

5. Examination Questions

1. The factor that affects the rate of sludge digestion is *Basic*
 - a. Temperature.
 - b. Mixing or recirculation.
 - c. Manner of feeding raw sludge.
 - d. All of the above.

2. Sludge digestion is a decomposition process whereby waste materials are *Basic*
 - a. Dried on a drying bed.
 - b. Completely disinfected.
 - c. Filtered.
 - d. Biologically and chemically changed.
 - e. All of these.

3. The contents of a primary digester should be mixed to *Basic*
 - a. Distribute food in the tank.
 - b. Allow solids separation.
 - c. Keep the temperature below 60° F.
 - d. Warm up the sludge.
 - e. Increase the solids content of digested sludge.

4. The most favorable way to maintain a digester fed with primary sludge is to pump *Basic*
 - a. Once a day.
 - b. In small amounts at frequent intervals.
 - c. In large quantities with rest.
 - d. When the volatile solids drop below 60 percent.

5. Which of the following is less critical in bringing in a digester? *Basic*
 - a. Proper pH.
 - b. Heat 90° to 100° F.
 - c. A high percentage of solids.
 - d. Seed sludge.

6. Which test is not used to control an anaerobic digester? *Basic*
 - a. pH.
 - b. Alkalinity.
 - c. Chlorine residual.
 - d. CO₂ content of gas.

7. The volatile acids level should not be allowed to advance beyond *Basic*
 - a. 5 mg/l.
 - b. 2,000 mg/l.
 - c. 20,000 mg/l.

8. Buffer capacity in a digester is measured by *Basic*
 - a. Total dissolved solids.
 - b. Volatile solids content.
 - c. Chlorine residual.
 - d. Total alkalinity.
 - e. pH.

9. The purpose of sludge digestion is *Advanced*
- To decompose enough of the organic matter to avoid creating a nuisance.
 - To separate the liquid from the solids to facilitate drying.
 - To decrease the bulk of the sludge to facilitate handling.
 - All of these.
10. The temperature of a digester should not be changed more than 1° F/day to *Advanced*
- Avoid excessive heat losses.
 - Avoid overloading the heat exchanger.
 - Allow the walls of the digester time to expand and contract.
 - Allow the organisms in the digester time to adjust to the temperature change.
 - Allow time for heating gas to be produced in the digester.
11. If the effect of temperature on the rate of sludge digestion is considered, it may be safely assumed that *Advanced*
- A digester operating at 90° F can safely handle more sludge than one operated at 60° F.
 - Temperatures of 85° to 95° F will destroy the bacteria present in a digester.
 - Digestion will be most satisfactory if the temperature of the digester is maintained at the same temperature as the incoming raw sludge.
12. The reason for concentrating (thickening) sludges before digestion is to *Advanced*
- Increase detention time.
 - Reduce pumping.
 - Reduce heat requirements.
 - All of the above.
 - None of the above.
13. The action that occurs in a properly functioning anaerobic sludge digester may best be described as *Advanced*
- A biological and chemical process that breaks down complex organic substances in the absence of atmospheric oxygen into a simpler and more stable state.
 - An aerobic process of decomposition of organic solids.
 - A purely chemical process of separating the liquid from the solids.
14. Sludge digestion tank capacity requirements vary with the type of sludge to be handled. With heated tanks, the recommended cubic feet to be allowed per capita are *Advanced*
- 1 to 3
 - 2 to 4
 - 4 to 8
 - 6 to 12

15. The proper pH range for digested sludge is *Advanced*
- 5.8 to 6.2
 - 7.8 to 8.2
 - 6.8 to 7.2
 - None of the above.
16. As a digester approaches a "sour" condition *Advanced*
- Alkalinity of the sludge decreases.
 - Concentration of volatile acids increases.
 - Amount of methane production decreases.
 - All of the above.
17. The volatile acids in a well-operating digester reported as acetic acid should normally be held *Advanced*
- Below 10 mg/l.
 - Above 2,500 mg/l.
 - Between 50 and 500 mg/l.
 - Between 500 and 2,000 mg/l.
18. "Volatile acids" is a good control test for sludge digestion because it *Advanced*
- Measures the pH of the sludge.
 - Gives an early indication that the digestion process is upset.
 - Measures the alkalinity of the sludge.
 - Measures the amount of acid gas produced by the sludge.
19. The purpose of the recirculation of digested sludge may be *Advanced*
- To mix raw sludge with the anaerobic bacteria present.
 - To increase the efficiency of the heating of sludge in the digester.
 - To aid in scum control.
 - All of these.
20. A low hydrogen ion concentration of a digester may be adjusted by the use of *Advanced*
- Chlorine.
 - Distilled water.
 - Lime.
 - Fresh wastewater.
 - CO₂.
21. In the use of lime in a digester, which of the following takes place? *Advanced*
- The concentration of hydrogen ions decreases.
 - The concentration of hydrogen ions increases.
 - The concentration of OH ions decreases.
 - The calcium carbonate decreases.
22. Digester conditions are most favorable when primary sludge is added *Advanced*
- In small amounts at frequent intervals.
 - Preconditioned with lime.
 - In large quantities at infrequent intervals.
 - Once each day.

23. As a result of the digestion process, the solids are concentrated in such a way that the liquid separates from the solids. The liquid is called Advanced

- a. Supernatant.
- b. Digested sludge.
- c. Raw wastewater.
- d. SS.
- e. Settleable solids.

24. To prevent the formation of an insulating scale on the outside of digester heating coils, the circulating water inlet temperature should not exceed Advanced

- a. 90° F.
- b. 100° F.
- c. 140° F.
- d. 180° F.
- e. 212° F.

25. The purpose of adding lime to a failing digester is Basic

- a. To lower the pH.
- b. To increase calcium content.
- c. To raise the pH.
- d. To increase enzyme concentration.
- e. To increase acid-forming bacteria.

26. Foaming in a digester usually indicates Basic

- a. That all sludge should be drawn out.
- b. That the plant should be bypassed.
- c. That acid conditions are present.
- d. That the bar screen is not functioning properly.
- e. All of the above.

27. The following would indicate that trouble is brewing in a sludge digestion tank: Basic

- a. Methane gas production remains steady.
- b. The pH remains between 6.8 and 7.2.
- c. The pH falls below 6.8.
- d. The supernatant is unusually clear.

28. In withdrawing sludge from a digester, it is necessary to allow some sludge to remain in order Basic

- a. To prevent overloading the drying beds.
- b. To provide a seed material for raw sludge added to the digester.
- c. To prevent the tank from caving in.
- d. To increase the removal of phosphorous.

29. "Coning" in the digesters occurs when Basic

- a. Production of digester gas increases.
- b. Sludge withdrawal is too fast.
- c. Raw sludge pumping is too fast.
- d. CO₂ production increases.
- e. The digester loading is excessive.

30. An accumulation of sand or cinders in a sludge digester reduces the effective capacity of the digester, because such material Basic

- a. Is not digested but occupies the space that would otherwise be available to sludge in the digestion process.
- b. Kills the organisms responsible for digestion.
- c. Prevents the formation of a scum layer.
- d. Absorbs all of the heat intended for the sludge.

31. The location of a leak in digester gas piping may best be located by Basic

- a. The odor.
- b. Soap solution.
- c. A lighted match.
- d. Ammonia.

32. Wastewater gas normally obtained from a correctly operated digester contains Basic

- a. 70 percent methane.
- b. 70 percent hydrogen sulfide.
- c. 70 percent oxygen.

33. Digester gas usually is a mixture of Basic

- a. Hydrogen, methane, and carbon monoxide.
- b. Methane, carbon dioxide, and hydrogen.
- c. Methane, carbon monoxide, and nitrogen.
- d. Carbon dioxide, nitrogen, and methane.

34. When the content of CO₂ in digester gas increases to above 30 to 40 percent, the digester is Advanced

- a. Improving its gas production.
- b. Not functioning properly.
- c. Operating normally.
- d. Operating very well.
- e. Increasing the heat value of the digester gas.

35. Good sludge digestion will yield approximately how much gas per person per day, if it is assumed that there is no industrial waste? Advanced

- a. 0.25 to 0.45 cu ft.
- b. 0.8 to 1.2 cu ft.
- c. 2.4 to 5.0 cu ft.
- d. 6.0 to 8.0 cu ft.

36. The amount of wastewater sludge gas to be expected per pound of volatile solids added to a digester that is functioning properly is about Advanced

- a. 1 cu ft.
- b. 4 to 6 cu ft.
- c. 8 to 12 cu ft.
- d. 16 to 19 cu ft.

37. A pressure relief on the top of a digester should be set for Advanced

- a. 5 to 10 psi.
- b. 10 to 15 in. of water.
- c. 2 psi above atmospheric.
- d. 59 in. of water.

38. To burn digester gas, the operating pressure is normally *Advanced*
- Over 2 lb pressure.
 - 2 in. to 7 in. of water.
 - 4 in. to 10 in. of mercury.
 - Over 20 in. mercury.
39. A flame trap is found on *Advanced*
- A comminuter.
 - Plant electrical systems.
 - Digester gas piping.
 - Aeration tank piping.
 - None of these.
40. A well-digested sludge should show on analysis a volatile content, dry basis, in the total solids of *Advanced*
- 10 percent.
 - 35 percent.
 - 50 percent.
 - 70 percent.
 - 90 percent.
41. The main purpose of the secondary digester is to allow *Advanced*
- For more sludge digestion.
 - An opportunity for more mixing.
 - Storage for digester gas.
 - The liquids and solids in digested sludge to separate.
 - All of these.
42. If a digestion tank starts foaming at normal temperature, the following control measures should be undertaken at once: *Advanced*
- Increase the temperature 10° F above that normally considered desirable.
 - Recirculate the tank contents and add sufficient lime to maintain a pH of about 7.0.
 - Maintain the same temperature.
 - Shut off all heat.
43. Frequent withdrawing of small quantities of digested sludge is better than occasionally draining the digester because *Advanced*
- It tends to prevent acid conditions.
 - It lessens the chance of foaming.
 - It helps to maintain overall digester efficiency.
 - It helps to maintain a more even yield and composition of gas.
 - All of the above.
44. If the percentage of volatile matter in digested sludge removed from a digester indicates trouble, which of the following is least likely to correct the sick or sour digester? *Advanced*
- Stop feeding the unit.
 - Maintain heat and ensure proper temperature.
 - Make sure that the tank is mixed and is homogeneous throughout.
 - Transfer buffer material (well-digested sludge from another tank) and mix thoroughly.
 - Pull as much sludge as possible from the bottom of the tank onto drying beds.

45. On a dry weight basis, the quantity of fresh solids added daily to the digester should not exceed what percentage of the weight of solids already in the digester? *Advanced*
- 1 to 2 percent.
 - 4 to 6 percent.
 - 5 to 10 percent.
 - 10 to 15 percent.
46. The effective heat value per cubic foot of digester gas is *Advanced*
- 2 to 4 Btu's.
 - 500 to 800 Btu's.
 - 1,500 to 3,000 Btu's.
 - 3,000 to 5,000 Btu's.
47. The Btu value of a cubic foot of gas from a wastewater digester is about the same as the Btu value of *Advanced*
- Manufactured gas.
 - Hydrogen.
 - Propane.
 - Butane.
 - None of these.
48. The terms "standard rate" and "high rate" digestion refer to *Advanced*
- The rate of acid-forming reaction.
 - The rate of methane-forming reaction.
 - The rate of acid- and methane-forming reactions.
 - The rate of loading.
49. An Imhoff tank has *Basic*
- Five compartments.
 - Sludge scrapers.
 - A piping system that allows the flow in the tank to be reversed from one end to the other.
 - A separate sludge digestion compartment under the settling area.
 - An aerobic digester.
50. The slot or slots in the bottom of the sedimentation chambers of Imhoff tanks must be kept free from obstructions. This job may be done by *Basic*
- Superchlorinating the particles that cause obstructions.
 - Reversing the flow.
 - Dragging a chain through the slots.
 - Using a scum hoe.
 - Using a strong acid to dissolve particles that could cause obstructions.
51. The most effective step to inhibit foaming in an overloaded Imhoff tank is to *Basic*
- Avoid disturbing the surface of the scum in the gas vents.
 - Wet down the gas vents frequently.
 - Provide for greater velocity of flow through the sludge discharge lines.
 - Draw off all the sludge.
 - Close off a portion of the vent channels.

52. The best method of maintaining the gas vents of Imhoff tanks in good operating order is to *Advanced*

- a. Add lime regularly.
- b. Reverse the flow in the Imhoff tank.
- c. Break up scum daily with a suitable tool.
- d. Wash off with chlorine.
- e. Stop flow and let them dry out.

53. Excessive quantities of floating sludge in the flow-through compartment of an Imhoff tank indicates *Advanced*

- a. Poor digestion.
- b. Excessive gas production.
- c. That the slot in the bottom of the flow-through compartment is clogged.

54. "Short-circuiting" of wastewater through the sedimentation compartment of a Imhoff tank may occur when *Advanced*

- a. The tank is bypassed.
- b. The raw wastewater pumps are not functioning.
- c. The gas vents are covered with a thick layer of scum.
- d. The influent and effluent baffles are not in place or functioning properly.

55. Sludge withdrawal from a sedimentation or Imhoff tank should be *Advanced*

- a. At a rapid rate.
- b. At a slow enough rate so that wastewater will not break through the sludge.
- c. Forgotten about until such time as the treatment is so fouled up that it has to be done.

56. An Imhoff tank is designed to serve the same purpose in treating wastewater as *Advanced*

- a. An activated sludge tank.
- b. A primary clarifier.
- c. A digestion tank.
- d. A secondary clarifier.
- e. A primary clarifier and a digestion tank.

ANSWER KEY

SECTION 5 - Anaerobic Sludge Digestion

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|-------|-------|-------|
| 1. d | 26. c | 51. b |
| 2. d | 27. c | 52. c |
| 3. a | 28. b | 53. c |
| 4. b | 29. b | 54. d |
| 5. c | 30. a | 55. b |
| 6. c | 31. b | 56. e |
| 7. b | 32. a | |
| 8. d | 33. d | |
| 9. d | 34. b | |
| 10. d | 35. b | |
| 11. a | 36. b | |
| 12. d | 37. b | |
| 13. a | 38. b | |
| 14. a | 39. c | |
| 15. c | 40. c | |
| 16. d | 41. d | |
| 17. c | 42. b | |
| 18. b | 43. e | |
| 19. d | 44. e | |
| 20. e | 45. b | |
| 21. a | 46. b | |
| 22. a | 47. a | |
| 23. a | 48. d | |
| 24. c | 49. d | |
| 25. c | 50. c | |