Practice Math Problems

1. Calculate the percent solids reduction in a primary clarifier if the influent TSS is 400 mg/l and the effluent from the clarifier is 160 mg/l.

% removal formula:

$$\frac{\text{Influent} - \text{Effluent} \times 100}{\text{Influent}}$$

2. If the flow at a treatment plant is 1.75 MGD what chlorine residual would be expected if the chlorinator is set on 125 lb of CL_2 / day and the CL_2 demand is 7 mg/l.

TRC formula:

$$\text{Dosage / mg/l} - CL_2 \text{ demand}$$

3. Using the previous problem, at a chlorine to sulfur dioxide ratio of 1 to 1, how may pounds of SO_2 would need to be added to dechlorinated the effluent to a residual CL_2 of <0.01 mg/l**.**

4. Calculate the surface loading rate / hydraulic loading in GPD / ft^2 on a 75 ft diameter clarifier with a flow of 2 MGD.

SLR formula:

$$\frac{\text{Flow in GPD}}{\text{Surface area in } ft^2}$$

Area of a circle formula: 0.785 X diameter squared = surface area in ft^2

5. Two lagoons 700 ft by 500 ft, operated in parallel, are receiving an organic load of 203.8 mg/l of BOD_5 from a community of 1700 people. What is the organic load, in lbs of BOD_5 per acre per day?

Organic load/lbs/BOD_5/Day/ Acre

$$\frac{\text{Lbs/BOD}_5\text{/day}}{\text{Area/Acres}}$$

Lbs BOD_5 = Flow /mgd X 8.34 X mg/l/BOD_5

Area in acres

$$\frac{\text{Length ft X width ft X 2 lagoons}}{43{,}560\ \text{ft}^2\text{/ Acre}}$$

6. Calculate the organic loading on an extended aeration treatment plant with a flow of 0.2 MGD with a population of 1250 (assume 0.17 lb BOD_5/person/day).

Organic loading formula:

$$\frac{\text{Lbs of BOD}_5\text{/ day}}{\text{Aeration tank volume in 1000 ft}^3}$$

Lbs BOD_5 formula:

Population x 0.17 lb/BOD_5/day

AT volume formula:

$$\frac{\text{AT volume in gallons}}{\text{Gallons per ft}^3\ (7.48)}$$

7. What is the sludge age for a 0.85 mgd oxidation ditch with a MLSS of 2,850, an influent flow of 0.65 mgd with a TSS of 245 mg/l?

Sludge age =

$$\frac{\text{Lbs TSS in the aeration basin}}{\text{Lbs/day TSS in the influent}}$$

8. What is the square footage of a rectangular clarifier 75 feet long 40 feet wide and 10 feet deep?

Sq ft = length X width

9. What is the cubic footage of #8?

Cubic ft = length X width X depth

10. How many gallons in the tank mentioned in #9?

Gal per ft^3 X number of ft^3

7.48 gal/ ft^3

Wastewater Math Problems 1-10 Answers

1. % removal formula: $= \frac{\text{Influent} - \text{Effluent}}{\text{Influent}} \times 100$

Answer: $400 - 160 = 240$

$$\frac{240}{400} \times 100 = \boxed{60\%}$$

2. TRC formula = Dosage / mg/l – CL_2 demand

Answer:

$$\frac{125}{1.75 \text{ MGD} \times 8.34}$$

$$\frac{125}{14.595} = 8.56 \text{ mg/l}$$

$$8.56 \text{ mg/l} - 7.0 \text{ mg/l} = \boxed{1.56 \text{ mg/l}}$$

3. Answer: $1.75 \text{ MGD} \times 8.34 \times 1.56 \text{ mg/l} = \boxed{22.76 \text{ lbs } SO_2/\text{day}}$

Or

22.76 lbs SO_2/day + 0.15 lbs of CL_2 at 0.01 mg/l

22.91 lbs of SO_2 = 0.0 mg/l CL_2

4. SLR formula:

$$\frac{\text{Flow in GPD}}{\text{Surface area in ft}^2}$$

Area of a circle formula: 0.785 X diameter squared = surface area in ft^2

Answer: $75^2\ ft^2 = 75\ ft^2 \times 75\ ft^2 = 5{,}625\ ft^2$

$$75^2\ ft^2 \times 0.785 =$$

$$5{,}625\ ft^2 \times 0.785 = 4415.6\ ft^2$$

Convert 2 MGD to 2,000,000

$$\frac{2{,}000{,}000}{4415.6\ ft^2} = \boxed{453\ gpd/ft^2}$$

5. Organic load/lbs/BOD_5/Day/ Acre

$$\frac{\text{Lbs/BOD}_5\text{/day}}{\text{Area/Acres}}$$

$$\text{Lbs BOD}_5 = \text{Flow /mgd} \times 8.34 \times \text{mg/l/BOD}_5$$

Flow = 1,700 pop X 100 gal/day/person =170,000 gpd

Convert 170,000 to mgd = 17 mgd

0.17 mgd X 8.34 X 203.8 mg/l = 288.9 lbs/day

Area in acres

$$\frac{\text{Length ft X width ft X 2 lagoons}}{43{,}560\ ft^2/\text{ Acre}}$$

700 ft X 500 ft X 2

$$\frac{700{,}000\ ft^2}{43{,}560\ ft^2}$$

16 Acres

$$\frac{288.9 \text{ lbs } BOD_5/\text{day}}{16 \text{ Acres}}$$

18.05 lbs BOD_5 / Acre/day

6. Organic loading formula:

$$\frac{\text{Lbs of } BOD_5/\text{ day}}{\text{Aeration tank volume in 1000 ft}^3}$$

Lbs BOD_5 formula:

Population x 0.17 lb/BOD_5/day

1250 people X 0.17 lb BOD_5/capita =212.5 lbs

AT volume formula:

$$\frac{\text{AT volume in gallons}}{\text{Gallons per ft}^3 \text{ (7.48)}}$$

Convert 0.2 mgd to 200,000 gpd

$$\frac{200{,}000 \text{ gpd}}{7.48} = 26{,}738 \text{ ft}^3$$

Convert bottom of AT volume formula to 1000 ft^3 by dividing by 1000 (the 1000 ft^3 is a unit of measure in this calculation).

$$\frac{26{,}738 \text{ ft}^3}{1000 \text{ ft}^3} = 26.738,\ 1000 \text{ ft}^3$$

$$\frac{212.5}{26.738{,}1000 \text{ ft}^3} = \boxed{7.94 \text{ lbs } BOD_5{,}1000 \text{ ft}^3}$$

7. Sludge age = $\frac{\text{Lbs TSS in the aeration basin}}{\text{Lbs/day TSS in the influent}}$

Lbs TSS in the aeration basin

0.85 mgd X 8.34 X 2,850 mg/l

20,203.65 lbs TSS in AB

Lbs/day in influent

0.65 mgd X 8.34 X 245 mg/l

1,328.14 lbs TSS/day/influent

$\frac{\text{20,203.65 lbs TSS in AB}}{\text{1,328.14 lbs TSS/day/influent}}$

15.2 day old sludge

8. Sq ft = length X width

75 ft X 40 ft = 3,000 ft^2

9. Cubic ft = length X width X depth

75 ft X 40 ft X 10 ft = 30,000 ft^3

10. Gal per ft^3 X number of ft^3 = 7.48 gal/ ft^3

7.48 gal/ft^3 X 30,000 ft^3

224,400 gal