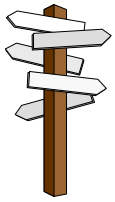

Certification Boulevard

Test Your Knowledge of Wastewater Treatment Topics
answer key

1. What are the closest loading equivalents in typical domestic wastewater?
   (select the closest answer for each)

   - TSS, lbs per capita per day

     a. 1.0 to 2.0
     b. 0.01 to 0.02
     c. 5.0 to 10.0
     d. 0.1 to 0.2

   - $CBOD_5$, lbs per capita per day

     a. 0.017 to .025
     b. 0.15 to 0.2
     c. 1.0 to 2.0
     d. 20 to 30

   - Hydraulic Capacity, gals per capita per day

     a. 100 to 150
     b. 250 to 350
     c. 500 to 1,000
     d. 10 to 50

2. Given the following data, what is the solids loading rate on the secondary clarifiers?

   - Plant Influent Flow is 15 mgd
   - RAS Rate is 85% of Q
   - Two (2) 120 ft Diameter Secondary Clarifiers
   - Aeration MLSS is 2,500 mg/L

   a. 13.8 lbs/day/ft^2
   b. 17.5 lbs/day/ft^2
   c. 25.6 lbs/day/ft^2
   d. 51.2 lbs/day/ft^2

Solids Loading, lbs/day/ft^2 = ***Total lbs/day of MLSS Entering the Secondary Clarifiers divided by the Total Surface Area of Secondary Clarifiers in ft^2***

Total lbs/day MLSS = ***(15 mgd x 1.85) x 2,500 mg/L x 8.34 lbs/gal***
= ***578,587 lbs MLSS Entering the Secondary Clarifiers***

Total Clarifier Surface Area = ***0.785 x d^2 x 2 Clarifiers***
= ***22,608 ft^2***

= ***578,587 lbs/day MLSS ÷ 22,608 ft^2 Surface Area***
= ***25.59 lbs/day/ft^2***

3. What is the best adjustment to make (from the list of possible answers) if solids are rising in the secondary clarifier accompanied by small gas bubbles and solids that break apart when they surface?

    a. Increase aeration D.O.
    b. Decrease the RAS rate
    c. Decrease the WAS rate
    d. Decrease aeration D.O.

    This describes classic denitrification in the secondary clarifier caused by over-aeration, a high degree of process nitrification and low denitrification in the aeration system. Reducing the aeration tank D.O. will improve the biological denitrification process in the aeration system and decrease the denitrification in the secondary clarifier.

4. Given the following data, what is the required WAS pumping rate (gpm) from this activated sludge process?

    - Aeration capacity is 6.4 mg
    - MLSS Concentration is 2,500 mg/L
    - Mixed Liquor is 79% Volatile
    - Desired MLSS Inventory is 120,000 Lbs
    - WAS Concentration is 7,500 mg/L
    - WAS Removal to be Completed in 16 Hours per Day

    a. 2,222 gpm
    b. 224 gpm
    c. 559 gpm
    d. 185 gpm

Actual Lbs MLSS Inventory = ***Aeration capacity, mg x MLSS conc., mg/L x 8.34***
= ***6.4 mg x 2,500 mg/L x 8.34 lbs/gal***
= ***133,440 lbs MLSS***

Excess Inventory (to waste) = ***133,440 actual lbs MLSS – 120,000 desired lbs MLSS***
= ***13,440 lbs/day to waste***

mgd to Waste = ***lbs/day to waste ÷ (WAS conc., mg/L x 8.34 lbs/gal)***
= ***13,440 lbs/day ÷ (7,500 mg/L x 8.34 lbs/gal)***
= ***0.214868 mgd***

gpd to Waste = ***mgd to waste x 1,000,000***
= ***0.214868 mgd x 1,000,000***
= ***214,868 gpd to waste***

gpm to Waste = ***16 hours per day x 60 mins/hr***
= ***960 minutes per day***
= ***214,868 gpd ÷ 960 min/day***
= ***223.8 gpm … say 224 gpm***

5. Is a high-rate aeration process typically overloaded or underloaded by design?

    a. <u>Overloaded</u>
    b. Underloaded
    c. High MLSS
    d. Low F/M Ratio

    Aeration loading refers to the $CBOD_5$ entering the system; therefore, a high-rate aeration process is typically overloaded due to the low SRT and high F/M ratio.

6. Given the following data, and using the data provided in question 2, what is the F/M ratio of this activated sludge process?

    - Influent $CBOD_5$ is 205 mg/L
    - Primary Clarifier Removes 28% of the Influent $CBOD_5$
    - MLVSS is 75% of MLSS
    - Three (3) Aeration Tanks Each 220 Feet Long, 45 Feet Wide and 15 Feet Deep

    a. 0.23
    b. 0.53
    c. <u>0.35</u>
    d. 0.11

F/M/ Ratio = lbs/day $CBOD_5$ Entering Aeration divided by lbs MLVSS in Aeration

Lbs/day $CBOD_5$ Entering Aeration = 15 mgd x (205 mg/L x 0.72) x 8.34 lbs/gal = 18,465 lbs/day $CBOD_5$

Note: 72% (100% - 28% removal) of the $CBOD_5$ remains in the primary effluent and enters the aeration system.

Lbs MLVSS in Aeration = (220 ft x 45 ft x 15 ft x 7.48 gal/ft^3 x 3 Aeration Tanks) ÷ 1,000,000 x (2,500 mg/L x 0.75) x 8.34 lbs/gal = 52,109 lbs MLVSS

18,465 lbs/day $CBOD_5$ ÷ 52,109 lbs MLVSS = 0.354 F/M … say 0.35

7. Given the following data, calculate the OUR?

    - Beginning D.O. is 7.1 mg/L
    - Ending D.O. is 1.9 mg/L
    - Test Time is 4.2 Minutes

    a. ***<u>74.3 mg/L/hr</u>***
    b. 192.7 mg/L/hr
    c. 24.5 mg/L/hr
    d. 58.4 mg/L/hr

OUR, mg/L/hr = (Start D.O., mg/L – Ending D.O., mg/L) ÷ Test Time, mins x 60 mins/hr

(Start D.O., 7.1 mg/L – Ending D.O., 1.9 mg/L) ÷ 4.2 mins x 60 mins/hr
= 74.3 mg/L/hr OUR

8. Given your answer in question No.7 is correct, and given this is a healthy and properly operated activated sludge process, which location of the aeration tank did this sample come from?

    a. End of the aeration tank
    b. Entering the secondary clarifier
    c. Beginning of the aeration tank
    d. Not enough data to identify the location

    The beginning of a healthy and properly operated aeration tank should have an OUR reading between 50 to 100 mg/L/hr. The end of that same aeration tank should have an OUR reading of about 20 to 30 mg/L/hr.

9. Match the closest oxygen demand values, in lbs of O_2 for each pound oxidized or converted, for the following compounds:

    - $CBOD_5$
        a. 0.1 to 0.5
        b. 0.8 to 1.4
        c. 4.0 to 5.0
        d. 5.0 to 10.0

    - NH_3
        a. 0.1 to 0.5
        b. 0.8 to 1.4
        c. 4.0 to 5.0
        d. 5.0 to 10.0

10. Given the following data, calculate the SRT of this activated sludge facility.

    - Plant Flow is 15.5 mgd
    - Aeration capacity is 6.4 mg
    - MLSS Concentration is 2,500 mg/L
    - Mixed Liquor is 76% Volatile
    - WAS Concentration is 7,500 mg/L
    - QWAS is 249,750 gpd
    - Final Effluent TSS is 1.5 mg/L

    a. 12.6 days
    b. 4.8 days
    c. 6.2 days
    d. 8.4 days

$$\textit{SRT, Days} = \frac{\textit{Lbs Aeration MLSS}}{\textit{(Lbs/day WAS TSS + Lbs/day Final Eff TSS)}}$$

Lbs MLSS Inventory = Aeration capacity, mg x MLSS conc., mg/L x 8.34 lbs/gal
= 6.4 mg x 2,500 mg/L x 8.34 lbs/gal
= 133,440 lbs MLSS

Lbs/Day WAS TSS = QWAS, mgd x WAS TSS, mg/L x 8.34
= 0.24975 mgd x 7,500 mg/L x 8.34 lbs/gal
= 15,622 Lbs/Day

Lbs/Day Eff TSS = Q, mgd x Final Eff TSS, mg/L x 8.34
= 15.5 mgd x 1.5 mg/L x 8.34 lbs/gal
= 193.9 Lbs/Day

$$\textit{SRT, Days} = \frac{\textit{133,440 Lbs MLSS}}{\textit{(15,622 Lbs/day WAS TSS + 194 Lbs/day Final Eff TSS)}}$$

SRT, Days = 8.4 Days

Please forward your comments and sample questions for publication to:

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