Certification Boulevard

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Test Your Knowledge of Residuals Management

1. Which factors affect the operation of an anaerobic digestion process?
   a. Detention time
   b. Temperature
   c. Acid-to-alkalinity ratio
   d. Volatile solids loading rate
   e. All of the above

2. Given the following data, what is the Specific Oxygen Utilization Rate (SOUR) in an aerobic digester?
   • OUR test starting D.O. is 7.2 mg/L.
   • OUR test ending D.O. is 3.1 mg/L.
   • OUR test time is 10 minutes.
   • Digested sludge total solids concentration is 1.5 percent.
   a. 2.1 mg/hr/gm TS
   b. 1.1 mg/hr/gm TS
   c. 1.64 mg/hr/gm TS
   d. 10.9 mg/hr/gm TS

3. Based on the correct answer in Question No.2, is this SOUR acceptable to meet Class B standards for Vector Attraction Reduction requirements?
   a. Yes
   b. No
   c. SOUR does not apply to aerobic digestion.

4. Which factors generally affect the amount of sludge that can be applied to a land application site?
   a. Nitrogen and heavy metals
   b. Carbon and chlorides
   c. Phosphorus and alkalinity
   d. pH and $CBOD_5$

5. Given the following data, how much WAS should be removed on a daily basis from this activated sludge facility?
   • Aeration tank volume is 0.77 mg.
   • Two aeration tanks in service.
   • MLSS is 2,700 mg/L.
   • Mixed liquor is 75 percent volatile.
   • WAS TSS is 5,250 mg/L.
   • Desired MLSS is 2,200 mg/L.
   a. 0.073 mgd
   b. 59,267 gpd
   c. 0.147 mgd
   d. 14,671 gpd

6. What is most likely to occur in an aerobic digester when the air is turned off for certain periods each day?
   a. Nitrates are increased, the pH decreases, and the volatile solids reduction worsens.
   b. Nitrates are decreased, the pH increases, and volatile solids reduction improves.
   c. Air rates do not have an affect on nitrates, pH, or volatile solids reduction in an aerobic digester.
   d. Nitrates are increased and alkalinity is decreased.

7. What is one of the alternate methods for vector attraction reduction for an anaerobic digestion process if the volatile solids reduction does not meet 38 percent?
   a. Chlorine residual
   b. SOUR
   c. Extended 40-day bench test
   d. Alkalinity

8. Given the following data, what is the percent volatile solids reduction in an anaerobic digester using the Approximate Mass Balance (AMB) formula?
   • Feed Sludge Total Solids = 3.4 percent
   • Feed Sludge Volatile Solids = 2.7 percent
   • Feed Sludge Daily Flow = 90,000 gpd
   • Digested Sludge Out Total Solids = 2.4 percent
   • Digested Sludge Out Volatile Solids = 1.5 percent
   • Digested Sludge Out Flow = 0.09 mgd
   a. 40.1 percent
   b. 37.0 percent
   c. 34.5 percent
   d. 44.4 percent

9. 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 increased.

10. Given the following data, what is the volatile solids loading rate in an anaerobic digester?
    • Digester tank diameter is 75 feet.
    • Digester side water depth is 24 feet to overflow.
    • Volume in cone is 35,000 gallons.
    • Digester sludge feed rate is 125 gpm for 8 hrs/day.
    • Sludge feed total solids concentration is 3.2 percent.
    • Sludge feed volatile content is 81 percent.
    a. 0.12 lbs per day VS per ft^3
    b. 0.34 lbs per day VS per ft^3
    c. 0.17 lbs per day VS per ft^3
    d. 1.5 lbs per day VS per ft^3

ANSWERS ON PAGE 64

Operators, Send Us Your Problems!

The Troubleshooting Way is a regular feature of the *Florida Water Resources Journal* that focuses on identifying common—and not so common—conditions, problems, and recommended actions associated with wastewater treatment plants. The information is published in each month's *Journal* in "case study" format.

Operators are welcome to share any problems in operations, maintenance, and management for which they are seeking solutions—and also problems in these areas that they have been able to solve. Fill out the questionnaire below to describe the problem and its potential causes, operational difficulties resulting from the problem, and any corrective actions that have been taken to solve it.

If your problem has not yet been solved, you could be contacted by the FWEA Operations Research Committee for additional information to study the problem in more detail and provide advice on actions that may be taken to resolve it. The committee may also request that your case study be featured in *The Troubleshooting Way*. All Operators who submit unsolved problems will receive written responses from the committee.

Please provide as many details on your problem as possible. Photos of your facility, particularly photos of the affected process area, will help the committee and *Journal* readers better understand the problem and its resolution. Send digital photos separately as jpeg files by e-mail to Roy.Pelletier@cityoforlando.net. Please send high-resolution photos only.

An online questionnaire has been developed to help you submit the details of your problem—solved or unsolved. To reach the questionnaire, visit the Journal Web site at **http://www.fwrj.com/troubleshootingway.html**

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

From page 42

1. **e. All of the above**
   All of these items are important for successful operating performance of an anaerobic digestion process.

2. **c. 1.64 mg/hr/gm TS**
   SOUR, mg/hr/gm TS
   = OUR, mg/L/hr ÷ TS, gm/L
   = (7.2 mg/l – 3.1 mg/L) ÷ 10 minutes x 60 mins/hr = 24.6 mg/L/hr OUR
   gm/L TS
   = mg/L TSS ÷ 1,000
   = 1.5% TS x 10,000 = 15,000 mg/L TSS
   = 24.6 mg/L/hr ÷ (15,000 ÷ 1,000)
   = 1.64 mg/hr/gm TS

3. **b. No**
   The maximum allowable SOUR value for the aerobic digestion process to meet Class B standards for Vector Attraction Reduction is 1.5 mg/hr/gm TS.

4. **a. Nitrogen and heavy metals**

5. **c. 0.147 mgd**
   Excess Pounds Aeration Inventory to Waste
   = 0.77 mg x 2 tanks x (2,700 mg/L – 2,200 mg/L) x 8.34 lbs/gal
   = 6,422 lbs MLSS
   = 6,422 lbs/day to waste ÷ (5,250 mg/L x 8.34)
   = 0.1466712 mgd x 1,000,000
   = 146,671 gpd

6. **b. Nitrates are decreased, the pH increases, and volatile solids reduction improves.**
   Shutting off the air will create anoxic conditions in the digester. This reaction will consume nitrates as a source of oxygen, thereby adding alkalinity back into the digested sludge and increasing the pH. Also, due to the anoxic conditions, additional volatile solids will be reduced.

7. **c. Extended 40-day bench test**

8. **d. 44.4%**
   Approximate Mass Balance formula
   = (VS in, lbs/day – VS Out lbs/day) ÷ VS in, lbs/day x 100 = % VS reduction
   VS in, lbs/day
   = 0.09 mgd x 27,000 mg/L x 8.34 lbs/gal
   = 20,266 lbs/day
   VS out, lbs/day
   = 0.09 mgd x 15,000 mg/L x 8.34 lbs/gal
   = 11,259 lbs/day
   Approximate Mass Balance
   = (20,266 – 11,259) ÷ 20,266 x 100
   = 44.4% VS reduction

9. **a. The pH decreases**
   Carbon dioxide is acidic, and the pH drops when CO_2 is trapped in aerobically digested sludge.

10. **a. 0.12 lbs per day VS per ft³**
    VS loading rate, lbs VS per day per ft³ digester capacity
    = lbs/day VS feed to digester ÷ ft³ digester capacity
    flow to digester
    = 480 mins/day x 125 gpm
    = 60,000 gpd = 0.06 mgd
    volatile solids fraction
    = 3.2% TS x 81% volatile
    = 2.592% volatile fraction
    lbs/day VS feed
    = 0.06 mgd x 25,920 mg/L VS x 8.34 lbs/gal
    = 12,970 lbs/day VS feed to digester
    digester ft³ capacity
    = (πr^2 x SWD, ft) + (cone volume, gals ÷ 7.48 gal/ft³)
    = (3.14 x 37.5 ft x 37.5 ft x 24 ft SWD) + (35,000 gallons in cone ÷ 7.48 gal/ft³)
    = 105,975 ft³ + 4,679 ft³
    = 110,654 ft³
    VS loading rate
    = 12,970 lbs/day VS ÷ 110,654 ft³
    = 0.117 lbs/day VS per ft³ digester capacity