Class 3 & 4 Exam

Choose the best answer

1. After making a change in the operation of a biological treatment process, how long does it take to properly evaluate whether the change was beneficial?

    a. One MCRT (mean cell residence time)
    b. Two to four days
    c. Two to three times the MCRT
    d. Until lab results are completed

2. What is affected first when the anaerobic digestion process is starting to deteriorate?

    a. Volatile Acids/Alkalinity ratio
    b. Temperature
    c. Supernatant quality
    d. Volatile solids concentration

3. In certain situations, a supervisor encourages the employees to make their own decision. This is considered to be:

    a. Against the rules to follow past experience in decision making
    b. Highly desirable because it encourages employee growth and frees the supervisor for other tasks
    c. Bad form because the supervisor eventually loses control
    d. Passing the buck

4. Generally, as an individual progresses upward in management, reliance on personal technical skill:

    a. Becomes more complex
    b. Decrease
    c. Increase
    d. Remains the same

5. The BOD in an aeration tank is oxidized in what order?

    a. Carbonaceous then nitrogenous
    b. Solid then soluble
    c. Nitrosomonas then nitrobacter
    d. Nitrogenous then carbonaceous

.

6. Chloramines are:

   a. Free chlorine
   b. Enzymes
   c. Found in polluted air
   d. Combined chlorine

7. If a pre-aerated grit chamber is aerated above design guidelines, the following will occur:

   a. More accumulation of organics in the grit
   b. Less accumulation of organics in the grit
   c. Distribution to the primary settling tanks will be upset
   d. An increase in dissolved oxygen will be detected

8. The purpose of adding sodium thiosulfate to a microbiological (such as fecal coliform) sample bottle is to:

   a. Extend the allowable holding time from 6 hours to 30 hours
   b. React with nitrates that interfere with the MPN test
   c. Remove any chlorine residual present
   d. Insure sterilization of sample bottle

9. Job specifications refer to:

   a. The functional elements of a position
   b. The information gained from employees who hold various positions
   c. The human qualities necessary to perform the job adequately
   d. The principal duties and functions of various jobs

10. What is the purpose of returned activated sludge (RAS)?

    a. To keep a biological population and to aerobically digest the sludge
    b. To keep the sludge blanket down in the secondary clarifier
    c. To increase the mixed liquor in the aeration tank
    d. To keep a biological population and re-aerate the microorganisms

11. Under which one of the following conditions should sludge wasting normally be increased?

    a. Mixed liquor settles to slowly
    b. Large pillows of white foam start forming on the aeration tank surface
    c. A dark brown scummy foam appears on the aeration tank surface
    d. All of the above

.

12. During the past month at your plant the SVI has continually decreased. The suspended solids in the effluent are increasing and the CBOD of the effluent is below 10 mg/L. What should you do?

    a. Increase RAS
    b. Decrease RAS
    c. Increase WAS
    d. Decrease WAS

13. Which of the following causes the greatest friction loss in a pipe?

    a. Decreasing the rate of flow
    b. Increasing the temperature of the wastewater
    c. Increasing the velocity of the wastewater
    d. Decreasing the pressure

14. What microscopic organisms will be found in a stable activated sludge process?

    a. Flagellates and amoeboid organisms
    b. Flagellates and free swimming ciliates, but no stalked ciliates or rotifers
    c. Free swimming and stalked ciliates and rotifers
    d. Nematodes, rotifers, ciliates, flagellates and amoeboids

15. The ash content is the same as which of the following?

    a. Difference in raw sludge and the sludge after air drying
    b. Inorganic solids
    c. Organic solids
    d. Volatile solids

16. What is the purpose of a zoogleal mass on a fixed growth secondary process?

    a. To filter the suspended solids
    b. To add dissolved oxygen to the wastewater
    c. To oxidize the BOD
    d. To filter the BOD out of the system

17. What are the end products of the aerobic biochemical reaction?

    a. H_2O and CO_2
    b. H_2O and CH_4
    c. CH_4 and CO_2
    d. Organic acids

.

18. How can you tell if a new pump is delivering design flows and pressures?

    a. Check the information printed on the nameplate
    b. Review several months' records and look for sudden flow variations
    c. Prepare your own pump curve from delivered flow and pressure data
    d. Measure the flows and pressures and compare with manufacture's pump curve

19. Pump packing should be:

    a. Changed every week
    b. Tightened down to a drip
    c. Greased when smoke is detected
    d. Tightened to where there is no leakage

20. The fusible plug that is in all chlorine cylinders:

    a. Should be removed after the cylinder is emptied
    b. May be used as a top for the chlorine source
    c. Is used as an electrical connection for evaporating coils
    d. Should never be removed or tampered with

21. A piston or a diaphragm pump would be used for pumping:

    a. Primary sludge
    b. Raw wastewater
    c. Final effluent
    d. Activated sludge

22. Collection system variables that could upset an activated sludge process include:

    a. Activities of collection system maintenance crew
    b. Chlorination of return sludge flows
    c. Recycling a digester supernatant
    d. Decrease in influent flow

23. After sludge has been applied to the drying bed, the sludge draw-off line should be:

    a. Cleaned out and left open at one end to allow gas to escape
    b. Closed and sealed tightly to keep out rodents and insects
    c. Filled with treated plant effluent
    d. Left filled with sludge and closed at both ends.

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24. The most commonly found scaling problem in an anaerobic digester is:

a. Calcium carbonate
b. Sodium chloride
c. Magnesium ammonium phosphate
d. Calcium ammonium phosphate

25. The supervisor is responsible for the management of resources of all types, but the supervisor's most important task is the proper utilization of _____.

a. Finances
b. Equipment
c. People
d. Energy

26. Which of the following is a method for treating flow to the primary settling tank that would increase grease removal efficiency of that unit?

a. Lower the pH to less than 7
b. Increase the temperature of the wastewater
c. Add activated silica
d. Preaerate

27. What 2 factors indicate that a filter press cycle is completed?

a. Small filtrate discharge; increased pump pressure
b. Increased filtrate discharge; increased pump pressure
c. Small filtrate discharge; decreased pump pressure
d. Small filtrate discharges; near constant pump pressure

28. The most critical criterion for determining when a mixed media filter should be backwashed is:

a. Head loss
b. Flow rate
c. Filter effluent quality
d. Visual inspection of the filter surface

29. If the filter cake on a vacuum filter develops cracks just before it reaches the end of the drying zone, this indicates what?

a. The vacuum is too high
b. The filter is operating well
c. The sludge is not properly conditioned
d. The drum speed should be decreased

.

30. What problems can develop if to much grease is used in lubricating an electric motor?

a. The motor will spin backward
b. Heat will be generated
c. It may cause brush wear
d. It may cause bearing problems or damage the windings

31. From a public health standpoint, which of the following is the safest sludge for solid conditioning purposes?

a. Sludge dewatered on sand filters or vacuum filters
b. Liquid raw sludge
c. Heat dried sludge
d. Liquid digested sludge

32. The major purpose of an inlet baffle in a settling tank is to:

a. Reduce velocity and disperse flow
b. Increase velocity to prevent excessive settling near the inlet
c. Remove scum from the wastewater
d. Protect the scraping mechanism from damage by excessive velocities

33. The COD test

a. Estimate the nitrification oxygen demand only
b. Provide results quicker than BOD test
c. Measure the biochemical oxygen demand
d. Measure the carbon oxygen demand
e. Estimate the total oxygen consumed

34. Which of the following data is not needed to evaluate vacuum filter performance?

a. Filter size
b. Percent volatile solids of sludge feed
c. Percent total solids of sludge feed
d. Amount of chemical used

35. As a digester approaches "sour" condition:

a. Alkalinity of solids decrease
b. Concentration of volatile acids increase
c. Amount of methane production decrease
d. All of the above

.

36. The concentration of volatile solids in the feed sludge to a digester is an indirect measure of the:

a. Amount of sample that will evaporate when standing
b. "Food" available for bacteria in the digester
c. Number of bacteria in the digester
d. Primary effluent suspended solids

37. A chlorine demand test will show the:

a. Safe amount of chlorine that may be fed without killing the fish
b. Number of pounds of chlorine that may be fed without killing the fish
c. Amount of chlorine required to give the desired residual after a given time
d. Amount of chlorine required to satisfy the biochemical oxygen demand

38. The most important rule in flow meter maintenance is:

a. The instruments must be kept clean and in good working conditions
b. Operators should review prints and specifications for pumping facilities
c. Check for foreign objects fouling the system
d. Change meters on a regular basis

39. The chemicals that are added to distilled water for the BOD test serves what purpose?

a. Assure the presence of DO at all times
b. Increase thermal conductivity of the solution
c. Adjust the pH within the desirable range and provide essential elements for the growth of the biological life actually exerting the oxygen demand
d. Satisfy the natural oxygen demand that might exist in the sample

40. An operator runs a Winkler by the azide modification of the Winkler method. He runs out of standard sodium thiosulfate. Which reagent can be used instead?

a. Calcium hypochlorite
b. Phenylarsenine oxide
c. Sodium bicarbonate
d. Ferrous ammonium sulfate

41. The type of fire extinguisher in a pumping station should be:

a. All-purpose A-B-C chemical type fire extinguisher
b. Liquid type fire extinguisher
c. Solids material fire extinguisher
d. Power overload type

.

42. Insensitivity to hydrogen sulfide gas odor is caused by:

a. Lower concentration of the gas in the air
b. Higher concentration of the gas in the water
c. Paralysis of the olfactory nerve responsible for odor detection.
d. All of the above

43. Staffing a new treatment plant should be viewed primarily as the responsibility of the:
a. Personnel department
b. Supervisory management
c. Employee
d. Every operator

44. A benefit of using fixed film reactors is that:

a. Temperature variations do not influence performance of process
b. Odors are not a problem
c. Snails help degrade organic matter
d. Biomass is visible to the operator

45. Which activated sludge process could handle shock loads of dairy waste most effectively?

a. High rate activated sludge
b. Tapered aeration
c. Step feed
d. Conventional activated sludge

46. Which of the following can cause foaming in the anaerobic digesters?

a. Nocardia
b. Fluctuating temperature
c. Inadequate mixing
d. All of the above

47. Which of the following sets of characteristics describe a good quality of activated sludge?

a. Good settling characteristics, some dissolved oxygen present, and brown in color
b. Brown color, high in ammonia and BOD
c. Black color, very small particles, that do not settle, and a musty odor
d. Zero dissolved oxygen content, brown color, and good gas production

.

48. How does breakpoint chlorination remove ammonia?

a. By breaking down the ammonia
b. By oxidizing the ammonia-nitrogen to nitrogen gas
c. By producing alkaline conditions
d. By removing the nitrifying bacteria

49. Possible techniques for controlling filamentous organisms in an activated sludge process include

a. Dosage of return sludge with oxidants such as hydrogen peroxide or chlorine
b. Lower DO levels in aeration bans so filamentous organisms can not breathe or respire
c. Lower F/M level to starve filamentous organisms
d. Stop wasting to allow activated sludge bugs to gain control

50. The best water quality indicator to monitor the enhanced nitrogen oxidation process is:

a. Alkalinity.
b. MLSS.
c. pH
d. Temperature

51. Low sulfonator injector vacuum reading could be caused by:

a. Low back pressure
b. Missing gasket
c. Low flow of injector water
d. Wrong orifice

52. RCRA was established to:

a. Prevent wastewater from being discharged into receiving body water
b. Encourage recycling
c. Protect federal land
d. Classify hazardous waste

53. The temperature versus DO relationship is:

a. The higher the temperature, the higher the DO
b. The lower the temperature, the higher the DO
c. There is no relationship between DO and temperature
d. The lower the temperature, the lower the DO

.

54. An increasing F/M ratio and decreasing MCRT indicates:

a. Excessive solids wasting causing a decrease in solids inventory
b. Inadequate solids wasting causing an increase in the solids inventory
c. Decreased hydraulic load increasing the sludge detention time
d. Operation is normal

55. High-rate anaerobic digestion refers to the fact that the organic waste material is applied to an anaerobic reactor at high _____ loading rates.

a. Gravimetric
b. Hydraulic
c. Volumetric
d. Organic

56. On a large scale which is the best method for removing ammonia nitrogen from wastewater?

a. Trickling filter
b. Activated sludge
c. Breakpoint chlorination
d. Ion exchange

57. An increase in plant effluent coliform level could be caused by:

a. Short circuiting in contact chamber
b. A decrease in effluent BOD
c. High chlorine residual
d. Lack of solids in contact chamber

58. A belt filter press is processing secondary sludge. Some of the sludge is squeezing out from between the belts and contaminating the effluent by falling out into the filtrate trays. How could this problem be corrected?

a. Chlorinate the effluent
b. Build baffles around the belt
c. Blend primary sludge with the secondary sludge
d. Filter the effluent
e. Move the filtrate trays

59. One of the greatest advantages of a complete mix activated sludge system is:

a. It is capable of absorbing sudden shock loads without losing equilibrium.
b. The aeration tanks may be designed in any convenient shape or size to fit the available area.
c. Less air is required than in conventional aeration.

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60. Which of the following is not one of the four important physical variables that control the performance of a wet air oxidation unit?

a. Temperature
b. Type of sludge
c. Air supply
d. Feed solids concentration
e. Pressure

61. When operating a multiple hearth incinerator, the formation of carbon monoxide, soot, and odorous hydrocarbons in the stack are:

a. Typical for this type of unit
b. Due to improper temperature
c. A symptom of scrubber malfunction
d. A symptom of inadequate air or oxygen supply

62. Ozone is a good disinfectant because

a. It is cheap and easy to produce
b. Small amounts can kill any bacteria
c. It forms less carcinogenic compounds when it reacts with wastewater than other disinfectants
d. It has a metallic odor

63. The principal difference between step-feed aeration and conventional aeration is that in step-feed aeration the incoming waste load is introduced in slugs at the tank entrance.

a. True
b. False

64. The height or energy of water above a point is commonly referred to as the:

a. Flow
b. Pressure
c. Distance
d. Head

65. Surface- active agents can cause:

a. Slippery surfaces
b. Bulking
c. Super floc agents that cause the sludge to be to thick to pump
d. Filamentous bacteria

.

66. Which of the following factors could cause a demand for more oxygen in an aeration tank?

a. Increase in pH
b. Increase in microorganisms
c. Increase in inert or inorganic wastes
d. Increase in toxic substances

67. Categorical regulations apply to:

a. Specific pollutants
b. Industries with specific flows
c. Discharges to surface waters only
d. Specific industrial groups

68. Which is not an example of a velocity flow meter

a. Parshall flume
b. Propeller
c. Pitot tube
d. Magnetic

69. Why does some of the suspended material in wastewater fail to be removed by setting in 1 hour?

a. Because it takes 1.5 hours to settle
b. Because it is lighter than water
c. Because it's specific gravity is very close to that of water and it is so small in size
d. Because it is attached to fine air bubbles

70. What kind of sludge is air flotation typically used to handle?

a. Primary sludge
b. Waste activated sludge
c. Digested sludge
d. Trickling filter sludge

71. The most abundant pollutant entering natural bodies of water (river, lakes, etc.) is:

a. Domestic waste
b. Food processing waste
c. Non-point source
d. Hospitals

.

72. Responsibilities of pretreatment facility inspectors include:

a. Coordinating compliance efforts with industries
b. Determining if a pretreatment facility is being properly operated and maintained
c. Enforcing rules and regulations
d. All of the above

73. The liquid drained from a blacktop drying bed is normally piped to the:

a. Primary clarifier
b. Aeration basin.
c. Chlorine contact basin
d. Secondary clarifier

74. The most important factor used to determine the number of samples to be collected is the:

a. Discharge limits of waste being monitored
b. Purpose for the sampling
c. Flow characteristics of wastestream
d. Wastewater characteristics

75. The basis for all compliance and enforcement activities taken by POTWs against industrial users in violation of pretreatment standards and requirements is information:

a. Produced by industrial self-monitoring activities
b. Provided by concerned citizens
c. Collected during inspections and monitoring activities
d. Developed by newspaper investigative reporters

76. In dissolved air floatation thickeners, floated solids are kept out of the effluent by use of:

a. Hardware cloth screens
b. Effluent baffles
c. Scum scrapers
d. Water sprays

77. How many persons are required to enter a manhole?

a. 1
b. 2
c. 3
d. 4

.

78. If the volatile acids/alkalinity ratio is increasing and the pH is dropping, which of the following should be done?

a. Decrease the raw sludge feed to the digester
b. Increase the raw sludge feed to that digester
c. Increase the digester-loading ratio
d. Both a and c
e. Both b and c

79. What information must be on a warning tag attached to a switch that has been locked out?

a. Directions for removing tag
b. Time to unlock switch
c. Signature of person who locked out switch and who is authorized to remove tag
d. Name of nearest physician to call in case of emergency

80. Return activated sludge flow rate may be adjusted or controlled by which of the following?

a. Food/Microorganism ratio
b. SVI approach
c. Mean Cell Residence Time (MCRT)
d. Sludge Age

81. A plant operated at a longer MCRT of _____ days will produce a nitrified effluent.

a. Over 40
b. 20 to 25
c. 25 to 30
d. 15 to 20

82. The primary element in a control system is also called a:

a. Sensor
b. Controller
c. Receiver
d. Transmitter

.

83. Denitrification in the secondary clarifier in an activated sludge system indicates:

a. Sludge withdrawal is to fast
b. Septic conditions
c. Sludge withdrawal is to slow
d. The clarifier is working properly

84. Sludge blanket depths may be measured by the use of:

a. Ultrasonic transmitters and receivers
b. Floats connected to cables and pulleys
c. Bubbler tubes
d. A hose and an aspirator

85. When collecting a fecal sample, it should be

a. A grab sample preserved with copper sulfate
b. A composite sample preserved with copper sulfate
c. A grab sample preserved with sodium thiosulfate
d. A composite sample preserved with sodium thiosulfate

86. The presence of white pillowing foam on an aeration tank indicates:

a. The aeration tank is loaded hydraulically
b. The aeration tank is overloaded organically
c. The aeration tank is underloaded organically
d. None of the above

87. The correct amount of chemical used to remove turbidity is known as the:

a. Coagulation range
b. Optimum dosage
c. Efficiency range
d. Combination

88. In order, what are the top three injuries in wastewater?

a. Face, feet and back
b. Back, leg and hand
c. Back, hand and face
d. Hand, back and leg

.

89. In order to get coagulation to proceed, a chemical change process must occur which is called

a. Precipitation
b. Destabilization
c. Flocculation
d. Brownian

90. Calculate the BOD for a sample volume of 15 mL. The initial DO is 8.0 mg/L. the 5 day DO is 6.0 mg/L. The seed correction is 1.2 mg/L

a. 1.6 mg/L
b. 12 mg/L
c. 16 mg/L
d. 1.2 mg/L

91. Determine the reduction percent of volatile solids as a result of digestion when the raw sludge is 66% volatile solids and the digested sludge is 52% volatile solids.

a. 21%
b. 44%
c. 54%
d. 50%

92. What is the surface loading rate for a circular clarifier with a diameter of 50 ft and a depth of 8 ft? The flow is 0.9 MGD.

a. 300 GPD/A_2
b. 500 GPD/A_2
c. 459 GPD/A_2
d. 600 GPD/A_2

93. For a plant with the information below, if the target MCRT was 6 days, determine the amount of WAS in pounds per day:
MLSS 6,465 lbs SS lost in effluent 267 lbs/day Flow 2 MGD

a. 1,078 lbs/day
b. 811 lbs/day
c. 1000 lbs/day
d. 89 lbs/day

.

94. What is the sludge age if the aeration tank volume is 0.5 MG, the MLSS is 1,800 mg/L, the primary effluent suspended solids is 110 mg/L and the flow is 2.0 MGD?

a. 2 days
b. 3 days
c. 3.5 days
d. 4 days

95. Calculate the volume of seed sludge in gallons needed for a 50 ft diameter digester with a normal water depth of 18 feet if the seed sludge required is estimated to be 20 percent of the digester volume.

a. 530,000 gallons
b. 53,000 gallons
c. 147 gallons
d. 353 gallons

96. A circular clarifier with a diameter of 50 feet and a depth of 10 feet treats a flow of 2 MGD. What is the detention time in hours?

a. 2 hours
b. 1.8 hours
c. 3 hours
d. 1 hour

97. A trickling filter 80 feet in diameter and 4 feet deep treats a flow of 2.4 MGD with a BOD of 120 mg/L. What is the organic loading weight in lbs/day/1,000 A_3?

a. 120 lbs BOD/day/1,00 cu ft
b. 12.0 lbs BOD/day/1,00 cu ft
c. 24 lbs BOD/day/1,00 cu ft
d. 1200 lbs BOD/day/1,00 cu ft

98. A wet well is 10 ft long and 10 ft wide. If it takes 10.5 minutes to lower the well 5 ft, What is the pumping rate GPM?

a. 35.7
b. 357
c. 400
d. 110

.

99. To maintain satisfactory chlorine residual in a plant effluent, the chlorine must be 10 mg/L when the flow is 0.37 MGD. Determine the chlorine setting feed rate in pounds per day.

a. 28 lbs/day
b. 31 lbs/day
c. 3.1 lbs/day
d. 2.8 lbs/day

100. Polymer is supplied to your plant at a concentration of 0.6 pound polymer per gallon. The polymer feed pump delivers a flow of 0.12 GPM and the flow being treated is 2,500 GPM. What is the polymer dose in mg/L in the water being treated?

a. 345 mg/L
b. 34.5 mg/L
c. 3.45 mg/L
d. 35.6 mg/L

.

Answers
Class 3 & 4

1.	c	44.	d	87.	b
2.	a	45.	c	88.	b
3.	b	46.	d	89.	a
4.	b	47.	a	90.	c
5.	a	48.	b	91.	b
6.	d	49.	a	92.	c
7.	b	50.	a	93.	b
8.	c	51.	c	94.	d
9.	d	52.	d	95.	b
10.	d	53.	b	96.	b
11.	c	54.	a	97.	a
12.	c	55.	c	98.	b
13.	c	56.	b	99.	b
14.	c	57.	a	100.	c
15.	b	58.	c		
16.	c	59.	a		
17.	a	60.	b		
18.	b	61.	d		
19.	b	62.	c		
20.	d	63.	b		
21.	a	64.	d		
22.	a	65.	c		
23.	a	66.	b		
24.	c	67.	d		
25.	c	68.	d		
26.	d	69.	c		
27.	a	70.	b		
28.	c	71.	c		
29.	b	72.	d		
30.	c	73.	a		
31.	c	74.	b		
32.	a	75.	c		
33.	b	76.	b		
34.	b	77.	c		
35.	d	78.	b		
36.	b	79.	c		
37.	c	80.	b		
38.	a	81.	a		
39.	c	82.	a		
40.	b	83.	c		
41.	a	84.	a		
42.	c	85.	c		
43.	a	86.	c		

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CLASS III AND CLASS IV – FALL 2008

Activated Sludge

Discuss the flow path for oxidation ditches.

Describe the types of package plant treatment processes.

Describe microorganisms of importance in the activated sludge processes.

What are the desirable microorganisms in the activated sludge processes?

Describe the term “endogenous respiration” in the aerobic biological processes.

Discuss the wasting of activated sludge.

Describe the variations of the activated sludge process.

Explain the term “mean cell residence time” (MCRT).

Study the glossary on activated sludge.

Describe the activated sludge process.

Study the design criteria for an oxidation ditch.

Describe the impact of various wastewater discharges to the POTW.

Explain the process changes necessary to meet an upset condition of activated sludge plants.

Discuss the problem of foaming in activated sludge plants.

Explain the rising sludge problems in an activated sludge plant

Describe troubleshooting methods for the activated sludge processes.

Describe the various modes of operation of the activated sludge processes.

Discuss the interpretation of microscopic study of the mixed liquor suspended solids.

Discuss comparing the microscopic results with laboratory process data in an activated sludge plant.

Discuss process changes in an activated sludge plant.

Describe the control methods of return activated sludge.

Discuss the operation strategy for high organic waste loads in an activated sludge plant.

Discuss ammonia removal by breakpoint chlorination.

Discuss nitrogen as a nutrient in a stream.

Describe the different types of nitrogen removal systems.

Describe nitrification.

Discuss denitrification.

How does breakpoint chlorination work in ammonia reduction?

Discuss the ion exchange method of nitrogen removal.

Describe the overland flow system of nitrogen removal.

Discuss the equipment necessary for nitrification.

Describe nitrification using suspended growth reactors.

Compare five types of suspended growth nitrification processes.

Discuss daily operation of the suspended growth denitrification system.

Describe the chemical reaction of the denitrification process.

Discuss the flow sheet of a nitrification-denitrification activated sludge system.

Describe the operation of ammonia stripping from wastewater.

Describe the necessary controls for the breakpoint chlorination method of ammonia reduction.

Study the troubleshooting guide for nitrification systems.

Chemical-Physical Treatment

Discuss the need to remove solids from secondary effluent.

Describe polymeric flocculants.

Describe the use of microscreens.

Describe the use of ultraviolet lights for a microscreen.

Discuss the operational strategy of the microscreening process.

Describe a rapid sand filter system.

Explain the backwashing process of a rapid sand filter.

Discuss surface straining and depth filtration in a rapid sand filtration process.

Discuss the selection of filter media in a rapid sand filter system.

Describe the term 'scouring' in regards to filter media in a rapid sand filter system.

Discuss headloss in a rapid sand filter system.

Describe the normal operation of a rapid sand filter.

Discuss the operational strategy of a rapid sand filter.

Discuss the troubleshooting of a rapid sand filter system.

Discuss phosphorus as a nutrient.

Discuss the types of phosphorus removal systems.

Describe the process of luxury uptake.

Describe a phosphorus stripping tank.

Discuss safety in the luxury uptake phosphorus removal system.

Disinfection

Describe the term “chlorine requirement” in wastewater disinfection.

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Discuss the effectiveness in microorganism removal by various treatment processes.

Discuss the use of hypochlorite components for disinfection.

Describe the chlorine solution discharge lines.

Discuss the term "compound loop control" in wastewater disinfection by chlorine.

Describe the installation and the maintenance routines of chlorination facilities.

Describe seven basic methods of chlorinator control.

Discuss an operators response to exposure to sulfur dioxide.

Describe the sulfonator parts.

Review the troubleshooting guide for a gas sulfonator system.

Discuss the need of dechlorination.

Describe the term "disinfection.".

Describe the reaction of chlorine in wastewater.

Discuss the use of chlorine dioxide in wastewater disinfection.

Discuss the reaction of chlorine with inorganic reducing materials.

Describe the reaction of chlorine with ammonia.

Explain the factors influencing disinfection by chlorine.

Describe a preventive maintenance program for chlorination hazards.

Discuss the safe handling of chlorine cylinders.

Discuss the operation of a chlorinator.

Discuss chlorine injector water supply.

Describe the use of chlorine for odor control.

Describe the chemical reaction of sulfur dioxide with wastewater.

Discuss the method of detection of residual sulfur dioxide.

Describe the term 'ultraviolet irradiation' for disinfection.

What variables affect the efficiency of ultraviolet (U.V.) disinfection?

Describe the elements of a process control system available in ultraviolet disinfection.

Discuss preventive maintenance of an ultraviolet disinfection system.

Describe the equipment used in ultraviolet disinfection.

Fixed Film

Describe the troubleshooting methods for the operation of a trickling filter plant.

Describe the operational troubleshooting methods of rotating biological contactors (RBCs).

Describe how to identify problems in a rotating biological contactor (RBC) by observation of the media.

Explain the principles of operation of a trickling filter plant.

How are trickling filters classified?

Discuss the responses to poor trickling filter performance.

Describe the daily operational procedures of a trickling filter.

Discuss ponding in a trickling filter.

Discuss odor problems from a trickling filter operation.
Describe filter fly problems in a trickling filter.

Describe the operational process of a rotating biological contactor.

Discuss the loading calculation on a rotating biological contactor.

Laboratory, Sampling & Monitoring

Discuss the use of a spectrophotometer.

Describe laboratory safety.

Discuss personal hygiene in the laboratory.

Describe accident prevention in a laboratory.

Discuss representative sampling.

Compare the types of samples.

Discuss the preservation of samples (i.e. BOD, ammonia, solids, pH, and metal testings).

Describe the testing method for settleable solids.

Discuss the determination of total sludge solids.

Compare the settleability test and the settleable solids test.

Describe the determination of sludge age.

Explain the determination of dissolved oxygen in an aerator.

Discuss the determination of mean cell residence time (MCRT).

Discuss the determination of volatile acids for anaerobic digesters.

Discuss the determination of total alkalinity for an anaerobic digester.

Describe the determination of supernatant solids for an anaerobic digester.

Describe the COD determination methods.

Discuss the determination of coliform group bacteria.

Discuss the D.O. measurement by the Winkler method and the D.O. probe.

WASTEWATER OPERATOR EXAMINATION STUDY GUIDE
CLASS III AND CLASS IV – FALL 2008

Describe the methods of BOD measurement and know what samples should be seeded.

Discuss the measurement of pH.

Describe the determination of metals in wastewater.

Explain nitrogen in wastewater and its determination.

Discuss the determination of ammonia nitrogen using an ion-selective electrode.

Discuss the method of oil and grease determination.

Discuss the determination of phosphorus in wastewater.

Discuss the determination of surfactants.

Describe the determination total organic carbon (TOC).

Know the glossary of laboratory terms.

Define a molar solution

Understand the term“oxidation-reduction” reaction.

Discuss the importance of effluent disposal.

Explain the treatment requirements of wastewater.

Describe the monitoring D.O. in receiving waters.

Describe types of receiving waters other than streams and rivers.

Discuss the need for analyzing and presenting data.

Describe the average or arithmetic mean of data.

Describe the range of values of collected data.

Discuss the geometric mean.

Describe the terms 'variance', 'standard deviation', and 'mode'.

Explain how one decides how many samples need to be collected.

Discuss who will analyze the samples after collection.

Discuss what kind of sample containers will be used.

Discuss the collection of a representative sample of an industrial wastewater source to public sewers.

Describe three types of samples.

Maintenance

What is "water hammer"?

Describe centrifugal pumps.

Describe progressive cavity pumps.

Explain the methods to clean scum lines.

Discuss maintenance of plant tanks and channels.

Describe trouble shooting of malfunctioning meters.

Management

How is "management" defined and what are the three broad areas of management control?

What does "good management" begin with?

What does the management function entail?

Describe the common type of management plan used in a treatment plant.

In management, how can "directing" be defined?

Discuss the need and method of public communication for a wastewater plant manager.

How is an emergency operating plan developed?

Discuss the financial management of a wastewater treatment plant..

What should be included in a good maintenance management system of a wastewater treatment plant?

Preliminary Treatment

Discuss the safety hazards around bar screens and racks.

What is the function of grit channels?

Discuss the basics of flow measurement.

Describe the use of a float in the flow measurement of an open channel.

How does a bubbler system work in flow measurement?

Discuss electromagnetic flow meters.

Discuss turbine and propeller type flow meters.

Describe ultrasonic flow meters in a closed pipe.

Describe open-channel flow measurement.

Describe flow measurement by weirs.

Explain the use of dipping probes in the flow measurement.

Describe a capacitance probe in flow measurement.

State methods of checking the accuracies of open channel flow meters.
Explain the use of pitot tubes.

What are velocity modified flow meters?

Pretreatment

Describe U.S. EPA's general pretreatment regulations relative to delegation of federal authority.

What is regulated under the general pretreatment regulations?

What are the categorical pretreatment standards?

What is TTO and how should it be sampled?

What is the general pretreatment regulation?

What is an Enforcement Response Guide (ERG)?

Safety & Emergency Response

Discuss safety in a confined space.

Discuss the safety hazards due to oxygen deficiency.

Describe the safety measures in the operation of anaerobic digesters.

What are amines?

Discuss the effect of surface-active agents at a wastewater treatment plant.

Discuss "tailgate" safety meetings.

Discuss the paper work which is important in developing your safety program.

Discuss safety equipment and supplies needed.

Discuss Material Safety Data Sheets (MSDSs).

Describe the atmospheric hazards of confined spaces.

Define "confined space".
What toxic gases may be encountered in the wastewater field.

Can hydrogen sulfide gas be always detected by smell? If not, what is the reason?

Describe flammable/explosive gas.

Discuss the hazard of an oxygen deficient atmosphere.

What precautions are needed in entering a confined space?

What hazardous materials may be encountered during inspection and sampling?

What corrosive materials may be encountered at wastewater treatment plants?

Discuss the infection agents which can be found at a wastewater treatment plant.

Describe the types of physical hazards encountered during sampling and inspection.

Describe safety regulations and OSHA.

Discuss the type of flammable material discharged to the sewer from industries.

Discuss emergency planning.

Discuss the identification of spilled matter.

Discuss the control of spilled matter in sewer.

Describe the POTW process changes during an emergency spill..

Discuss the initial response procedures during an emergency spill.

What steps must be taken in reporting a spill?

Sedimentation

Discuss troubleshooting of sedimentation tanks.

Describe the principle and function of a primary clarifier.

Discuss the secondary clarifiers for the activated sludge process.

Describe the flotation processes.

Discuss typical clarifier efficiencies.

Compare the loading rates of trickling filter clarifiers with primary clarifiers.

Solids Treatment & Handling

Discuss the purpose of anaerobic sludge digestion.

Explain how anaerobic digestion works.

Describe the components of an anaerobic digester system.

Explain the function of a floating cover on an anaerobic digester.

Describe the function of flame arresters in an anaerobic digester system.

Describe sediment traps in an anaerobic digester system.

Discuss a waste gas burner in an anaerobic digestion system.

Discuss mixing of an anaerobic digester.

Describe the component parts of a floating cover for an anaerobic digester.

Discuss the effect of raw sludge, waste activated sludge and scum on anaerobic digestion.

Describe the start-up of an anaerobic digester.

Explain foaming in an anaerobic digester.

Describe gas production in an anaerobic sludge digestion system.

Discuss digester supernatant and secondary digesters in an anaerobic digestion system.

Discuss anaerobic digestion control.

Describe the operational strategy of an anaerobic digestion system.

Discuss the need for cleaning an anaerobic digester.

Compare aerobic and anaerobic digestion.

Describe the operation of aerobic digesters.

Describe the operation of sludge drying beds.

Discuss blacktop drying beds.

Describe sludge types and characteristics.

Discuss sludge handling alternatives.

Discuss the factors affecting gravity thickeners.

Describe troubleshooting the operation of gravity thickeners.

Discuss dissolved air flotation thickeners.

Discuss factors affecting dissolved air flotation.

Describe a centrifuge thickener.

What factors will affect the performance of centrifuge thickeners.

Describe the aerobic digestion process.

Discuss troubleshooting of the aerobic digestion process

Discuss the chemical stabilization of sludge.

Describe chemical sludge conditioning.

Discuss factors affecting the thermal conditioning of sludge.

Discuss factors affecting wet oxidation.

Describe a belt filter press.

Describe the operation of vacuum filters for sludge dewatering.

Discuss the dewatering of wet oxidation sludge by sand drying beds.

Describe factors affecting sand drying beds.

Describe the composting of sludge.

Describe factors affecting sludge composting.

Discuss the troubleshooting of sludge composting operations.

Describe the process of sludge incineration.

Discuss disposal of screenings, grit, and scum.

Discuss vectors found in wastewater threatening the public health.

Mathematics

Given the horsepower of a pump and the pumping head, calculate the flow rate of water being pumped.

Given the size of a wet well in a lift station, the drop in water level, and the duration of the drop, calculate the pumping rate.

Given the flow rate, the TDH of a pump system, the efficiency of a pump and motor, and the unit cost of electricity, calculate the cost of operating a pump.

An estimate of the flow in an open channel was made by use of a Pitot tube. Given the water rise, calculate the flow rate.

Given the flow rate, the dimensions of a clarifier, and the concentration of MLSS, determine the detention time, the surface loading, and the solids loading.

Given the flow rate, the aeration tank volume, the MLSS, and the primary effluent TSS, calculate the sludge age; given other pertinent data.

Given the pertinent influent, calculate F/M ratio.

Given the pertinent information, calculate the necessary waste sludge pumping rate.

Given the pertinent information, calculate the mean cell residence time.

Given the primary effluent COD (or BOD), the flow rate, the aerator volume and the desired F/M ratio, determine the necessary MLVSS.

Given the 30 minute settling data and the flow rate, calculate the necessary return sludge rate.

WASTEWATER OPERATOR EXAMINATION STUDY GUIDE CLASS III AND CLASS IV – FALL 2008

Given the size of an aeration tank and the MLSS, calculate the pounds of solids under aeration.

Calculate the hydraulic and organic loading rates of a trickling filter given the pertinent data.

Given the flow rate and other pertinent data, calculate the feed rate of $S0_2$ for dechlorination.

Given the chlorine feed rate, the flow rate, and the residual chlorine, calculate the chlorine demand.

Calculate the feed rate of chlorinated lime given the desired feed rate of chlorine and the chlorine content of chlorinated lime.

Given the polymer pumping rate to a rapid sand filter influent, the filter loading and the polymer concentration, calculate the polymer dosage.

Calculate the volume of seed sludge given the digester size and the required per cent (%) of seed sludge.

Given the volume of raw sludge pumped, the solids content and the volatile solids per cent (%), calculate the poundage volatile sotids under digestion.

Given the primary effluent flow rate and the settleable solid test data, estimate the sludge pumping rate to a digester.

Given the volatile solids per cent (%) before (influent) and after (outflow) sludge digestion, calculate the per cent (%) reduction of volatile solids.

Given the dimensions of a piston cylinder and stroke length, calculate the volume of sludge pumped per stroke.

Given pertinent data, calculate the per cent (%) volatile solids.

Calculate the variance given several measurements of the D.O.

Given the normality of a stock acid solution, how many mL of the acid solution will be required to make 1.0 L of 0.02N acid.

Determine the median value given a set of data.

Calculate the geometric mean given a set of data.

Given the BOD test data with seed correction, calculate BOD.

Given pertinent data, calculate the solids loading to a gravity thickener.

Calculate the desired pounds of solids under aeration given the daily solids addition and the desired sludge age.

Determine the effect of an increase in the sludge concentration on the digestion time of an aerobic digester.

CLASS III

A storm sewer, industrial sewer, and domestic sewer that share the same collection system are referred to as a combined system.

The invert of a pipe is the bottom, inside of the pipe. (Also called the flowline.)

The length of pipe connecting 2 manholes is called a pipe run.

The amount of flow in a collection system can be affected by sump pump connections, downspout connections, and cracked/broken sewer joints.

An inverted siphon in a sewer line can be used to carry uninterrupted flow under a stream or river.

Collection system inflow/infiltration problems can be controlled by sewer ordinances, smoke testing, and dye testing.

Smoke and dye testing can determine sources of inflow and infiltration.

Storms have increased the flows at a lift station. The lead and lag pumps are both running, but the level in the wet well remains constant. The lead pump check-valve is up, and the check-valve is down on the lag pump. Gauge shows operating pressure consistent for one pump. What's wrong?

> Lag pump check-valve being down indicates it is probably air-locked and not pumping.

A manhole with an inlet pipe above the invert (flowline), allowing the flow to drop down into the manhole, is referred to as a "drop" manhole.

One way to control root-intrusion in a collection system is by proper construction of joints and fittings.

If the comminutor has sharp, free-turning cutters but allows passage of numerous rags, etc., incorrect alignment of those cutters may be the problem.

Lots of rags getting into a treatment plant can plug pumps and fill digesters.

Too many organics are collecting in the grit chamber. Increasing the velocity through the chamber by removing baffles is one solution.

The design velocity through a grit chamber is about 1.0 foot per second.

Flow volume through a grit chamber should be about 1.0 cubic foot per second. This allows for the inorganics to settle properly.

An aerated grit chamber uses the air to keep the organics suspended and above the grit.

To calculate the flow through a parshall flume, the hydraulic head is measured.

Pressure measurements determine flow when using a venture meter.

Head measurements are used to calculate flows over an open channel retangular weir. (Head being the measurement from the water surface to the top of the weir, usually about 4 weir lengths upstream.)

Overheating an electric motor shortens the insulation life of the windings.

If a 3-phase motor is running backwards, reverse 2 of the motor leads to correct the problem.

A grounded 3-phase motor that loses a phase, will heat up and sustain damage unless shutdown by a thermal control device.

Low voltage can cause a noisy (or chattering) magnet in an electric motor.

Replace worn parts before they break while performing pump maintenance.

Packing is used in pumps to prevent air from getting in, and to keep water from getting out.

A centrifugal pump can be started with a closed discharge valve, causing no problem.

Operating a progressive cavity pump for an extended period without flow will usually burn up the stator. (The flow is the coolant.)

A piston pump has 2 check valves.

A particle of solids entering a rectangular clarifier, should start settling upon entry.

The primary clarifier has sludge pumped off for 10 minutes each hour. Starting at 6% solids, and finishing at 4% after the 10 minutes. The sludge collectors are running properly and the blanket is still high. What can be done?

Pump for a longer time to reduce the sludge blanket in the clarifier.

A circular primary clarifier normally has a design detention-time of 1 to 2 hours.

Cleaning the scum layer daily helps provide the best operation of an Imhoff tank.

Removing sludge from an Imhoff tank should be done before the sludge blanket gets within 18 inches of the slot in the sedimentation tank.

A circular primary clarifier normally has a design detention-time of 1 to 2 hours.

Cleaning the scum layer daily helps provide the best operation of an Imhoff tank.

Removing sludge from an Imhoff tank should be done before the sludge blanket gets within 18 inches of the slot in the sedimentation tank.

"Foaming" in a Imhoff tank is usually the result of an acid condition.
(pH needs to be kept 6.8 -7.0 for best operation.)

BOD removals of 15 to 35 % can be achieved with a properly operated Imhoff tank.

Addition of sodium nitrate throughout, can help restore aerobic activity to a facultative lagoon that has turned anaerobic.

Low organic loadings in summertime, can be the reason to run a 3-cell facultative lagoon in series mode.

Facultative lagoons operate properly relying on biological activity and algae.

Lagoons operate best with warm temperatures.

To measure the dosing application of wastewater to a trickling filter, place same size pans across the radius of the filter to collect the water from the distributor arm.

The rock or media bed of a typical trickling filter is about 3 to 8 feet in depth.

Flooding the filter, chlorination, and removing weeds/shrubs around the filter are some control methods for the development of filter flies in a trickling filter.

Reduce the organic loading to prevent "pooling" on your trickling filter.

Running a recirculation rate of 1:1, low DO and odor problems begin to appear at a trickling filter. Increasing the recirculation rate should help resolve the problems.

Increasing the recirculation rate during low flow periods to provide consistent dosing should alleviate an issue with inconsistent, periodic dosage from the reduced flow.

A trickling filter has a 2:1 recirculation rate, with underdrains 75% full, and odor problems starting. Decreasing the recirculation rate should allow proper drainage from the media and reduce the odor problem.

The nozzles on a trickling filter arm are for even distribution of the wastewater on the media.

Rock media used in a trickling filter is usually about 2 to 4 inches diameter.

Trickling filter media provides surface area for the growth of biological slime.

An RBC with a white growth usually is receiving a septic influent flow.

An RBC rotates at an average speed of 1.5 – 1.6 rpm.

Normal operation of a first-stage RBC is indicated by a brownish film growth.

The bearings on an RBC shaft need to be greased to protect the bearing from water corrosion .

A secondary clarifier is needed after RBC units for the removal of sloughed solids.

Snails developing in an RBC process are indicative of a low organic loading.

Short circuiting in a secondary clarifier can be caused by a low spot in the weir surface.

Typical design detention time for secondary clarifiers is in the 2 to 3 hours range.

Denitrification is the usual cause for "rising" solids in a secondary clarifier.

Fusible plugs in a chlorine tank keep the tank from bursting at high temperatures.

An exhaust fan at floor level provides ventilation in a closed room used for chlorine storage.

Chlorine gas is greenish-yellow and is heavier than air.

With a consistent plant flow and a constant chlorine feed rate, an increase in BOD can cause a drop in the chlorine residual.

Ultraviolet light is an alternative to chlorine for wastewater disinfection.

Sodium dioxide is used for dechlorination.

Running a constant flow to intermittent sand filters can plug them up.

Sand drying beds should have a maximum application depth of 8-12 inches.

Uniformity coefficient and granular size in a sand filter refers to the size and similarity of the sand.

Application rate to intermittent sand filters after secondary treatment, should be around 500,000 gallons per acre per day.

Sand depth in intermittent sand filters is 24 inches minimum.

Performance of anaerobic digesters is usually measured by monitoring the acidity-alkalinity ratio, pH and temperature.

A drop of 1 degree F can upset the balance of an anaerobic digester.

Poor gas quality from anaerobic digesters can be indicated by increased gas production, waste flame burning orange and frequently going out, and shutting down of boilers for heat exchangers.

A well-operated, heated digester will have volatile acid concentrations in the range from 50 to 300 mg/L.

High solids in the anaerobic digester supernatant are usually caused by too much mixing.

Floating covers on anaerobic digesters provide a seal against explosive conditions.

Heated anaerobic digesters should have an alkalinity level of 2000-5000 mg/L.

Anaerobic digesters operating in the mesophilic range of about 90 to 100 degrees F to optimize performance.

A pH range of 6.8 to 7.2 needs to be maintained in anaerobic digesters.

Maintain uniformity in the primary anaerobic digester by proper mixing.

Stay on the concrete pads while cleaning sludge drying beds to prevent damage to the underdrain piping.

Sludge should be removed from a drying bed only when it is dry .

An extremely odorous sludge on a drying bed is most likely due to inadequate sludge digestion.

Protect workers and equipment from start-up hazards by using lockouts and tagouts.

Hepatitis and dysentery are two diseases associated with wastewater.

When entering a well-ventilated chlorine storage room, it is important to make sure a breathing apparatus is nearby in case of need.

The minimum acceptable limit for oxygen in a confined space is 19.5%.

The proper DO depletion for a 5-day BOD is 2.0 mg/L.

5-day BODs should be incubated at 20 degrees C.

Influent ammonia is 25 mg/L and nitrate is 4 mg/L. Effluent ammonia is 6 mg/L and nitrate is 3 mg/L. These conditions indicate low detention time, and not enough air to completely oxidize ammonia.

Fecal coliform tests measure pathogens.

Sodium thiosulfate is used in the laboratory for dechlorination.

A circular clarifier has a diameter of 120 feet and a depth of 12 feet. What is the surface area in square feet?

Area = .785 X D X D

.785 X 120 X 120 = 11, 304 sq. ft. - surface area

A lagoon is 400 feet wide, 700 feet long, and 10 feet deep with a flow of .250 MGD. What is the detention time, in days, in this lagoon?

$$\text{Detention time} = \frac{\text{volume, gal.}}{\text{flow rate, gpd}}$$

$$\frac{400 \times 700 \times 10 \times 7.48}{250{,}000} = \textbf{84 days}$$

A circular clarifier has a diameter of 90 feet and a depth of 15 feet with a flow of 6.2 MGD. What is the detention time in hours?

$$\text{Detention time} = \frac{\text{volume, gal.}}{\text{flow rate, gpd}}$$

$$\frac{.785 \times 90 \times 90 \times 15 \times 7.5}{6200000 \text{ gpd}} = \frac{715{,}331}{258{,}333} = \textbf{2.77 hrs.}$$

24 hrs./dy.

The influent flow to a trickling filter plant is 200,000 gpd. The SS is 250 mg/L and the BOD is 175 mg/L. The Imhoff tank removes 40% of the applied SS and 35% of the applied BOD. The trickling filter removes 30% of the applied SS and 40% of the applied BOD. What is the estimated SS following the trickling filter?

	(Imhoff)		(Trickling Filter)	
250 mg/L SS	250	250	150	150
	X .40	-100	X .30	-45
	100	150	45	**105 mg/L SS**

The influent to a trickling filter plant is 200,000 gpd. The trickling filter is 90 feet in diameter with a media depth of 6 feet. If the BOD concentration applied to the trickling filter is 250 mg/L, what is the organic loading rate of the trickling filter per 1000 cubic feet of media?

$$\text{Organic Loading Rate (Lbs./dy per 1000 cu.ft.)} = \frac{\text{BOD lbs./dy.}}{\text{Units of 1000 Cu.Ft.}}$$

$$\frac{250 \times .200 \text{ MGD} \times 8.34}{.785 \times 90 \times 90 \times 6 \text{ (1000 Cu. Ft.)}} = \frac{417 \text{ lbs./dy.}}{38151 \text{ Cu (1000 Cu.Ft.)}} = \textbf{10.93 lbs./dy. BOD / 1000 Cu. Ft. of media}$$

A lagoon has an influent flow of 500,000 gpd with a BOD concentration of 900 mg/L. What is the population equivalent of the wastewater influent?

$$\text{Population Equivalent} = \frac{\text{Lbs./dy. BOD}}{\text{Lbs. BOD/dy./person}} \qquad \textbf{(PE = .17 lbs. BOD/dy./person)}$$

$$\frac{900 \times .500 \times 8.34}{.17 \text{ lbs. BOD/dy./person}} = \frac{3753}{0.17} = \textbf{22,076 population}$$

A lift station wet well has a diameter of 15 feet and is 30 feet deep. Assuming nothing is going into the wetwell, what is the pumping rate of the pump in gpm when the well drops 6 feet in 10 minutes?

$$\text{Flow Rate (gpm)} = \frac{\text{Volume, gal.}}{\text{Time, min.}}$$

$$\frac{.785 \times 15 \times 15 \times 6 \times 7.5}{10} = \frac{7948}{10} = \textbf{795 gpm}$$

Running a suspended solids test, the initial weight of the crucible is 17.9567 grams. After running 125 ml of sample through and weighing again, the weight is 17.9590 g. What is the SS in mg/L?

$$\frac{\text{Weight \#2 - Weight \#1 X 1,000,000}}{\text{ml of sample used}} = \text{SS mg/L}$$

$$\frac{17.9590\text{g} - 17.9567\text{g} \times 1{,}000{,}000}{125 \text{ ml}} = \frac{2300}{125} = \textbf{18.4 mg/L SS}$$

Running a BOD test, the initial D.O. is 8.2 mg/L. After 5 days the D.O. reads 7.4 mg/L. What is the BOD in mg/L if 150 ml sample was used in a 300 ml BOD bottle?

$$\frac{\text{Initial DO - 5 day DO X Bottle Volume}}{\text{ml of sample}} = \text{BOD mg/L}$$

$$\frac{(8.2 - 7.4) \times 300}{150 \text{ ml}} = \frac{.8 \times 300}{150} = \frac{240}{150} = \textbf{1.6 mg/L}$$

An anaerobic digester has a volatile acids concentration of 170 mg/L. The alkalinity is 3,000 mg/L. What is the volatile acids alkalinity ratio?

$$\text{Volatile acids/alkalinity ratio} = \frac{\text{volatile acids, mg/L}}{\text{alkalinity, mg/L}}$$

$$\frac{170}{3000} = \textbf{.06 volatile acids/alkalinity ratio}$$

A field selected for sludge application is 1,987 feet by 3,693 feet. How many acres is it?

$$\text{Acres} = \frac{\text{Area, sq. ft.}}{\text{43,560 sq. ft./ac.}} \qquad \frac{1987 \times 3693}{43560} = \frac{7337991}{43560} = \textbf{168.45 acres}$$

An RBC has a surface area of 900,000 sq. ft. and receives a daily flow of 3.4 MGD. What is the average hydraulic loading rate of the RBC?

$$\text{Hydraulic Loading} = \frac{\text{Flow, gpd}}{\text{Surface Area, sq.ft.}} = \frac{3{,}400{,}000}{900{,}000} = \mathbf{3.8\ gpd/sq.ft.}$$

A rectangular clarifier is 45 feet wide , 110 feet long, and 12 feet deep. What is the surface area of the calrifier in square feet?

$$\text{Area, sq.ft.} = \text{length X width} = 110 \times 45 = \mathbf{4950\ sq.ft., surface}$$

Placing a basketball at the start of the grit chamber, and timing its travel of 60 feet yields 30 seconds. What is the velocity through the grit channel?

$$\text{Velocity, ft./sec.} = \frac{\text{Distance, ft.}}{\text{Time, sec.}} = \frac{60\ \text{ft.}}{30\ \text{sec.}} = \mathbf{2.0\ ft./sec.}$$

A rectangular clarifier has 125 feet of weir. What is the weir overflow rate in gpd/ft. when the flow is 1.5 MGD?

$$\text{Weir Overflow Rate, gpd/ft.} = \frac{\text{Flow, gpd}}{\text{Length of weir, ft.}} = \frac{1{,}500{,}000\ \text{gal.}}{125\ \text{ft.}} = \mathbf{12{,}000\ gpd/ft.}$$

How many cubic feet are in a tank 95 feet long, 30 feet wide and 15 feet deep?

$$\text{Volume, Cu. Ft.} = \text{Length X Width X Depth}$$

$$95 \times 30 \times 15 = \mathbf{42{,}750\ Cu.\ Ft.}$$

How many gallons of water are in 42,750 cubic feet?

$$1\ \text{Cubic Foot} = 7.5\ \text{gallons} \qquad 42{,}750\ \text{Cu. Ft.} \times 7.5 = \mathbf{320{,}625\ gals.}$$

In tons, how much would 320,625 gallons of water weigh?

$$\text{Weight, tons} = \frac{\text{Gallons X 8.34 lbs./gal.}}{\text{2000 lbs./ton}} = \frac{320{,}625 \times 8.34}{2000} = \mathbf{1337\ tons}$$

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An RBC has a surface area of 900,000 sq. ft. and receives a daily flow of 3.4 MGD. What is the average hydraulic loading rate of the RBC?

Hydraulic Loading = $\frac{\text{Flow, gpd}}{\text{Surface Area, sq.ft.}} = \frac{3{,}400{,}000}{900{,}000}$ **= 3.8 gpd/sq.ft.**

Placing a basketball at the start of the grit chamber, and timing its travel of 60 feet yields 30 seconds. What is the velocity through the grit channel?

Velocity, ft./sec. = $\frac{\text{Distance, ft.}}{\text{Time, sec.}} = \frac{60 \text{ ft.}}{30 \text{ sec.}}$ **= 2.0 ft./sec.**

How many cubic feet are in a tank 95 feet long, 30 feet wide and 15 feet deep?

Volume, Cu. Ft. = Length X Width X Depth

95 X 30 X 15 = **42,750 Cu. Ft.**

How many gallons of water are in 42,750 cubic feet?

1 Cubic Foot = 7.5 gallons 42,750 Cu. Ft. X 7.5 = **320,625 gals.**

In tons, how much would 320,625 gallons of water weigh?

Weight, tons = $\frac{\text{Gallons X 8.34 lbs./gal.}}{\text{2000 lbs./ton}} = \frac{320{,}625 \text{ X } 8.34}{2000}$ = **1337 tons**

A storm sewer, industrial sewer, and domestic sewer that share the same collection system are referred to as a combined system.

The invert of a pipe is the bottom, inside of the pipe. (Also called the flowline.)

The length of pipe connecting 2 manholes is called a pipe run.

The amount of flow in a collection system can be affected by sump pump connections, downspout connections, and cracked/broken sewer joints.

An inverted siphon in a sewer line can be used to carry uninterrupted flow under a stream or river.

Collection system inflow/infiltration problems can be controlled by sewer ordinances, smoke testing, and dye testing.

Smoke and dye testing can determine sources of inflow and infiltration.

Storms have increased the flows at a lift station. The lead and lag pumps are both running, but the level in the wet well remains constant. The lead pump check-valve is up, and the check-valve is down on the lag pump. Gauge shows operating pressure consistent for one pump. What's wrong?

> Lag pump check-valve being down indicates it is probably air-locked and not pumping.

A manhole with an inlet pipe above the invert (flowline), allowing the flow to drop down into the manhole, is referred to as a "drop" manhole.

One way to control root-intrusion in a collection system is by proper construction of joints and fittings.

If the comminutor has sharp, free-turning cutters but allows passage of numerous rags, etc., incorrect alignment of those cutters may be the problem.

The design velocity through a grit chamber is about 1.0 foot per second.

Flow volume through a grit chamber should be about 1.0 cubic foot per second. This allows for the inorganics to settle properly.

To calculate the flow through a parshall flume, the hydraulic head is measured.

Pressure measurements determine flow when using a venture meter.

Head measurements are used to calculate flows over an open channel retangular weir. (Head being the measurement from the water surface to the top of the weir, usually about 4 weir lengths upstream.)

Overheating an electric motor shortens the insulation life of the windings.

If a 3-phase motor is running backwards, reverse 2 of the motor leads to correct the problem.

A grounded 3-phase motor that loses a phase, will heat up and sustain damage unless shutdown by a thermal control device.

Low voltage can cause a noisy (or chattering) magnet in an electric motor.

Replace worn parts before they break while performing pump maintenance.

Packing is used in pumps to prevent air from getting in, and to keep water from getting out.

A centrifugal pump can be started with a closed discharge valve, causing no problem.

Operating a progressive cavity pump for an extended period without flow will usually burn up the stator. (The flow is the coolant.)

A piston pump has 2 check valves.

Cleaning the scum layer daily helps provide the best operation of an Imhoff tank.

Cleaning the scum layer daily helps provide the best operation of an Imhoff tank.

"Foaming" in a Imhoff tank is usually the result of an acid condition.
(pH needs to be kept 6.8 -7.0 for best operation.)

BOD removals of 15 to 35 % can be achieved with a properly operated Imhoff tank.

Addition of sodium nitrate throughout, can help restore aerobic activity to a facultative lagoon that has turned anaerobic.

Low organic loadings in summertime, can be the reason to run a 3-cell facultative lagoon in series mode.

Facultative lagoons operate properly relying on biological activity and algae.

Lagoons operate best with warm temperatures.

Fusible plugs in a chlorine tank keep the tank from bursting at high temperatures.

An exhaust fan at floor level provides ventilation in a closed room used for chlorine storage.

Chlorine gas is greenish-yellow and is heavier than air.

With a consistent plant flow and a constant chlorine feed rate, an increase in BOD can cause a drop in the chlorine residual.

Ultraviolet light is an alternative to chlorine for wastewater disinfection.

Sodium dioxide is used for dechlorination.

Running a constant flow to intermittent sand filters can plug them up.

Sand drying beds should have a maximum application depth of 8-12 inches.

Uniformity coefficient and granular size in a sand filter refers to the size and similarity of the sand.

Application rate to intermittent sand filters after secondary treatment, should be around 500,000 gallons per acre per day.

Sand depth in intermittent sand filters is 24 inches minimum.

Stay on the concrete pads while cleaning sludge drying beds to prevent damage to the underdrain piping.

Sludge should be removed from a drying bed only when it is dry .

An extremely odorous sludge on a drying bed is most likely due to inadequate sludge digestion.
Protect workers and equipment from start-up hazards by using lockouts and tagouts.

Hepatitis and dysentery are two diseases associated with wastewater.

When entering a well-ventilated chlorine storage room, it is important to make sure a breathing apparatus is nearby in case of need.

The minimum acceptable limit for oxygen in a confined space is 19.5%.

The proper DO depletion for a 5-day BOD is 2.0 mg/L.

5-day BODs should be incubated at 20 degrees C.

Influent ammonia is 25 mg/L and nitrate is 4 mg/L. Effluent ammonia is 6 mg/L and nitrate is 3 mg/L. These conditions indicate low detention time, and not enough air to completely oxidize ammonia.

Fecal coliform tests measure pathogens.

Sodium thiosulfate is used in the laboratory for dechlorination.

An operator's license is subject to revocation, fine, and imprisonment.

TSS is measured by filtering through a Gooch crucible.

One purpose of dosing intermittent sand filters at intervals is for better treatment of the wastewater.

BOD tests are incubated for 5 days at 20 degrees Celsius.

A sample with a pH of 8.5 is considered alkaline.

Renewal information for an N.P.D.E.S. permit that is expiring must be submitted 180 days before the expiration date.

Records of Discharge Monitoring Reports, (DMRs), must be kept for 3 years.

Operations records are kept to help operators with process control.

A D.O. meter needle fluctuates, normally, when the membrane in the probe needs attention.

With ponds or lagoons, the term "Freeboard" refers to the working area remaining above the water surface.

In an intermittent sand filter, the top 1 to 3 inches of sand is the portion replaced during normal operation.

Chlorine is heavier than air.

Trickling filter treatment does not follow lagoons.

An automatic vent fan that runs during the time the door is open is considered good ventilation in a lift station.

The greatest maintenance task for intermittent sand filters is cleaning of the sand.

Before entering a manhole, check for lower explosive limits both before and after ventilation.

Corrosion in manholes is caused by hydrogen sulfide gas.

When digging for a sewer line, dig to about 18 inches above where it is shown on the plans.
(Use a tile prod to locate and close on it.)

Operators raise lagoon levels in the fall and lower them in the spring.

If a stabilization pond is going "septic", raise the level. (The oxygen level is raised by the additional water volume.)

The level of Dissolved Oxygen is greatest at mid-afternoon, in stabilization ponds.

Splash goggles are the apparel worn when pouring chemicals.

The first action taken when opening a manhole lid and discovering gasoline, is to call the police and fire departments.

If a sewer line is plugged, look for a manhole with reduced or no flow when the manhole upstream is flowing full.

The outfall sewer line is located at the effluent end of the plant.

A weir is the type of flow measurement that has flow falling from a higher point to a lower point.

Lock-out and tag-out is the procedure done when working on electrical equipment.

A parshall flume is sometimes used for flow measurement.

A proportional weir is design to maintain a constant flow through a grit channel.

The bars are 2 to 4 inches apart in a bar rack.

Photosynthesis is the biological process allows plants to convert nutrients and sunlight to oxygen.

There are 7.5 gallons in 1 cubic foot of wastewater.

Grit is disposed of in a landfill, buried under 6 inches of dirt minimum.

The velocity of a collection system is designed for 2 feet per second.

Sand, gravel, and grit are composed of inorganic materials.

If one circuit burns out in a series circuit, all circuits go out.

Weighing chlorine cylinders is the best way to determine when they are empty.

The green color of pond indicates that it is operating correctly.

A minimum depth of 3 feet is recommended for weed control in a facultative pond.

The chemical sodium nitrate can be used to help increase D.O. in a lagoon.

A properly operate pond may experience a developing cover of scum that can produce odors, cause a decrease in D.O., and give botulism to waterfowl.

Facultative lagoons have both aerobic and anaerobic processes.

Waving a rag, (dampened with ammonia), around the fittings on a chlorine tank is the proper way to check for leaking chlorine. ((If leaks, white fumes will appear.))

An Imhoff cone is used to determine the amount of settleable solids.

Composite samples are samples collected and combined over several hours during the day.

A rubber bulb should always be used to pipette wastewater or chemicals.

Disease-causing bacteria are referred to as pathogenic.

In a stabilization pond, oxygen for aerobic bacteria comes from a form of plant life called algae.

Biological activity in a lagoon can be provided all by aerobic bacteria, anaerobic bacteria, and algae.

Equipment nameplate data must be filed and recorded because:

The name plate may become lost or unreadable.
The manufacturer may not retain the information.
The information is necessary to order replacement parts.

A separate sewer system is one in which storm water is carried separate from wastewater.

Measuring the time it takes for dye to get from one manhole to another, can be used to determine the velocity of water flowing in a collection system.

An accident report should contain the following:

Description of the accident.
Number of people involved.
What defective equipment or unsafe conditions contributed to the accident.

Samples taken for routine analysis should be preserved by refrigeration.

An air gap device prevents wastewater from contaminating potable water.

A pH meter should be calibrated before each use.

No chemicals are used in the suspended solids test.

The effluent of a pond should be located just below the surface.

Pond (organic) loading is expressed in pounds of BOD per acre per day.

5 milligrams per liter **equals** 5 parts per million.

Possible reasons a pump won't pump:

Air leaks in the suction line.
Loose connections.
Discharge head too high.

Floats, electrodes, diaphragms are all examples of level control systems used in wet wells.

Daily use of chlorine can be defined as "chlorine demand".

If a fuse continues to blow, thoroughly inspect the affected equipment to determine the cause.

Iron is a material that is not normally used in the construction of collection systems.

Performance of a stabilization pond is a function of surface area.

BOD dilution water is aerated distilled water with nutrients and buffer added.

Hydrogen sulfide is the gas most associated with septic wastewater.

An electric motor is wound for a grounded 3-phase circuit. If the motor is fully loaded and one phase cuts out while it is in operation, it will heat up and be damaged unless stopped by a thermal control device.

The suction fan for a forced ventilation system used in a chlorinator room must be located near the floor.

The term BOD refers to biochemical oxygen demand.

Disinfection is the process by which all pathogenic bacteria are destroyed or removed.

The abbreviation for milligrams per liter is mg/L.

A pH range of 0 to 7 is acidic.

Total solids are made up of suspended solids + dissolved solids.

Disinfection is utilized to control diseases of Cholera, Typhoid, and Polio.

Fresh wastewater has a characteristic grey color.

Facultative bacteria can utilize either free dissolved oxygen or combined oxygen.

Combined sewers are both sanitary and storm sewers.

Detritus is a heavy coarse mixture of grit and organic materials settled out in a grit chamber.

Biological activity in long, sluggish-flow, flat-grade sewer lines will probably cause:

Concrete or metal corrosion.
Oxygen deficiency in the air in manholes.
Toxic gas production.

The bars in a bar screen are ¼ inch to 2 inches apart.

Wastewater in which solids have decomposed to inert solids is referred to as “stable”.

Cyclone is not a type of pump.

Gaseous chlorine is approximately 2 ½ times heavier than air.

To increase the D.O. in a lagoon, the operator could add sodium nitrate.

Facultative lagoons are generally 3 to 6 feet deep.

Aerobic lagoons are generally 3 to 4 feet deep.

The term “septic” refers to wastewater that has little or no dissolved oxygen.

Inorganic waste is material that has a mineral origin.