

Test Your Knowledge of Operations and Utilities Management Topics



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- Given the following data, what is the cost of polymer used, in dollars per dry ton processed, in this gravity belt thickener (GBT)?
 - Total sludge feed to the GBT is 375 gpm for 24 hrs per day
 - Feed sludge concentration is 0.65 percent
 - Total neat polymer used is 21 gpd
 - Polymer specific gravity (S.G.) is 1.02
 - Polymer cost is \$1.18 per lb

A. \$25.24 per dry ton
B. \$11.26 per dry ton
C. \$21.72 per dry ton
D. \$14.39 per dry ton
- Given the data and correct answer from question No.1, is this an acceptable cost of polymer usage for a GBT?

A. Yes, it is acceptable.
B. No, it is way too high.
C. There is not enough data to calculate this parameter.
- Given the following data, what is the annual budget for lime in this plant?
 - Lime dose rate is 9.5 percent of the sludge wet weight processed
 - Sludge volume is 16.5 dry tons per day
 - Sludge cake concentration (before lime addition) is 18.5 percent total solids
 - Lime cost is \$175.00 per ton delivered
 - Sludge is processed 7 days per week, 24 hours per day

A. \$355,998 B. \$541,021
C. \$148,594 D. \$581,060

- Given the data, correct calculations, and answer from question 3, what is the lime dosage based on the dry weight of the sludge processed?

A. 30.5 percent
B. 9.5 percent
C. 51.33 percent
D. 112.25 percent
- What is the specific oxygen utilization rate (SOUR) in an aerobic digester, given the following data?
 - OUR test starting dissolved oxygen (DO) is 7.2 mg/l
 - OUR test ending DO is 4.0 mg/l
 - OUR test time is 10 min
 - Digested sludge total solids concentration is 1.75 percent

A. 2.1 mg/hr/gm TS
B. 1.1 mg/hr/gm TS
C. 1.6 mg/hr/gm TS
D. 0.1 mg/hr/gm TS
- Given the data and correct answer from question 5, does this aerobically digested sludge meet the 62-640 vector attraction reduction (VAR) requirements for Class B residuals?

A. Yes, it is acceptable.
B. No, it is too high.
- What is the main purpose of greasing an anti-friction bearing?

A. To stabilize friction.
B. To comply with the warranty.
C. To increase operating temperature.
D. To protect steel from corrosion.
- Given the following data, what is the total revenue collected annually from the industrial contributors?
 - Total plant flow is 2.55 mgd
 - Residential connections = 82 percent

- of the total flow
 - Industrial sewer charge is \$3.50 per 1,000 gal
- A. \$1,606 per year
B. \$586,372 per year
C. \$293,186 per year
D. \$2,671,252 per year
- Why are flow measurements important in treatment plants?

A. They help to determine DO.
B. They help to determine loading rates.
C. They help to determine nitrate levels.
D. They help to determine suspended solids removal.
 - What procedure should never be performed while entering a manhole that has been classified as a permit-required confined space?

A. Wear a body harness.
B. Test the air with a gas detector.
C. Complete a confined space entry permit.
D. Enter without an attendant.

Answers on page 48

SEND US YOUR QUESTIONS

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 email to roy.pelletier@cityoforlando.net, or by mail to:

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Certification Boulevard Answer Key

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1. **D) \$14.39 per dry ton**

Formula: Total Cost of Polymer Used, \$ ÷ Total Dry Tons of Sludge Processed, dtpd
 Cost of Polymer
 = 21 gpd x 8.34 lbs/gal x 1.02 S.G.
 = 178.64 lbs polymer used
 = 178.64 lbs polymer x \$1.18 per lb polymer
 = \$210.80 polymer used
 gpd Processed
 = 375 gpm x (24 x 60)
 = 540,000 gpd divided by 1,000,000 = 0.54 mgd
 Dry Tons Processed
 = 0.54 mgd x 6,500 mg/L x 8.34 lbs/gal
 = 29,373.4 lbs dry solids divided by 2,000 lbs/ton
 = 14.64 dry tons processed
 Total Cost of Polymer Used \$210.80 ÷ Total Dry Tons of Sludge Processed 14.64 dtpd
 = \$14.39 per dry ton processed

2. **Yes, it is acceptable.**

An acceptable cost of polymer used per dry ton (dt) processed in a GBT depends on the type of sludge, sludge volume index (SVI), and the age of the activated sludge process. Typically, with conventional or biological nutrient removal-activated sludge, acceptable polymer consumption in a properly operated GBT is anything less than about \$15 per dt processed.

3. **B) \$541,021**

Total wet tons of sludge per day
 = 16.5 dry tons divided by 0.185 (18.5 percent) (wtpd)
 = 89.19 wtpd
 Lime used per day
 = 89.19 wtpd sludge x 0.095 (9.5 percent)

= 8.47 tons per day lime used
 Cost per day lime used
 = 8.47 tons per day x \$175.00 per ton
 = \$1,482.25 per day lime used
 Cost per year lime used
 = \$1,482.25 per day x 365 days per year
 = \$541,021 lime per year

4. **C) 51.33 percent**

Sludge Dry Weight
 = 16.5 dry tons per day (given in the data)
 Lime used per day
 = 8.47 tons per day ... 16.5 dtpd sludge ÷ 0.185 x .095 lime dose by wet wt
 Lime Dosage by Dry Weight
 = 8.47 tpd lime divided by 16.5 dtpd sludge
 = 0.5133 x 100
 = 51.33 percent lime dosage by dry weight

5. **B). 1.1 mg/hr/gm TS**

SOUR, mg/hr/gm TS
 = OUR, mg/L/hr ÷ gm/L TS
 OUR, mg/L/hr
 = Start D.O. - End D.O. ÷ Test minutes x 60 mins/hr
 = 7.2 mg/L - 4.0 mg/L ÷ 10 mins x 60 mins/hr
 = 19.2 mg/L/hr
 gm/L TS
 = TS, mg/L ÷ 1,000 ml/L
 = 1.75% x 10,000 ÷ 1,000
 = 17.5 gm/L TS
 SOUR, mg/hr/gm TS
 OUR 19.2 mg/L/hr ÷ TS 17.5 gm/L
 = 1.097 mg/hr/gm TS

6. **A) Yes, it is acceptable.**

The requirement in 62-640 for aerobically digested sludge to meet the Class B standards for vector

attraction reduction (VAR) using the SOUR method is to be no greater than 1.5 mg/hr/gm TS. However, there are a few caveats: 1) the sludge concentration must be no greater than 2.0 percent total solids, and 2) the sludge temperature should be stable at 20°C.

7. **A) To stabilize friction.**

Greasing an anti-friction bearing stabilizes friction and improves the bearing's performance. Bearing lubricants form a microscopically smooth molecular bond that permanently adheres to the entire contact area. It also helps to fill in surface imperfections, pits, gaps and even helps to repairs some corrosion.

8. **B) \$586,372 per year**

Flow contribution from industrial users:
 Flow is 2.55 mgd; residential flow is 82 percent; industrial flow is 18 percent
 Industrial flow is 2.55 mgd x 0.18 = 0.459 mgd x 1,000,000 = 459,000 gpd
 Daily industrial user charge is 459,000 ÷ 1,000 x \$3.50 per 1,000 gals = \$1,606.50 per day
 Annual industrial user charge is \$1,606.50 per day x 365 days per year = \$586,372.50

9. **B) They help to determine loading rates.**

Loading rates are important to determine how close the facility may be getting to the original design loading values, and, loading rates cannot be accurately calculated without flow measurement devices (flow meters).

10. **D) Enter without an attendant.**

While following all permit-required confined space entry procedures, there must be a trained attendant available before entering the space—no exceptions to this rule!