Division of Drinking and Ground Waters

APPLIED DRINKING WATER MATH FORMULA SHEET AND CONVERSION FACTORS

12 in = 1 ft	27 cu. Ft. = 1 cu. Yd	1000 mg = 1 gm	60 sec = 1 min
3 ft = 1yd	7.48 gal = 1 cu. Ft.	1000 gm = 1 kg	60 min = 1 hour
5280 ft = 1 mi	8.34 lbs = 1 gal water	1000 ml = 1 liter	1440 min = 1 day
144 sq. in. = $1ft^2$	62.4 lbs = 1 ft^3 water	2.31 ft water = 1 psi	10,000 mg/L = 1%
43,560 ft^2 = 1 acre	1 grain/gal = 17.1 mg/L	0.433 psi = 1 ft water	454 gm = 1 lb
746 watts = 1hp			

L = Length	B = Base	π = 3.14	W = Width	H = Height	R = Radius
Q = Flow Rate	A = Area	V = Volume	v = velocity	Gr = grains	

AREA

Rectangle: A = L x W

Triangle: A = ½ B x H

Circle: Area = πR^2

VOLUME

Cylinder: V = $\pi R^2 H$

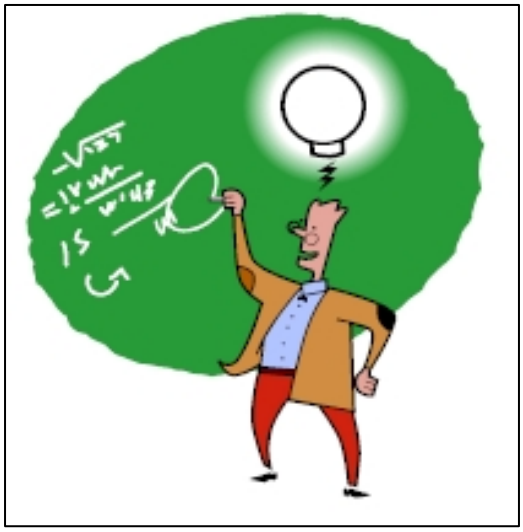
Rectangle: V = L x W x H

Cone: V = $1/3\pi R^2 H$

VELOCITIES and FLOW RATES

1. $v = \frac{\text{distance}}{\text{time}}$

2. Q = v x A



DETENTION TIME

1. Detention Time = $\frac{V}{Q}$

PARTS PER MILLION / POUNDS

1. lbs = 8.34 lbs / gal x mg/L x MG

LOADINGS

1. Weir overflow rate = $\frac{Q}{\text{length of weir}}$

2. Surface loading, gal / day / sq.ft. = $\frac{Q}{\text{surface area}}$

3. Rise rate (ft / min) = $\frac{\text{surface loading (gal / min / ft}^2\text{)}}{7.48 \text{ (gal / ft}^3\text{)}}$

CHEMICAL MIXING & SOLUTION STRENGTHS

1. Chemical, % = $\frac{\text{dry chemical (lbs) x 100\%}}{\text{[dry chemical (lbs) + water (lbs)]}}$

2. Dry Chemical, lbs = $\text{water (lbs)} \times \left[\frac{(100\%)}{\text{Chemical (\%)}}\right]^{-1}$

3. Water (lbs) = $\frac{\text{dry chemical (lbs) x (100\%) - dry chemical (lbs)}}{\text{Chemical, \%}}$

4. Liquid Chemical (gal) = $\frac{\text{Chemical solution (\%) x gal of solution}}{\text{Liquid Chemical (\%)}}$

5. Scale setting, % = $\frac{\text{desired feed rate (gal / hr) x 100\%}}{\text{maximum feed rate (gal / hr)}}$

6. Feeder setting, % = $\frac{\text{desired feed rate (lbs / day) x 100\%}}{\text{maximum feed rate (lbs / day)}}$

7. Water added, gal. = $\frac{\text{hypo (gal) x hypo (\%) - hypo (gal) x desired hypo (\%)}}{\text{desired hypo (\%)}}$

8. Chemical feed = $\frac{\text{Chemical conc. x vol. pumped}}{\text{time pumped}}$

9. Feed rate (lbs / day) = $\frac{\text{chemical, lbs / day}}{\text{(chemical, lbs) / (lb of commercial chemical)}}$

10. ion purity (%) = $\frac{\text{(molecular weight of ion in compound) (100\%)}}{\text{molecular weight of compound}}$

11. Feed rate (lbs / day) = $\frac{\text{Q x concentration desired (mg/L x 8.34 (lbs / gal) (100\%)(100\%)}}{\text{solution (\%) x purity (\%)}}$

12. Feed rate, gal / day = $\frac{\text{feed rate, lbs / day}}{\text{chemical solution, lbs / day}}$

13. Portion of ion = $\frac{\text{(commercial chemical purity, \%) (ion, \%)}}{\text{(100\%) (100\%)}}$

FILTRATION

1. Backwash pumping rate, gal / min = (filter surface area, ft^2) x (backwash rate, gal / min / ft^2)

2. Backwash rinse, in / min = $\frac{\text{(backwash rate, GPM / ft}^2\text{) (12 in / ft)}}{7.48 \text{ gal / ft}^3}$

3. Backwash % = $\frac{\text{(backwash water, gal) x (100\%)}}{\text{water filered, gal}}$

4. UFRV, gal / sq.ft. = $\frac{\text{volume filtered, gal}}{\text{Filter surface area, ft}^2}$

SOFTENING & DEMINERALIZATION

1. Lime feed, mg/L = $\frac{A + B + C + D \times 1.15}{\text{purity of lime as a decimal}}$

   A = carbon dioxide, source water (mg/L as CO^2) x (56/44)
   B = bicarbonate alkalinity, source water (mg/L as $CaCO^3$) x (56/100)
   C = hydroxide alkalinity, source water (mg/L as $CaCO^3$) x (56/100)
   D = magnesium, source water (mg/L as Mg^{2+}) x (56/24.3)

   If hydrated lime is used instead of quicklime, substitute 74 for 56 in A, B, C, and D.

2. Lime demand, mg/L = (2.27 x CO2) + (Total Alkalinity) + 4.12 x Mg) x 0.56

3. Lime demand, lbs / MG = $\frac{\text{(Lime demand, mg/L) (1 MG) (4.67 lb/ MG / mg/L) (excess lime, \% / 10)}}{\text{Calcium oxide purity (\% / 100)}}$

4. Exchange capacity, grains = (removal capacity, gr / ft^3) (media vol. ft^3)

5. Water treated, gal. = $\frac{\text{exchange capacity, grains}}{\text{Hardness removed, grains / gal.}}$

6. Bypass flow, gal / day = $\frac{\text{(total flow, gal / day) (finished water hardness, grains / gal.)}}{\text{Raw water hardness, grains / gal.}}$

7. Salt, lbs = (salt required, lbs / 1,000 grains) (hardness removed, grains)

8. Brine, gal = $\frac{\text{salt needed, lbs}}{\text{salt solution, lbs / gal.}}$

9. Mineral rejection, % = $\frac{\text{1 – product water TDS, mg/L}}{\text{feedwater TDS, mg/L}} \times 100\%$

10. Recovery, % = $\frac{\text{product flow}}{\text{feed flow}} \times 100\%$

11. Non-Carbonate Hardness = Mg/L as $CaCO^3$

    Total Hardness – Total Alkalinity = Non-Carbonate Hardness
    Raw Non-Carbonate Hardness – Finished Non-Carbonate Hardness = Non-Carbonate Hardness Removed

12. Soda Ash = (Non-Carbonate Hardness) (106 / 100)

LABORATORY

1. Temperature, F = (temperature C)(1.8) + 32

2. Dilute to mL = $\frac{\text{(Actual Weight, gm) (1,000 mL)}}{\text{(Desired Weight, gm)}}$

3. Langelier Index (L.I.) = pH – pHs