Sidney's Big Book of Water and Wastewater Math

Indigo Water Group

Unit Conversions to Know by Heart

1 inch = 2.54 centimeters
1 meter = 3.28 feet
1 mile = 5280 feet

1 gallon = 8.34 lbs when specific gravity is 1.0
1 kg = 2.2 lbs

1 acre = 43,560 ft^2
1 m^2 = 10.76 ft^2

1% = 10,000 mg/L
1 mg/L = 1 ppm
1 µg/L = 1 ppb

1 gallon = 3.785 liters
1 ft^3 = 7.48 gallons
1 m^3 = 35.31 ft^3

1 day = 1440 minutes
1 hp = 0.746 kW

1 ft water = 0.433 psi

1 gram = 15.43 grains
1 grain per gallon = 17.1 mg/L

Water Formulas

pounds per day = (concentration in mg/L)*(flow rate in mgd)*(8.34)

chlorine dose = demand + residual

$$\text{velocity} = \frac{\text{flow}}{\text{area}} \qquad V = \frac{Q}{A}$$

$$\text{flow rate} = \frac{\text{volume}}{\text{time}} \qquad Q = \frac{V}{t}$$

$$\text{overflow rate} = \frac{\text{flow rate}}{\text{area}}$$

$$\text{weir loading rate} = \frac{\text{flow rate}}{\text{feet of weir}}$$

(concentration 1)*(volume 1) = (concentration 2)*(volume 2) $\qquad C_1V_1 = C_2V_2$

(conc. 1)*(volume 1) + (conc. 2)*(volume 2) = (conc. 3)*(volume 3)

$$C_1V_1 + C_2V_2 = C_3V_3$$

$$\text{horsepower} = \frac{(\text{flow in gpm})*(\text{lift in feet})}{3960}$$

Process Efficiency

Process Efficiency

$$\text{PERCENT REMOVAL} = \frac{(In - Out)}{In} * 100$$

Example:
Primary clarifier influent TSS = 150 mg/L
effluent TSS = 90 mg/L
Find percent removal.

$$\text{PERCENT REMOVAL} = \frac{(In - Out)}{In} * 100$$

$$\text{PERCENT REMOVAL} = \frac{(150\ mg/L - 90\ mg/L)}{150\ mg/L} * 100$$

Are units consistent? Do we need to correct?

PERCENT REMOVAL or PERCENT EFFICIENCY

1. If the influent SS are 200 mg/l and the effluent SS are 16 mg/l what is the removal efficiency?
   a) 93%
   b) 92%
   c) 85%
   d) 97%

2. What is the percent of BOD removed in a plant when the influent BOD is 245 mg/L and the effluent BOD is 22 mg/L?
   a) 92%
   b) 86%
   c) 35%
   d) 13%
   e) 9%

3. Calculate the percentage reduction of BOD through the plant, given the following data: Wastewater entering the plant has a BOD of 275 mg/l; Plant effluent has a BOD of 30 mg/l
   a) 11%
   b) 30%
   c) 45%
   d) 89%

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4. The influent suspended solids concentration is 80 mg/l. The effluent suspended solids concentration is 20 mg/l. Calculate the treatment efficiency of the plant.
   a) 25%
   b) 40%
   c) 60%
   d) 75%

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5. If primary treatment can be expected to remove 30% of BOD and secondary treatment can remove 85% of BOD, then the expected overall BOD removal will be
   a) 95%
   b) 89.5%
   c) 77.5%

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JOB EFFICIENCY JOB NO. 48
SHEET NO. OF
CALCULATED BY DATE
CHECKED BY DATE
SUBJECT

1. $\%\ \text{REMOVAL} = \left[\frac{IN - OUT}{IN}\right] * 100$

$\%\ \text{REMOVAL} = \left[\frac{200 - 16}{200}\right] * 100$

$\%\ \text{REMOVAL} = 92.0$

2. $\%\ \text{REMOVAL} = \left[\frac{245 - 22}{245}\right] * 100$

$\%\ \text{REMOVAL} = 91.0$

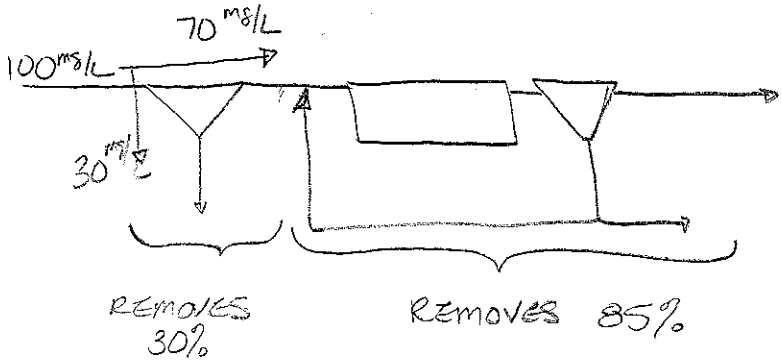
3. $\%\ \text{REDUCTION} = \left[\frac{275 - 30}{275}\right] * 100$

$\%\ \text{REDUCTION} = 89.0$

4. $\%\ \text{EFFICIENCY} = \left[\frac{80 - 20}{80}\right] * 100$

$\%\ \text{EFFICIENCY} = 75.0$

5.



ASSUME: 100 mg/L ENTERS THE WWTP

70 mg/L GOES TO SECONDARY PROCESS WHICH REMOVES 85%. $(70\ mg/L)(0.85) = 59.5\ mg/L$

SO $70\ mg/L - 59.5\ mg/L = 10.5\ mg/L$ IN THE FINAL EFFLUENT

JOB EFFICIENCY JOB NO. 4/9

SHEET NO. OF

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5. CONT

$$\% \text{ EFFICIENCY} = \left[\frac{IN - OUT}{IN}\right] * 100$$

$$\% \text{ EFFICIENCY} = \left[\frac{100 - 10.5}{100}\right] * 100$$

$$\% \text{ EFFICIENCY} = 89.5$$