

## Test Your Knowledge of Residuals Management



Roy Pelletier

1. What is the main concept of sludge dewatering?
  - A. To increase total solids concentration.
  - B. To decrease total solids concentration.
  - C. To reduce the volatile content.
  - D. To convert suspended solids into settleable solids.
2. Which statement basically describes a gravity belt thickener (GBT)?
  - A. The bottom half of a belt filter press.
  - B. The top half of a belt filter press.
  - C. A machine that does not resemble a belt filter press.
  - D. A machine that stabilizes waste activated sludge (WAS).
3. Which adjustment will normally decrease the size of floc particles exiting an inline venturi mixer of a belt filter press?
  - A. Open the venturi mixer.
  - B. Close the venturi mixer.
  - C. Place a second venturi mixer into service.
  - D. The venturi mixer has nothing to do with floc size.
4. What is the purpose for the washwater nozzles on a belt filter press?
  - A. To clean the chicanes.
  - B. To clean the venturi mixer.
  - C. To clean the belts.
  - D. To backflush the hydraulic pump.
5. What is the hydraulic retention time (HRT), in days, of an aerobic digester given the following data:
  - 75 ft diameter tank
  - 20 ft deep
  - Digester sludge feed 15,500 gal per day (gpd)
  - Tank depth averaged 85 percent full during calculation period
  - A. 62.6 days
  - B. 31.3 days
  - C. 23.5 days
  - D. 36.2 days
6. Given the following data, and using the VanKleek formula, what is the percent volatile solids reduction in this anaerobic digester?
  - Feed sludge total solids = 3.4 percent
  - Feed sludge volatile solids = 2.7 percent
  - Digested sludge out total solids = 2.4 percent
  - Digested sludge out volatile solids = 1.7 percent
  - A. 40.1 percent
  - B. 37.1 percent
  - C. 34.5 percent
  - D. 47.1 percent
7. Carbon dioxide is a common byproduct in an aerobic digester. If carbon dioxide is trapped, it will tend to:
  - A. Increase the pH.
  - B. Decrease the pH.
  - C. Neutralize the pH
  - D. It has no effect at all on pH.
8. Given the following data, what is the volume of this digester?
  - Digester tank diameter is 75 ft
  - Digester depth is 24 ft to overflow
  - Digester sludge feed rate is 125 gal per min (gpm) for 8 hrs/day
  - A. 1,125,147 gals
  - B. 792,693 gals
  - C. 3,170,772 gals
  - D. 157,045 gals
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 (DO).
  - C. Decrease the digester solid retention time (SRT).
  - D. Decrease the air supply and decrease the DO.
10. A properly operated anaerobic digester will have a volatile solids reduction of about 20 to 30 percent.
  - A. True
  - B. False

Answers on page 59

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## Certification Boulevard Answer Key

From page 40

1. **A) To increase total solids concentration.**

*The higher the cake solids, the lower the operating cost for hauling. Most cake is hauled according to a cost-per-wet-ton basis.*

2. **B) The top half of a belt filter press.**

*The GBT looks and acts just like the top portion of a belt filter press. The process consists of gravity dewatering through the belt without any applied pressure.*

3. **B) Close the venturi mixer.**

*An inline (or in-pipe) venturi mixer is designed to impart energy on the two streams being mixed: sludge feed and polymer solution. As the mixer is closed, more energy is imparted and the size of the resultant floc particles will be smaller.*

4. **C) To clean the belts.**

*The belt press washbox contains several nozzles that spray high pressure water to clean sludge/polymer out of the belt weave. Streaks of sludge on the belt as it leaves the washbox indicate plugged nozzles.*

5. **D) 36.2 days**

*Aerobic digester HRT, days  
= Volume of tank, gals ÷ Feed sludge, gpd*

*Volume of tank, gals  
=  $\pi r^2 \times \text{depth, ft.} \times 7.48 \text{ gal/ft}^3 \times \text{percent full}$*

*=  $3.14 \times 37.5 \times 37.5 \times 20 \text{ ft} \times 7.48 \text{ gal/ft}^3 \times 0.85$   
= 561,490.9 gals*

*Sludge Feed, gpd  
= 15,500*

*Aerobic digester HRT, days  
=  $561,491 \text{ gals} \div 15,500 \text{ gpd}$   
= 36.2 days*

6. **B) 37.1 percent**

*VanKleek VS Reduction, percent  
=  $\text{VS IN} - \text{VS OUT} \div \text{VS IN} - (\text{VS IN} \times \text{VS OUT}) \times 100$*

*VS IN = VSS ÷ TSS  
=  $2.7 \text{ percent} \div 3.4 \text{ percent}$   
= 0.794*

*VS OUT = VSS ÷ TSS  
=  $1.7 \text{ percent} \div 2.4 \text{ percent}$   
= 0.708*

*VanKleek VS Reduction, percent  
=  $0.794 - 0.708 \div 0.794 - (0.794 \times 0.708) \times 100$   
= 37.09 percent*

7. **B) Decrease the pH.**

*Carbon dioxide is acidic, and trapping it will tend to reduce the pH. Continuous aeration typically lowers the pH due to increased nitrification consuming additional alkalinity. Anoxic reactions will tend to increase the pH due to nitrates being used as a source of oxygen and alkalinity being replenished.*

8. **B) 792,693 gals**

*Tank volume, 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 gals*

*note: consider  $\pi$  as 3.14*

9. **D) Decrease the air supply and decrease the DO.**

*Typically, white foam produced in an aerobic digester can be the result of overaeration. Reducing the air supply, and resultant dissolved oxygen levels, can often 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. **B) False**

*The volatile solids reduction should be at least 38 percent to meet Class B standards for Vector Attraction Reduction (VAR). Typically, anaerobic digestion accomplishes volatile solids reduction of about 40 to 60 percent. However, this depends on several factors, including volatile content of the feed sludge, digestion time (HRT), sludge temperature, acid to alkalinity ratio, mixing efficiency, and others.*