment affecting the efficiency of biological nutrient removal.

A. Mature biofilm
B. Activated sludge system
C. Advanced treatment technologies
D. Application-specific microbiology
E. Pretreatment and pollution prevention
F. None of the Above

56. The right laboratory prepared bugs are more efficient in organics removal if they have the right growth environment. This efficiency is multiplied if microorganisms are allowed to grow as a layer of biofilm on specifically designed support media. In this way, __________________ of a waste stream can occur.

A. Denitrification process
B. Optimized biological processing
C. Bulking sludge
D. Insufficient aeration in the reactor
E. Anaerobic sludge
F. None of the Above

57. To reduce the start-up phase for growing a mature biofilm one can also purchase "__________________" from appropriate microbiology vendors.

A. Mature biofilm
B. Activated sludge system
C. Advanced treatment technologies
D. Application-specific microbiology culture
E. Pretreatment and pollution prevention
F. None of the Above

Topic 2 - Primary Treatment Processes

Primary Treatment

58. Coarse solids are removed from the wastewater in the primary stage of treatment. In some treatment plants, _____________may be combined into one basic operation.

A. Solid(s)
B. Finer debris
C. Grit and gravel
D. Suspended growth process(es)
E. Primary and secondary stages
F. None of the Above

59. The secondary stage uses ______________to further purify wastewater. Sometimes, these stages are combined into one operation.

A. Very fine solids
B. Biological processes
C. Pollutant(s)
D. Primary sludge
E. Grit and screenings
F. None of the Above

Preliminary Treatment

60. The ___________enters from the collection system into the Coarse Screening process. After the wastewater has been screened, it may flow into a grit chamber where sand, grit, cinders, and small stones settle to the bottom.

A. Solid(s)
B. Finer debris
C. Grit and gravel
D. Raw wastewater
E. Dissolved organic and inorganic constituents
F. None of the Above

61. Removing the ______________that washes off streets or land during storms is very important, especially in cities with combined sewer systems.

A. Very fine solids
B. Grit and gravel
C. Pollutant(s)
D. Primary sludge
E. Grit and screenings
F. None of the Above

62. Large amounts of ______________entering a treatment plant can cause serious operating problems, such as excessive wear of pumps and other equipment, clogging of aeration devices, or taking up capacity in tanks that is needed for treatment.
A. Solid(s) D. Grit and sand
B. Finer debris E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

63. The _______________ removed by these processes must be periodically collected and trucked to a landfill for disposal or are incinerated.
A. Very fine solids D. Primary sludge
B. Wastewater E. Grit and screenings
C. Pollutant(s) F. None of the Above

64. __________________is removed and placed into a dumpster for disposal into the landfill.
A. Solid(s) D. This debris
B. Finer debris E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

65. The _____________then passes into the Raw Influent Pumping process that consists of submersible centrifugal pumps.
A. Wastewater D. Dissolved organic and inorganic constituents
B. Split samples E. Grit and gravel
C. Duplicate samples F. None of the Above

66. The ________________then passes into the Static Fine Screening process which consists of two stationary (or static) screens which remove finer debris not captured by the coarse screens.
A. Solid(s) D. Flow
B. Finer debris E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

67. Debris is then collected in hoppers, dewatered, and disposed into a landfill. The screened and _________then enters into Primary Sedimentation.
A. Very fine solids D. Primary sludge
B. De-gritted wastewater E. Grit and screenings
C. Pollutant(s) F. None of the Above

Primary Sedimentation

68. The _____________consist of minute particles of matter that can be removed from the wastewater with further treatment such as sedimentation or gravity settling, chemical coagulation, or filtration.
A. Solid(s) D. Suspended growth process(es)
B. Suspended solids E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

69. Pollutants that are dissolved or are very fine and remain suspended in the wastewater are not removed effectively by gravity settling. When the wastewater enters a sedimentation tank, it slows down and the suspended solids gradually sink to the bottom. This mass of solids is called _________________.

A. Very fine solids D. Primary sludge
B. Wastewater E. Grit and screenings
C. Pollutant(s) F. None of the Above

70. Various methods have been devised to remove __________, newer plants have some type of mechanical equipment to remove the settled solids and some plants remove solids continuously while others do so at intervals.

A. Solid(s) D. Suspended growth process(es)
B. Finer debris E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

Secondary Treatment

71. After the _____________ has been through Primary Treatment processes, it flows into the next stage of treatment called secondary.

A. Very fine solids D. Primary sludge
B. Wastewater E. Grit and screenings
C. Pollutant(s) F. None of the Above

72. Secondary treatment processes can remove up to 90 percent of the ____________in wastewater by using biological treatment processes. The two most common conventional methods used to achieve secondary treatment are attached growth processes and suspended growth processes.

A. Solid(s) D. Suspended growth process(es)
B. Finer debris E. Organic matter
C. Grit and gravel F. None of the Above

73. The Secondary Treatment stage consists of a biological process such as _______________ and a physical process, Secondary Clarification.

A. Wildlife habitat D. Phosphorus-reduction system(s)
B. Oxidation Ditches E. Excessive sludge production
C. Denitrification F. None of the Above

74. The Preliminary Treatment stage removes as much ___________ as possible using physical processes, however, very fine solids are still present that cannot be removed physically.

A. Solid(s) D. Suspended growth process(es)
B. Finer debris E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

75. The wastewater enters from Preliminary Treatment into the Oxidation Ditches process which is a biological process consisting of large oval shaped basins which are capable of removing these finer solids. This is accomplished by maintaining a population of microorganisms within the oxidation basins which consume the ________________(which are primarily organic) and also adhere to the solids themselves.

A. Total Solids
B. TDS
C. Very fine solids
D. Elevated Hardness, Salty Taste, or Corrosiveness
E. Wastewater temperature
F. None of the Above

76. By consuming and adhering to these _____________they form larger and heavier aggregates that can by physically separated. Thus, after this process has taken place within the Oxidation Ditches the wastewater then enters Secondary Clarification process which can provide this physical separation.

A. Solid(s)
B. Finer debris
C. Grit and gravel
D. Finer solids
E. Dissolved organic and inorganic constituents
F. None of the Above

Secondary Clarification Process

77. The clear overflow (or upper layer) is collected at the end of the tank and passed onto the __________for additional treatment if available.

A. Nitrogen removal system(s)
B. Tertiary process
C. Microorganism(s)
D. Suspended film system(s)
E. Recirculating sand filters (RSFs
F. None of the Above

78. The majority of microorganism-rich underflow (or lower layer) is re-circulated to tanks as Return Sludge to help sustain the microorganism population in the _____________ process.

A. Trickling filter(s)
B. Oxidation Ditches
C. Nitrogen removal system(s)
D. Aerobic nitrification processes
E. Recirculating sand filters (RSFs)
F. None of the Above

Fixed Film Systems

79. _____________________ grow microorganisms on substrates such as rocks, sand or plastic.

A. Mature biofilm
B. Activated sludge system
C. Advanced treatment technologies
D. Application-specific microbiology
E. Fixed film systems
F. None of the Above

80. As organic matter and nutrients are absorbed from the wastewater, the film of microorganisms grows and thickens. ________________, rotating biological contactors, and sand filters are examples of fixed film systems.

A. Trickling filter(s)
B. Oxidation Ditches
C. Nitrogen removal system(s)
D. Aerobic nitrification processes
E. Recirculating sand filters (RSFs)
F. None of the Above

Suspended Film Systems

81. ___________________________ stir and suspend microorganisms in wastewater. As the microorganisms absorb organic matter and nutrients from the wastewater, they grow in size and number.

A. Nitrogen removal system(s)
B. Tertiary process
C. Microorganism(s)
D. Suspended film system(s)
E. Recirculating sand filters (RSFs
F. None of the Above

82. Some of the sludge is pumped back into the incoming wastewater to provide "seed" microorganisms. The remainder is wasted and sent on to a sludge treatment process. Activated sludge, _____________, oxidation ditch, and sequential batch reactor systems are all examples of suspended film systems.

A. Trickling filter(s)
B. Extended aeration
C. Nitrogen removal system(s)
D. Aerobic nitrification processes
E. Recirculating sand filters (RSFs)
F. None of the Above

Lagoon Systems

83. Lagoon systems are shallow basins which hold the wastewater for several months to allow for the natural degradation of sewage. These systems take advantage of **______________**and microorganisms in the wastewater to renovate sewage.

A. Nitrogen removal system(s)
B. Tertiary process
C. Natural aeration
D. Suspended film system(s)
E. Recirculating sand filters (RSFs
F. None of the Above

Nitrogen Control

84. Nitrogen in one form or another is present in municipal wastewater and is usually not removed by secondary treatment. If discharged into lakes and streams or estuary waters, nitrogen in the form of ________________can exert a direct demand on oxygen or stimulate the excessive growth of algae.

A. Nitrification
B. Ammonia
C. Nitrogen
D. Nitrogen in the nitrate form
E. Ammonia to the non-toxic nitrate
F. None of the Above

85. By providing additional __________beyond the secondary stage, nitrifying bacteria present in wastewater treatment can biologically convert ammonia to the non-toxic nitrate through a process known as nitrification.

A. Nitrification
B. Denitrification
C. Nitrogen
D. Nitrogen in the nitrate form
E. Biological treatment
F. None of the Above

86. Since nitrate is also a nutrient, excess amounts can contribute to the uncontrolled growth of algae. In situations where nitrogen must be completely removed from effluent, ________________process can be added to the system to convert the nitrate to nitrogen gas.

A. Nitrification
B. Denitrification
C. Nitrogen
D. Nitrogen in the nitrate form
E. Additional biological
F. None of the Above

Conversion of Nitrate to Nitrogen Gas

87. The conversion of nitrate to ____________is accomplished by bacteria in a process known as denitrification.

A. Nitrogen gas D. Nitrate nitrogen
B. Phosphorus E. Methanol
C. Nitrogen F. None of the Above

88. Effluent with nitrogen in the form of nitrate is placed into a tank devoid of oxygen, where carbon-containing chemicals, such as ______________, are added or a small stream of raw wastewater is mixed in with the nitrified effluent. In this oxygen free environment, bacteria use the oxygen attached to the nitrogen in the nitrate form, releasing nitrogen gas.

A. Nitrogen gas D. Nitrate nitrogen
B. Phosphorus E. Methanol
C. Nitrogen F. None of the Above

89. Because ______________ comprises almost 80 percent of the air in the earth's atmosphere, the release of nitrogen into the atmosphere does not cause any environmental harm.

A. Phosphorus D. Nitrate nitrogen
B. Phosphorus E. Methanol
C. Nitrogen F. None of the Above

Biological Phosphorus Control

90. ______________ removal can be achieved through chemical addition and a coagulation-sedimentation process.

A. Nitrification D. Nitrate nitrogen
B. Phosphorus E. Oxygen
C. Nitrogen F. None of the Above

91. Some biological treatment processes called biological nutrient removal (BNR) can also achieve nutrient reduction, removing ____________________.

A. Both nitrogen and phosphorus D. Nitrate nitrogen
B. Phosphorus E. Oxygen
C. Nitrogen F. None of the Above

92. Most of the BNR processes involve modifications of suspended growth treatment systems so that the bacteria in these systems also convert ____________ to inert nitrogen gas and trap phosphorus in the solids that are removed from the effluent.

A. Both nitrogen and phosphorus D. Nitrate nitrogen
B. Phosphorus E. Oxygen
C. Nitrogen F. None of the Above

Coagulation-Sedimentation Process

93. A process known as _________is used to increase the removal of solids from effluent after primary and secondary treatment. Solids heavier than water settle out of wastewater by gravity. With the addition of specific chemicals, solids can become heavier than water and will settle.

A. Carbon adsorption D. A form of stabilization
B. An advanced process E. Processed wastewater solids
C. Chemical coagulation-sedimentation F. None of the Above

94. ______________added to the wastewater to remove phosphorus. With these chemicals, the smaller particles 'floc' or clump together into large masses. The larger masses of particles will settle faster when the effluent reaches the next step the sedimentation tank. This process can reduce the concentration of phosphate by more than 95 percent.
A. Other alkaline materials D. Alum, lime, or iron salts are chemicals
B. A form of stabilization E. Phosphate
C. Sewage solids, or sludge F. None of the Above

95. Although used for years in the treatment of industrial wastes and in water treatment, __________is considered an advanced process because it is not routinely applied to the treatment of municipal wastewater. In some cases, the process is used as a necessary pretreatment step for other advanced techniques. This process produces a chemical sludge, and the cost of disposing of this material can be significant.
A. Carbon adsorption D. A form of stabilization
B. An advanced process E. Processed wastewater solids
C. Coagulation-sedimentation F. None of the Above

Carbon Adsorption
96. Carbon adsorption technology can remove organic materials from wastewater that resist removal by___________. These resistant, trace organic substances can contribute to taste and odor problems in water, taint fish flesh, and cause foaming and fish kills.
A. Denitrification process D. Insufficient aeration in the reactor
B. Biological treatment E. Anaerobic sludge
C. Bulking sludge F. None of the Above

97. _____________ consists of passing the wastewater effluent through a bed or canister of activated carbon granules or powder which remove more than 98 percent of the trace organic substances.
A. Carbon adsorption D. A form of stabilization
B. An advanced process E. Processed wastewater solids ("sewage sludge")
C. Phosphate F. None of the Above

Topic 3 - Activated Sludge Process Section

Activated Sludge Methods
Organic Load
98. The organic load (generally coming from primary treatment operations such as settling, screening or flotation) enters the reactor where the active microbial population (____________) is present. The reactor must be continuously aerated.
A. Nitrifying bacteria D. Aerobic bacteria
B. Methane forming bacteria E. Anaerobic, heterotrophic bacteria
C. Activated sludge F. None of the Above

99. The mixture then passes to a secondary settling tank where the cells are settled. The treated wastewater is generally discharged after disinfection while the ___________is recycled in part to the aeration basin.
A. Secondary settling D. Organic load
B. High degradation rate E. Settled biomass
C. Aeration basin F. None of the Above

100. The cells must be recycled in order to maintain sufficient biomass to degrade the ________________ as quickly as possible.
A. Secondary settling
B. High degradation rate
C. Aeration basin
D. Organic load
E. Settled biomass
F. None of the Above

101. The amount that is recirculated depends on the need to obtain a high degradation rate and on the need for the bacteria to flocculate properly so that the secondary settling separates the cells satisfactorily. As the cells are retained longer in the system, the flocculating characteristics of the cells improve since they start to produce extra cellular slime which favors____________________.
A. Secondary settling
B. High degradation rate
C. Flocculating
D. Organic load
E. Settled biomass
F. None of the Above

Common Types
102. The most common types of activated sludge are the conventional and the continuous flow stiffed tank, in which the contents are completely mixed. In the conventional process, the wastewater is circulated along the__________, with the flow being arranged by baffles in plug flow mode. The oxygen demand for this arrangement is maximum at the inlet as is the organic load concentration.
A. Smooth plug flow
B. High degradation rate
C. Aeration basin
D. Aeration tank
E. Reactor
F. None of the Above

103. The flow peaks can be damped in the primary treatment tanks. _______________would require less reactor volume if smooth plug flow could be assured, which usually does not occur.
A. Smooth plug flow
B. The conventional configurations
C. Aeration basin
D. Organic load or flow peaks
E. Reactor
F. None of the Above

Topic 4- Advanced Wastewater Treatment Methods

Advanced Treatment Technologies
104. Treatment levels beyond secondary are called advanced treatment. ______________ can be extensions of conventional secondary biological treatment to further stabilize oxygen-demanding substances in the wastewater, or to remove nitrogen and phosphorus.
A. Mature biofilm
B. Activated sludge system
C. Advanced treatment technologies
D. Application-specific microbiology
E. Pretreatment and pollution prevention
F. None of the Above

105. Advanced treatment may also involve physical-chemical separation techniques such as adsorption, flocculation/precipitation, membranes for advanced filtration, _______________, and reverse osmosis. In various combinations, these processes can achieve any degree of pollution control desired.
A. Denitrification process
B. Organic material
C. Ion exchange
D. Aeration in the reactor
E. Application-specific microbiology
F. None of the Above

The Use or Disposal of Wastewater Residuals and Biosolids

106. When pollutants are removed from water, there is always something left over. It may be rags and sticks caught on the screens at the beginning of primary treatment. It may be the _________ that settle to the bottom of sedimentation tanks.

A. Other alkaline materials
B. Solids
C. Sewage solids, or sludge
D. Biosolids
E. Rags and sticks
F. None of the Above

Processed Wastewater Solids

107. Biosolids are ___________ ("sewage sludge") that meet rigorous standards allowing safe reuse for beneficial purposes.

A. Other alkaline materials
B. A form of stabilization
C. Sewage solids, or sludge
D. Processed wastewater solids
E. Rags and sticks
F. None of the Above

Biosolids Stabilization

108. Prior to utilization or disposal, ________ are stabilized to control Odours and reduce the number of disease-causing organisms.

A. Biosolids
B. An advanced process
C. Sewage solids, or sludge
D. Other alkaline materials
E. Processed wastewater solids ("sewage sludge")
F. None of the Above

109. ___________________, when separated from the wastewater, still contain around 98 percent water. They are usually thickened and may be dewatered to reduce the volume to be transported for final processing, disposal, or beneficial use.

A. Biosolids
B. An advanced process
C. Sewage solids, or sludge
D. Other alkaline materials
E. Processed wastewater solids ("sewage sludge")
F. None of the Above

Dewatering Processes

110. _____________ include drying beds, belt filter presses, plate and frame presses, and centrifuges. To improve dewatering effectiveness, the solids can be pretreated with chemicals such as lime, ferric chloride, or polymers to produce larger particles which are easier to remove.

A. Dewatering processes
B. A form of stabilization
C. Sewage solids, or sludge
D. Stabilization of solids
E. Digestion
F. None of the Above

Digestion

111. Digestion is a form of _____________where the volatile material in the wastewater solids can decompose naturally and the potential for odor production is reduced.

A. Dewatering processes
B. Digestion
C. Sewage solids, or sludge
D. Stabilization of solids
E. Stabilization
F. None of the Above

112. ________________in an enclosed tank (anaerobic solids digestion) has the added benefit of producing methane gas which can be recovered and used as a source of energy.

A. Dewatering processes
B. Digestion without air
C. Sewage solids, or sludge
D. Stabilization of solids
E. Digestion
F. None of the Above

113. ____________ may also be accomplished by composting, heat treatments, drying or the addition of lime or other alkaline materials. After stabilization, the biosolids can be safely spread on land.
A. Dewatering processes D. Stabilization of solids
B. A form of stabilization E. Digestion
C. Sewage solids, or sludge F. None of the Above

Microorganisms in Lagoons

114. Swimming and ______________engulf bacteria or other prey.
A. Strict aerobes D. Heterotrophic bacteria
B. Predators E. Gliding ciliates
C. Bacteria F. None of the Above

115. _____________ attach to the biomass and vortex suspended bacteria into their gullets, while crawlers break bacteria loose from the floc surface.
A. Treatment organism(s) D. Floc-forming bacteria
B. Aerobic bacteria E. Filamentous bacteria
C. Stalked ciliate(s) F. None of the Above

116. Predators feed mostly on stalked and___________. The omnivores, such as most rotifers, eat whatever is readily available, while the worms feed on the floc or prey on larger organisms. Microorganisms are directly affected by their treatment environment.
A. Strict aerobes D. Heterotrophic bacteria
B. Swimming ciliates E. Many bacterial species
C. Bacteria F. None of the Above

117. Changes in food, dissolved oxygen, temperature, pH, total dissolved solids, sludge age, presence of toxins, and other factors create a dynamic environment for the ____________.
A. Treatment organism(s) D. Floc-forming bacteria
B. Aerobic bacteria E. Filamentous bacteria
C. Stalked ciliate(s) F. None of the Above

118. Food (organic loading) regulates____________, diversity, and species when other factors are not limiting. The relative abundance and occurrence of organisms at different loadings can reveal why some organisms are present in large numbers while others are absent.
A. Strict aerobes D. Heterotrophic bacteria
B. Predators E. Many bacterial species
C. Microorganism numbers F. None of the Above

Aerobic Bacteria

119. The _______________ that occur are similar to those found in other treatment processes such as activated sludge. Three functional groups occur: freely dispersed, single bacteria; floc-forming bacteria; and filamentous bacteria. All function similarly to oxidize organic carbon (BOD) to produce CO_2 and new bacteria (new sludge).
A. Treatment organism(s) D. Floc-forming bacteria
B. Aerobic bacteria E. Filamentous bacteria
C. Stalked ciliate(s) F. None of the Above

120. _______________ that degrade wastes grow as single bacteria dispersed in the wastewater. Although these readily oxidize BOD, they do not settle and hence often leave the system in the effluent as solids (TSS). These tend to grow in lagoons at high organic loading and low oxygen conditions.
A. Strict aerobes D. Heterotrophic bacteria
B. Predators E. Many bacterial species
C. Bacteria F. None of the Above

121. More important are the ________________, those that grow in a large aggregate (floc) due to exocellular polymer production (the glycocalyx).
A. Treatment organism(s) D. Floc-forming bacteria
B. Aerobic bacteria E. Filamentous bacteria
C. Stalked ciliate(s) F. None of the Above

122. This growth form is important as these flocs degrade ____________and settle at the end of the process, producing a low TSS effluent.
A. Anaerobic action D. Aerobic bacteria
B. Absence of free oxygen E. Application-specific bacteria
C. BOD F. None of the Above

123. _________________occur in lagoons, usually at specific growth environments.
A. Anaerobic action D. Aerobic bacteria
B. Absence of free oxygen E. Application-specific bacteria
C. A number of filamentous bacteria F. None of the Above

124. _______________have a wide range in environmental tolerance and can function effectively in BOD removal over a wide range in pH and temperature.
A. Strict aerobes D. Most heterotrophic bacteria
B. Predators E. Many bacterial species
C. Bacteria F. None of the Above

125. Aerobic BOD removal generally proceeds well from pH 6.5 to 9.0 and at temperatures from 3-4°C to 60-70°C (_______________are replaced by thermophilic bacteria at temperatures above 35°C).
A. Treatment organism(s) D. Floc-forming bacteria
B. Aerobic bacteria E. Filamentous bacteria
C. Mesophilic bacteria F. None of the Above

126. BOD removal generally declines rapidly below 3-4°C and ceases at 1-2°C.A very specialized group of bacteria occurs to some extent in lagoons (and other wastewater treatment systems) that can oxidize ammonia via nitrite to nitrate, termed___________.
A. Strict aerobes D. Heterotrophic bacteria
B. Predators E. Many bacterial species
C. Nitrifying bacteria F. None of the Above

Aerated lagoons

127. The aerated lagoons are basins, normally excavated in earth and operated without ____________ recycling into the system. This is the major difference with respect to activated sludge systems.

A. Solids D. Odours
B. Sludge E. Complete nitrification
C. Aerated lagoon(s) F. None of the Above

128. Two types are the most common: the completely mixed lagoon (also called completely suspended) in which the concentration of solids and dissolved oxygen are maintained fairly uniform and neither the incoming solids nor the biomass of microorganisms settle, and the facultative (___________________) lagoons.

A. Non-biodegradable fraction D. Aerobic-anaerobic or partially suspended
B. Substantial alkalinity E. Suspended solids in the effluent
C. Completely mixed lagoon F. None of the Above

129. In the facultative lagoons, the power input is reduced causing accumulation of solids in the bottom which undergo_______________, while the upper portions are maintained aerobic..

A. Facultative lagoon(s) D. Odours
B. Anaerobic decomposition E. Complete nitrification
C. Aerated lagoon(s) F. None of the Above

130. Being open to the atmosphere, the lagoons are exposed to low temperatures which can cause _____________ and eventually the formation of ice.

A. Non-biodegradable fraction D. Reduced biological activity
B. Substantial alkalinity E. Suspended solids in the effluent
C. Completely mixed lagoon F. None of the Above

131. If excavated basins are used for settling, care should be taken to provide a residence time long enough for the________________, and there should also be provision for the accumulation of sludge.

A. Facultative lagoon(s) D. Odours
B. Sludge E. Complete nitrification
C. Solids to settle F. None of the Above

132. There is a very high possibility of offensive odor development due to the decomposition of the ____________ might develop in the upper layers contributing to an increased content of suspended solids in the effluent.

A. Non-biodegradable fraction D. Settled sludge, and algae
B. Substantial alkalinity E. Suspended solids in the effluent
C. Completely mixed lagoon F. None of the Above

133. _________________ can be minimized by using minimum depths of up to 2 m, while algae production is reduced with liquid retention time of less than two days.

A. Facultative lagoon(s) D. Odours
B. Sludge E. Complete nitrification
C. Aerated lagoon(s) F. None of the Above

134. These accumulated solids will, on the whole, _____________ , but since there is always a non-biodegradable fraction, a permanent deposit will build up. Therefore, periodic removal of these accumulated solids becomes necessary.
A. Non-biodegradable fraction
B. Substantial alkalinity
C. Completely mixed lagoon
D. Decompose in the bottom
E. Suspended solids in the effluent
F. None of the Above

Nitrification
135. It was once thought that only two bacteria were involved in nitrification: Nitrosomonas europaea, which oxidizes ammonia to nitrite, and_____________ , which oxidizes nitrite to nitrate.
A. Nitrifying bacteria
B. Methane forming bacteria
C. Nitrobacter winogradskyi
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

136. Besides oxygen, these ____________ require a neutral pH (7-8) and substantial alkalinity (these autotrophs use CO2 as a carbon source for growth).
A. Nitrifying bacteria
B. Methane forming bacteria
C. Two bacteria
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

137. Nitrification ceases at pH values above pH 9 and declines markedly at pH values below 7. This results from the growth inhibition of the ____________.
A. Nitrifying bacteria
B. Methane forming bacteria
C. Two bacteria
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

138. Nitrification, however, is not a major pathway for nitrogen removal in lagoons. Nitrifying bacteria exists in low numbers in lagoons. They prefer attached growth systems and/or____________.
A. Nitrifying bacteria
B. Methane forming bacteria
C. High MLSS sludge systems
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

Anaerobic Bacteria
139. _______________ that commonly occur in lagoons are involved in methane formation (acid-forming and methane bacteria) and in sulfate reduction (sulfate reducing bacteria).
A. Nitrifying bacteria
B. Methane forming bacteria
C. Only two bacteria
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

140. Anaerobic methane formation involves _____________bacteria that function together to convert organic materials to methane via a three-step process.
A. Acid-forming bacteria
B. Methane fermentation
C. Methane bacteria
D. Organic overloading and anaerobic conditions
E. Three different groups of anaerobic
F. None of the Above

141. ________________________- many genera of anaerobic bacteria hydrolyze proteins, fats, and poly saccharides present in wastewater to amino acids, short-chain peptides, fatty acids, glycerol, and mono- and di-saccharides.
A. Nitrifying bacteria
B. Methane forming bacteria
C. General anaerobic degraders
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

Photosynthetic Organisms

142. _________________ - this diverse group of bacteria converts products from above under anaerobic conditions to simple alcohols and organic acids such as acetic, propionic, and butyric. These bacteria are hardy and occur over a wide pH and temperature range.
A. BOD and sulfate
B. Methane fermentation
C. Methane bacteria
D. Organic overloading and anaerobic conditions
E. Acid-forming bacteria
F. None of the Above

143. ________________ - these bacteria convert formic acid, methanol, methylamine, and acetic acid under anaerobic conditions to methane.
A. Nitrifying bacteria
B. Methane forming bacteria
C. General anaerobic degraders
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

144. Methane is derived in part from these compounds and in part from CO_2 reduction. __________ are environmentally sensitive and have a narrow pH range of 6.5-7.5 and require temperatures > 14^{o} C.
A. BOD and sulfate
B. Methane fermentation
C. Methane bacteria
D. Organic overloading and anaerobic conditions
E. Acid-forming bacteria
F. None of the Above

145. Note that the products of the __________________become the substrate for the methane producers.
A. Nitrifying bacteria
B. Methane forming bacteria
C. Acid formers (principally acetic acid)
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

146. Also, _____________ ceases at cold temperature, probably not occurring in most lagoons in the wintertime in cold climates.
A. BOD and sulfate
B. Methane fermentation
C. Methane bacteria
D. Organic overloading and anaerobic conditions
E. Acid-forming bacteria
F. None of the Above

147. A number of anaerobic bacteria (14 genera reported to date (Bolt et al., 1994)) called ___________can use sulfate as an electron acceptor, reducing sulfate to hydrogen sulfide.
A. Nitrifying bacteria
B. Methane forming bacteria
C. Sulfate reducing bacteria
D. Aerobic bacteria
E. Anaerobic, heterotrophic bacteria
F. None of the Above

148. This occurs when BOD and sulfate are present and oxygen is absent. _____________is a major cause of Odours in ponds.
A. Sulfate reduction D. Organic overloading and anaerobic conditions
B. Methane fermentation E. Acid-forming bacteria
C. Methane bacteria F. None of the Above

149. The anaerobic sulfur bacteria, generally grouped into the _________________and represented by about 28 genera, oxidize reduced sulfur compounds (H_2S) using light energy to produce sulfur and sulfate.
A. Nitrifying bacteria D. Aerobic bacteria
B. Methane forming bacteria E. Anaerobic, heterotrophic bacteria
C. Red and green sulfur bacteria F. None of the Above

150. All are either strict anaerobes or microaerophilic. Most common are_______________, which can grow in profusion and give a lagoon a pink or red colour. Finding them is most often an indication of organic overloading and anaerobic conditions in an intended aerobic system.
A. Chromatium, Thiocystis, and Thiopedia D. Organic overloading
B. Methane fermentation E. Acid-forming bacteria
C. Methane bacteria F. None of the Above

151. Conversion of odorous sulfides to sulfur and sulfate by these ________________is a significant odor control mechanism in facultative and anaerobic lagoons, and can be desirable.
A. BOD and sulfate D. Organic overloading and anaerobic conditions
B. Sulfur bacteria E. Acid-forming bacteria
C. Methane bacteria F. None of the Above

Treatment Lagoon

152. The ___________ at a treatment lagoon is determined by the various chemical species of alkalinity that are present.
A. Bicarbonate ion (HCO_3) D. pH
B. CO_2 E. Phosphorus
C. Carbonate ion (CO_2^3) F. None of the Above

153. High amounts of ___________ yield a low lagoon pH, while high amounts of CO_2^3 yield a high lagoon pH.
A. Alkalinity and Ph D. Algal growth
B. CO_2 E. Phosphorus
C. BOD F. None of the Above

154. Bacterial growth on BOD releases CO_2 which subsequently dissolves in water to yield______________ .
A. Bicarbonate ion (HCO_3) D. Carbonic acid (H_2CO_3)
B. CO_2 E. Phosphorus
C. Carbonate ion (CO_2^3) F. None of the Above

155. Algal growth in lagoons has the opposite effect on lagoon___________, raising the pH due to algal use for growth of inorganic carbon (CO_2 and HCO_3).
A. Alkalinity and Ph D. pH
B. CO_2 E. Phosphorus
C. BOD F. None of the Above

156. Algal growth reduces the lagoon alkalinity which may cause the ________ to increase if the lagoon alkalinity (pH buffer capacity) is low.

A. Bicarbonate ion (HCO_3)
B. CO_2
C. Carbonate ion (CO_2^3)
D. pH
E. Phosphorus
F. None of the Above

157. Algae can grow to such an extent in lagoons (a bloom) that they consume ________________ present for photosynthesis, leaving only carbonate (CO_2^3) as the pH buffering species.

A. Alkalinity and Ph
B. CO_2
C. BOD
D. All of the CO_2 and HCO_3
E. Phosphorus
F. None of the Above

158. It should be noted that an increase in the lagoon pH caused by ___________ can be beneficial. Natural disinfection of pathogens is enhanced at higher pH.

A. Bicarbonate ion (HCO_3)
B. CO_2
C. Carbonate ion (CO_2^3)
D. Algal growth
E. Phosphorus
F. None of the Above

159. _________________ removal by natural chemical precipitation is greatly enhanced at pH values greater than pH = 8.5.

A. Alkalinity and Ph
B. CO_2
C. BOD
D. Algal growth
E. Phosphorus
F. None of the Above

Protozoans and Microinvertebrates

160. Many higher life forms (animals) develop in lagoons. These include protozoans and microinvertebrates such as rotifers, daphnia, annelids, chironomids (____________), and mosquito larvae.

A. Mosquitoes
B. Bacteria and algae
C. Protozoans
D. Midge larvae
E. Culex tarsalis
F. None of the Above

161. _____________ are the most common higher life forms in lagoons with about 250 species identified in lagoons to date (Curds, 1992).

A. Mosquitoes
B. Bacteria and algae
C. Protozoans
D. Rotifers and daphnia
E. Culex tarsalis
F. None of the Above

162. _____________ are particularly important in controlling algal overgrowth and these often "bloom" when algal concentrations are high.

A. Mosquitoes
B. Bacteria and algae
C. Protozoans
D. Rotifers and daphnia
E. Culex tarsalis
F. None of the Above

163. ___________are relatively slow growing and generally only occur in systems with a detention time of >10 days.

A. Mosquitoes
B. Bacteria and algae
C. Protozoans
D. Rotifers and daphnia
E. These microinvertebrates
F. None of the Above

Advanced Methods of Wastewater Treatment

164. As our country and the demand for clean water have grown, it has become more important to produce cleaner wastewater effluents, yet ___________ are more difficult to remove than others.

A. Biofilm
B. Some contaminants
C. Secondary treatment effluent
D. Soluble nutrients
E. Oxygen and organic waste
F. None of the Above

165. The demand for cleaner discharges has been met through better and more complete methods of removing pollutants at wastewater treatment plants, in addition to pretreatment and pollution prevention which helps limit _______________discharged to the sanitary sewer system.

A. Types of wastes
B. Activated sludge system
C. Advanced treatment technologies
D. Application-specific microbiology
E. Pretreatment and pollution prevention
F. None of the Above

166. Currently, nearly all WWTPs provide a minimum of____________. In some receiving waters, the discharge of secondary treatment effluent would still degrade water quality and inhibit aquatic life. Further treatment is needed.

A. Biofilm
B. Secondary treatment
C. Secondary treatment effluent
D. Pretreatment and pollution prevention
E. Oxygen and organic waste
F. None of the Above

Topic 5 - Wastewater Sampling Section

Aquatic Life Criteria

167. ______________ provide protection for plants and animals that are found in surface waters.

A. Aquatic life criteria
B. Water pollutant(s)
C. Water quality standard(s)
D. Concentration of pollutant(s)
E. A pollutant level
F. None of the Above

168. ______________are designed to provide protection for both freshwater and saltwater aquatic organisms from the effects of acute (short term) and chronic (long term) exposure to potentially harmful chemicals.

A. Allowable concentrations
B. Water quality
C. Aquatic life criteria
D. Acute (short term) and chronic (long term)
E. Human health and aquatic life criteria
F. None of the Above

169. ______________ are based on toxicity information and are developed to protect aquatic organisms from death, slower growth, reduced reproduction, and the accumulation of harmful levels of toxic chemicals in their tissues that may adversely affect consumers of such organisms.

A. Aquatic life criteria
B. Water pollutant(s)
C. Water quality standard(s)
D. Concentration of pollutant(s)
E. A pollutant level
F. None of the Above

Sediment Quality Criteria Guidance

170. In a healthy aquatic community, ___________provide a habitat for many living organisms. Worms, plants, and tiny microorganisms living in or on the sediment sustain the fish and shellfish that, in turn, nourish larger fish, wildlife, and man.

A. Allowable concentrations D. Acute (short term) and chronic (long term)
B. Water quality E. Human health and aquatic life criteria
C. Sediments F. None of the Above

Pollutants in the Sediment

171. Controlling the concentration of ______________helps to protect bottom dwelling species and prevents harmful toxins from moving up the food chain and accumulating in the tissue of animals at progressively higher levels.

A. Pollutants in the sediment D. Concentration of pollutant(s)
B. Water pollutant(s) E. A pollutant level
C. Water quality standard(s) F. None of the Above

172. This is particularly important at the lower levels of the food chain because the concentration of many pollutants may increase at each link in the _______________.

A. Toxic pollutant(s) D. Biological treatment(s)
B. Food chain E. Heterotroph(es)
C. Biological integrity F. None of the Above

173. __________________ in the sediment that does not harm snails of small fish may bioaccumulate in the food chain and become very harmful to larger fish, birds, mammals, wildlife, and people.

A. Aquatic life criteria D. Concentration of pollutant(s)
B. Water pollutant(s) E. A pollutant level
C. Water quality standard(s) F. None of the Above

Biological Criteria

174. A water body in its natural condition is free from the________, habitat loss, and other negative stressors. It is characterized by a particular biological diversity and abundance of organisms.

A. Allowable concentrations D. Acute (short term) and chronic (long term)
B. Harmful effects of pollution E. Human health and aquatic life criteria
C. In a healthy aquatic community F. None of the Above

175. These methodologies will describe scientific methods for determining a particular aquatic community's health and for maintaining optimal conditions in_____________.

A. Allowable concentrations D. Various bodies of water
B. Water quality E. Human health and aquatic life criteria
C. A healthy aquatic community F. None of the Above

Summary

176. The goal of all biological wastewater treatment systems is to remove the non-settling solids and the dissolved organic load from the effluents by using microbial populations. Biological treatments are generally part of_________________.

A. Denitrification process D. Insufficient aeration in the reactor
B. Secondary treatment systems E. Anaerobic sludge
C. Bulking sludge F. None of the Above

177. The microorganisms used are responsible for the degradation of the __________ and the stabilization of organic wastes.
A. Allowable concentrations
B. Water quality
C. In a healthy aquatic community
D. Organic matter
E. Human health and aquatic life criteria
F. None of the Above

178. Most of the microorganisms present in wastewater treatment systems use the _____________ of the wastewater as an energy source to grow, and are thus classified as heterotrophes from a nutritional point of view.
A. Toxic pollutant(s)
B. Food chain
C. Biological integrity
D. Biological treatment(s)
E. Organic content
F. None of the Above

Genera

179. In a well-functioning system, protozoas and rotifers are usually present and are useful in consuming dispersed __________ or non-settling particles. More extensive description and treatment of the microbiology of wastewater treatment systems are given elsewhere.
A. Bacteria
B. Attached growth processes
C. Protozoas and rotifers
D. Suspended growth processes
E. Food-to-microorganism ratio, F/M
F. None of the Above

180. The organic load present is incorporated in part as ____________ by the microbial populations, and almost all the rest is liberated as gas (carbon dioxide (CO_2) if the treatment is aerobic, or carbon dioxide plus methane (CH_4) if the process is anaerobic) and water. In fisheries wastewaters the non- biodegradable portion is very low.
A. Biological denitrification
B. Organic load
C. Bacteria
D. Biomass
E. Aerobic and facultative microorganisms
F. None of the Above

181. Unless the cell mass formed during the biological treatment is removed from the wastewater, the treatment is largely incomplete, because the biomass itself will appear as _____________ in the effluent and the only pollution reduction accomplished is that fraction liberated as gases.
A. Carbonaceous BOD
B. Attached growth processes
C. Organic load
D. Suspended growth processes
E. Food-to-microorganism ratio, F/M
F. None of the Above

182. The biological treatment processes used for wastewater treatment are broadly classified as aerobic in which aerobic and facultative microorganisms predominate or anaerobic which use _________.
A. Biological denitrification
B. Organic load
C. Anaerobic microorganism
D. Nitrogen and phosphorus
E. Aerobic and facultative microorganisms
F. None of the Above

183. If the microorganisms or Bugs are suspended in the wastewater during biological operation, the operations are called "________________", while the microorganisms that are attached to a surface over which they grow are called "attached growth processes".
A. Carbonaceous BOD
B. Attached growth processes
C. Protozoas and rotifers
D. Suspended growth processes
E. Food-to-microorganism ratio, F/M
F. None of the Above

Hand Compositing

184. Hand compositing is a series of time proportional grab samples which are collected and composited by hand. Provided the _________________are equal and are collected at even intervals, the results should be the same as if done by an automatic sampler (i.e., flow proportional composite sampling).

A. Sample volumes D. Routine QA/QC measures
B. Sample preservation E. Blanks
C. Duplicate samples F. None of the Above

185. A specific instance where this sampling method may be used is in metal plating shops which have batch discharges from the treatment tank. Provided the tank contains a homogeneous mixture, _______________are taken of equal amounts and at evenly spaced intervals of time during discharge, to accurately represent the entire tank.

A. Quantify the pollutants D. A minimum of four grab samples
B. Grab samples E. Flow proportional composites
C. Hand composites F. None of the Above

186. This should represent the waste characteristics of the entire batch discharge to the sewer. ________________ per batch discharge would be equivalent to a 24-hour composite sample taken at other types of facilities. The sampling data would be compared with the average daily categorical standards or local limits where applicable.

A. An analysis D. Taste test
B. Split samples E. One hand composite
C. Duplicate samples F. None of the Above

POTW's Wastewater Samples

General

187. There are four types of samples that are collected by the POTW's Sampling Section: grab, time proportional composites, flow proportional composites, and hand composites. ________________used depends largely on the types of analyses to be run, and the nature of the wastestream being sampled.

A. An analysis D. Taste test
B. The sampling method E. Blanks
C. Duplicate samples F. None of the Above

188. _________________________is an individual sample collected in less than 15 minutes without regard for flow or time of day. pH, cyanide, oil and grease, sulfide, and volatile organics must be collected as grab samples.

A. Entire batch discharge D. An individual sample
B. The volume of sample E. Proportional composite sampling
C. A grab sample F. None of the Above

189. ______________ to be collected by any of these methods is dependent on the number and types of analyses that must be performed.

A. Entire batch discharge D. An individual sample
B. The volume of sample E. Proportional composite sampling
C. Concentration of pollutants F. None of the Above

Wastewater Grab Samples

190. _______________ are normally taken manually, but can be pumped. Oil and grease samples and purgeable organics are exceptions and must be taken manually.
A. Quantify the pollutants D. Time proportional composite sampling methods
B. Grab samples E. Flow proportional composites
C. Hand composites F. None of the Above

A grab sample is usually taken when a sample is needed to:

191. Provide information about ________________of pollutants at a specific time.
A. Entire batch discharge D. An individual sample
B. The volume of sample E. An instantaneous concentration
C. Concentration of pollutants F. None of the Above

192. Quantify the _______________in a non-continuous discharge (e.g., batch discharge).
A. Pollutants D. Taste test
B. Split samples E. Blanks
C. Duplicate samples F. None of the Above

193. Corroborate _______________ if the waste is not highly variable.
A. Entire batch discharge D. An individual sample
B. The volume of sample E. Proportional composite sampling
C. Composite samples F. None of the Above

194. _______________not amenable to compositing such as pH, temperature, dissolved oxygen, chlorine, purgeable organics and sulfides, oil and grease, coliform bacteria, and sulfites.
A. Quantify the pollutants D. Monitor parameters
B. Grab samples E. Flow proportional composites
C. Hand composites F. None of the Above

Timed Composites

195. __________________are usually taken in instances where the intention is to characterize the wastes over a period of time without regard to flow, or where the flow is fairly constant.
A. Timed samples D. Time proportional composite sampling methods
B. Grab samples E. Flow proportional composites
C. Hand composites F. None of the Above

196. _________________consist of a series of equal volume grab samples taken at regular intervals.
A. Timed composite samples D. Time proportional composite sampling methods
B. Grab samples E. Flow proportional composites
C. Hand composites F. None of the Above

Flow Proportional Composites

197. _________________________consist of: a series of grab samples whose volumes are equal in size and proportion to the flow at the time of sampling.
A. The sampling point(s) D. Routine QA/QC measures
B. Sample preservation E. Flow proportional composite samples
C. Duplicate samples F. None of the Above

198. ___________________are taken at varying time intervals, or continuous samples taken over a period of time based on the flow. .
A. Entire batch discharge D. An individual sample
B. The volume of sample E. Samples
C. Concentration of pollutants F. None of the Above

Background on Emerging Contaminants
199. The term "____________________" refers broadly to those synthetic or naturally occurring chemicals, or to any microbiological organisms, that have not been commonly monitored in the environment but which are of increasing concern because of their known or suspected adverse ecological or human health effects.
A. SRTs D. Emerging contaminants
B. PPCPs E. Endocrine disrupting chemicals (EDCs)
C. Nitrifying bacteria F. None of the Above

200. ________________can fall into a wide range of groups defined by their effects, uses, or by their key chemical or microbiological characteristics.
A. PPCPs D. Longer activated sludge SRTs
B. Emerging contaminants E. Slower growing bacteria
C. Ammonia oxidizing bacteria F. None of the Above

201. Two groups of emerging contaminants that are of particular interest and concern at present are _________________ and pharmaceutical and personal care products (PPCPs).
A. SRTs D. Any microbiological organisms
B. PPCPs E. Endocrine disrupting chemicals (EDCs)
C. Nitrifying bacteria F. None of the Above

202. _______________may interfere with the endocrine systems by damaging hormone-producing tissues, changing the processes by which hormones are made or metabolized, or mimicking hormones.
A. PPCPs D. Longer activated sludge SRTs
B. EDCs E. Slower growing bacteria
C. Ammonia oxidizing bacteria F. None of the Above

203. _____________ encompass a wide variety of products that are used by individuals for personal health or cosmetic reasons, and also include certain agricultural and veterinary medicine products.
A. SRTs D. Any microbiological organisms
B. PPCPs E. Endocrine disrupting chemicals (EDCs)
C. Nitrifying bacteria F. None of the Above

Wastewater Sample Preservation
204. Wastewater usually contains one or more unstable pollutants that require immediate analysis or preservation until ___________ can be made.
A. An analysis D. Taste test
B. Split samples E. Blanks
C. Duplicate samples F. None of the Above

205. Sample preservation is needed for______________, for example, which may be stored for as long as 24 hours prior to transferring them to the laboratory.
A. Nitrified effluent D. Nitrogen and phosphorus levels
B. Composite samples E. Activated sludge
C. Total Nitrogen (TN) F. None of the Above

Quality Assurance/Quality Control Policy Example
206. Quality Assurance/Quality Control (QA/QC) measures taken by the sampling crew include equipment blanks, trip blanks, split samples and duplicate samples. Equipment blanks and ____________are routine QA/QC measures.
A. The sampling point(s) D. Routine QA/QC measures
B. Sample preservation E. Trip blanks
C. Duplicate samples F. None of the Above

207. ________________ are taken for Local Limits (pretreatment) sampling and when requested by an industry or laboratory. Split samples requested by an industry are analyzed by their lab at their expense.
A. An analysis D. Taste test
B. Split samples E. Blanks
C. Duplicate samples F. None of the Above

208. The laboratory prepares _______________used by the sampling crews. This is performed in the laboratory rather than in the field in order to assure that there is no field contamination in the blanks.
A. The sampling point(s) D. Routine QA/QC measures
B. Sample preservation E. All trip blanks/travel blanks
C. Duplicate samples F. None of the Above

209. Any contamination detected in the _______________ would result from field exposure which could in turn affect collected samples.
A. An analysis D. Taste test
B. Split samples E. Blanks
C. Duplicate samples F. None of the Above

Chain-of-Custody
210. Documentation of all pertinent data concerning the collection, preservation and transportation of ________________is critical to the overall success of the Wastewater Sampling Program.
A. The sampling point(s) D. Routine QA/QC measures
B. Sample preservation E. Samples
C. Duplicate samples F. None of the Above

211. If sampling is performed for the Pretreatment program, any sampling data may be used as evidence in court proceedings against a noncompliant industrial user. In this case _____________________ becomes critical.
A. Sampling crew D. Documentation
B. Duplicate samples E. Noncompliant industrial user
C. Pre-preserved bottles F. None of the Above

212. ________________is returned to the laboratory. It is also important to note that the sampling vehicle should be kept locked at all times when the sampling crew is not in the vehicle, or in full view of the vehicle.
A. Sampling crew D. Safety Data Sheet (SDS)
B. Duplicate samples E. The original form
C. Pre-preserved bottles F. None of the Above

Proper Sample Handling
213. The proper handling of _________________also includes wearing gloves. Gloves not only protect field personnel, but also prevent potential contamination to the water sample. Always wear powderless, disposable gloves. When sampling for inorganics, wear latex gloves.
A. Other parameters D. Some samples
B. Pre-preserved bottles E. Water quality samples
C. Preservatives F. None of the Above

214. Nitrile gloves are appropriate for __________________.
A. Other parameters D. Some samples
B. Pre-preserved bottles E. Organics
C. Preservatives F. None of the Above

215. Use ___________procedures when coolers and containers are prepared, sealed and shipped.
A. Chain-of-custody D. Safety Data Sheet (SDS)
B. Duplicate samples E. Noncompliant industrial user
C. Pre-preserved bottles F. None of the Above

216. The most common ___________ are hydrochloric, nitric, sulfuric and ascorbic acids, sodium hydroxide, sodium thiosulfate, and biocides.
A. Other parameters D. Some samples
B. Pre-preserved bottles E. Organics
C. Preservatives F. None of the Above

217. Many laboratories provide ____________ filled with measured amounts of preservatives.
A. Sampling crew D. Safety Data Sheet (**SDS**)
B. Duplicate samples E. Noncompliant industrial user
C. Pre-preserved bottles F. None of the Above

218. When the _______________are received from the laboratory, check to see that none have leaked. Be aware that many preservatives can burn eyes and skin, and must be handled carefully.
A. Other parameters D. Some samples
B. Pre-preserved bottles E. Containers and preservatives
C. Preservatives F. None of the Above

219. ______________should be labeled with type of preservative used, type of analysis to be done and be accompanied by a Safety Data Sheet (SDS).
A. Sampling crew D. Sampling bottles
B. Duplicate samples E. Noncompliant industrial user
C. Pre-preserved bottles F. None of the Above

220. Make sure you can tell which containers are pre-preserved, because extra care must be taken not to overfill them when collecting samples in the field. Check with the laboratory about _______________when using pre-preserved bottles.

A. Other parameters
B. Quality control procedures
C. Preservatives
D. Some samples
E. Organics
F. None of the Above

221. Coolers used for _______________must be large enough to store containers, packing materials and ice. Obtain extra coolers, if necessary. Never store coolers and containers near solvents, fuels or other sources of contamination or combustion. In warm weather, keep coolers and samples in the shade.

A. Sampling crew
B. Duplicate samples
C. Pre-preserved bottles
D. Sample shipment
E. Noncompliant industrial user
F. None of the Above

Field Parameters

222. Measure and record the field parameters of temperature, electrical conductivity, pH and __________________ in an undisturbed section of stream flow. Other parameters may be measured, if desired.

A. Nitrified effluent
B. Nitrogen
C. Total Nitrogen (TN)
D. Dissolved oxygen
E. Activated sludge
F. None of the Above

Removal of Emerging Contaminants by Nutrient Removal Technologies

Several studies have examined the effectiveness of current wastewater treatment technologies in the removal of emerging contaminants.

The significant findings are also presented as follows:

223. Removal efficiencies were enhanced for several investigated contaminants at longer SRTs, with critical _______________for some beyond which removal rates did not improve.

A. SRTs
B. PPCPs
C. Nitrifying bacteria
D. Any microbiological organisms
E. Endocrine disrupting chemicals (EDCs)
F. None of the Above

224. ____________allow for the establishment of slower growing bacteria (e.g., nitrifying bacteria in activated sludge), which in turn provide a more diverse community of microorganisms with broader physiological capabilities.

A. PPCPs
B. Longer SRTs
C. Ammonia oxidizing bacteria
D. Longer activated sludge SRTs
E. Slower growing bacteria
F. None of the Above

225. ____________________ may play a key role in biodegradation but the role of heterotrophic bacteria may also play a significant role.

A. SRTs
B. PPCPs
C. Nitrifying bacteria
D. Any microbiological organisms
E. Endocrine disrupting chemicals (EDCs)
F. None of the Above

226. Reverse osmosis has been found to effectively remove ______________ below detection limits including those that that were not consistently removed at longer SRTs.
A. PPCPs D. Longer activated sludge SRTs
B. Nitrification E. Slower growing bacteria
C. Ammonia oxidizing bacteria F. None of the Above

Role of Solids Retention Time in Removal Efficiency
227. The focus of several studies has been the relationship of the SRT to the removal of emerging contaminants. In particular, many investigated whether longer SRTs would result in increased removal efficiencies for estrogens and__________________.
A. SRTs D. Other categories of PPCPs
B. PPCPs E. Endocrine disrupting chemicals (EDCs)
C. Nitrifying bacteria F. None of the Above

228. __________________allow for the establishment of slower growing bacteria (e.g., nitrifying bacteria in activated sludge), which in turn provide a more diverse community of microorganisms with broader physiological capabilities.
A. Ammonia oxidation D. An aerobic wastewater treatment facility
B. Phosphorus removal E. Oxygen demand of wastewater
C. Longer activated sludge SRTs F. None of the Above

229. Conversely, _____________that are routinely detected in influent (i.e., detected in at least 20 percent of the influent samples) were not well removed by secondary treatment (BHA, DEET, musk ketone, triclosan, benzophenone, galaxolide).
A. SRTs D. Any microbiological organisms
B. PPCPs E. Endocrine disrupting chemicals (EDCs)
C. Six compounds F. None of the Above

Topic 6 - Laboratory Analysis Section

230. What is the theory that states than an acid is a substance that produces Hydronium ions when it is dissolved in water, and a base is one that produces hydroxide ions when dissolved in water?
A. Newton's D. Amadeus
B. Alkalinity E. Arrhenius
C. Lord Calvin's F. None of the Above

231. What is the term associated with a charged species, an atom or a molecule, that has lost or gained one or more electrons?
A. A proton D. An electron
B. Ion E. A cation
C. Anti-matter F. None of the Above

232. What is a substance that has the ability to reduce other substances and is said to be reductive in nature?
A. Protons D. Electrons
B. An electron donor E. Cations
C. Anti-matter F. None of the Above

233. Pure water has a pH very close to __________________.
A. 5 D. 7.7
B. 6 E. 7.5
C. 7 F. None of the Above

234. According to the manual, which of the following parameter/methods/measurements determine a parameter using a concentration cell with transference by measuring the potential difference.
A. Primary pH standard values D. pH measurement(s)
B. Alkalinity E. Measurement of pH
C. pH F. None of the Above

235. Mathematically speaking, pH is the negative logarithm of the activity of the (solvated) hydronium ion, often expressed as the measurement of ________________.
A. Electrons D. Cation measurement(s)
B. Alkalinity E. Ions
C. Hydronium ion concentration F. None of the Above

236. When measuring alkalinity in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater, this measurement can be one of the best measures of the sensitivity of the stream to acid inputs.
A. True B. False

237. One definition of pH is that it is defined as the decimal logarithm of the reciprocal of the _________________ , a_H+, in a solution.
A. Hydrogen ion activity D. Brønsted–Lowry acid–base theory
B. Ion-selective electrode(s) E. Acid-base behavior
C. (Solvated) hydronium ion F. None of the Above

238. With respect to standard buffer values, when more than two buffer solutions are used the electrode can be calibrated by fitting observed pH values to a straight line.
A. True B. False

240. Commercial standard buffer solutions usually comes with information about value and a correction factor to be applied for what temperatures?
A. 4 °C D. 10 °C
B. 25 °C E. 70 °F
C. 39 °F F. None of the Above

241. Because the pH scale is logarithmic, therefore pH is ________________.
A. Universal indicator D. Excess of Ion concentrations
B. A dimensionless quantity E. A set of non-linear equations
C. A Spectrophotometer F. None of the Above

242. What is the new pH scale is referred to as?
A. Total scale D. Ph_3
B. POH E. POE
C. P3H F. None of the Above

243. Alkalinity is able to neutralize _________________ and is measured in a quantitative capacity in an aqueous solution.
A. Acid D. pH measurement(s)
B. Base E. Bond formation
C. pH F. None of the Above

244. When using a visual comparison of the test solution with a standard colour chart, measuring pH values should be done to the?
A. Universal indicator D. Spectrophotometer Example
B. Colourwheel measurement E. Lab test
C. Nearest whole number F. None of the Above

245. A(n) _____________is an example of a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution.
A. Universal indicator D. A chemical speciation calculation
B. pH log E. A set of non-linear simultaneous equations
C. A set of linear equations F. None of the Above

246. According to the manual, under normal circumstances strong acids and bases are compounds that, for practical purposes, are completely dissociated in water, this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of__________.
A. The concentration value D. End-point pH
B. The pH E. A set of non-linear simultaneous equations
C. The Spectrophotometer F. None of the Above

247. The sum of all the titratable bases is the Alkalinity of water and its acid-neutralizing capacity. What would cause the measured value to vary significantly ?
A. Acid D. pH measurement(s)
B. Alkalinity E. End-point pH
C. pH F. None of the Above

248. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires the solution of a quadratic equation.
A. True B. False

249. If the pH of a solution contains a weak base, this may require?
A. The solution of a cubic equation D. A set of linear simultaneous equations
B. The solution of a linear equation E. A set of non-linear equations
C. The solution of a squared equation F. None of the Above

250. While the general case requires the pH solution of ?
A. The solution of a cubic equation D. A set of linear simultaneous equations
B.The solution of a linear equation E. A set of non-linear simultaneous equations
C. The solution of a squared equation F. None of the Above

251. Because alkalinity is significant in many uses and treatments of natural waters and wastewaters. The measured values also may include contributions from ___________________or other bases if these are present.

A. Acids
B. Light metals
C. Rare earths
D. Borates, phosphates, silicates
E. Caustics
F. None of the Above

252. Calculations are not necessary except in extreme situations for strong acids and bases. The pH of a solution containing a weak acid requires___________.

A. The concentration value
B. The solution of a quadratic equation
C. The Spectrophotometer
D. Visual comparison
E. The solution of a cubic equation
F. None of the Above

253. What factor is key in in determining the suitability of water for irrigation.

A. pH of 8
B. pH of 7
C. pH of 3
D. Alkaline earth metal concentrations
E. Borates, phosphates, silicates
F. None of the Above

254. The calculation of the pH of a solution containing acids and/or bases is an example of a ______________ calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution

A. Universal indicator
B. Colourwheel measurement
C. Spectrophotometer
D. Visual comparison
E. Chemical speciation
F. None of the Above

255. Since pH is a logarithmic scale, a difference of one pH unit is equivalent to a ______________difference in hydrogen ion concentration

A. 1
B. 2
C. 5
D. 10
E. 100
F. None of the Above

256. According to the manual, this key water measurement is used in the <u>interpretation and control</u> of water and wastewater treatment processes.

A. Acid
B. Alkalinity
C. pH
D. Chemical ion
E. Hydrogen bond formation
F. None of the Above

257. These compounds for all practical purposes, are completely dissociated in water.

A. Strong acids and bases
B. Strong bases
C. Chemical ions in chains
D. Strong bases and weak acids
E. Weak acids and weak bases
F. None of the Above

258. Sodium hydroxide, NaOH, is an example of?

A. Strong acid and base
B. Strong base
C. Weak base
D. Strong base and weak acid
E. Weak acids and weak bases
F. None of the Above

259. According to the text, what is the pH of pure water at 50 °C?
A. 7.7 D. 6.55
B. 8.0 E. 7.00
C. 9.0 F. None of the Above

Dissolved Oxygen
260. Dissolved oxygen (DO) in water is not considered a contaminant. However, the (DO) level is important because too much or not enough dissolved oxygen can create________________.
A. Unfavorable conditions D. Frequent dissolved oxygen measurement
B. DO analysis E. Aerobic conditions
C. Carbon dioxide F. None of the Above

261. Generally, a lack of (DO) in natural waters creates _____________. Anaerobic means without air. Certain bacteria thrive under these conditions and utilize the nutrients and chemicals available to exist.
A. Winkler Method D. Anaerobic conditions
B. Dissolved Oxygen E. The iodometric (titration) test
C. Only molecular oxygen F. None of the Above

262. Where the intermediates are________________. At least two general forms of bacteria act in balance in a wastewater digester: Saprophytic organisms and Methane Fermenters.
A. Sample(s) D. Butyric acid, mercaptans and hydrogen sulfide gas
B. DO analysis E. Aerobic conditions
C. Carbon dioxide F. None of the Above

263. The saprophytes exist on dead or decaying materials. The _______________live on the volatile acids produced by these saprophytes. The methane fermenting bacteria require a pH range of 6.6 to 7.6 to be able to live and reproduce.
A. Wildlife habitat D. Phosphorus-reduction system(s)
B. Methane fermenters E. Excessive sludge production
C. Denitrification F. None of the Above

264. _________________ indicate that dissolved oxygen is present. Aerobic bacteria require oxygen to live and thrive. When aerobes decompose organics in the water, the result is carbon dioxide and water.
A. Sample(s) D. Frequent dissolved oxygen measurement
B. DO analysis E. Aerobic conditions
C. Carbon dioxide F. None of the Above

265. _____________ in a water sample can be detrimental to metal pipes in high concentrations because oxygen helps accelerate corrosion.
A. Winkler Method D. Anaerobic conditions
B. Dissolved Oxygen E. The iodometric (titration) test
C. Only molecular oxygen F. None of the Above

266. The amount of _________________in a water sample will affect the taste of drinking water also.
A. Sample(s) D. Dissolved oxygen
B. DO analysis E. Aerobic conditions
C. Carbon dioxide F. None of the Above

Methods of Determination

267. There are two methods that we will be using in the lab. The _______________ procedure is based on the rate of diffusion of molecular oxygen across a membrane. The other is a titrimetric procedure (Winkler Method) based on the oxidizing property of the (DO).

A. Membrane electrode method
B. Dissolved Oxygen
C. Only molecular oxygen
D. Anaerobic conditions
E. Iodometric (titration) test
F. None of the Above

268. Many factors determine the ____________in a water sample. Temperature, atmospheric pressure, salinity, biological activity and pH all have an effect on the (DO) content.

A. Solubility of oxygen
B. DO analysis
C. Carbon dioxide
D. Frequent dissolved oxygen measurement
E. Aerobic conditions
F. None of the Above

Iodometric Test

269. Reactions take place with the addition of certain chemicals that liberate iodine equivalent to the_________________. The iodine is then measured to the starch iodine endpoint. We then calculate the dissolved oxygen from how much titrate we use.

A. Original (DO) content
B. Dissolved Oxygen
C. Only molecular oxygen
D. Anaerobic conditions
E. Iodometric (titration) test
F. None of the Above

270. _____________________can liberate iodine from iodides (positive interference), and some reducing agents reduce iodine to iodide (negative interferences).

A. Ammonia oxidation
B. Phosphorus removal
C. Certain oxidizing agents
D. An aerobic wastewater treatment facility
E. Oxygen demand of wastewater
F. None of the Above

271. _______________________effectively removes interference caused by nitrates in the water sample, so a more accurate determination of (DO) can be made.

A. Winkler Method
B. Dissolved Oxygen
C. Only molecular oxygen
D. The alkaline Iodide-Azide reagent
E. The iodometric (titration) test
F. None of the Above

272. __________________are highly dependent on the source and characteristics of the sample. The membrane electrode method involves an oxygen permeable plastic membrane that serves as a diffusion barrier against impurities.

A. Methods of analysis
B. DO analysis
C. Carbon dioxide
D. Frequent dissolved oxygen measurement
E. Aerobic conditions
F. None of the Above

273. _________________ passes through the membrane and is measured by the meter. This method is excellent for field testing and continuous monitoring.

A. Carbon dioxide
B. Dissolved Oxygen
C. Only molecular oxygen
D. H_2S
E. Carbon
F. None of the Above

274. Membrane electrodes provide an excellent method for _________________in polluted, highly coloured turbid waters and strong waste effluents.
A. Sample(s) D. Frequent dissolved oxygen measurement
B. DO analysis E. Aerobic conditions
C. Carbon dioxide F. None of the Above

275. These interferences could cause serious errors in other procedures. Prolonged usage in waters containing such gases as ___________________ tends to lower cell sensitivity. Frequent changing and calibrating of the electrode will eliminate this interference.
A. Carbon dioxide D. H_2S
B. Dissolved Oxygen E. Carbon
C. Only molecular oxygen F. None of the Above

276. Samples are taken in ______________bottles where agitation or contact with air is at a minimum. Either condition can cause a change in the gaseous content. Samples must be determined immediately for accurate results.
A. Sample(s) D. Frequent dissolved oxygen measurement
B. DO analysis E. Aerobic conditions
C. BOD F. None of the Above

277. ________________is the one of the most important analyses in determining the quality of natural waters. The effect of oxidation wastes on streams, the suitability of water for fish and other organisms and the progress of self-purification can all be measured or estimated from the dissolved oxygen content.
A. Winkler Method D. Anaerobic conditions
B. Dissolved Oxygen E. The iodometric (titration) test
C. The dissolved oxygen test F. None of the Above

278. In aerobic sewage treatment units, the minimum objectionable odor potential, maximum treatment efficiency and stabilization of wastewater are dependent on maintenance of adequate dissolved oxygen. Frequent __________measurement is essential for adequate process control.
A. Sample(s) D. Dissolved oxygen
B. DO analysis E. Aerobic conditions
C. Carbon dioxide F. None of the Above

Sludge Volume Index (SVI)
Sludge Volume Index Lab
279. The Sludge Volume Index (SVI) of activated sludge is defined as the volume in milliliters occupied by _____________ after settling for 30 minutes.
A. A closed loop D. Trickling filter FFSs
B. 1g of activated sludge E. A portion of the denitrified effluent
C. Optimal DO levels F. None of the Above

Proprietary Filters/Improved and Emerging Technologies
Sustainable Nutrient Recovery

280. The concept behind these new technologies is to separate and treat _____________ before it leaves the home or building and mixes with the larger waste stream to be carried to WWTPs.
A. Toilet waste D. Nitrogen and phosphorus pollution
B. Community drainfield(s) E. Small volumes of wastewater
C. High-aluminum mud(s) F. None of the Above

281. Recent studies have shown that about 80 percent of the ___________________ and 50 percent of the phosphorus in wastewater are derived from urine although urine makes up only 1 percent of the volume of wastewater (Larsen and Leinert, 2007).
A. Total Solids D. Nitrogen
B. TDS E. Wastewater temperature
C. pH F. None of the Above

282. Separating the urine from wastewater could offer various advantages: WWTPs could be built on a smaller scale, water bodies will be better protected from ______________pollution, nutrients could be recycled for agricultural use, and various constituents of concern including hormones and pharmaceutical compounds could be removed before being mixed with wastewater and released to the environment.
A. Total Solids D. Nitrogen
B. TDS E. Nitrogen and phosphorus
C. pH F. None of the Above

283. A major benefit would be reduced energy consumption at WWTPs as a result of reduced treatment requirements for _______________. Also, separating 50 to 60 percent of urine could reduce in-plant nitrogen gas discharges and result in fewer impurities in methane captured from sludge digestion.
A. Total Solids D. Nitrogen
B. TDS E. Nitrogen and phosphorus
C. pH F. None of the Above

Total Dissolved Solids

284. ___________ refer to any minerals, salts, metals, cations or anions dissolved in water.
A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness
B. TDS E. Dissolved solids
C. pH F. None of the Above

285. __________________ comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and some small amounts of organic matter that are dissolved in water.
A. Treatment processes D. Both treatment and the environment
B. Total dissolved solids (TDS) E. Universal solvent
C. Quality of the water F. None of the Above

286. Elevated _____________ has been due to natural environmental features such as: mineral springs, carbonate deposits, salt deposits, and sea water intrusion, but other sources may include: salts used for road de-icing, anti-skid materials, drinking water treatment chemicals, stormwater and agricultural runoff, and point/non-point wastewater discharges.

A. Total Solids
B. TDS
C. pH
D. Elevated Hardness, Salty Taste, or Corrosiveness
E. Wastewater temperature
F. None of the Above

287. In general, the __________ concentration is the sum of the cations (positively charged) and anions (negatively charged) ions in the water. Therefore, the total dissolved solids test provides a qualitative measure of the amount of dissolved ions, but does not tell us the nature or ion relationships.

A. Treatment processes
B. Total dissolved solids (TDS)
C. Quality of the water
D. Both treatment and the environment
E. Universal solvent
F. None of the Above

288. In addition, the test does not provide us insight into the specific water quality issues, such as: Elevated Hardness, Salty Taste, or ______________.

A. Total Solids
B. TDS
C. pH
D. Corrosiveness
E. Wastewater temperature
F. None of the Above

289. Therefore, the ____________ test is used as an indicator test to determine the general quality of the water.

A. Treatment processes
B. Total dissolved solids
C. Quality of the water
D. Both treatment and the environment
E. Universal solvent
F. None of the Above

Total Solids

290. The term "_____________" refers to matter suspended or dissolved in water or wastewater, and is related to both specific conductance and turbidity.

A. Total Solids
B. TDS
C. pH
D. Elevated Hardness, Salty Taste, or Corrosiveness
E. Wastewater temperature
F. None of the Above

291. ______________(also referred to as total residue) are the term used for material left in a container after evaporation and drying of a water sample.

A. Treatment processes
B. Total dissolved solids (TDS)
C. Quality of the water
D. Total solids
E. pH
F. None of the Above

292. _______________ includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids, the portion that passes through a filter (American Public Health Association, 1998).

A. Total Solids
B. TDS
C. pH
D. Elevated Hardness, Salty Taste, or Corrosiveness
E. Wastewater
F. None of the Above

293. ______________can be measured by evaporating a water sample in a weighed dish, and then drying the residue in an oven at 103 to 105° C. The increase in weight of the dish represents the total solids. Instead of total solids, laboratories often measure total suspended solids and/or total dissolved solids.

A. Treatment processes
B. Total dissolved solids (TDS)
C. Quality of the water
D. Total solids
E. Wastewater
F. None of the Above

Total Suspended Solids (TSS)

294. Total Suspended Solids (TSS) are solids in water that can be trapped by a filter. ___________ can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.

A. Total Solids
B. TDS
C. pH
D. TSS
E. Wastewater
F. None of the Above

295. ________________can block light from reaching submerged vegetation. As the amount of light passing through the water is reduced, photosynthesis slows down. Reduced rates of photosynthesis causes less dissolved oxygen to be released into the water by plants.

A. Total Solids
B. TDS
C. pH
D. Total Suspended Solids (TSS)
E. High TSS
F. None of the Above

296. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and will die. As the plants are decomposed, bacteria will use up even more oxygen from the water. _______________can lead to fish kills.

A. Oxygen
B. High TSS
C. Low dissolved oxygen
D. Total Suspended Solids (TSS)
E. Suspended sediment
F. None of the Above

297. ______________ can also cause an increase in surface water temperature, because the suspended particles absorb heat from sunlight.

A. Oxygen
B. High TSS
C. Settling sediments
D. Total Suspended Solids (TSS)
E. Suspended sediment
F. None of the Above

298. ______________________ can also clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development.

A. Oxygen
B. High TSS
C. Settling sediments
D. Total Suspended Solids (TSS)
E. Suspended sediment
F. None of the Above

299. __________________ can fill in spaces between rocks which could have been used by aquatic organisms for homes.

A. Oxygen
B. High TSS
C. Settling sediments
D. Total Suspended Solids (TSS)
E. Suspended sediment
F. None of the Above

300. _______________ at stores and other businesses typically occur during business hours and during meal times at restaurants. Rental properties, resorts, and commercial establishments in tourist areas may have extreme flow variations seasonally.
A. Peak flow(s) D. This can increase flow(s)
B. Flow volume(s) E. Original design load
C. Additional flows F. None of the Above

301. Estimating ___________________ for centralized treatment systems is a complicated task, especially when designing a new treatment plant in a community where one has never existed previously.
A. Peak flow(s) D. This can increase flow(s)
B. Flow volume(s) E. Original design load
C. Additional flows F. None of the Above

302. Engineers must allow for ________________ during wet weather due to inflow and infiltration of extra water into sewers.
A. Peak flow(s) D. This can increase flow(s)
B. Flow volume(s) E. Original design load
C. Additional flows F. None of the Above

303. ___________________can enter sewers through leaky manhole covers and cracked pipes and pipe joints, diluting wastewater, which affects its overall characteristics. This can increase flows to treatment plants sometimes by as much as three or four times the original design load.
A. Peak flow(s) D. Excess water
B. Flow volume(s) E. Original design load
C. Additional flows F. None of the Above

304. Wastewater treatment plants are designed to function as "microbiology farms," where bacteria and other microorganisms are fed ___________________________.
A. BOD and COD D. Soluble nutrients
B. Some contaminants E. Oxygen and organic waste
C. Second ary treatment effluent F. None of the Above

305. Treatment of wastewater usually involves ____________such as the activated sludge system in the secondary stage after preliminary screening to remove coarse particles and primary sedimentation that settles out suspended solids.
A. Biological processes D. Application-specific microbiology
B. Activated sludge system E. Pretreatment and pollution prevention
C. Advanced treatment technologies F. None of the Above

306. These secondary treatment steps are generally considered environmental biotechnologies that harness natural self-purification processes contained in bioreactors for the biodegradation of organic matter and bioconversion of _______________ in the wastewater.
A. Biofilm D. Soluble nutrients
B. Some contaminants E. Oxygen and organic waste
C. Secondary treatment effluent F. None of the Above

Topic 7- Microorganism Section

Aerobic Processes

307. In fisheries wastewaters, the need for addition of nutrients (the most common being ____________) seldom appears, but an adequate provision of oxygen is essential for successful operation of the systems. The most common aerobic processes are: activated sludge systems, lagoons, trickling filters and rotating disk contactors.
A. Biological denitrification D. Nitrogen and phosphorus
B. Organic load E. Aerobic and facultative microorganisms
C. Bacteria F. None of the Above

308. Most ____________ are used to degrade carbonaceous BOD. It is also possible to design and/or operate the basic system to oxidize ammonia (nitrification).
A. Carbonaceous BOD D. Suspended growth processes
B. Attached growth processes E. Food-to-microorganism ratio, F/M
C. Activated sludge processes F. None of the Above

309. Many plants are now designed to achieve nitrification. Other system modifications include phosphorus removal and _____________. Activated sludge plants are usually designed from pilot plant and laboratory studies.
A. Biological denitrification D. Nitrogen and phosphorus
B. Organic load E. Aerobic and facultative microorganisms
C. Bacteria F. None of the Above

310. From this approach, it is possible to design a process based on the amount of time the sludge spends in the system, generally termed______________, or on the amount of food provided to the bacteria in the aeration tank (the food-to-microorganism ratio, F/M).
A. Carbonaceous BOD D. Suspended growth processes
B. Attached growth processes E. Food-to-microorganism ratio, F/M
C. Mean cell residence time (MCRT) F. None of the Above

Bacteria Section

311. Bacteria come in a variety of shapes. The simplest shape is a round sphere or ball. Bacteria formed like this are called _________(singular coccus). The next simplest shape is cylindrical. Cylindrical bacteria are called rods (singular rod).
A. Cocci D. Spiral
B. Rods E. Spirochaetes
C. Balls F. None of the Above

312. Some bacteria are basically rods but instead of being straight they are twisted, bent or curved, sometimes in a_____________. These bacteria are called spirilla (singular spirillum).
A. Cocci D. Spiral
B. Rods E. Spirochaetes
C. Balls F. None of the Above

313. _______________ are tightly coiled up bacteria.
A. Cocci D. Spiral
B. Rods E. Spirochaetes
C. Balls F. None of the Above

314. Bacteria are friendly creatures; you never find one bacteria on its own. They tend to live together in clumps, chains or planes. When they live in chains, one after the other, they are called ____________________ - these often have long thin cells.
A. Biofilm bacteria D. Activated sludge
B. Filamentous bacteria E. An omnivore
C. Some bacteria F. None of the Above

315. When they tend to collect in a plane or a thin layer over the surface of an object, they are called a biofilm. Many bacteria exist as _____________and the study of biofilms is very important.
A. Filamentous Bacteria D. Either anaerobic or aerobic conditions
B. A biofilm E. Anaerobic to aerobic state
C. Application-specific bacteria F. None of the Above

316. ________________secrete sticky substances that form a sort of gel in which they live. The plaque on your teeth that causes tooth decay is a biofilm.
A. Biofilm bacteria D. Activated sludge
B. Filamentous bacteria E. An omnivore
C. Some bacteria F. None of the Above

Filamentous Bacteria
317. ________________ are a type of bacteria that can be found in a wastewater treatment system.
A. Filamentous Bacteria D. Either anaerobic or aerobic conditions
B. Facultative E. Anaerobic to aerobic state
C. Application-specific bacteria F. None of the Above

318. They function similar to ___________since they degrade BOD quite well. In small amounts, they are quite good to a biomass. They can add stability and a backbone to the floc structure that keeps the floc from breaking up or shearing due to turbulence from pumps, aeration or transfer of the water. In large amounts they can cause many problems.
A. Biofilm bacteria D. Activated sludge
B. Filamentous bacteria E. Floc forming bacteria
C. Some bacteria F. None of the Above

319. Filaments are _______________that grow in long thread-like strands or colonies.
A. Filamentous Bacteria D. Bacteria and fungi
B. Facultative E. Anaerobic to aerobic state
C. Application-specific bacteria F. None of the Above

Site Specific Bacteria
320. Aeration and biofilm building are the key operational parameters that contribute to the efficient degradation of organic matter (BOD/COD removal). Over time, the ___________ become site-specific as the biofilm develops and matures and is even more efficient in treating the site-specific waste stream.
A. Anaerobic action D. Aerobic bacteria
B. Absence of free oxygen E. Application-specific bacteria
C. Facultative bacteria F. None of the Above

Facultative Bacteria

321. Most of the bacteria absorbing the organic material in a wastewater treatment system are ____________ in nature. This means they are adaptable to survive and multiply in either anaerobic or aerobic conditions.

A. Filamentous Bacteria
B. Facultative
C. Application-specific bacteria
D. Either anaerobic or aerobic conditions
E. Anaerobic to aerobic state
F. None of the Above

322. The nature of individual bacteria is dependent upon the environment in which they live. Usually, facultative bacteria will be ___________ unless there is some type of mechanical or biochemical process used to add oxygen to the wastewater.

A. Anaerobic
B. Absence of free oxygen
C. Facultative bacteria
D. Aerobic
E. Application-specific bacteria
F. None of the Above

323. When bacteria are in the process of being transferred from one environment to another, the metamorphosis from _______________ (and vice versa) takes place within a couple of hours.

A. Filamentous Bacteria
B. Facultative
C. Application-specific bacteria
D. Either anaerobic or aerobic conditions
E. Anaerobic to aerobic state
F. None of the Above

Anaerobic Bacteria

324. ________________live and reproduce in the absence of free oxygen. They utilize compounds such as sulfates and nitrates for energy and their metabolism is substantially reduced.

A. Anaerobic action
B. Anaerobic bacteria
C. Facultative bacteria
D. Aerobic bacteria
E. Application-specific bacteria
F. None of the Above

325. In order to remove a given amount of organic material in an anaerobic treatment system, the organic material must be exposed to a ________________ and/or detained for a much longer period of time.

A. Anaerobic action
B. Absence of free oxygen
C. Facultative bacteria
D. Aerobic bacteria
E. Significantly higher quantity of bacteria
F. None of the Above

326. A typical use for _______________ would be in a septic tank. The slower metabolism of the anaerobic bacteria dictates that the wastewater be held several days in order to achieve even a nominal 50% reduction in organic material.

A. Filamentous organisms
B. Floc particles
C. Organic material
D. Anaerobic bacteria
E. Biosurfactant trehalose
F. None of the Above

327. The advantage of using the ____________ is that electromechanical equipment is not required. Anaerobic bacteria release hydrogen sulfide as well as methane gas, both of which can create hazardous conditions.

A. Filamentous Bacteria
B. Anaerobic process
C. Application-specific bacteria
D. Either anaerobic or aerobic conditions
E. Anaerobic to aerobic state
F. None of the Above

328. Even as the ______________ begins in the collection lines of a sewer system, deadly hydrogen sulfide or explosive methane gas can accumulate and be life threatening.
A. Anaerobic action
B. Absence of free oxygen
C. Facultative bacteria
D. Aerobic bacteria
E. Application-specific bacteria
F. None of the Above

Aerobic Bacteria

329. _______________ live and multiply in the presence of free oxygen. Facultative bacteria always achieve an aerobic state when oxygen is present. While the name "aerobic" implies breathing air, dissolved oxygen is the primary source of energy for aerobic bacteria.
A. Filamentous Bacteria
B. Aerobic bacteria
C. Application-specific bacteria
D. Either anaerobic or aerobic conditions
E. Anaerobic to aerobic state
F. None of the Above

330. The metabolism of aerobes is much higher than for___________. This increase means that 90% fewer organisms are needed compared to the anaerobic process, or that treatment is accomplished in 90% less time.
A. Anaerobic action
B. Anaerobes
C. Facultative bacteria
D. Aerobic bacteria
E. Application-specific bacteria
F. None of the Above

331. This provides a number of advantages including a higher percentage of organic removal. The by-products of _______________ are carbon dioxide and water.
A. Anaerobic action
B. Absence of free oxygen
C. Facultative bacteria
D. Aerobic bacteria
E. Application-specific bacteria
F. None of the Above

332. _________________ live in colonial structures called floc and are kept in suspension by the mechanical action used to introduce oxygen into the wastewater. This mechanical action exposes the floc to the organic material while treatment takes place.
A. Anaerobic action
B. Absence of free oxygen
C. Facultative bacteria
D. Aerobic bacteria
E. Application-specific bacteria
F. None of the Above

333. Following digestion, a gravity clarifier separates and settles out the floc. Because of the mechanical nature of the_____________, maintenance and operator oversight are required.
A. Aerobic digestion process
B. Facultative
C. Application-specific bacteria
D. Either anaerobic or aerobic conditions
E. Anaerobic to aerobic state
F. None of the Above

Protozoans and Metazoans

334. In a wastewater treatment system, the next higher life form above bacteria is ______.
A. Nematodes and rotifers
B. Metazoan(s)
C. Protozoan(s)
D. Protozoan and metazoan
E. Aerobic floc
F. None of the Above

335. _________________are also indicators of biomass health and effluent quality. Because protozoans are much larger in size than individual bacteria, identification and characterization is readily performed.
A. Organic material D. Biomass health and effluent quality
B. Protozoans E. Aerobic flocs
C. Macroinvertebrates F. None of the Above

336. ______________ are very similar to protozoans except that they are usually multi-celled animals.
A. Nematodes and rotifers D. Protozoan and metazoan
B. Metazoan(s) E. Aerobic floc
C. Protozoan(s) F. None of the Above

337. Macroinvertebrates, such as_______________, are typically found only in a well developed biomass.
A. Nematodes and rotifers D. Protozoan and metazoan
B. Metazoan(s) E. Macroinvertebrates
C. Protozoan(s) F. None of the Above

338. The presence of __________________and the relative abundance of certain species can be a predictor of operational changes within a treatment plant. In this way, an operator is able to make adjustments and minimize negative operational effects simply by observing changes in the protozoan and metazoan population.
A. Nematodes and rotifers D. Protozoans and metazoans
B. Metazoan(s) E. Macroinvertebrates
C. Protozoan(s) F. None of the Above

Dispersed Growth
339. Dispersed growth is material suspended within the activated sludge process that has not been adsorbed into the floc particles. This material consists of very small quantities of colloidal (too small to settle out) bacteria as well as organic and__________________.
A. Filamentous organisms D. Inorganic particulate material
B. Floc particles E. Biosurfactant trehalose
C. Organic material F. None of the Above

340. While a small amount of ______________between the floc particles is normal, excessive amounts can be carried through a secondary clarifier. When discharged from the treatment plant, dispersed growth results in higher effluent solids.
A. Denitrification process D. Dispersed growth
B. Organic material E. Anaerobic sludge
C. Bulking sludge F. None of the Above

Activated Sludge Aerobic Flocs
341. _______________ in a healthy state are referred to as activated sludge. While aerobic floc has a metabolic rate approximately 10 times higher than anaerobic sludge, it can be increased even further by exposing the bacteria to an abundance of oxygen.
A. Organic material D. Biomass health and effluent quality
B. Activated sludge process E. Aerobic flocs
C. Macroinvertebrates F. None of the Above

342. Compared to a septic tank, which takes several days to reduce the organic material, an activated sludge tank can reduce the same amount of organic material in approximately 4-6 hours. This allows a much higher degree of overall process efficiency. In most cases, treatment efficiencies and removal levels are so much improved that additional downstream treatment components are_________________.
A. Denitrification process
B. Organic material
C. Bulking sludge
D. Insufficient aeration in the reactor
E. Dramatically reduced or totally eliminated
F. None of the Above

Problems may appear during the operation of activated sludge systems, including:
343. ______________ content in clarified effluent, which may be due to too high or too low solids retention time and to growth of filamentous microorganisms.
A. Organic material
B. High solids
C. Macroinvertebrates
D. Biomass health and effluent quality
E. Aerobic flocs
F. None of the Above

344. _______________, occurring when sludge that normally settles rises back to the surface after having settled. In most cases, this is caused by the denitrification process, where nitrate present in the effluent is reduced to nitrogen gas, which then becomes trapped in the sludge causing this to float.
A. Denitrification process
B. Organic material
C. Bulking sludge
D. Insufficient aeration in the reactor
E. Rising sludge
F. None of the Above

345. This problem can be reduced by decreasing the flow from the aeration basin to the settling tank or reducing the sludge resident time in the settler, either by increasing the rate of recycle to the aeration basin, increasing the _________from the bottom, or increasing the sludge wasting rate from the system.
A. Organic material
B. Activated sludge process
C. Rate of sludge collection
D. Biomass health and effluent quality
E. Aerobic flocs
F. None of the Above

346. _____________, that which settles too slowly and is not compactable, caused by the predominance of filamentous organisms.
A. Denitrification process
B. Organic material
C. Bulking sludge
D. Insufficient aeration in the reactor
E. Anaerobic sludge
F. None of the Above

347. Insufficient reduction of organic load, probably caused by a______________ , insufficient amount of nutrients such as P or N (rare in fisheries wastewaters), short-circuiting in the settling tank, poor mixing in the reactor and insufficient aeration or presence of toxic substances.
A. Filamentous organisms
B. Floc particles
C. Organic material
D. Low solids retention time
E. Biosurfactant trehalose
F. None of the Above

348. Odours, caused by ___________in the settling tanks or insufficient aeration in the reactor.
A. Denitrification process
B. Organic material
C. Bulking sludge
D. Insufficient aeration in the reactor
E. Anaerobic conditions
F. None of the Above

Filamentous Organisms

349. The majority of filamentous organisms are bacteria, although some of them are classified as algae, fungi or other life forms. There are a number of types of filamentous bacteria which proliferate in the ________________.

A. Larger floc particles
B. Activated sludge process
C. Floating scum mat
D. Biomass
E. Filaments
F. None of the Above

350. Filamentous organisms perform several different roles in the process, some of which are beneficial and some of which are detrimental. When filamentous organisms are in low concentrations in the process, they serve to strengthen the ______________. This effect reduces the amount of shearing in the mechanical action of the aeration tank and allows the floc particles to increase in size.

A. Filamentous organisms
B. Floc particles
C. Organic material
D. Process control variation
E. Biosurfactant trehalose
F. None of the Above

351. Larger floc particles are more readily settled in a clarifier. _______________ settling in the clarifier also tend to accumulate smaller particulates (surface adsorption) as they settle producing an even higher quality effluent.

A. Larger floc particles
B. Activated sludge process
C. Floating scum mat
D. Biomass
E. Filaments
F. None of the Above

352. Conversely, if the _________________ reach too high a concentration, they can extend dramatically from the floc particles and tie one floc particle to another (interfloc bridging) or even form a filamentous mat of extra-large size.

A. Filamentous organisms
B. Floc particles
C. Organic material
D. Process control variation
E. Biosurfactant trehalose
F. None of the Above

353. Due to the increased surface area without a corresponding increase in mass, the _______________ will not settle well.

A. Larger floc particles
B. Activated sludge
C. Floating scum mat
D. Biomass
E. Filaments
F. None of the Above

354. Due to the high surface area of the__________________, once they reach an excess concentration, they can absorb a higher percentage of the organic material and inhibit the growth of more desirable organisms.

A. Filamentous organisms
B. Floc particles
C. Organic material
D. Process control variation
E. Filamentous bacteria
F. None of the Above

Filamentous Bacteria Identification

355. Filamentous Identification should be used as a tool to monitor the health of the biomass when a _______________is suspected.

A. Larger floc particles
B. Activated sludge process
C. Floating scum mat
D. Biomass
E. Filament problem
F. None of the Above

356. ____________ usually have a process control variation associated with the type of filament present that can be implemented to change the environment present and select out for floc forming bacteria instead. Killing the filaments with chlorine or peroxide will temporarily remove the filaments, but technically it is a band-aid.
A. Filamentous organisms D. All filamentous bacteria
B. Floc particles E. Biosurfactant trehalose
C. Organic material F. None of the Above

357. __________________ change must be made or the filaments will return with time eventually. Find out what filaments are present, find out the cause associated with them and make a process change for a lasting fix to the problems.
A. Larger floc particles D. Biomass
B. Activated sludge process E. A process
C. Floating scum mat F. None of the Above

Bugs or MOs
358. Four groups of bugs do most of the "eating" in the activated sludge process. The first group is the bacteria which eat the dissolved organic compounds. The second and third groups of bugs are microorganisms known as the free-swimming and stalked ciliates. These larger bugs eat the bacteria and are heavy enough to settle by gravity. The fourth group is a microorganism, known as_______________ , which feeds on the larger bugs and assists with settling.
A. Mixed liquor D. Free-swimming and stalked ciliates
B. Suctoria E. The contracting stalk
C. Stalked ciliate F. None of the Above

359. The interesting thing about the bacteria that eat the dissolved organics is they have no mouths. _____________have an interesting property, their "fat reserves" are stored on the outside of their bodies. This fat layer is sticky and is what the organics adhere to.
A. Shelled amoeba(s) D. The bacteria
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

360. Once the __________ have "contacted" their food, they start the digestion process. A chemical enzyme is sent out through the cell wall to break up the organic compounds. This enzyme, known as hydrolytic enzyme, breaks the organic molecules into small units which are able to pass through the cell wall of the bacteria.
A. Nitrifying bacteria D. Aerobic bacteria
B. Methane forming bacteria E. Anaerobic, heterotrophic bacteria
C. Bacteria F. None of the Above

361. In wastewater treatment, this process of using ___________in the presence of oxygen to reduce the organics in water is called activated sludge. .
A. Shelled amoeba(s) D. Bacteria-eating bugs
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

362. The fat storage property of the bacteria is also an asset in settling. As the bugs “bump” into each other, the fat on each of them sticks together and causes flocculation of the non-organic solids and biomass. From the aeration tank, the wastewater, now called mixed liquor, flows to a secondary clarification basin to allow the ____________ to settle out of the water.
A. Mixed liquor D. Free-swimming and stalked ciliates
B. Bacteria E. Flocculated biomass of solids
C. Stalked ciliate F. None of the Above

363. The solids biomass, which is the activated sludge, contains millions of bacteria and other microorganisms, is used again by returning it to the influent of the aeration tank for mixing with the primary effluent and____________________.
A. Filamentous Bacteria D. Ample amounts of air
B. Facultative E. Anaerobic to aerobic state
C. Application-specific bacteria F. None of the Above

Paramecium sp.
364. ________________ is a medium to large size (100-300 µm) swimming ciliate, commonly observed in activated sludge, sometimes in abundant numbers. The body is either foot-shaped or cigar-shaped, and somewhat flexible.
A. Shelled amoeba(s) D. Stalked ciliate
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

365. ________________ is uniformly ciliated over the entire body surface with longer cilia tufts at the rear of the cell.
A. Shelled amoeba(s) D. Stalked ciliate
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

366. Paramecium swims with a smooth gliding motion. It may also be seen paired up with another _________________ which makes a good diagnostic key.
A. Shelled amoeba(s) D. Stalked ciliate
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

367. ________________ is described as a filter-feeding ciliate because its cilia move and filter bacteria from the water.
A. Shelled amoeba(s) D. Stalked ciliate
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

Vorticella sp.
368. Vorticella is a stalked ciliate. There are at least a dozen species found in activated sludge ranging in length from about 30 to 150 µm. These organisms are oval to round shaped, have a contractile stalk, a domed feeding zone, and a water vacuole located near the terminal end of_____________ .
A. The feeding cavity D. Free-swimming and stalked ciliates
B. Bacteria E. The contracting stalk
C. Stalked ciliate F. None of the Above

369. One organism is found on each stalk except during cell division. After reproducing, the offspring develops a band of swimming cilia and goes off to form its own stalk. The evicted organism is called a "________________________."

A. Shelled amoeba(s)
B. Euglypha
C. Vorticella
D. Swarmer
E. Paramecium
F. None of the Above

370. ______________ feeds by producing a vortex with its feeding cilia. The vortex draws bacteria into its gullet. Vorticella's principal food source is suspended bacteria. The contracting stalk provides some mobility to help the organism capture bacteria and avoid predators.

A. Shelled amoeba(s)
B. Euglypha
C. Vorticella
D. Stalked ciliate
E. Paramecium
F. None of the Above

371. The stalk resembles a coiled spring after its rapid contraction. Indicator: If treatment conditions are bad, for example low DO or toxicity, _______________ will leave their stalks. Therefore, a bunch of empty stalks indicates poor conditions in an activated sludge system.

A. Shelled amoeba(s)
B. Euglypha
C. Vorticella
D. Stalked ciliate
E. Paramecium
F. None of the Above

372. __________________sp. are present when the plant effluent quality is high.

A. Shelled amoeba(s)
B. Euglypha
C. Vorticella
D. Stalked ciliate
E. Paramecium
F. None of the Above

Euglypha sp.

373. ______________ (70-100 µm) is a shelled (testate) amoeba. Amoebas have jelly-like bodies. Motion occurs by extending a portion of the body (pseudopodia) outward.

A. Shelled amoeba(s)
B. Euglypha
C. Vorticella
D. Stalked ciliate
E. Paramecium
F. None of the Above

374. _______________ have a rigid covering which is either secreted or built from sand grains or other extraneous materials. The secreted shell of this Euglypha sp. consists of about 150 oval plates. Its spines project backward from the lower half of the shell.

A. Euglypha
B. Shelled amoeba(s)
C. Rotifer(s)
D. Euchlanis
E. Spirochaetes
F. None of the Above

375. ______________ spines may be single or in groups of two or three. The shell has an opening surrounded by 8-11 plates that resemble shark teeth under very high magnification.

A. Shelled amoeba(s)
B. Euglypha
C. Vorticella
D. Stalked ciliate
E. Paramecium
F. None of the Above

376. The shell of _____________ is often transparent, allowing the hyaline (watery) body to be seen inside the shell. The pseudopodia extend outward in long, thin, rays when feeding or moving. Euglypha primarily eats bacteria.
A. Euglypha D. Euchlanis
B. Shelled amoeba(s) E. Spirochaetes
C. Rotifer(s) F. None of the Above

377. _______________ are common in soil, treatment plants, and stream bottoms where decaying organic matter is present. They adapt to a wide range of conditions and therefore are not good indicator organisms.
A. Shelled amoeba(s) D. Stalked ciliate
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

Euchlanis sp.

378. This microscopic animal is a typical ___________. Euchlanis is a swimmer, using its foot and cilia for locomotion. In common with other rotifers, it has a head rimmed with cilia, a transparent body, and a foot with two strong swimming toes.
A. Euglypha D. Euchlanis
B. Shelled amoeba(s) E. Spirochaetes
C. Rotifer(s) F. None of the Above

379. ________________ is an omnivore, meaning that its varied diet includes detritus, bacteria, and small protozoa.
A. Euglypha D. Euchlanis
B. Shelled amoeba(s) E. Spirochaetes
C. Rotifer(s) F. None of the Above

380. _______________ has a glassy shell secreted by its outer skin. The transparent body reveals the brain, stomach, intestines, bladder, and reproductive organs.
A. Euglypha D. Euchlanis
B. Shelled amoeba(s) E. Spirochaetes
C. Rotifer(s) F. None of the Above

381. A characteristic of ____________ is their mastax, which is a jaw-like device that grinds food as it enters the stomach. At times the action of the mastax resembles the pulsing action of a heart. Rotifers, however, have no circulatory system. Indicator:
A. Euglypha D. Euchlanis
B. Shelled amoeba(s) E. Spirochaetes
C. Rotifer(s) F. None of the Above

382. Euchlanis is commonly found in ______________ when effluent quality is good. It requires a continual supply of dissolved oxygen, evidence that aerobic conditions have been sustained.
A. Biofilm bacteria D. Activated sludge
B. Filamentous bacteria E. An omnivore
C. Some bacteria F. None of the Above

Nocardia amarae

383. Nocardia amarae, a common cause of ______________ in waste treatment plants, is a slow groing, usually gram-positive, chemoautotrophic, filamentous, strict aerobe that produces the biosurfactant trehalose.

A. Viscous brown colour
B. Staining gram-positive
C. Mixotrophic
D. Gram-positive, chemoautotrophic, filamentous
E. Disruptive foaming
F. None of the Above

384. Colonies can be_______________, so colour alone is not a key to identifying this species. N. amarae, member of the Actinomycetes family, is not motile, so it relies on movement of the water to carry it through the system. It produces catalase, urease and nitrate reductase enzymes, but not casease.

A. Stain gram-negative
B. Not casease
C. Slower growing filaments
D. Disruptive foaming
E. Brown, pink, orange, red, purple, gray or white
F. None of the Above

385. The foam from Nocardia amarae is usually a _____________ unless algae are entrapped in it, in which case it appears green and brown.

A. Viscous brown colour
B. Staining gram-positive
C. Mixotrophic
D. Gram-positive, chemoautotrophic, filamentous
E. Disruptive foaming
F. None of the Above

Nostocoida limicola

386. Nostocoida limicola is yet another common cause of disruptive foaming in waste treatment plants, motile in its Hormogonia and sometimes Trichome phases. This oxygenic phototrophic species often forms a ______________or large sheets of cells, forming symbiotic relationships with other species.

A. Stain gram-negative
B. Confluent gel encasing flattened discs
C. Slower growing filaments
D. Disruptive foaming
E. Multicellular rigid filaments
F. None of the Above

387. _______________, Nostocoida produces round cells within tight coil formations. Nostocoida can also be dentified by their starburst effect formations using phase contrast microscopy at 400 to 1000x magnification. After chlorination, a few dead cells sticking out identify stress to this species.

A. Viscous brown colour
B. Staining gram-positive
C. Staining gram-negative
D. Gram-positive, chemoautotrophic, filamentous
E. Disruptive foaming
F. None of the Above

Thiothrix

388. Thiothrix spp., the second most common cause of disruptive foaming in wastewater treatment plants appears as straight to slightly curved cells with rectangular shape form filaments up to 500 microns in length, in multicellular rigid filaments, ___________, with obligately aerobic respiration.

A. Viscous brown colour
B. Staining gram-positive
C. Staining gram-negative
D. Gram-positive, chemoautotrophic, filamentous
E. Disruptive foaming
F. None of the Above

389. Thiothrix are ___________, using several small organic carbons and reduced inorganic sulfur sources for growth and energy.
A. Viscous brown colour
B. Staining gram-positive
C. Mixotrophic
D. Gram-positive, chemoautotrophic, filamentous
E. Disruptive foaming
F. None of the Above

390. Thiothrix I is one of the largest filament found using phase contrast microscopy at 400 to 1000x magnification. Thiothrix II produces rectangular filaments up to 200 microns in length and is easily identified by their _______________using phase contrast microscopy at 400 to 1000x magnification.
A. Stain gram-negative
B. Not casease
C. Slower growing filaments
D. Starburst effect formations
E. Multicellular rigid filaments
F. None of the Above

Microthrix parvicella

391. Microthrix parvicella is another common cause of _____________ in waste treatment plants, producing filaments up to 400 microns in length, easily visualized by phase contrast microscopy at 400x magnification. This species is usually found outside floc, tangling with structures in the system, but can also be found hanging out of the floc.
A. Viscous brown colour
B. Staining gram-positive
C. Mixotrophic
D. Gram-positive, chemoautotrophic, filamentous
E. Disruptive foaming
F. None of the Above

Sphaeroliticus natans

392. Sphaeroliticus natans is another filamentous species, and yet it is reputed to increase settleability by branching between flocs, increasing surface area. Cells are straight to slightly curved, up to 1000 microns in length and _______________. These large cells can be easily visualized by phase contrast microscopy at 100x magnification.
A. Stain gram-negative
B. Not casease
C. Slower growing filaments
D. Disruptive foaming
E. Multicellular rigid filaments
F. None of the Above

393. Certain conditions favor the proliferation of filamentous species. A low F/M (food to mass) ratio favors filamentous organisms, because their higher ratio of surface area to volume provides them with a selective advantage for_____________.
A. Viscous brown colour
B. Staining gram-positive
C. Mixotrophic
D. Gram-positive, chemoautotrophic, filamentous
E. Securing nutrients in nutrient limited environments
F. None of the Above

394. When a plant runs an extremely long sludge age, the slower growing filaments have a better chance to establish a strong colony. As_____________, high levels of oxygen are necessary to sustain this species. Mesophilic, Nocardia amarae thrives in temperatures from 17 to 37 deg. C.
A. Stain gram-negative
B. A strict aerobe
C. Slower growing filaments
D. Disruptive foaming
E. Multicellular rigid filaments
F. None of the Above

395. The presence of high levels of fats, oils and greases or hydrocarbons and phenols, can encourage this species, particularly when insufficient levels of nitrogen and phosphorus are present to balance these______________________.

A. Carbon sources
B. Dissolved oxygen decrease
C. Sludge bulking
D. Bacteria and other microbes
E. Oxygen-demanding pollutants
F. None of the Above

Filamentous Bacteria

396. A problem that often frustrates the performance of activated sludge is bulking sludge due to the growth of filamentous bacteria. Sludge bulking can often be solved by careful process modifications. However, different filamentous bacteria such as Microthrix, Sphaerotilus, Nostocoida, Thiothrix or "Type 021N" and others cause__ ______________________.

A. Bulking for very different reasons
B. Dissolved oxygen decrease
C. Sludge bulking
D. Bacteria and other microbes
E. Oxygen-demanding pollutants
F. None of the Above

397. Many filamentous species have not even been given a scientific name yet. Consequently, in order to make the right kind of process modification, knowledge to identify them and experience with the process ecology are required. The potential for instability with ______________________is an acute problem when strict demands on treatment performance are in place.

A. Organic carbon
B. Activated sludge
C. Domestic wastewater
D. High BOD
E. Growth of filamentous bacteria
F. None of the Above

Other Wastewater Treatment Components
Biochemical Oxygen Demand

398. Biochemical Oxygen Demand (BOD or BOD5) is an indirect measure of ______________in water, and is determined by measuring the dissolved oxygen decrease in a controlled water sample over a five-day period.

A. Biodegradable organic compounds
B. Dissolved oxygen decrease
C. Sludge bulking
D. Bacteria and other microbes
E. Oxygen-demanding pollutants
F. None of the Above

399. In general, a ________________ reflects high concentrations of substances that can be biologically degraded, thereby consuming oxygen and potentially resulting in low dissolved oxygen in the receiving water.

A. Organic carbon
B. Human sources
C. Domestic wastewater
D. High BOD
E. Growth of filamentous bacteria
F. None of the Above

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

A. BOD
B. Dissolved oxygen decrease
C. Sludge bulking
D. Bacteria and other microbes
E. Oxygen-demanding pollutants
F. None of the Above

Organic Carbon

401. ____________in water occurs as partly degraded plant and animal materials, some of which are resistant to microbial degradation.

A. Most organic carbon D. High BOD
B. Human sources E. Growth of filamentous bacteria
C. Domestic wastewater F. None of the Above

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

A. An essential nutrient D. Detritus
B. Dissolved oxygen decrease E. Oxygen-demanding pollutants
C. Sludge bulking F. None of the Above

Total Organic Carbon

403. (TOC) bears a direct relationship with biological and chemical oxygen demand; high levels of TOC can result from human sources, the ___________________being the main concern.

A. Organic carbon D. High BOD
B. High oxygen demand E. Growth of filamentous bacteria
C. Domestic wastewater F. None of the Above

Topic 8- Nitrogen and Phosphorus Section

Nutrient Constituents in Wastewater and Measurement Methods

404. The major contributors of nitrogen to wastewater are _________________ such as food preparation, showering, and waste excretion.

A. Human activities D. Bacteria and other microbes
B. Dissolved oxygen decrease E. Oxygen-demanding pollutants
C. Sludge bulking F. None of the Above

405. The per capita contribution of nitrogen in domestic wastewater is about 1/5th of that for BOD. __________________in domestic wastewater typically ranges from 20 to 70 mg/L for low to high strength wastewater (Tchobanoglous et al., 2003).

A. Organic carbon D. High BOD
B. Total nitrogen E. Growth of filamentous bacteria
C. Domestic wastewater F. None of the Above

406. Factors affecting concentration include the extent of infiltration and the presence of industries. Influent concentration varies during the day and can vary significantly during rainfall events, as a result of_________________.

A. An essential nutrient D. Inflow and infiltration to the collection system
B. Dissolved oxygen decrease E. Oxygen-demanding pollutants
C. Sludge bulking F. None of the Above

The TKN method has three major steps:

407. Digestion to convert organic nitrogen to ____________________;

A. TKN D. Ammonium sulfate
B. Organic nitrogen E. Dissolved, biodegradable compounds
C. Aliphatic N compounds F. None of the Above

408. Conversion of _______________into condensed ammonia gas through addition of a strong base and boiling; and

A. Ammonia gas D. Ammonium sulfate
B. Effluent limits E. Domestic wastewater organic nitrogen
C. DON F. None of the Above

409. Measurement using colourimetric or titration methods. Because the measured concentration includes ammonia, the ___________________is subtracted from the TKN to determine organic nitrogen.

A. TKN D. Ammonium sulfate
B. Organic nitrogen E. Ammonia-nitrogen concentration
C. Aliphatic N compounds F. None of the Above

410. Nitrogen components in wastewater are typically reported on an "__________________" basis so that the total nitrogen concentration can be accounted for as the influent nitrogen components are converted to other nitrogen compounds in wastewater treatment.

A. Ammonia gas D. As nitrogen
B. Effluent limits E. Domestic wastewater organic nitrogen
C. DON F. None of the Above

411. WWTPs designed for nitrification and denitrification can remove 80 to 95 percent of_________________, but the removal of organic nitrogen is typically much less efficient.

A. TKN D. Ammonium sulfate
B. Organic nitrogen E. Iinorganic nitrogen
C. Aliphatic N compounds F. None of the Above

412. Domestic wastewater organic nitrogen may be present in particulate, colloidal or dissolved forms and consist of proteins, amino acids, _____________, refractory natural compounds in drinking water (e.g. Humic substances), or synthetic compounds (e.g. ethylene Diamine tetraacetic acid (EDTA)).

A. Ammonia gas D. Aliphatic N compounds
B. Effluent limits E. Domestic wastewater organic nitrogen
C. DON F. None of the Above

413. _______________ may be released in secondary treatment by microorganisms either through metabolism or upon death and lysis. Some nitrogen may be contained in recondensation products.

A. TKN D. Ammonium sulfate
B. Organic nitrogen E. Dissolved, biodegradable compounds
C. Aliphatic N compounds F. None of the Above

414. ____________________ by microorganisms releases some organic nitrogen as dissolved, biodegradable compounds.

A. Ammonia gas D. Hydrolysis of particulate and colloidal material
B. Effluent limits E. Domestic wastewater organic nitrogen
C. DON F. None of the Above

415. Amino acids are readily degraded during secondary biological treatment, with 90 to 98 percent removal in activated sludge systems and 76 to 96 percent removal in trickling filters. However, other forms of _____________ may be more persistent in wastewater treatment processes.
A. TKN D. Ammonium sulfate
B. Organic nitrogen E. Dissolved, biodegradable compounds
C. Aliphatic N compounds F. None of the Above

416. The importance of ________________has increased as effluent limits on nitrogen have become more stringent. With more impaired waterways from nutrient loads, effluent limits for total nitrogen
(TN) concentrations of 3.0 mg/L or less are becoming more common.
A. Ammonia gas D. Organic nitrogen
B. Effluent limits E. Domestic wastewater organic nitrogen
C. DON F. None of the Above

417. For systems without effluent filtration or membrane bioreactors (MBRs) that are trying to meet a TN treatment goal of 3.0 mg/L, the effluent ____________contribution can easily be 20 to 50 percent of the total effluent nitrogen concentration, compared to only about 10 percent for conventional treatment (Pehlivanoglu-Mantas and Sedlak, 2004).
A. TKN D. Ammonium sulfate
B. Organic nitrogen E. DON
C. Aliphatic N compounds F. None of the Above

418. The chemical composition of DON in wastewater effluents is not completely understood. Sedlak (2007) has suggested that only about 20 percent of the DON has been identified as free and combined amino acids, _______________, and other trace nitrogen compounds.
A. Ammonia gas D. EDTA
B. Effluent limits E. Domestic wastewater organic nitrogen
C. DON F. None of the Above

Phosphorus

419. __________in domestic wastewater typically ranges between 4 and 8 mg/L but can be higher depending on industrial sources, water conservation, or whether a detergent ban is in place. Sources of phosphorus are varied. Some phosphorus is present in all biological material, as it is an essential nutrient and part of a cell's energy cycle.
A. Phosphorus as phosphate D. Pyrophosphate and trimetaphosphate
B. Phosphorus E. Total phosphorus (TP)
C. Orthophosphate F. None of the Above

420. __________________ is used in fertilizers, detergents, and cleaning agents and is present in human and animal waste.
A. Phosphorus as phosphate D. Pyrophosphate and trimetaphosphate
B. Phosphorus E. Total phosphorus (TP)
C. Orthophosphate F. None of the Above

421. Polyphosphates are high-energy, condensed phosphates such as _______________. They are also soluble but will not be precipitated out of wastewater by metal salts or lime. They can be converted to phosphate through hydrolysis, which is very slow, or by biological activity.
A. Phosphorus as phosphate
B. Phosphorus
C. Orthophosphate
D. Pyrophosphate and trimetaphosphate
E. All biological material
F. None of the Above

422. __________________can either be in the form of soluble colloids or particulate. It can also be divided into biodegradable and non-biodegradable fractions. Particulate organically bound phosphorus is generally precipitated out and removed with the sludge. Soluble organically bound biodegradable phosphorus can be hydrolyzed into orthophosphate during the treatment process.
A. Phosphorus
B. Orthophosphate
C. Organic phosphorus
D. Organically bound phosphorus
E. Soluble organically bound non-biodegradable phosphorus
F. None of the Above

423. _____________will pass through a wastewater treatment plant. A typical wastewater contains 3 to 4 mg/L phosphorus as phosphate, 2 to 3 mg/L as polyphosphate, and 1 mg/L as organically bound phosphorus (WEF and ASCE, 2006).
A. Phosphorus
B. Orthophosphate
C. Organic phosphorus
D. Organically bound phosphorus
E. Soluble organically bound non-biodegradable phosphorus
F. None of the Above

424. Ion chromatography is a second common technique used to measure ____________ in wastewater. As with colourimetric methods, digestion is required for TP measurement, with persulfate digestion recommended (WEF and ASCE, 2006).
A. Phosphorus
B. Orthophosphate
C. Soluble colloids
D. Organic phosphorus
E. Total dissolved orthophosphate
F. None of the Above

Phosphorus Removal by Chemical Addition
Principles
425. To achieve removal, various coagulant aids are added to wastewater where they react with ______________to form precipitates. The precipitates are removed using a solids separation process, most commonly settling (clarification).
A. Phosphorus as phosphate
B. Phosphorus
C. Orthophosphate
D. Pyrophosphate and trimetaphosphate
E. Soluble phosphates
F. None of the Above

426. Chemical precipitation is typically accomplished using either ___________or a metal salt such as aluminum sulfate (alum) or ferric chloride. The addition of polymers and other substances can further enhance floc formation and solids settling. Operators can use existing secondary clarifiers or retrofit primary clarifiers for their specific purposes.
A. Oxygen
B. Carbon dioxide
C. Gravity
D. Secondary treatment
E. Lime
F. None of the Above

Nitrogen and Phosphorus Removal Technologies
Introduction

427. The actual technology selected will be site-specific and dependent on many factors including______________, influent water quality, required effluent levels, disposal options, availability of land, cost, etc. In some cases, a combination of technologies may be necessary to effectively remove all the contaminants of concern.

A. Soil conditions
B. Free water surface (FWS) systems
C. Oxygen
D. Conventional recirculation tank
E. Anaerobic septic tank effluent
F. None of the Above

428. Small system owners and operators should work closely with their state onsite and decentralized program staff as well as engineers to ensure that the technologies selected will work effectively in combination to achieve the __________________goals.

A. Effluent
B. Oxidation
C. Optimal DO levels
D. Trickling filter FFSs
E. A portion of the denitrified effluent
F. None of the Above

Nutrient Removal Technologies
Fixed-film systems - Aerobic/anaerobic trickling filter package plant

429. ______________________are biological treatment processes that employ a medium such as rock, plastic, wood, or other natural or synthetic solid material that will support biomass on its surface and within its porous structure (USEPA, 2008c).

A. Trickling filter(s)
B. Fixed-film systems (FFSs)
C. Nitrogen removal system(s)
D. Aerobic nitrification processes
E. Recirculating sand filters (RSFs)
F. None of the Above

430. _________________are typically constructed as beds of media through which wastewater flows. Oxygen is normally provided by natural or forced ventilation.

A. A closed loop
B. Nitrogen removal system(s)
C. Optimal DO levels
D. Trickling filter FFSs
E. A portion of the denitrified effluent
F. None of the Above

431. Commercial on-site systems use synthetic media and receive wastewater from overlying sprayheads for aerobic treatment and nitrification. ______________returns to the anoxic zone to mix with either septic tank contents or incoming septic tank effluent for denitrification.

A. Filamentous organisms
B. Floc particles
C. Organic material
D. Nitrified effluent
E. Biosurfactant trehalose
F. None of the Above

432. A portion of the ___________________is discharged for disposal or further treatment. Aerobic tanks are available in residential or small community sizes.

A. Ammonia oxidation
B. Phosphorus removal
C. Nitrate removal
D. Denitrified effluent
E. Oxygen demand of wastewater
F. None of the Above

433. Typical trickling filters systems currently available are capable of producing effluent _________________ concentrations of 5 to 40 mg/L.

A. Nitrified effluent
B. Nitrogen
C. Total Nitrogen (TN)
D. Nitrogen and phosphorus levels
E. BOD and TSS
F. None of the Above

434. Systems can be configured for single-pass use where the ___________________is applied to the trickling filter once before being disposed of, or for multi-pass use where a portion of the treated water is cycled back to the septic tank and re-treated via a closed loop.
A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness
B. TDS E. Treated water
C. pH F. None of the Above

435. Multi-pass systems result in higher treatment quality and assist in removing _______________ levels by promoting nitrification in the aerobic media bed and denitrification in the anaerobic septic tank.
A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness
B. TDS E. Total Nitrogen (TN)
C. pH F. None of the Above

436. Factors affecting performance include influent wastewater characteristics, hydraulic and organic loading, medium type, maintenance of optimal DO levels, and___________________.
A. Wildlife habitat D. Phosphorus-reduction system(s)
B. Recirculation rates E. Excessive sludge production
C. Denitrification F. None of the Above

Sequencing batch reactor (SBR)
437. The SBR process is a sequential suspended growth (activated sludge) process in which all major steps occur in the same tank in sequential order (USEPA, 2008d). The SBR system is typically found in packaged configurations for onsite and small community or ____________.
A. Decanter D. Cluster applications
B. Underdrain system E. Process control timer(s)
C. Sand filter(s) F. None of the Above

438. The major components of the package include the batch tank, aerator, mixer, decanter device, process control system (including timers), pumps, piping, and appurtenances. _______________may be provided by diffused air or mechanical devices.
A. Decanter D. Fixed-film bioreactor(s)
B. Sand filter(s) E. Aeration
C. Chemical adsorption F. None of the Above

439. _____________are often sized to provide mixing as well and are operated by the process control timers.
A. Underdrain system D. Conventional recirculation tank
B. Free water surface (FWS) systems E. Anaerobic septic tank effluent
C. SBRs F. None of the Above

440. Mechanical aerators have the added value of potential operation as mixers or aerators. The decanter is a critical element in the process. Several decanter configurations are available, including________________.
A. Fixed and floating units D. Septic tank effluent
B. Recirculating filter(s) E. Distribution network
C. Available adsorption sites F. None of the Above

441. The key to the _____________ is the control system, which consists of a combination of level sensors, timers, and microprocessors which can be configured to meet the needs of the system.
A. SBR process
B. Underdrain system
C. Sand filter(s)
D. Cluster applications
E. Process control timer(s)
F. None of the Above

442. ________________can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, in addition to removing TSS and BOD.
A. Trickling filter(s)
B. Oxidation Ditches
C. Nitrogen removal system(s)
D. SBRs
E. Recirculating sand filters (RSFs)
F. None of the Above

443. ___________________are suitable for areas with little land, stringent treatment requirements, and mall wastewater flows such as RV parks or mobile homes, campgrounds, construction sites, rural schools, hotels, and other small applications.
A. Package plant SBRs
B. Sand filter(s)
C. Chemical adsorption
D. Fixed-film bioreactor(s)
E. Diffused air or mechanical devices
F. None of the Above

Topic 9 - Disinfection Section

Reactivity
444. Conditions Contributing to Instability: Cylinders of chlorine may burst when exposed to elevated temperatures. When there is Chlorine in solution, this forms______________.
A. Hydrogen sulfide
B. Oxomonosilane
C. Ammonia
D. A characteristic pungent odor
E. A corrosive material
F. None of the Above

445. Incompatibilities: What is formed when chlorine is in contact with combustible substances (such as gasoline and petroleum products, hydrocarbons, turpentine, alcohols, acetylene, hydrogen, ammonia, and sulfur), reducing agents, and finely divided metals?
A. Exposure to chlorine
B. Odor thresholds
C. A corrosive material
D. Fires and explosions
E. Moisture, steam, and water
F. None of the Above

446. Chlorine reacts with hydrogen sulfide and water to form this substance?
A. Hydrogen sulfide
B. Oxomonosilane
C. Sodium Chloride
D. Chlorinates
E. Hydrochloric acid
F. None of the Above

447. According to the text, chlorine is also incompatible with ____________________.
A. Air
B. Ammonia
C. Sodium Chloride
D. Hydrogen sulfide
E. Moisture, steam, and water
F. None of the Above

Properties

448. In studying and _________________ -- compounds that have at least one atom of the element carbon in their molecular structure. All living organisms, including humans, are composed of organic compounds.

A. Synthesizing organic compounds
B. Chlorine disinfection compounds
C. Chlorine inorganic compounds
D. Organic compounds
E. Abundant chemical elements
F. None of the Above

449. This is a huge reservoir of dissolved chlorine weathered from the continents and transported to the oceans by Earth's rivers.

A. Brine
B. Sodium chloride
C. Ancient seawater
D. Useful chemical elements
E. Seawater
F. None of the Above

450. Chemical elements have their own set of unique properties and chlorine is known as _____________ so reactive, in fact, that it is usually found combined with other elements in the form of compounds.

A. Synthesizing organic compounds
B. A very reactive element
C. Chlorine compounds
D. Organic compounds
E. One of the most abundant chemical elements
F. None of the Above

451. This substance capable of removing a wide variety of disease-causing germs from drinking water and wastewater as well as from hospital and food production surfaces.

A. Inorganic disinfectant
B. Chlorine-based disinfectants
C. Ancient seawater
D. Useful chemical elements
E. Organic compounds
F. None of the Above

452. Various states of chlorine includes when chlorine is isolated as a free element, chlorine is a greenish yellow gas, which is___________.

A. 2.5 times heavier than water
B. 2.5 times lighter than air
C. 10 times heavier than air
D. 2.5 times heavier than air
E. 25 times heavier than air
F. None of the Above

Types of Residual

453. _____________ is all chlorine that is available for disinfection.

A. Chlorine residual
B. Chlorine demand
C. Free chlorine
D. Break-point chlorination
E. Total chlorine
F. None of the Above

454. Total chlorine residual = free +____________________________.

A. Chlorine residual
B. Chlorine demand
C. Free chlorine
D. Combined chlorine residual
E. Total chlorine residual
F. None of the Above

455. In water, there are always other substances (interfering agents) such as iron, manganese, turbidity, etc., which will combine chemically with the chlorine. This is called the_________________.

A. Chlorine residual
B. Chlorine demand
C. Pathogen reduction
D. Break-point chlorination
E. Total chlorine residual
F. None of the Above

456. According to the text, once chlorine molecules are combined with these interfering agents, they are not capable of disinfection. ______________ is much more effective as a disinfecting agent.
A. Chlorine residual D. Break-point chlorination
B. Chlorine demand E. Total chlorine residual
C. Free chlorine F. None of the Above

457. Either a total or a ___________can be read when a chlorine residual test is taken,
A. Chlorine residual D. Break-point chlorination
B. Chlorine demand E. Total chlorine residual
C. Free chlorine residual F. None of the Above

458. __________________ is a much stronger disinfecting agent. Therefore, most water regulating agencies will require that your daily chlorine residual readings be of free chlorine residual.
A. Free chlorine D. "CT" disinfection concept
B. Total residual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

459. ________________________ is where the chlorine demand has been satisfied, and any additional chlorine will be considered free chlorine.
A. Chlorine residual D. Break-point chlorination
B. Chlorine demand E. Total chlorine residual
C. Free chlorine F. None of the Above

Residual Concentration/Contact Time (CT) Requirements
460. Since monitoring for very low levels of pathogens in treated water is analytically very difficult, utilizing the ________________ is recommended to demonstrate satisfactory treatment.
A. Free chlorine D. "CT" disinfection concept
B. Total residual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

461. ______________ = Concentration (mg/L) x Time (minutes)
A. CT D. Total chlorine
B. The amount of chlorine E. pH value and temperature
C. Chlorine Demand F. None of the Above

462. The effective reduction in pathogens can be calculated by reference to standard tables of required ___________________.
A. Free chlorine D. "CT" s
B. Total residual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

Calculation and Reporting of CT Data
463. Reduction Ratio should be reported, along with the appropriate pH, temperature, and ________________.
A. Reduction Ratio D. Disinfectant residual
B. CT actual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

464. The ____________ must be greater than 1.0 to be acceptable.
A. Reduction Ratio D. "CT" disinfection concept
B. CT actual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

465. You can also calculate and record actual log reductions. Reduction Ratio = CT actual divide by ___________.
A. Reduction Ratio D. "CT" disinfection concept
B. CT E. CT required
C. Free chlorine residual F. None of the Above

466. This shall be calculated daily, using either the maximum hourly flow and the disinfectant residual at the same time, or by using the lowest CT value if it is calculated more frequently.
A. Free chlorine D. "CT" disinfection concept
B. Total residual E. Disinfection CT values
C. Free chlorine residual F. None of the Above

Chlorine Review
467. What term describes the minimum amount of Chlorine needed to react in a water purification system; used as a monitoring measurement by system operators?
A. Chlorine Demand D. Monitoring measurement
B. Liquid E. Ammonia or organic amines
C. Total chlorine F. None of the Above

468. Operator may add ________________ to chlorinated public water supplies to provide inorganic chloramines.
A. Combined chlorine D. Ammonia
B. Liquid E. Organic amines
C. Total chlorine F. None of the Above

469. What term describes the concentration of residual chlorine in water present as dissolved gas (Cl_2), hypochlorous acid (HOCl), and/or hypochlorite ion (OCl-)?
A. Chlorine Demand D. Total chlorine
B. Chlorine total E. Residual chlorine
C. Free Chlorine F. None of the Above

470. What term describes the concentration of chlorine in the water after the chlorine demand has been satisfied. The concentration is normally expressed in terms of total chlorine residual, which includes both the free and combined or______________________________.
A. Chlorine Residual D. Total chlorine
B. Chlorine Demand E. Residual chlorine
C. Combined F. None of the Above

471. What term describes the amount of chlorine used up in a water purification system; used as a monitoring measurement by system operators?
A. Chlorine Residual D. Total chlorine
B. Chlorine Demand E. Residual chlorine
C. Combined Chlorine Residual F. None of the Above

472. What term describes the residual chlorine existing in water in chemical combination with ammonia or organic amines which can be found in natural or polluted waters?
A. Chlorine Residual D. Total chlorine
B. Chlorine Demand E. Residual chlorine
C. Combined Chlorine Residual F. None of the Above

473. ___________________ of at least 1.0 mg/L should be maintained in the clear well or distribution reservoir immediately downstream from the point of post-chlorination and .2 mg/L in the distribution system to guard against backflow.
A. Chlorine Demand D. Total chlorine
B. Chlorine total E. Residual chlorine
C. Free chlorine residual F. None of the Above

474. What term describes the total of free residual and combined residual chlorine in a water purification system; used as a monitoring measurement by system operators?
A. Chlorine Demand D. Total combined chlorine
B. Chlorine total E. Residual chlorine
C. Total Chlorine Residual F. None of the Above

475. What term describes the total chlorine is essentially equal to free chlorine since the concentration of ammonia or organic nitrogen compounds will be very low? When chloramines are present in the municipal water supply, then total chlorine will be higher than free chlorine.
A. Chlorine Demand D. Total chlorine
B. Chlorine total E. Residual chlorine
C. Combined chlorine F. None of the Above

Common Terms
476. What is the best term that describes chlorine addition of chlorine at the plant headworks or prior to other water treatment or groundwater production processes and mainly used for disinfection and control of tastes, odours, and aquatic growth?
A. Chlorination D. Demand
B. Post-chlorination E. Pre-chlorination
C. Chlorine Demand F. None of the Above

477. What term best describes the sum of free and combined chlorine?
A. Organic amine(s) D. Breakpoint chlorination
B. Disinfection E. Total Chlorine
C. Free chlorine F. None of the Above

478. When chlorinating most potable water supplies, total chlorine is essentially equal to ________________since the concentration of ammonia or organic nitrogen compounds (needed to form combined chlorine) will be very low.
A. Chlorination D. Total chlorine
B. The amount of chlorine E. Free chlorine
C. Chlorine Demand F. None of the Above

479. What term best describes the residual chlorine existing in water in chemical combination with ammonia or organic amines which can be found in natural or polluted waters?
A. Combined chlorine D. Breakpoint chlorination
B. Disinfection E. Total chlorine residual
C. Free chlorine F. None of the Above

480. Ammonia is sometimes deliberately added to chlorinated public water supplies to provide_________________.
A. Chlorination D. Flavor
B. Inorganic chloramines E. Increase pH value
C. Chlorine Demand F. None of the Above

481. What term best describes the concentration of residual chlorine in water present as dissolved gas (Cl_2), hypochlorous acid (HOCl), and/or hypochlorite ion (OCl-)?
A. Organic amine(s) D. Breakpoint chlorination
B. Disinfection E. Total chlorine residual
C. Free chlorine F. None of the Above

482. What term best describes the minimum amount of chlorine needed to react in a water purification system; used as a monitoring measurement by system operators?
A. Chlorination D. Total chlorine
B. The amount of chlorine E. Disinfection
C. Chlorine Demand F. None of the Above

483. What term best describes the concentration of chlorine in the water after the chlorine demand has been satisfied?
A. Chlorine Residual D. Breakpoint chlorination
B. Disinfection E. Total chlorine residual
C. Free chlorine F. None of the Above

484. What term best describes the addition of chlorine after a process or adding chlorine downstream to meet a Demand in the system?
A. Chlorination D. Demand
B. Post-chlorination E. Pre-chlorination
C. Chlorine Demand F. None of the Above

485. Hook up the chlorinator to the container or cylinder with the chlorine valve turned off. Use the _________________not the liquid if using a 1-ton container.
A. Cylinder valve outlet cap D. Safety device
B. Cylinder valve E. Gas side
C. Yoke F. None of the Above

486. Check the valve face for damage after removing the _______________ and. Clean with wire brush if necessary. If the valve face is smooth, clean proceed with hooking up the cylinder.
A. Cylinder valve outlet cap D. Safety device
B. Cylinder valve E. Lead gasket
C. Yoke F. None of the Above

Chlorine's Effectiveness

487. Chlorination depends on the chlorine demand of the water, the concentration of the chlorine solution added, the time that ________________is in contact with the organism, and water quality.

A. Oxidizing chemical(s) D. Caustic soda
B. Chlorine E. Sodium and chlorine ions
C. Sodium F. None of the Above

488.___________ is less effective in cloudy (turbid) water.

A. Oxidizing chemical(s) D. Caustic soda
B. Chlorination E. Sodium and chlorine ions
C. Sodium F. None of the Above

489. ___________ is less effective as the water's pH increases (becomes more alkaline).

A. Chlorination D. Chlor-alkali membrane process
B. Caustic soda E. Required contact time
C. Chlorine ion F. None of the Above

490. When chlorine is added to the water supply, part of it combines with other chemicals in water (like iron, manganese, ___________) and is not available for disinfection.

A. Hydrogen sulfide, and ammonia D. Chlor-alkali membrane process
B. Caustic soda E. Required contact time
C. Chlorine ion F. None of the Above

Topic 10 - Authorizations to Deposit

Application

491. These Regulations apply in respect of a wastewater system that, when it deposits effluent via its final discharge point, deposits a deleterious substance prescribed in section 5 in water or a place referred to in subsection 36(3) of the Act and that

(a) is designed to collect an average daily volume of 100 m^3 or more of___________; or

A. Deposit D. An average daily volume of effluent
B. Effluent E. Final discharge point
C. Influent F. None of the Above

492. (b**)** during any calendar year, collects an average daily volume of 100 m^3 or more of ________________.

A. Deposit D. An average daily volume of effluent
B. Effluent E. Final discharge point
C. Influent F. None of the Above

Purpose

493. For the purpose of paragraph 36(4)(b) of the Act, an owner or operator of a wastewater system may deposit or permit the deposit of effluent that contains any of ___________________prescribed in section 5 via the final discharge point.

A. Deposit D. An average daily volume of effluent
B. Effluent E. The deleterious substances
C. Influent F. None of the Above

Definition of Deposit

494. A deposit, in relation to _______________, includes to permit the deposit of the effluent.

A. Deposit D. An average daily volume of effluent
B. Effluent E. Final discharge point
C. Influent F. None of the Above

Transitional Authorization

495. Any period of 12 consecutive months during the 15 months immediately before the day on which the application is made, if the________________________, during the previous calendar year in respect of that period of 12 consecutive months, an average daily volume of effluent via its final discharge point of

- **(i)** less than or equal to 17 500 m^3, for an intermittent wastewater system, or
- **(ii)** less than or equal to 2 500 m^3, for a continuous wastewater system with a hydraulic retention time of five or more days.

A. Deposit D. An average daily volume of effluent
B. Effluent E. Wastewater system deposited
C. Influent F. None of the Above

496. Any three consecutive months in any of those periods of 12 consecutive months, if the wastewater system deposited, during the previous calendar year in respect of that period of 12 consecutive months, an average daily volume of effluent via its final discharge point of

- **(i)** greater than 2 500 m^3 and less than or equal to 17 500 m^3, for a continuous wastewater system with a ________________retention time of five or more days, and
- **(ii)** less than or equal to 17 500 m^3, for any other continuous wastewater system;

A. Hydraulic D. An average daily volume of effluent
B. Effluent E. Final discharge point
C. Influent F. None of the Above

497. Any three months in any of those periods of 12 consecutive months, if the wastewater system deposited, during the previous calendar year in respect of that period of 12 consecutive months, an average daily volume of effluent via its ____________of greater than 17500 m^3.

A. Deposit D. An average daily volume of effluent
B. Effluent E. Final discharge point
C. Influent F. None of the Above

Conditions on Transitional Authorizations

498. A holder of a transitional authorization in respect of a wastewater system is authorized — during a given calendar year, quarter or month, determined in accordance with subsection 6(2), in the period of authorization — to deposit effluent that contains any of the deleterious substances prescribed in section 5 via the final discharge point if — during the previous calendar year, previous quarter or previous month — the effluent met the following conditions: the average carbonaceous biochemical oxygen demand due to the quantity of CBOD matter in the effluent referred to in paragraph 6(1)(a), determined in accordance with subsections 6(2) and (3), did not exceed 1.25 times the average determined for the carbonaceous biochemical oxygen demand due to the ________________referred to in subparagraph 25(1)(k)(i) or the greatest of those averages referred to in subparagraph 25(1)(k)(ii), as the case may be, if the product resulting from that multiplication is greater than 25 mg/L

A. Effluent D. Deleterious substances
B. Quantity of CBOD matter E. Average concentration of suspended solids
C. Total residual chlorine F. None of the Above

499. 1.25 times the average concentration of _______________referred to in subparagraph 25(1)(k)(i) or the greatest of those averages referred to in subparagraph 25(1)(k)(ii), as the case may be, if the product resulting from that multiplication is greater than 25 mg/L,

A. Effluent
B. Quantity of CBOD matter
C. Total residual chlorine
D. Deleterious substances
E. Suspended solids
F. None of the Above

Temporary Authorization to Deposit Un-Ionized Ammonia

500. The owner or operator of a wastewater system whose effluent deposited via its final discharge point is acutely lethal because of the _____________ in it may apply to an authorization officer for a temporary authorization to deposit effluent that contains un-ionized ammonia via the final discharge point if the concentration of un-ionized ammonia in the water.

A. Acute lethality of the effluent
B. Effluent
C. Ammonia
D. Concentration of un-ionized ammonia
E. Least two samples of effluent
F. None of the Above