WASTEWATER OPERATOR EXAM FORMULA SHEET

10/2/2015

1 cubic foot (ft^3) = 1,728 cubic inches (in^3)
1 mile = 5,280 feet (ft)
1 acre = 43,560 square feet (ft^2)
1 cubic yard (yd^3) = 27 ft^3
1 ft^3 = 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 (ft^3/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 (µg/L) = 1 parts per billion (ppb) = 0.001 mg/L

Class I

lb = MGD x 8.34 x mg/L

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

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

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

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

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

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

AREA OF A CIRCLE Area, ft^2 = 0.785 x (Diameter, ft)^2 = π (Radius, ft)^2

VOLUME OF CIRCULAR TANK Vol, ft^3 = 0.785 (Diameter, ft)^2 x Liquid Depth, ft

AREA OF A RECTANGLE Area, ft^2 = L, ft x W, ft

VOLUME OF RECTANGULAR TANK Vol, ft^3 = L, ft x W, ft x Liquid Depth, ft

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

Centigrade, °C = (°F – 32) x 0.555

Fahrenheit, °F = (°C x 1.8) + 32

Class II

BOD = biochemical oxygen demand
DO = dissolved oxygen
TSS = total suspended solids
MLSS = mixed liquor suspended solids
SVI = sludge volume index

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, ft^2

Circumference = $\pi \times D$

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

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

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

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

Composite samples:

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

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

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

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

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

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

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

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

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

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

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