Equivalents

Time
1 minute = 60 seconds
1 hour = 60 minutes
1 day = 86,400 seconds
1 day = 1,440 minutes
1 day = 24 hours

Flow
1 cfs = 448 gpm
1 gpm = 1,440 gpd
1 MGD = 1.55 cfs
1 MGD = 694.4 gpm

Length
1 inch = 2.54 centimeters
12 inches (in) = 1 foot (ft)
1 yard (yd) = 3 feet (ft)
1 mile (mi) = 5,280 feet (ft)

Area
1 square foot (ft^2) = 144 square inches (in^2)
1 acre (ac) = 43,560 square feet (ft^2)

Weight and Mass
1 gallon of water = 8.34 pounds (lbs)
1 cubic foot of water (ft^3) = 62.4 lbs
1 pound (lb) = 453.6 grams (g)
1 kilogram (kg) = 1,000 grams (g)
1 gram =1,000 milligrams (mg)
1% = 10,000 milligrams per liter (mg/L)

Volume
1 mL = 1,000 microliters (µL)
1 liter = 1,000 milliliters (mL)
1 gallon = 3,785 Milliliters (mL)
1 gallon = 3.785 Liters (L)
1 gallon = 8 pints
1 ft^3 = 7.48 gallons (gal)
1 cubic foot = 62.38 pounds
1 cubic yard = 27 cubic feet
1 acre/foot (ac-ft) = 43,560 cubic feet (ft^3)
1 acre-foot (ac-ft) = 325,828.8 gallons (gal)

Pressure and Head
1 foot of head = 0.433 pounds per square in (psi)
1 pound per square inch (psi) =2.31 feet of head

Temperature Conversions
°C = [°F - 32°] x (5/9)
°F = [(9/5) x °C] + 32°

Power
1 Horsepower (HP) = 746 watts (W)
1 Horsepower (HP) = 0.746 kilowatts (kW)

Miscellaneous
1 mg/L = 1 ppm
π (pi) = 3.14
1 grain per gallon = 17.12 mg/L
1 pound = 7,000 grains

FILTRATION

Filtration Rate (GPM/sq.ft) = $\frac{\text{Filter Production (gallons per day)}}{\text{(Filter area sq. ft.) x (1,440 min/day)}}$

Loading Rate (GPM/ sq. ft.) = $\frac{\text{(Flow Rate, GPM)}}{\text{(Filter Area, sq. ft.)}}$

Daily Filter Production (GPD) = (Filter Area, sq. ft.) x (GPM/ sq. ft. x 1,440 min/day)

Backwash Pumping Rate (GPM) = (Filter Area, sq. ft.) x (Backwash Rate, GPM/ sq. ft.)

Backwash Volume (Gallons) =
(Filter Area, sq. ft.) x (Backwash Rate, gpm/ sq. ft.) x (Time, min).

Backwash Rate, GPM/ sq. ft. = $\frac{\text{(Backwash Volume, gallons)}}{\text{(Filter Area, sq. ft.) x (Time, min)}}$

Rate of Rise (inches per min.) = $\frac{\text{(backwash rate gpm/sq.ft.) x 12 inches /ft}}{\text{7.48 gal/cu.ft.}}$

Unit Filter Run Volume, (UFRV) = $\frac{\text{(gallons produced in a filter run)}}{\text{(filter area sq. ft.)}}$

STEP BY STEP

1. Write what you know
2. Determine the units needed
3. Write the equation out
4. Fill in known variables
5. Multiply by numbers on top
6. Divide by numbers on bottom
7. Solve the equation
8. Double check your work

C• T CALCULATIONS

C• t = (Chlorine Residual, mg/L)x(Time, minutes)

Time, minutes = $\frac{\text{(C• t)}}{\text{(Chlorine Residual, mg/L)}}$

Chlorine Residual (mg/L) = $\frac{\text{(C• t)}}{\text{(Time, minutes)}}$

Inactivation Ratio = $\frac{\text{(Actual System C• t)}}{\text{(Table “E” C• t)}}$

C• t Calculated =
T_{10} Value, minutes x Chlorine Residual, mg/L

Log Removal =
$1.0 - \frac{\%\ \text{Removal}}{100} \times \text{Log key} \times (-1)$

SEDIMENTATION

Surface Loading Rate, (GPD/ sq. ft.) = $\frac{\text{(Total Flow, GPD)}}{\text{(Surface Area, sq.ft.)}}$

Detention Time = $\frac{\text{Volume}}{\text{flow}}$

Detention Time hours =
$\frac{\text{volume (cu ft) x 7.48 gal/cu ft x 24 hr/day}}{\text{Gal/day}}$

Flow Rate = $\frac{\text{Volume}}{\text{Time}}$

Weir Overflow Rate, GPD/L.F. = $\frac{\text{(Flow, GPD)}}{\text{(Weir length, ft.)}}$

Chemical Dosage Calculations

** Note (% purity) and (% commercial purity) used in decimal form

Lbs/day gas feed dry = MGD x (ppm or mg/L) x 8.34 lbs/gal

Lbs/day = $\frac{\text{MGD x (ppm or mg/L) x 8.34 lbs/gal}}{\text{\% purity}}$

GPD = $\frac{\text{MGD x (ppm or mg/L) x 8.34 lbs/gal}}{\text{(\% purity) x lbs/gal}}$

GPD = $\frac{\text{MGD x (ppm or mg/L) x 8.34 lbs/gal}}{\text{(commercial purity \%) x (ion purity \%) x (lbs/gal)}}$

ppm or mg/l = $\frac{\text{lbs/day}}{\text{MGD x 8.34 lbs/gal}}$ or $\frac{\text{gallons x \% purity x lbs/gal}}{\text{MG x 8.34 lbs/gal}}$

Units and Conversion Factors

1 cubic foot of water weighs 62.3832 lb
1 gallon of water weighs 8.34 lb
1 liter of water weighs 1,000 gm
1 mg/L = 1 part per million (ppm)
1% = 10,000 ppm
ft^2 = square feet and ft^3 = cubic feet
1 mile = 5,280 feet (ft)
1 yd^3 = 27ft^3 and 1 yard = 3 feet
1 acre (a) = 43,560 square feet (ft^2)
1 acre foot = 325,829 gallons
1 cubic foot (ft^3) = 7.48 gallons (gal)
1 gal = 3.785 liters (L)
1 L = 1,000 milliliters (ml)
1 pound (lb) = 454 grams (gm)
1 lb = 7,000 grains (gr)
1 grain per gallon (gpg) = 17.1 mg/L
1 gm = 1,000 milligrams (mg)
1 day = 24 hr = 1,440 min = 86,400 sec
1,000,000 gal/day ÷ 86,400 sec/day ÷ 7.48 gal/cu ft = 1.55 cu ft/sec/MGD

CHLORINATION

Dosage, mg/l =(Demand, mg/l) + (Residual, mg/l)

(Gas) lbs = Vol, MG x mg/L x 8.34 lbs/gal

HTH Solid (lbs) =

$$\frac{\text{(Vol, MG) x (ppm or mg/L) x 8.34 lbs/gal}}{\text{(\% Strength / 100)}}$$

Liquid (gal) =

$$\frac{\text{(Vol, MG) x (ppm or mg/L) x 8.34 lbs/gal}}{\text{(\% Strength /100) x Chemical Wt. (lbs/gal)}}$$

PRESSURE

PSI = $\frac{\text{(Head, ft.)}}{\text{2.31ft./psi}}$ **PSI** = Head, ft. x 0.433 PSI/ft.

lbs Force = (0.785) (D, ft.)^2 x 144 in^2/ft^2 PSI.

PUMPING

Water Hp = $\frac{\text{(GPM) x (Total Head, ft)}}{\text{(3,960 gal/min/ft)}}$

Brake Hp = $\frac{\text{(GPM) x (Total Head, ft)}}{\text{(3,960) x (Pump \% Efficiency)}}$

Motor Hp = $\frac{\text{(GPM) x (Total Head, ft)}}{\text{(3,960) x Pump \% Eff. x Motor \% Eff.}}$

VOLUME

Rectangular Basin (Volume, gal) =
(Length, ft) x (Width, ft) x (Height, ft) x7.48 gal/cu.ft.

Cylinder , Volume, gal =
(0.785) x (Dia, ft)^2 x (Height, Depth, or Length in ft.) x 7.48 gal/ft^3

Time, Hrs. = $\frac{\textit{Volume, gallons}}{\textit{(Pumping Rate, GPM, x 60 Min/Hr)}}$

Supply, Hrs. =

$$\frac{\textit{Storage Volume, Gals}}{\text{(Flow In, GPM – Flow Out, GPM) x 60 min/hr.)}}$$

SOLUTIONS

Lbs/Gal = $\frac{\text{(Solution \%)}}{100}$ x 8. 34 lbs/gal x Specific Gravity

Lbs Chemical = Specific Gravity x 8.34 lbs/ gallons x Solution(gal)

Specific Gravity = $\frac{\text{Chemical Wt. (lbs/gal)}}{\text{8. 34 (lbs/gal)}}$

% of Chemical in Solution = $\frac{\text{(Dry Chemical, Lbs)}}{\text{(Dry Wt. Chemical, Lbs) + (Water, Lbs)}}$ x 100

GPD = $\frac{\text{(MGD) x (ppm or mg/L) x 8.34 lbs/gal}}{\text{(\% purity) x Chemical Wt. (lbs/gal)}}$

GPD = $\frac{\text{(Feed, ml/min. x 1,440 min/day)}}{\text{(1,000 ml/L x 3.785 L/Gal)}}$

Two – Normal Equations:

a) $C_1V_1 = C_2V_2$

b) $C_1V_1 + C_2V_2 = C_3V_3$

C = Concentration, V = Volume, Q = Flow

Flow, velocity, area

Q = A x V Quantity = Area x Velocity

Flow (ft^3/sec) = Area(ft^2) x Velocity (ft/sec)

$$\frac{\text{MGD x 1.55 cu ft/sec/MGD}}{\text{.785 x pipe diameter ft x pipe diameter ft}} = \frac{\text{cu ft/sec}}{\text{sq ft}} = \text{ft/sec}$$

"Wire to Water" Efficiency =
(Motor, % Efficiency x Pump % Efficiency)

Cost, $ =
(Hp) x (0.746 Kw/Hp) x (Operating Hrs.) x cents/Kw-Hr

1 horsepower (Hp) = 746 watts = 0.746 kw = 3,960 gal/min/ft