7. Examination Questions

1. The treatment given to settled wastewater in an aeration tank is accomplished by *Basic*

a. Simple chemical reactions involving the combination of nitrogen with organic matter.
b. The agitation that causes the wastewater solids to become so finely divided that settling in the receiving stream is impossible.
c. The attachment of air bubbles to the wastewater solids, thus forcing them to be carried into the final settling tank.
d. The organisms living in the activated sludge that use the organic matter for food and convert it to a less objectionable condition.

2. The term "bioprecipitation," which describes a process in wastewater treatment, may properly be applied to *Advanced*

a. Oxidation by trickling filters followed by chlorination.
b. The activated sludge process.
c. Chemical coagulation.
d. Sedimentation.
e. Intermittent sand filtration.

3. The term "activated sludge" refers to *Basic*

a. The solids removed from wastewater in a degritting process using aeration.
b. The material precipitated from raw wastewater when activated silica gel is used as a coagulating agent.
c. The sludge in a digester having a high volatile acids content.
d. The brownish flocculent culture of organisms developed in an aeration tank under controlled conditions.

4. The aeration and oxidation of wastewater is accomplished most effectively by *Basic*

a. Introducing air under pressure, as in an air-lift, to the pipe connections between tanks through which wastewater is being passed.
b. Introducing compressed air at one side and near the bottom of tanks through which the wastewater flows.
c. Blowing air upward through porous plates in the bottom and center of tanks through which the wastewater flows.
d. Operating revolving paddles half submerged in the wastewater flowing through a tank.
e. Passing the wastewater over several flights of step aerators.

5. Mixed liquor is *Basic*

a. A chemical mixture added to the raw wastewater to control odors.
b. A mixture of activated sludge and wastewater in the aeration tank undergoing activated sludge treatment.
c. Harmful to the plant and should be wasted to the digester.
d. All of the above.
e. None of the above.

6. The bacteria used in the activated sludge process *Basic*

a. Are obtained from companies that sell "enzymes."
b. Would also be found in septic tanks.
c. Are normally present in any domestic wastewater.
d. May be killed if the DO level is held at 0.5 to 2.0 mg/l for 6 hr.

7. In a conventional activated sludge plant, the principal purpose of returning sludge to the aeration tank is to *Basic*

a. Keep it always in circulation.
b. Maintain a satisfactory biological population.
c. Concentrate the incoming primary effluent.
d. Oxidize inorganic solids.

8. Which of the following is a modification of the activated sludge process? *Basic*

a. Aerated lagoons.
b. Contact stabilization.
c. Activated carbon filters.
d. Wet oxidation.

9. The Kraus process is sometimes used in connection with *Basic*

a. Grit removal.
b. Biofiltration.
c. Chemical precipitation.
d. The activated sludge process.

10. One of the differences between extended aeration and the conventional activated sludge system is *Basic*

a. The type of wastewater treated.
b. The amount of settleable solids in the influent.
c. The presence or absence of primary tank.
d. The presence or absence of comminutor.
e. The type of biological growth in the aeration tank.

11. Which of the following is not a modified method of the activated sludge process? *Advanced*

a. Step aeration.
b. Complete mixing.
c. Kraus process.
d. Contact stabilization.
e. Wet oxidation process.

12. The Kraus process is used when *Advanced*

a. BOD in raw wastewater is very low.
b. The nitrogen content in raw wastewater is excessive.
c. The settleable solids fraction in raw wastewater is very high.
d. Sludge digestion is working very poorly.
e. The ratio of carbonaceous : nitrogenous material is higher than normal.

13. The Kraus process is used mainly to supply _____ to the activated sludge system. *Advanced*

a. Digested sludge.
b. Oxygen.
c. Carbonaceous material.
d. Nitrogenous material.
e. Phosphorus.

14. The air introduced into wastewater in the aeration tank of an activated sludge plant serves mainly to *Basic*

a. Agitate the mixture and provide oxygen for the organisms present in the activated sludge.
b. Agitate the mixture and provide nitrogen for the organisms present in the activated sludge.
c. Displace the hydrogen sulfide in the wastewater.
d. Maintain the desirable temperature in the wastewater.

17. How may one determine when the air filters of an aeration system need cleaning? *Advanced*

a. By visual observation.
b. By hearing the noise.
c. By sampling the air at the upstream and downstream side of the filter.
d. By differential pressure between the intake and discharge of the filter.
e. By the BOD removal efficiency in the trickling filter.

18. The primary purpose of the final settling tank following an aeration tank at an activated sludge plant is to *Basic*

a. Hold the aerated wastewater long enough to allow the activated sludge floc to use all of the available DO.
b. Hold the aerated wastewater long enough to allow the excess DO to escape to the atmosphere.
c. Provide a longer period of contact between the activated sludge and the wastewater.
d. Provide conditions that will allow the activated sludge to settle, thus preventing it from being discharged to the receiving stream.

19. Oxygen requirements for aeration are dependent on *Basic*

a. BOD.
b. SS.
c. Toxic materials.
d. Salt.

20. The amount of oxygen required in an aeration tank depends partially on the *Basic*

a. Type of diffusers.
b. Size of blowers.
c. Amount of solids in the mixed liquor.
d. Depth of aeration tank.

21. Depletion of DO levels may be expected during *Basic*

a. The presence of large amounts of unstable organic materials.
b. High coliform counts.
c. Periods of failure of effluent chlorinator.

22. Air requirements in an activated sludge tank are governed by *Advanced*

a. The BOD loading and the desired efficiency in BOD removal.
b. The SS concentration in the primary clarifier effluent.
c. The volatile solids content of the tank.
d. All of the above.
e. None of the above.

23. Which of the following would not affect the DO content of mixed liquor in an activated sludge plant? *Advanced*

a. Change of Wane index.
b. SS content.
c. Rate of air feed to the tank.
d. Turbulence of the tank.
e. Temperature of the waste.

24. The DO test would be most helpful in controlling efficiency in the *Basic*

a. Grit chamber.
b. Primary sedimentation tank.
c. Digester.
d. Aeration tank.

25. The best laboratory control tests to be performed on the aerated wastewater in the aeration basin of an activated sludge plant are *Basic*

a. SS and chlorine demand.
b. BOD and chlorine demand.
c. pH and alkalinity.
d. DO and SS.
e. BOD and SS.

26. A good quality of activated sludge is shown by *Basic*

a. Black color and very small particle size.
b. The ability to stay well mixed throughout a sample when allowed to stand in a glass jar.
c. A zero DO content.
d. Brown color, good settling characteristics, and some DO present.

27. Settled activated sludge is generally _____ than raw sludge. *Basic*

a. Thinner.
b. Thicker.
c. Denser.
d. Saltier.
e. None of the above.

28. What should one do if a mixed liquor sample is taken from an aeration tank and, after 30 min, solids settle to the bottom and then float to the top? *Advanced*

a. Add coagulant.
b. Reduce BOD loading.
c. Reduce aeration rate.
d. Increase chlorine contact time.
e. Increase nitrate concentration by adding sodium nitrate to the aeration tank.

29. Frothing in an aeration tank may be alleviated by

a. Increasing the aeration rate. *Advanced*
b. Increasing the detention time.
c. Increasing the polysaccharide content.
d. Decreasing the digester supernatant return.
e. Maintaining a high mixed liquor suspended solids (MLSS) concentration.

30. Assuming a steady aeration rate, as MLSS increase, DO in the aeration tank would be expected to *Advanced*

a. Remain steady.
b. Increase.
c. Decrease.
d. Rise above 2 mg/l.

31. Assuming insufficient withdrawal of secondary sludge, which of the following conditions would be expected to exist? *Advanced*

a. Presence of gas bubbles in the secondary clarifier.
b. Sludge rising to the surface in the secondary clarifier.
c. Sludge in the chlorine contact chamber.
d. Odors near the secondary clarifier.
e. All of the above.
f. None of the above.

32. The floc mass in an activated sludge aeration tank generally consists of *Basic*

a. Bacteria only.
b. Yeast and fungi.
c. Iron oxides.
d. Suspended clay.
e. Microorganisms.

33. Recycling of activated sludge back to the aeration tank

a. Lowers the DO of the effluent. *Advanced*
b. Provides bacteria for incoming wastewater.
c. Reduces the need for air in the aeration tank.
d. Is dependent on the temperature of the sludge.

34. Why must some activated sludge be wasted? *Advanced*

a. To prevent clogging of sludge return line.
b. To prevent overloading of sludge return pumps.
c. To improve filterability of sludge.
d. To prevent an excessive solids buildup.
e. To increase digester gas production.

35. The purpose of the sludge division box is to *Advanced*

a. Concentrate the waste activated sludge.
b. Divert the waste activated sludge directly to the digester.
c. Separate the organic solids from the grit.
d. Separate the final tank sludge into two portions, diverting some to the aerators and some to waste.

36. Sludge should be pumped from the final settling tanks of a conventional activated sludge plant *Basic*

a. At least once a day.
b. When sampling indicates the sludge is about 2 ft deep.
c. Continuously.
d. Often enough to prevent flotation of sludge solids resulting from septic action.

37. When the return sludge rate in activated sludge process is too low, what happens? *Basic*

a. The tank will not fill.
b. There will be insufficient organisms to meet the waste load entering the aerator.
c. The activated sludge in the aerator will starve.
d. The activated sludge in the primary clarifier could become septic.
e. The sludge blanket in the secondary clarifier could become too low.

38. Activated return sludge *Basic*

a. Is normally returned continuously to the aeration tank.
b. Should be brown in color with no obnoxious odor.
c. Is often also returned in small portions to the primary settling tanks to aid sedimentation.
d. All of the above.
e. None of the above.

39. The concentration of the SS in the mixed liquor is usually controlled by *Basic*

a. Adjustment of the air flow.
b. Adjustment of detention period.
c. Adjustment of the wastewater flow.
d. Adjustment of the waste sludge control device.

40. A common method of disposal of waste activated sludge is to return it to primary sedimentation. Combining raw sludge and waste activated sludge is desirable because *Basic*

a. Waste activated sludge increases the sedimentation rate of raw sludge.
b. Raw sludge acts somewhat as a coagulant and increases the settling rate of waste activated sludge.
c. It is the easiest and cheapest method of disposal.

41. The division of flow from a sludge division box *Advanced*

a. Once set at proper proportions should remain unchanged indefinitely.
b. Should be altered as often as necessary to maintain the desired concentration of solids in the aerators.
c. Should be altered as often as necessary to maintain the desired concentration of solids in the primary settling tank.
d. Is determined by the desired efficiency of the primary settling tank.

42. When operating an activated sludge plant, which is the most important SS test? *Advanced*

a. Primary effluent.
b. Aerator mixed liquor.
c. Chlorine tank effluent.
d. Final clarifier effluent.
e. Plant influent.

43. The amount of active biological mass in the aeration tank may best be estimated by *Advanced*

a. Settleable solids.
b. SS.
c. Volatile acid.
d. VSS.
e. Dissolved organic matter.

44. Sludge age may expressed by *Advanced*

a. Pound of BOD in aeration tank per day per pounds of BOD added.
b. Pounds of BOD in aeration tank per day per pounds of SS added.
c. Pounds of VSS in aeration tank per day per pounds of VSS added.
d. Pounds of dissolved solids in aeration tank per day per pounds of VSS added.
e. Pounds of SS in aeration tank per day per pounds of SS added.

45. If the concentration of sludge solids in the aeration tank is not controlled, the excess sludge will *Basic*

a. Be completely oxidized in the aeration tank.
b. Appear in the plant effluent.
c. Cause the tank to turn black or septic.
d. Not cause any difficulty.

46. The condition known as bulking of activated sludge refers to *Basic*

a. A decrease in the ability of the sludge to settle and its consequent loss over the settling tank weirs.
b. An increase in the specific gravity of the sludge.
c. The loss of DO in the mixed liquor.
d. A sizable increase in the amount of the sludge present.

47. Sludge volume index (SVI) is measured on *Basic*

a. Mixed liquor of aeration tank.
b. Settled sludge.
c. Primary supernatant.
d. Chlorine tank effluent.
e. Digester supernatant.

48. Results from the settleability test of activated sludge solids may be used to *Advanced*

a. Calculate SVI.
b. Calculate COD.
c. Calculate residual chlorine.
d. Determine ability of oil to separate from liquid in final clarifier.
e. All of these.

49. The SVI is *Advanced*

a. The percentage of the final settling tank volume occupied by sludge.
b. An index of the probable settling properties of activated sludge.
c. The volume of sludge added to the digester per day.
d. The volume of 1 lb of primary sludge after settling 1 hr in an Imhoff cone.

50. Good settling quality of activated sludge is indicated by

a. A high SVI. *Basic*
b. A low sludge density index.
c. A low SVI.
d. A low sludge age.

51. A rise in the SVI indicates that *Basic*

a. The density of the sludge is increasing.
b. The volatile content of the sludge is decreasing.
c. There is danger of bulking sludge.
d. The sludge is settling faster.

52. Causes of sludge bulking include *Basic*

a. Bulk of sludge too large.
b. Air supply too high.
c. Loading rate too high.
d. Diffuser distance too short.
e. CO_2 content in air too high.

53. Bulking in activated sludge aeration tanks, as associated with operation, is caused mainly by *Advanced*

a. Presence of DO.
b. Low inorganic content.
c. Too high a temperature of sludge.
d. Low grease content.
e. Excess SS content.

54. Sludge bulking in the final settling tank of an activated sludge plant may be caused by improper balance of BOD load, SS concentration in the mixed liquor, and the *Advanced*

a. Depth of the aeration tank.
b. Length of the aeration tank.
c. Amount of air used in aeration.
d. Size of the final settling tank.
e. Amount of chlorine added.

55. Remedial steps to prevent sludge bulking are *Basic*

a. Reduction of solids content of aeration tank by removal of some of the activated sludge as excess.
b. Chlorination of return activated sludge.
c. Reaeration of return activated sludge before return to the aeration tanks.
d. All of the above.

56. Bulking activated sludge will *Basic*

a. Settle quickly.
b. Result in high plant efficiency.
c. Prevent algae blooms.
d. Result in high solids removal.
e. Be caused by abnormally high pH industrial waste.

57. Chlorination of return activated sludge is practiced when *Advanced*

a. Filamentous organisms are present, causing bulking.
b. The BOD loading to the aerator is too low.
c. The oxygen content in the aerator is too low.
d. Nitrification is proceeding in the final settling tank, causing rising sludge.

58. Bulking sludge in the final clarifier of an activated sludge plant may result in *Basic*

a. Septic activated sludge.
b. Plugged air diffusers.
c. Excessive discharge of SS.
d. Decreased detention time in aeration tank.

59. 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 probably *Basic*

a. Have a dishwater appearance and an odor of grease.
b. Have a black or brackish appearance and an offensive odor.
c. Appear dark brown and have no odor.
d. Contain a very fine light brown floc.

60. When the plant is operating properly, the color of the liquid in the aeration tank of an extended aeration plant should be *Basic*

a. Similar to dishwater.
b. Black.
d. Dark brown.
c. Clear.

61. An estimate of the quantity of MLSS to be wasted from the aeration tank of an extended aeration plant may be determined by *Basic*

a. The temperature of the sludge solids.
b. The pH of the sludge solids.
c. The appearance of the sludge solids.
d. The rate of settling and centrifuge test on the sludge solids.

62. The rate of biological activity per pound of activated sludge in the oxidation ditch process in the summer is _____ that in the winter. *Advanced*

a. More than
b. Less than
c. The same as

63. Solid wasting in the extended aeration systems is required because of *Advanced*

a. Volatile fraction of SS.
b. Inert fraction of SS.
c. Phosphorus content in wastewater.
d. Settleable solids in raw wastewater.
e. Colloidal fraction in SS.

Answer Key

SECTION 7 - Activated Sludge and Aerobic Digestion

1. d
2. b
3. d
4. b
5. b
6. c
7. b
8. b
9. d
10. c
11. e
12. e
13. d
14. a

17. d
18. d
19. a
20. c
21. a
22. d
23. a
24. d
25. d

26. d
27. a
28. a & b
29. e
30. c
31. e
32. e
33. b
34. d
35. d
36. c
37. b
38. d
39. d
40. b
41. b
42. d
43. d
44. e
45. c
46. a
47. a
48. a
49. b
50. c

51. c
52. c
53. e
54. c
55. d
56. e
57. a
58. c
59. b
60. d
61. d
62. a
63. b