



Chapter Assessment

1. What is the activated sludge floc made of
2. What properties of activated sludge floc are key to the effectiveness of the activated sludge process
3. List the activated sludge process control parameters (names/description)
4. List the key design differences between a rectangular and circular primary clarifier
5. Why is it important to ensure having a "good" microbiological composition of the activated sludge process (5 points)
6. What is/are the main factor/s that control the microbial population
7. MLVSS represents the _____ fraction of the MLSS
8. Optimal range of SVI is between _____ to _____
9. Straggler floc is associated with [type1] sludge while pin-floc is associated with _____ sludge
Bulking and foaming is due to _____ bacteria
10. Portion of the activated sludge floc settled in the clarifier that is returned to the front of the aeration basin to seed the incoming primary effluent is called [name]
11. List the key design differences between a rectangular and circular primary clarifier
Correct Answer(s):
12. Why is it important to ensure having a "good" microbiological composition of the activated sludge process (5 points)
Correct Answer(s):
13. What is/are the main factor/s that control the microbial population
Correct Answer(s):
14. Which one of the following statements is TRUE regarding the various modifications of the activated sludge process
 - a. MCRT of 5 to 10 days is typical for extended aeration
 - *b. Typical hydraulic detention times in the contact tank of the contact stabilization process need only be 0.5 to 1.0 hour.
 - c. F to M ratios of 0.03 to .1 are appropriate for the step-aeration mode of the activated sludge

process

d. Pure oxygen activated sludge floc often has a large population of rotifers.

e. Step feed -aeration involves decreasing the air being fed along the length of the aeration tank.

15. What is the significance/importance of measuring OUR and SOUR and what are their respective units of measurement

Correct Answer(s):

16. List the advantages and disadvantages of the constant RAS flow control

Correct Answer(s):

17. Name and describe the two RAS control approaches

Answer the following related to activated sludge floc:

18. What is the activated sludge floc made of (3 points)

19. What properties of activated sludge floc are key to the effectiveness of the activated sludge process (3 points)

20. List the activated sludge process control parameters (names/description)

21. Activated sludge is an anaerobic process

a. True

*b. False

22. Secondary treatment is mainly to remove the organic content of the wastewater

*a. True

b. False

23. The contents of an aeration tank utilized in activated sludge treatment is referred to as mixed liquor.

*a. True

b. False

24. In conventional activated sludge plants, six to eight hours of aeration detention time is used for acceptable plant operation.

*a. True

b. False

25. Bulking occurs in primary clarifiers and is associated with improper scum removal.

a. True

*b. False

26. Contact stabilization is a modification of the conventional activated sludge system.

*a. True

b. False

27. Contact stabilization is a modification of the conventional activated sludge system.

*a. True

b. False

28. In secondary settling tanks, the sludge pumping considerations would be the same as in primary settling tanks.

a. True

*b. False

29. The main function of a launder in a secondary clarifier is to prevent scum and other floatables from leaving with the effluent flow

a. T

@Incorrect. Launder collects and conveys the effluent flow. Effluent baffles prevent scum and other floatables from leaving with the effluent flow

- *b. F
- @Correct. Launder collects and conveys the effluent flow. Effluent baffles prevent scum and other floatables from leaving with the effluent flow
- 30. Activated sludge is an anaerobic process
 - a. True
 - *b. False
- 31. Excessive filamentous bacteria in activated sludge is typically controlled by bleach addition to RAS
 - *a. True
 - b. False
- 32. SVI is a measure of the sludge volume that needs to be wasted
 - a. True
 - *b. False
- 33. Extended aeration involves operating the activated sludge process at a high F:M ratio
 - a. True
 - *b. False
- 34. Sludge bulking is caused by light sludge not settling properly
 - *a. True
 - b. False
- 35. pH has little effect on the activated sludge plant
 - a. True
 - *b. False
- 36. Bulking is caused by excessive filamentous bacteria
 - *a. True
 - b. False
- 37. Excessive filamentous bacteria in activated sludge is typically controlled by bleach addition to RAS
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 - b. False
- 38. Extended aeration involves operating the activated sludge process at a high F:M ratio
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- 39. Extended aeration involves operating the activated sludge process at a high F:M ratio
 - a. True
 - *b. False
- 40. Extended aeration involves operating the activated sludge process at a high F: M ratio
 - a. True
 - *b. False
- 41. In conventional secondary wastewater treatment processes, aerobic decomposition of solids will occur.
 - *a. True
 - b. False
- 42. In the activated sludge process, the wastewater oxygen demand may be separated into two categories: carbonaceous and nitrogenous
 - *a. True
 - b. False
- 43. MCRT refers to the average number of days that a “cell” remains in an activated sludge system.

- *a. True
 - b. False
44. MCRT refers to the average number of days that a "cell" remains in an activated sludge system.
- *a. True
 - b. False
45. In activated sludge treatment a young sludge age is marked by a low F:M ratio
- a. True
 - *b. False
46. The "M" in the F:M ratio is the mass of mixed liquor suspended solids in the aeration basin
- a. True
 - *b. False
47. The SVI test is used for establishing amount of sludge to be wasted
- a. True
 - *b. False
48. SVI test is conducted using an Imhoff cone
- a. True
 - *b. False
49. A WAS or RAS flow change of 25% in one day will have little impact on the activated sludge treatment process
- a. True
 - *b. False
50. Activated sludge is an anaerobic process
- a. True
 - *b. False
51. Secondary treatment is mainly to remove the organic content of the wastewater
- *a. True
 - b. False
52. Excessive filamentous bacteria in activated sludge is typically controlled by bleach addition to RAS
- *a. True
 - b. False
53. Rotifers are the dominant microorganisms in a young activated sludge
- a. True
 - *b. False
54. Secondary treatment is mainly to remove the organic content of the wastewater
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57. The F in the F to M ratio refers to the pounds of mixed liquor volatile suspended solids under aeration in an activated sludge plant.
- a. True
 - *b. False
58. The use of F:M ratio for controlling the activated sludge process implies the need for higher mass of microorganisms to treat a stream with a higher BOD
- *a. True
 - b. False
59. The white billowing foam commonly seen during the startup of the activated sludge plant is caused by low F:M ratio
- a. True
 - *b. False
60. When an activated sludge plant is first started, one should expect to see foaming
- *a. True
 - b. False
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79. The abundance of rotifers in the activated sludge is generally the cause of “bulking”
- a. True
 - *b. False
80. The F in the F to M ratio refers to the pounds of mixed liquor volatile suspended solids under aeration in an activated sludge plant.
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84. A consulting engineer has recommended addition of a roughing filter and intermediate clarifier between your primary clarifier and aeration basin to better handle increasing industrial loads. This addition would:
- a. Be the best form of flow equalization available
- b. Remove most of the fixed dissolved solids
- c. Reduce drastically the fine dissolved matter
- d. Cost a lot and do nothing
- *e. Reduce the organic load on the aeration basin
85. MLVSS represents the _____ fraction of the MLSS
86. Optimal range of SVI is between _____
87. Straggler floc is associated with [_____ sludge while pin-floc is associated with _____ sludge
88. Bulking and foaming is due to _____ bacteria
89. Portion of the activated sludge floc settled in the clarifier that is returned to the front of the aeration basin to seed the incoming primary effluent is called [name]
90. What is the purpose of a clarifier?
- a. Aerate the primary effluent
- *b. Allow for the solids to settle
- c. To disinfect the secondary effluent
- d. To remove the inorganic solids
91. The four (4) basic components of every activated sludge treatment system are:
- a. Primary treatment, secondary treatment, clarification and disinfection
- b. Pre-treatment, aeration, clarification and disinfection
- *c. Aeration, clarification, return sludge and waste sludge
- d. Pre-treatment, primary treatment, secondary treatment and disinfection
92. The basic objective in the activated sludge process is to maintain balanced conditions in the aeration basin, this balance is called:
- a. Endogenous respiration
- *b. Food/microorganism ratio
- c. Equilibrium status
- d. Mass balance ratio
93. The volume of settled sludge in the 30 minute settleability (ml/l) times 1000, divided by the MLSS concentration is called:
- *a. Sludge Volume Index
- b. Sludge Age
- c. Sludge Mass Ratio
- d. Mean Cell Residence Time

94. In the activated sludge treatment process, there are several control methods. One method is to maintain a BOD:MLVSS ratio. This is commonly referred to as:
- a. MCRT.
 - b. SA.
 - c. SA:SDI.
 - *d. F:M.
 - e. TS:SRT
95. The 1-liter graduated cylinder is used to measure the volume concentration of settleable solids.
- a. clarity of sludge supernatant.
 - b. suspended solids concentration in mg/L.
 - *c. 30-minute mixed liquor sludge settleability.
 - d. the sludge volume index in g/L
96. In calculating the detention time in an aeration tank, which one factor would not be considered?
- a. tank volume
 - b. RAS flow
 - c. plant flow
 - *d. MLSS concentration
 - e. none of the above
97. The BOD loading rate divided by the quantity of microorganisms present in the biological reactors (aeration tanks) is known as:
- a. organic loading
 - b. toxicity
 - c. hydraulic loading
 - *d. food to microorganism ration F:M
98. Sludge wasting from secondary clarifiers, are normally required in order to control
- a. Effluent BOD.
 - b. Effluent suspended solids.
 - c. Aerator mixed liquor solids.
 - *d. Sludge settleability
99. An activated sludge process that has a desired F/M ratio of 0.05 and a sludge age of 30 days is what type of activated sludge process modification?
- *a. Extended aeration
 - b. Conventional
 - c. Complete mix
 - d. Oxidation ditch
100. Two major operational difficulties which sometimes occur in activated sludge secondary clarifiers are:
- *a. Low D.O. and algae growth
 - b. Short circuiting and scum accumulation
 - c. Rising sludge and bulking sludge
 - d. Long detention time and short MCRT.
101. A thick, scummy, dark tan foam on the surface of an activated sludge aeration tank is an indication of:
- *a. Aeration tank is underloaded (high MLSS).
 - b. Aeration tank is overloaded (low MLSS).

- c. Excess grease in raw wastewater
 - d. Excess phosphates (detergents. in raw wastewater)
102. The four (4) basic components of every activated sludge treatment system are:
- a. Primary treatment, secondary treatment, clarification and disinfection
 - b. Pre-treatment, aeration, clarification and disinfection
 - *c. Aeration, clarification, return sludge and waste sludge
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 - c. plant flow
 - *d. MLSS concentration
 - e. none of the above
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- a. tank volume
 - b. RAS flow
 - c. plant flow
 - *d. MLSS concentration
 - e. none of the above
112. A good quality of activated sludge is shown by:
- a. Black color and very small particle size
 - b. Finely dispersed milky white particles
 - c. A chocolate brown MLSS that does not settle well in the jar test
 - d. A sludge that settles in one minute in the jar test
 - *e. A chocolate color which settles out in 20-30 minutes with a D.O. of 2.0
113. An activated sludge process that has a desired F/M ratio of 0.05 and a sludge age of 30 days is what type of activated sludge process modification?
- *a. Extended aeration
 - b. Conventional
 - c. Complete mix
 - d. Oxidation ditch
114. An aerobic treatment process is one that requires the presence of:
- a. Ozone
 - b. organic oxygen
 - c. no oxygen
 - d. combined oxygen
 - *e. dissolved oxygen
115. 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
116. A rapid and significant increase in filamentous organisms in the mixed liquor may be expected to:
- a. Result in a far better effluent because of the great amount of surface area for absorption
 - b. Plug up the return sludge pumps because the filaments hang upon valves and gaskets in the sludge line
 - c. Lead to much denser return sludge because the filaments would tend to strain the dispersed cells of ordinary organisms out of the effluent
 - *d. Cause bulking of the sludge solids to the point that some solids might be swept out along with

- an otherwise clear liquid phase and result in turbid, poor quality effluent
- e. Lead to a much lower F/M ratio because the filaments are so totally insoluble.
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- c. Lead to much denser return sludge because the filaments would tend to strain the dispersed cells of ordinary organisms out of the effluent
- *d. Cause bulking of the sludge solids to the point that some solids might be swept out along with an otherwise clear liquid phase and result in turbid, poor quality effluent
- e. Lead to a much lower F/M ratio because the filaments are so totally insoluble.
118. In the activated sludge treatment process, there are many control methods. One method is to maintain a constant BODs:MLVSS ratio. sludge treatment process. This is commonly referred to as:
- a. MCRT
- b. SA
- c. SA: SDI
- *d. F:M
- e. TS:SRT
119. The SVI of activated sludge is defined as:
- a. the volume of settled mixed liquor after 30 minutes or settling
- b. the weight in grams of 200 ml of settled activated sludge
- *c. the volume in ml of 1 gram of activated sludge after 30 minutes of settling
- d. the total volume of MLSS in the aeration tank
- e. the volume of settled sludge in the secondary clarifier
120. The amount of air required in the operation of an activated sludge aeration tank is independent of the:
- a. temperature
- b. flow
- c. detention time
- d. organic loading
- *e. none of the above
121. The successful operation of an activated sludge plant requires the maintenance of proper solids concentration in the system. One major limiting factor is:
- a. mixed liquor tank volume
- b. effluent flow
- *c. air supply
- d. chlorine demand
- e. none of the above
122. The main difference between primary and secondary clarifiers is the:
- a. overall dimensions
- b. type of outlet weirs
- *c. density of sludge
- d. detention period
- e. flow distribution
123. Given the data below, what is the most likely cause of the extended aeration facility problem?

DATA: DO level high

Blower normal

Wastewater characteristics normal

Drop pipe air control valves open

Surface turbulence high

a. Air relief valve stuck shut

*b. Blower speed too fast

c. Blower speed too slow

d. Drop pipe air control valves not open far enough

124. What test is used to determine the organic matter found in the mixed liquor?

a. COD

b. MLSS

*c. MLVSS

d. TOC

125. Fixed porous plate diffusers can be cleaned by scrubbing with

a. Detergent

b. A strong acid solution

*c. A strong chlorine solution

d. A weak sodium hydroxide solution

126. Given the following data, what is the most likely cause of the activated sludge problem?

DATA:

The aeration tanks in an activated sludge plant have maintained a stable white foam with a brownish tint less than one inch thick

BOD removals have been at their normal high efficiency

Settling of the activated sludge in the secondary

clarifiers has been good - as is normal

Air supplied to the system has been a normal 30,000 cfm, with a consistent DO of 25 mg/L

MLSS has been maintained at 2,500 mg/L - normal

Gradually during your shift the DO has risen to 50 mg/L

a. A toxic substance has affected the activated sludge

b. BOD loading on the aeration system has increased.

c. Increased BOD loading has caused a corresponding increase in activated sludge activity

*d. No change

127. Sludge wasting from secondary clarifiers, are normally required in order to control

a. Effluent BOD.

b. Effluent suspended solids.

c. Aerator mixed liquor solids.

*d. Sludge settleability

128. The four (4) basic components of every activated sludge treatment system are:

a. Primary treatment, secondary treatment, clarification and disinfection

b. Pre-treatment, aeration, clarification and disinfection

*c. Aeration, clarification, return sludge and waste sludge

d. Pre-treatment, primary treatment, secondary treatment and disinfection

129. The basic objective in the activated sludge process is to maintain balanced conditions in the aeration basin, this balance is called:

- a. Endogenous respiration
 - *b. Food/microorganism ratio
 - c. Equilibrium status
 - d. Mass balance ratio
130. A 30 minute settleability test MLSS sample should be collected:
- a. At the primary clarifier effluent
 - b. In the return sludge line
 - c. Where the return sludge mixes with the aeration basin contents
 - d. At the aeration basin influent
 - *e. At the aeration basin outlet
131. A consulting engineer has recommended addition of a roughing filter and intermediate clarifier between your primary clarifier and aeration basin to better handle increasing industrial loads. This addition would:
- a. Be the best form of flow equalization available
 - b. Remove most of the fixed dissolved solids
 - c. Reduce drastically the fine dissolved matter
 - d. Cost a lot and do nothing
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135. The volume of settled sludge in the 30 minute settleability (ml/l) times 1000, divided by the MLSS concentration is called:
- *a. Sludge Volume Index
 - b. Sludge Age
 - c. Sludge Mass Ratio
 - d. Mean Cell Residence Time
136. The most important adjustments to the activated sludge process are made by adjusting
- a. Aeration, pH and RAS
 - b. Aeration, pH and WAS
 - *c. RAS, WAS and aeration
 - d. pH, RAS and WAS

137. In the activated sludge treatment process, there are several control methods. One method is to maintain a BOD:MLVSS ratio. This is commonly referred to as:
- a. MCRT.
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138. In calculating the detention time in an aeration tank, which one factor would not be considered?
- a. tank volume
 - b. RAS flow
 - c. plant flow
 - *d. MLSS concentration
 - e. none of the above
139. The BOD loading rate divided by the quantity of microorganisms present in the biological reactors (aeration tanks) is known as:
- a. organic loading
 - b. toxicity
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140. Sludge wasting from secondary clarifiers, are normally required in order to control
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141. An activated sludge process that has a desired F/M ratio of 0.05 and a sludge age of 30 days is what type of activated sludge process modification?
- *a. Extended aeration
 - b. Conventional
 - c. Complete mix
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142. An activated sludge process that has a desired F/M ratio of 0.05 and a sludge age of 30 days is what type of activated sludge process modification?
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143. Two major operational difficulties which sometimes occur in activated sludge secondary clarifiers are:
- *a. Low D.O. and algae growth
 - b. Short circuiting and scum accumulation

- c. Rising sludge and bulking sludge
 - d. Long detention time and short MCRT.
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 - e. none of the above
154. Possible techniques for controlling filamentous organisms in an activated sludge process include:
- *a. Dosage of return sludge with a disinfectant such as chlorine or hypochlorite
 - b. Lower DO levels in aeration tanks so filamentous organisms cannot breathe or respire
 - c. Lower F/M level to starve filamentous organisms
 - d. Stop wasting to allow activated sludge bugs to gain control
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 - c. Lower F/M level to starve filamentous organisms
 - d. Stop wasting to allow activated sludge bugs to gain control
156. An activated sludge process that has a desired F/M ratio of 0.05 and a sludge age of 30 days is what type of activated sludge process modification?
- *a. Extended aeration
 - b. Conventional
 - c. Complete mix
 - d. Oxidation ditch
157. An aerobic treatment process is one that requires the presence of:
- a. Ozone
 - b. organic oxygen
 - c. no oxygen
 - d. combined oxygen
 - *e. dissolved oxygen
158. 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
159. A rapid and significant increase in filamentous organisms in the mixed liquor may be expected to:
- a. Result in a far better effluent because of the great amount of surface area for absorption
 - b. Plug up the return sludge pumps because the filaments hang upon valves and gaskets in the

sludge line

c. Lead to much denser return sludge because the filaments would tend to strain the dispersed cells of ordinary organisms out of the effluent

*d. Cause bulking of the sludge solids to the point that some solids might be swept out along with an otherwise clear liquid phase and result in turbid, poor quality effluent

e. Lead to a much lower F/M ratio because the filaments are so totally insoluble.

160. A thick, scummy, dark tan foam on the surface of an activated sludge aeration tank is an indication of:

*a. Aeration tank is underloaded (high MLSS).

b. Aeration tank is overloaded (low MLSS).

c. Excess grease in raw wastewater

d. Excess phosphates (detergents. in raw wastewater

161. During severe cold weather operation of an activated sludge plant biological activity and clarifier sludge settling is reduced. White of the following might help?

*a. Increase the MLSS

b. Decrease the MLSS

c. Increase the D.O.

d. Decrease the D.O.

e. Add ammonia

162. Excess white foam in an aeration basin can be corrected by

a. Decreasing the aeration rate

b. Decreasing detention time

*c. Increasing the MLSS

d. Decreasing the MLSS

e. Increasing aeration rate

163. Given the following data, what is the most likely cause of the activated sludge problem?

DATA: The aeration tanks in an activated sludge plant have maintained a stable white foam with a brownish tint less than one inch thick. ·

BOD removals have been at their normal high efficiency.

Settling of the activated sludge in the secondary clarifiers has been good - as is normal.

Air supplied to the system has been a normal 30,000 cfm, with a consistent DO of 2.5 mg/L.

MLSS has been maintained at 2,500 mg/L - normal.

Gradually during your shift the DO has risen to 5.0 mg/L.

a. A toxic substance has affected the activated sludge.

b. BOD loading on the aeration system has increased.

c. Increased BOD loading has caused a corresponding increase in activated sludge activity.

*d. No change.

164. Given the following data, what is the most likely cause of the secondary sedimentation tank problem?

DATA: Sludge depth in tank too high.

Tank effluent turbid.

Tank effluent requiring above normal chlorine dosage. Sweeparms in tank bottom operating.

Return activated sludge flow to aeration tank low.

Controls on return activated sludge pump on automatic.

Control sensors for return sludge operating normally.

- a. Accuracy of sludge depth measurement.
 - b. Return activated sludge pump worn, needing repair.
 - *c. Speed of sweeparms travel.
 - d. Sweep arm overload tripped.
165. How many gallons of paint will be required to paint the walls of a 40 ft long x 65 ft wide x 20 ft high tank if the paint coverage is 150 sq. ft per gallon. Note: We are painting walls only. Disregard the floor and roof areas.
- *a. 28 gallons
 - b. 63 gallons
 - c. 35 gallons
 - d. 56 gallons
166. If there is an insufficient supply of air or oxygen being introduced into the aeration tank of an extended aeration plant, the liquid in the tank will likely
- a. Contain a very fine light brown floc.
 - b. Contain very small air bubbles.
 - *c. Have a black or blackish appearance and an offensive odor.
 - d. Have a dishwater appearance and a greasy odor.
167. If the return sludge pump does not function the effect on other unit processes will be to:
- a. Turn the aeration basin influent dark
 - b. Increase chlorine residual
 - *c. Increase effluent suspended solids
 - d. All the above
 - e. None of the above.
168. If the sludge depth in a secondary sedimentation tank is too high, what will happen?
- a. Decreased turbidity in effluent.
 - b. Return activated sludge will have lower oxygen demand.
 - c. Settleable solids from aeration tank will increase.
 - *d. Sludge may become septic.
169. If you must waste sludge from an activated sludge plant the maximum rate is:
- *a. 20 % per day
 - b. 40 % per day
 - c. 60 % per day
 - d. 75% per day
 - e. 100 % perday
170. In an activated sludge system, what is perhaps the most important parameter affecting biological activity?
- a. pH.
 - b. Alkalinity.
 - *c. Dissolved oxygen.
 - d. Temperature.
171. In calculating the detention time in an aeration tank, which one factor would not be considered?
- a. tank volume
 - b. RAS flow
 - c. plant flow
 - *d. MLSS concentration

- e. none of the above
172. In the activated sludge treatment process, there are several control methods. One method is to maintain a BOD:MLVSS ratio. This is commonly referred to as:
- a. MCRT.
 - b. SA.
 - c. SA:SDI.
 - *d. F:M.
 - e. TS:SRT
- Mean cell residence time (MCRT, represents the theoretical time that a microorganism stays in the activated sludge system. The typical values for most activated sludge processes are:
- a. 3 - 30 days
 - *b. 3 - 15 days
 - c. 5 - 15 days
 - d. 5 - 20 days
173. Nocardia is associated with a particular type of brown, viscous scum or foam on the surface of the activated sludge aeration tank. One operational strategy that has been somewhat successful in reducing the severity of this foam is:
- a. to increase the plant's MCRT.
 - *b. to decrease the plant's mixed liquor concentration.
 - c. to operate at an F:M ratio of less than 0.025.
 - d. to spray the foam with fine mist water sprays.
 - e. to increase the luxury DO concentration at the end of the aeration tank.
174. One limitation in using constant mixed liquor volatile suspended solids (MLVSS) or mixed liquor total suspended solids (MLTSS) as the control methodology for activated sludge treatment is
- *a. In practice it is not possible to operate at a constant MLTSS or MLVSS.
 - b. It is based on consistency of raw waste load which seldom exists.
 - c. Most facilities don't have the lab equipment necessary to determine MLVSS.
 - d. None of the above.
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