



EQUIVALENTS:

1 acre	= 43,560 sq. ft.
1 cubic ft.	= 7.48 gals
Gals/ac-ft.	= 325,828
1 gallon	= 8.34 lbs
1 day	= 1,440 minutes
1 MGD	= 694.4 GPM, 1.55 CFS and 3.07 ac-ft/day
1.0%	= 10,000 mg/L
π	= 3.14
1 PSI	= 2.31 ft. of water
1 Ft Water	= 0.433 PSI/ft.
1 Hp	= 0.746 Kw
1 cfs	= 448.8 GPM

FORMULAS:

Areas

Area of a rectangle, sq. ft. = Length x width

Area of a circle, sq. ft. = $0.785 (D, \text{ft.})^2$

Circumference, ft. = $\pi \times D, \text{ft.}$

Volumes

Rectangular

Basin, gals = $L, \text{ft.} \times W, \text{ft.} \times H, \text{ft.} \times 7.48$

Right Cylinder,

gals = $0.785 (D, \text{ft.})^2 \times H, \text{ft.} \times 7.48$

Right cone,

gals = $\frac{0.785 (D, \text{ft.})^2 \times H, \text{ft.} \times 7.48}{3}$

Volume, gals = GPM x Time, minutes

Mass, Lbs / BOD / SS

Lbs/Day = MGD x mg/L x 8.34 lbs/gal

mg/L = $\frac{\text{Lbs / day}}{\text{MGD} \times 8.34 \text{ lbs/gal}}$

Lbs = $(\text{Gals} \times 8.34 \text{ lbs/gal}) \times \frac{\%}{100}$

Percentage (%)

Percent (%) = $\frac{\text{In} - \text{Out}}{\text{In}} \times 100$

Population Equivalent

Pop. Equiv. = Population x 0.17
lbs/capita/day BOD / 0.20 TSS

Hydraulic Loading

Hydraulic Loading = People x 100 GPCD

Velocity

Q, CFS = Area, sq. ft. x V, FPS

Area, sq. ft. = Base, ft. x H, ft.

FPS = $\frac{\text{Distance, ft.}}{\text{Time, seconds}}$

Hydraulics

Head, ft. = PSI x 2.31 ft./PSI

PSI = $\frac{\text{Head, ft.}}{2.31 \text{ ft./PSI}}$

Pumps & Motors

Bhp = $\frac{\text{GPM} \times \text{Head, ft.}}{3,960 \times \% \text{ Pump Efficiency}}$

Motor, Effic. = $\frac{\text{Water Hp}}{\left(\frac{\text{Motor, \%}}{100} \times \frac{\text{Pump, \%}}{100} \right)}$

Cost/day = Bhp x 0.746 kw/Hp x Operating
Hours x $\frac{\text{\$/kw-hr}}{100}$

Sludge Vol, GPM = $0.785 (\text{Bore, ft.})^2 \times$
Stroke, ft x 7.48 x
stroke/min x %, Effic.

Solutions

GPD = $\frac{\text{MGD} \times \text{mg/L} \times 8.34}{\frac{\% \text{ sol}}{100} \times 8.34 \times \text{Sp. Gravity}}$

Lbs/gal = $\frac{\% \text{ sol}}{100} \times 8.34 \times \text{Sp. Gravity}$

$(Q_3V_3) = (Q_1V_1) + (Q_2V_2)$

Clarifiers

$$\text{D.T., Hrs.} = \frac{\text{Volume gals} \times 24 \text{ Hrs/day}}{\text{Flow, GPD}}$$

$$\text{S.S.L., GPD/sq. ft.} = \frac{\text{Total flow, GPD}}{\text{Surface area, sq. ft.}}$$

$$\text{W.O.R., GPD/L.F.} = \frac{\text{Total flow, GPD}}{\text{TT} \times \text{D, ft.}}$$

$$\text{Dry Sludge solids, lbs} = (\text{Gals} \times 8.34) \times \frac{\text{Sludge \%}}{100}$$

Ponds & Lagoons

$$\text{Volume, ac-ft.} = \text{Area, acres} \times \text{Depth, ft.}$$

$$\text{O.L.R., lbs/day/acre} = \frac{\text{MGD} \times \text{mg/L} \times 8.34}{\text{Pond, acres}}$$

$$\text{D.T., Days} = \frac{\text{Volume, ac-ft}}{\text{Flow, ac-ft/day}}$$

$$\text{Inches/Day} = \frac{\text{Volume In, GPD}}{\text{Acres} \times 325,828 \text{ gals/ac-ft.}} \times 12"/\text{ft.}$$

$$\text{MGD} = \frac{\text{Acres} \times 325,828 \text{ gals/ac-ft}}{1,000,000 \text{ gals/MGD}}$$

Trickling Filters

$$\text{O.L.R., Lbs/day/1,000 cu. ft.} = \frac{\text{MGD} \times \text{mg/L} \times 8.34}{\text{Vol, cu ft./ 1,000 cu. ft.}}$$

$$\text{Hydraulic Loading Rate, GPD/sq. ft.} = \frac{\text{GPD}}{\text{Surface area, sq. ft.}}$$

$$\text{Recirculation ratio} = \frac{\text{Recirc., Q, GPD}}{\text{Q, In, GPD}}$$

Activated Sludge

$$\text{F/M} = \frac{\text{MGD} \times \text{mg/L} \times 8.34 \text{ lbs/gal}}{\text{MGD} \times \text{MLSS, mg/L} \times \% \text{ Vol.} \times 8.34 \text{ Aerator}}$$

$$\text{MLSS, mg/L} = \frac{\text{MGD} \times \text{mg/L} \times 8.34 \text{ lbs/gal}}{\text{MGD} \times \text{F/M} \times \% \text{ Vol.} \times 8.34 \text{ Aerator}}$$

DAF Units

$$\text{Air / Solids ratio} = \frac{\text{Air, lbs/minute}}{\text{Solids, lbs/minute}}$$

$$\text{MCRT, Days} = \frac{\text{MGD} \times \text{mg/L} \times 8.34}{\text{MGD} \times \text{WAS mg/L} \times 8.34} + \frac{\text{MGD} \times \text{mg/L} \times 8.34}{\text{MGD} \times \text{mg/L} \times 8.34}$$

$$\text{TSS Wasted, lbs/day} = \frac{\text{Aeration Tnk, Lbs} + \text{Clar. Lbs} - \text{Eff. lbs}}{\text{MCRT, Days}}$$

$$\text{GPD Wasted} = \frac{\text{TSS, Lbs/day} \times 1,000,000}{\text{MGD} \times 8.34 \text{ lbs/gal}}$$

$$\text{SVI} = \frac{\text{Settled Volume, ml} \times 1,000 \text{ mg/G}}{\text{MLSS, mg/L}}$$

$$\text{SDI} = \frac{100}{\text{SVI}}$$

$$\text{RAS, \%} = \text{Q} \times \frac{\text{MLSS, mg/L}}{\text{RAS, mg/L} - \text{MLSS, mg/L}} \times 100$$

Anaerobic Digesters

$$\text{VS Reduced} = \frac{(\% \text{Vs, in} - \% \text{Vs Out})}{\% \text{Vs, in} - (\% \text{Vs, in} \times \% \text{Vs Out})} \times 100$$

$$\text{VS, Loading} = \frac{\text{Sludge Feed, VS, lbs/day}}{\text{Digester Vol, cu. ft.}}$$

$$\text{D.T., Days} = \frac{\text{Digester Volume}}{\text{Sludge feed}}$$

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

$$\text{VS Lbs} = (\text{Gals} \times 8.34) \times \frac{\text{TS \%}}{100} \times \frac{\text{VS\%}}{100}$$

Filtration

$$\text{Filtration Rate, GPM} = \text{Area, sq. ft.} \times \text{Rate, GPM/sq. ft.}$$

Disinfection- Chlorine

$$\text{Lbs/day} = \text{MGD} \times \text{mg/L} \times 8.34 \text{ lbs/gal}$$

$$65\% \text{ Lbs/day} = \frac{\text{MGD} \times \text{mg/L} \times 8.34 \text{ lbs/gal}}{0.65}$$

$$\text{GPD} = \frac{\text{MGD} \times \text{mg/L} \times 8.34}{\frac{\% \text{ sol}}{100} \times 8.34 \times \text{Sp. Gravity}}$$

$$\text{Dosage, mg/L} = \text{Demand, mg/L} + \text{Residual, mg/L}$$

Laboratory

$$\text{BOD} = \frac{\text{D.O. In mg/L} - \text{Final D.O. mg/L} \times 300}{\text{Sample Volume, ml}}$$