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, ft.)^2
- Circumference, ft. = π x D, ft.

Volumes

- Rectangular Basin, gals = L, ft. x W. Ft. x H, ft. x 7.48
- Right Cylinder, gals = 0.785 (D, ft.)^2 x H, ft x 7.48
- Right cone, gals = 0.785 (D, ft.)^2 x H, ft x 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 = Lbs/day / MGD x 8.34 lbs/gal
- Lbs = (Gals x 8.34 lbs/gal) x % / 100

Percentage (%)

- Percent (%) = (In – Out) x 100 / In

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 = Distance, ft. / Time, seconds

Hydraulics

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

Pumps & Motors

- Bhp = GPM x Head, ft. / 3,960 x % Pump Efficiency
- Motor, Effic. = Water Hp / (Motor, % x Pump, %)
- Cost/day = Bhp x 0.746 kw/Hp x Operating Hours x ¢ / kw - hr
- Sludge Vol, GPM = 0.785 (Bore, ft.)^2 x Stroke, ft x 7.48 x stroke/min x %, Effic.

Solutions

- GPD = (MGD x mg/L x 8.34 / % sol x 8.34 x Sp. Gravity) / 100
- Lbs/gal = % sol x 8.34 x Sp. Gravity / 100
- (Q3V3) = (Q1V1) + (Q2V2)
**Clarifiers**

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

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

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

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

**Ponds & Lagoons**

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

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

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

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

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

**Trickling Filters**

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

Hydraulic = \( \frac{\text{GPD}}{\text{Surface area, sq. ft. GPD/sq. ft.}} \)

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

**Activated Sludge**

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

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**

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

**Anaerobic Digesters**

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

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

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

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

**Filtration**

Filtration = \( \frac{\text{Area, sq. ft.} \times \text{Rate, GPM/sq. ft.}}{\text{Rate, GPM}} \)

**Disinfection- Chlorine**

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

\[ \text{Dosage, mg/L} = \frac{\text{Demand, mg/L} + \text{Residual, mg/L}}{\text{Sample Volume, ml}} \]

**Laboratory**

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