

Test Your Knowledge of Residuals Management



Roy Pelletier

1. What happens to the pH in an aerobic digester when carbon dioxide is trapped in the sludge?
 - a. The pH decreases.
 - b. The pH increases.
 - c. Carbon dioxide does not affect pH.
 - d. Alkalinity is decreased.
2. What are the two major gases produced in a properly operated anaerobic digestion process?
 - a. Methane and oxygen.
 - b. Methane and carbon dioxide.
 - c. H₂S and CH₄.
 - d. Nitrogen and O₂.
3. What is a typical percent of solids in the final cake of a belt filter press?
 - a. 2 percent to 4 percent.
 - b. 30 percent to 50 percent.
 - c. 15 percent to 20 percent.
 - d. 8 percent to 10 percent.
4. What is the fecal coliform limit to meet standards for Class A biosolids?
 - a. 1,000 #/gram TS
 - b. 10,000 #/gram TS
 - c. 1,000,000 #/gram TS
 - d. 2,000,000 #/gram TS
5. What is the top blanket of sludge called in the dissolved air flotation (DAF) process?
 - a. Subnatant
 - b. Decant
 - c. Float
 - d. Humus
6. Which digester, in a two-stage anaerobic digestion process, is normally not mixed and/or heated?
 - a. Primary digester
 - b. Secondary digester
 - c. Neither is normally mixed or heated.
 - d. Both are normally mixed and heated.
7. Given the following data, what is the capacity of this digester?
 - Digester tank diameter is 75 feet
 - Digester depth is 24 feet to overflow
 - Digester sludge feed rate is 125 gpm for 8 hrs/day
 - a. 1,125,147 gals
 - b. 792,693 gals
 - c. 3,170,772 gals
 - d. 157,045 gals
8. What does the following formula represent?
$$\frac{OUR, \text{mg/l/hr}}{TS, \text{gm/l}} = \text{mg/hr/gm}$$
 - a. Oxygen uptake rate
 - b. Specific oxygen utilization rate
 - c. Sludge volume index
 - d. Fecal coliform
9. Which process modifications may help resolve a condition of massive white foam and low pH in an aerobic digester?
 - a. Increase the sludge feed rate.
 - b. Increase the air supply and increase the dissolved oxygen.
 - c. Decrease the digester solids retention time (SRT).
 - d. Decrease the air supply and decrease the dissolved oxygen.
10. What is the fundamental concept of aerobic digestion operation?
 - a. Methane gas is a byproduct.
 - b. The overall sludge production is increased.
 - c. High rate, log growth is accomplished.
 - d. Endogenous decay occurs at a faster rate than microbial growth.

Answers on page 54

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Readers are welcome to submit questions or exercises on water or wastewater treatment plant operations for publication in Certification Boulevard. Send your question (with the answer) or your exercise (with the solution) by e-mail to roy.pelletier@cityoforlando.net, or by mail to:

Roy Pelletier
Wastewater Project Consultant
City of Orlando
Public Works Department
Environmental Services
Wastewater Division
5100 L.B. McLeod Road
Orlando, FL 32811
407-716-2971

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Certification Boulevard Answer Key

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1. **A) The pH decreases.**

Carbon dioxide (CO₂) is acidic and has a low pH. When CO₂ is trapped (through poor aeration and mixing), it increases the acidic nature of the sludge, decreases the alkalinity content, and decreases the pH value.

2. **B) Methane and carbon dioxide.**

Gas from a properly operated anaerobic digester should have methane content of about 70 percent and carbon dioxide content of about 30 percent (by volume). Higher methane content means that the digester quality has increased, and higher carbon dioxide content means that the digester quality has decreased.

3. **C) 15 percent to 20 percent.**

It depends on several factors: sludge feed origin (where it came from), aerobic or anaerobic digestion, sludge feed rate, polymer dosage, mixing and conditioning, belt speed, belt tension pressure, and others. However, a typical belt filter press produces cake solids of about 15 to 20 percent.

4. **A) 1,000 #/gram TS**

According to the EPA part 503 regulations, Class A residuals fecal coliform is no more than 1,000 #/gram TS. The fecal coliform limit for Class B residuals is 2,000,000 #/gram TS.

5. **C) Float**

It's called float because it floats on the surface of the tank. In a properly operated dissolved air flotation (DAF) system, the majority of the thickened sludge should be floating on the tank's surface.

6. **B) Secondary digester**

Typically, the secondary digester in a two-stage anaerobic digestion process is not mixed or heated. This tank is typically used as a gas and sludge holding tank.

7. **B) 792,693 gallons**

Tank Capacity, gals
 $= \pi r^2 \times \text{depth, ft.} \times 7.48 \text{ gal/ft}^3$
 $= 3.14 \times 37.5 \text{ ft.} \times 37.5 \text{ ft.} \times 24 \text{ ft.} \times 7.48 \text{ gal/ft}^3$
 $= 792,693 \text{ gallons}$
 note: consider π as 3.14

8. **B) Specific oxygen utilization rate**

The specific oxygen utilization rate (SOUR) is calculated by dividing the oxygen uptake rate (OUR) test results by the total solids content of the sample in grams per liter. The SOUR is used to determine potential for additional volatile solids reduction that is remaining in a sample. Typically, the SOUR results of aerobically digested sludge should be no greater than 1.5 mg/hr/gm TS to meet Class B standards for vector attraction reduction.

9. **D) Decrease the air supply and decrease the dissolved oxygen.**

Typically, white foam produced in an aerobic digester can be the result of over-aeration. Reducing the air supply, and resultant dissolved oxygen levels, can many times decrease the production of white foam. Shutting off the air altogether for several hours at a time can actually make foam white disappear. Also, this activity (of shutting off air supply) typically will result in increased destruction of volatile solids in the aerobic digester. Also, denitrification (use of nitrate as a source of oxygen) replenishes alkalinity, and usually results in an increased pH value.

10. **D) Endogenous decay occurs at a faster rate than microbial growth.**

Decomposition through endogenous decay should take place at a slightly faster rate than the growth rate that occurs due to the aerobic conditions. The mission of aerobic digestion is to reduce the volatile content of the sludge at a rate of at least 38 percent, based on the following formula: $(in - out) / in - (in \times out) \times 100$.