STATE OF CALIFORNIA
DEPARTMENT OF HEALTH SERVICES
WATER DISTRIBUTION OPERATOR CERTIFICATION PROGRAM

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 ug/L = 1 part per billion (ppb)
1 mile = 5,280 feet (ft)
1 yd = 3 feet
1 yd^3 = 27ft^3
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 gm = 1,000,000 micrograms (ug)

CHLORINATION

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

(Gas) lbs/day = (Vol, MG) x (Dosage, mgl) x (8.34 lbs/gal)

HTH Solid (lbs/day) =

$$\frac{\text{(Vol, MG)} \times \text{(Dosage, mg/l)} \times \text{(8.34lbs/gal)}}{\text{(\% Strength)}}$$

Liquid (gal/day) =

$$\frac{\text{(Vol, MG)} \times \text{(Dosage, mg/l)} \times \text{(8.34 lbs/gal)}}{\text{(\% Strength)} \times \text{(Specific Gravity} \times 8.34)}$$

PRESSURE

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

lbs Force = $(0.785)\,(\text{D, ft.})^2 \times 144\ \text{in}^2/\text{ft}^2$ PSI.

VOLUME

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

Cylinder, Volume, gal =
$(0.785) \times (\text{Dia, ft})^2 \times$ (Height, Length, or Depth, in ft.) x 7.48 gal/ft^3

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

Supply, Hrs. = $\dfrac{\text{Storage Volume, Gals}}{\text{(Flow In, GPM – Flow Out, GPM) x 60 min/hr.)}}$

SOLUTIONS

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

Lbs Chemical =
Specific Gravity x 8. 34 lbs/gallons x Solution(gal)

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

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

GPD = $\dfrac{\text{(Vol, MG)} \times \text{(Conc., mg/l)} \times \text{(8.34 lb/gal)}}{\text{(\% Strength)} \times \text{Chemical Wt. (lbs/gal)}}$

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

Two – Normal Equations:

a) $C_1V_1 = C_2V_2$ $\dfrac{Q_1}{V_1} = \dfrac{Q_2}{V_2}$

b) $C_1V_1 + C_2V_2 = C_3V_3$

C = Concentration, V = Volume, Q = Flow

PUMPING

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

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

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

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

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

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

Flow, velocity, area

Q = A x V Quantity = Area x Velocity

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

General

($) Cost / day = Lbs/day x ($) Cost/lb

Removal, Percent = $\dfrac{\text{(In - Out)}}{\text{In}} \times 100$

Specific Capacity, GPM/ft. = $\dfrac{\text{Well Yield, GPM}}{\text{Drawdown, ft.}}$

Gals/Day = (Population) x (Gals/Capita/Day)

GPD = $\dfrac{\text{(Meter Read 2 - Meter Read 1)}}{\text{(Number of Days)}}$

Volume, Gals = GPM x Time, minutes

SCADA = 4 mA to 20 mA analog signal

$\dfrac{\text{(live signal mA - 4 mA off set)}}{\text{(16 mA span)}}$ x process unit and range

4 mA = 0 20 mA full -range