

WASTEWATER OPERATOR EXAM FORMULA SHEET

9/1/2015

1 cubic foot (ft³) = 1,728 cubic inches (in³)
 1 mile = 5,280 feet (ft)
 1 acre = 43,560 square feet (ft²)
 1 cubic yard (yd³) = 27 ft³
 1 ft³ = 7.48 gallons (gal) = 62.4 pounds (lbs)
 1 gal of water = 8.34 lbs
 1 day = 24 hours (hr) = 1,440 minutes (min) = 86,400 seconds (sec)
 1 million gallons per day (MGD) = 694 gallons per minute (gpm)
 1 MGD = 1,000,000 gallons per day (gpd)
 1 MGD = 1.545 cubic foot per second (ft³/sec)
 1 milligram per liter (mg/L) = 1 parts per million (ppm)
 1 percent (%) = 10,000 ppm
 π (pi) = 3.14
 1 in = 2.54 centimeters (cm)
 1 meter = 100 cm
 1 gal = 3.785 liters (L) = 3,785 milliliters (mL)
 1 L = 1,000 mL
 1 gram = 1,000 milligrams (mg)
 1 kilogram (kg) = 1,000 grams
 1 lb = 453.6 grams = 0.4536 kg
 1 microgram per liter (μ g/L) = 1 parts per billion (ppb) = 0.001 mg/L

Class I

$$\text{lb} = \text{MGD} \times 8.34 \times \text{mg/L}$$

$$\text{PERCENT, \%} = \frac{\text{Part}}{\text{Whole}} \times 100$$

$$\text{mg/L} = \frac{\text{lbs}}{(\text{MGD} \times 8.34)}$$

$$\text{GRADE, \%} = \frac{\text{Rise, ft}}{\text{Run, ft}} \times 100$$

$$\text{MGD} = \frac{\text{lbs}}{(\text{mg/L} \times 8.34)}$$

$$\text{Pond loading} = \frac{\text{BOD Applied, lb/day}}{\text{Area, acres}}$$

$$\text{DETENTION TIME, hr} = \frac{(\text{Volume, gal} \times 24)}{\text{Flow, gpd}}$$

$$\text{AREA OF A CIRCLE} \quad \text{Area, ft}^2 = 0.785 \times (\text{Diameter, ft})^2 = \pi (\text{Radius, ft})^2$$

$$\text{VOLUME OF CIRCULAR TANK} \quad \text{Vol, ft}^3 = 0.785 (\text{Diameter, ft})^2 \times \text{Liquid Depth, ft}$$

$$\text{AREA OF A RECTANGLE} \quad \text{Area, ft}^2 = \text{L, ft} \times \text{W, ft}$$

$$\text{VOLUME OF RECTANGULAR TANK} \quad \text{Vol, ft}^3 = \text{L, ft} \times \text{W, ft} \times \text{Liquid Depth, ft}$$

$$\text{EFFICIENCY PERCENT} \quad \% \text{ Removal} = \text{Eff \%} = \frac{(\text{In} - \text{Out})}{\text{In}} \times 100$$

$$\text{Centigrade, } ^\circ\text{C} = (^\circ\text{F} - 32) \times 0.555$$

$$\text{Fahrenheit, } ^\circ\text{F} = (^\circ\text{C} \times 1.8) + 32$$

Class II

BOD = biochemical oxygen demand

DO = dissolved oxygen

TSS = total suspended solids

MLSS = mixed liquor suspended solids

Sludge dewatering:

$$V_1 \times P_1 = V_2 \times P_2$$

V_1 = original volume

V_2 = new volume (amount remaining)

P_1 = original percentage sludge

P_2 = new percentage sludge

$$Q = VA$$

Q = flow, cfs

V = Velocity, ft/sec

A = Cross sectional area, ft²

$$C = \pi \times D$$

$$\text{BOD, mg/L} = \frac{(\text{DO}_I - \text{DO}_F) \times 300}{\text{Sample vol, mL}}$$

$$\text{Conc, mg/L} = \frac{\text{Weight, grams}}{\text{Sample vol, mL}} \times 1,000,000$$

$$\text{Sludge Age} = \frac{\text{lbs MLSS in aeration basin}}{\text{lbs aeration basin influent TSS per day}}$$

Composite samples:

$$\frac{\text{TOTAL SAMPLE VOLUME in mL}}{\text{Total flow in MGD}} = \text{multiplier}$$

$$\text{SLUDGE VOLUME INDEX} = \frac{30 \text{ min settled sludge vol}}{\text{MLSS mg/L}} \times 1,000$$

Class III and IV

1 ton = 2,000 lbs = 1.102 metric tons

1 pounds per square inch (psi) = 2.31 ft of water

1 horsepower (HP) = 746 watts = 0.746 kW

F/M = food to microorganism ratio

VS = volatile solids

MLVSS = mixed liquor volatile suspended solids

MCRT = mean cell residence time

RSF = return sludge flow

SG = specific gravity

TDH = total dynamic head

$$F/M = \frac{\text{lbs BOD entering aeration basin per day}}{\text{lbs MLVSS in aeration basin}}$$

$$MCRT = \frac{\text{lbs MLSS under aeration}}{(\text{lbs SS wasted} + \text{lbs SS in effluent})}$$

$$\text{Work/Water HP} = \frac{\text{gpm} \times \text{TDH} \times \text{SG}}{3,960}$$

$$\text{Brake HP} = \frac{\text{gpm} \times \text{TDH} \times \text{SG}}{3,960 \times \text{Pump efficiency}}$$

$$\text{Motor HP} = \frac{\text{Brake HP}}{\text{Motor Efficiency}}$$

$$\% \text{ VS Reduction (Digester Efficiency)} = \frac{\text{Raw VS} - \text{Digested VS}}{\text{Raw VS} - (\text{Raw VS} \times \text{Digested VS})} \times 100 \text{ (Use decimal equiv)}$$

$$\text{RAS Flow} = \frac{30 \text{ min settled sludge vol, mL} \times \text{Influent flow}}{\text{Supernatant, mL}}$$

$$\text{Volatile acids/Alkalinity ratio} = \frac{\text{Volatile acids mg/L}}{\text{Alkalinity mg/L}}$$

$$\text{Alkalinity} = \frac{\text{Volatile acids mg/L}}{\text{Ratio}}$$