



Certification Boulevard

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Test Your Knowledge of Residuals Management

- What is the FIRST warning sign that trouble is starting in an anaerobic digester?
 - Increase in carbon dioxide.
 - Increase in pH.
 - Increase in sludge volume.
 - Increase in volatile acid/alkalinity relationship.
- Given the following data, what is the detention time of the sludge blanket in this gravity thickener?
 - 50-foot diameter.
 - Three-foot sludge blanket depth.
 - Four-foot cone depth.
 - 100k gpd thickened sludge removed.
 - 30.6 hours
 - 15.3 hours
 - 7.6 hours
 - 22.9 hours
- What device is used to blend polymer and sludge feed before it is applied to a GBT?
 - Retention vessel
 - Venturi mixer
 - Chicane
 - Drive unit
- What 15-minute test will help to identify the concentration of thickened sludge product from a gravity belt thickener system?
 - Laboratory TSS
 - Settleometer
 - Centrifuge spindown
 - Sludge judge
- Which term is most related to vector attraction reduction in an aerobic digester?
 - Settleometer
 - Pathogen
 - SOUR
 - F/M
- What causes sludge to float to the surface in a dissolved air flotation (DAF) process?
 - The addition of lime.
 - The addition of polymer.
 - The addition of air-saturated recycle water.
 - Withdrawing bottom sludge at a fast rate.
- What happens to digested sludge pH if carbon dioxide is trapped in the sludge?
 - The pH decreases.
 - The pH increases.
 - Carbon dioxide does not affect the pH.
 - Alkalinity is increased.
- What does the term "anaerobic" mean in regard to oxygen?
 - Free D.O. and combined oxygen are present.
 - Only free D.O. is present.
 - Only combined oxygen is present.
 - No oxygen is present in any form.
- Which anaerobic digestion temperature range represents stable Thermophilic conditions?
 - 75 to 90°F
 - 120 to 135°F
 - 85 to 100°F
 - 110 to 120°F
- What is polymer called when it has a positive charge?
 - Anionic
 - Reverse negative
 - Non-ionic
 - Cationic

ANSWERS ON PAGE 62

SEND US YOUR QUESTIONS FOR CERTIFICATION BOULEVARD

Do you have a question or an exercise you would like to feature in "Certification Boulevard?" We'll be glad to publish it. Just send your question (with the answer) or your exercise (with the solution) to:

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There is no limit to the number of questions or exercises you may submit. Please include your name, city, and organization or company so we can give you credit.

Certification Boulevard Answer Key

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1. **d. Increase in volatile acid/alkalinity relationship.**

Because the alkalinity is so high in an anaerobic digester, the pH is slow changing and the digester will basically go "sour" before the pH begins to drop. This is why the acid/alkalinity ratio is the best process tool to use to monitor the performance efficiency of anaerobic digestion.

2. **b. 15.3 hours**

Detention Time of Sludge Blanket, hours also known as Sludge Volume Retention Time (SVRT)

$$= (\text{gallons in blanket} + \text{gallons in cone}) \times 24 \text{ hr/day} \div \text{gpd removed from the tank}$$

Gals in Blanket

$$= \pi r^2 \times \text{blanket depth, ft.} \times 7.48 \text{ gals per cubic foot}$$

$$= 3.14 \times 25 \text{ ft.} \times 25 \text{ ft.} \times 3 \text{ ft.} \times 7.48 \text{ gal/ft}^3$$

$$= 44,038 \text{ gallons in blanket}$$

Gals in Cone

$$= \frac{1}{3} \pi r^2 \times \text{cone depth, ft.} \times 7.48 \text{ gals per cubic foot}$$

$$= 3.14 \times 25 \text{ ft.} \times 25 \text{ ft.} \times 4 \text{ ft.} \times 7.48 \text{ gal/ft}^3 \div 3$$

$$= 19,573 \text{ gallons in cone}$$

Blanket Detention Time

$$= (44,038 \text{ gals in blanket} + 19,573 \text{ gals in cone}) \times$$

$$24 \text{ hrs/day} \div 100,000 \text{ gpd removed}$$

$$= 15.27 \text{ hours}$$

3. **b. Venturi mixer**

The only device on this list of items that is capable of blending polymer and sludge feed being applied to a GBT is a venturi mixer, which is essentially a type of check valve assembly installed in the sludge feed pipe, usually equipped with some form of polymer dosing ring. The polymer/sludge combination passes through the venturi mixer, which imparts energy to accomplish fairly complete mixing of the materials. A retention vessel may be used to allow flocculation of the sludge to develop after it is mixed with the polymer.

4. **c. Centrifuge spindown**

A centrifuge spindown test takes about 15 minutes and provides an excellent indication of solids inventory. Comparing spindown test results can identify increasing or decreasing solids concentration. The centrifuge is not intended to replace a laboratory TS test ... only to supplement the lab data with quick indicators for field process control parameters.

5. **c. SOUR**

Vector attraction reduction (VAR) is related to volatile solids reduction, which identifies long-term stability of the conditioned sludge. Specific Oxygen Utilization Rate (SOUR) is the test most used to determine the vector attraction reduction performance of aerobically digested sludge. The maximum SOUR value allowed to meet vector attraction reduction for Class B standards is 1.5 mg/hr/gm total solids.

6. **c. The addition of air-saturated recycle water.**

Air-saturated recycle water, known as "white water," is mixed with the incoming sludge feed to the DAF tank. The air basically attaches itself to the sludge particles, and, as the air rises to the surface of the tank (seeking

atmospheric pressure), it also causes the sludge to rise to the tank's surface. The addition of polymer allows sludge particles to floc together; however, it's the addition of air that actually causes the sludge to rise. Many DAF systems operate very successfully without any addition of polymer ... these systems are typically operated at a reduced loading rate.

7. **a. The pH decreases.**

Carbon dioxide (CO₂) is acidic. Trapping it increases acidic conditions in the digester and forces the pH down. Removing CO₂ will allow the alkalinity to do a better job buffering the acids because there would be fewer acids to be buffered.

8. **c. Only combined oxygen is present.**

In regard to oxygen supply, anaerobic means there is an absence of free dissolved oxygen. There is, however, the presence of combined oxygen in the form of CO₂, SO₄, NO₂, and NO₃, which anaerobic bacteria use for their respiration.

9. **b. 120 to 135°F**

Typically, a temperature range between 120 and 135°F represents Thermophilic conditions. Mesophilic temperatures are about 85 to 100°F, with the optimum temperature between 95 to 98°F. Psychrophilic temperatures conditions are normally less than about 68°F.

10. **d. Cationic**

Polymers basically have three types of charge: Positive charge is called cationic, negative charge is called anionic, and neutral charge is called non-ionic. Typical wastewater sludge has a negative charge and requires a positively charged cationic polymer.