FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
DRINKING WATER A, B, C & D FORMULA SHEET AND CONVERSION FACTORS 10-09

12 in = 1 ft	27 cu. ft.= 1 cu. yd	1000 mg = 1 gm	60 sec = 1 min
3 ft = 1 yd	7.48 gal = 1 cu. ft.	1000 gm = 1 kg	60 min = 1 hour
5280 ft = 1 mi	8.34 lbs = 1 gal	1000 ml = 1 liter	1440 min = 1 day
144 sq. in.= 1 sq. ft.	62.4 lbs = 1 cu. ft.	3.785L = 1 gal	10,000 mg/L = 1%
43,560 sq. ft.= 1 acre	1 grain / gal = 17.1 mg/L	2.31 ft water = 1 psi	454 gm = 1 lb.
		0.433 psi = 1 ft water	

L = Length B = Base $\pi = 3.14$ W = Width H = Height R = Radius

AREA

Rectangle: $A = L \times W$ Triangle: $A = 1/2\ B \times H$ Circle: Area = $\pi \times R^2$

Volume

Cylinder: $V = \pi R^2 \times H$ Rectangle: $V = L \times W \times H$ Cone: $V = 1/3\pi \times R^2 \times H$

TEMPERATURE CONVERSIONS

C^o to $F^o = C^o \times 1.8 + (32)$ F^o to $C^o = \frac{(F^o - 32)}{1.8}$

VELOCITIES and FLOW RATES

1. $V = \frac{\text{distance, feet}}{\text{time, min}}$

2. $Q = V \times A$ Flow rate = (velocity, ft / sec x area, sq. ft.)

DETENTION TIME

1. Detention Time = $\frac{\text{(tank, cap.,gal) x (24 hours/day)}}{\text{rate of flow (gal / time)}}$

2. Detention Time, Minutes = $\frac{\text{(cap.,gal.)(24 hr./day) (60 min./hr.)}}{\text{(Flow, gal./day)}}$

PARTS PER MILLION / POUNDS

1. mg/L = $\frac{\text{pounds of chemical}}{\text{(8.34 lbs / gal x MG)}}$

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

LOADINGS

1. Weir overflow, gal / day / ft = $\frac{\text{total flow, gal / day}}{\text{length of weir, ft.}}$

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

3. Rise rate, ft / min = $\frac{\text{surface loading, gal / min / sq. ft.}}{\text{7.48 gal / cu. ft.}}$

CHEMICAL MIXING & SOLUTION STRENGTHS

1. Polymer, % = $\frac{\text{(dry polymer, lbs) x (100\%)}}{\text{(dry polymer, lbs + water, lbs)}}$

2. Dry polymer, lbs = (Water, Lbs) / ((100 / polymer %) -1)

3. Water, lbs = $\frac{\text{dry polymer, lbs x 100\%}}{\text{polymer \%}}$ - dry polymer, lbs

4. Liquid polymer, gal = $\frac{\text{(polymer solution, \%) (gal of solution)}}{\text{liquid polymer, \%}}$

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

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

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

8. Polymer feed, lbs/day = $\frac{\text{(polymer conc., mg/L)(vol. pumped, ml)(60 min/hr)(24 hr/day)}}{\text{(time pumped, min.)(1,000 mg/L)(1,000 mg/gm)(454 gm/lb)}}$

FILTRATION

1. Filtration rate, gal / min / sq. ft. = $\frac{\text{flow, gal / min}}{\text{surface area, sq. ft.}}$

2. Backwash pumping rate, gal / min = (filter surface area, sq. ft.) (BW rate, gal / min / sq. ft.)

3. Backwash rise, in/min. = $\frac{\text{(backwash, GPM/sft)(12in/ft)}}{\text{(7.48 gal/cft)}}$

4. Backwash % = $\frac{\text{(backwash water, gal) (100\%)}}{\text{water filtered, gal.}}$

5. UFRV, gal / sq. ft. = $\frac{\text{volume filtered, gal}}{\text{filter surface area, sq. ft.}}$

6. UFRV, gal/sq. ft. = (Filtration Rate, GPM/sq ft)(Filter Run, hr)(60 min/hr)

SOFTENING & DEMINERALIZATION

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

A =	carbon dioxide, source water	(mg/L as CO_2)	x	(56 / 44)
B =	bicarbonate alkalinity, source water	(mg/L as $Ca\,CO_3$)	x	(56 / 100)
C =	hydroxide alkalinity, source water	(mg/L as $Ca\,CO_3$)	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 = $\frac{\text{[(2.27 x } CO_2\text{) + (Total Alkalinity) + (4.12 x Mg) x 0.56] x (excess)}}{\text{Calcium oxide purity (\% / 100)}}$

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 / cu. ft.) (media vol, cu. ft.)

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 req'd, lbs / 1000 grains) (hardness removed, grains)

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

9. Mineral rejection, % $= 1 - \left(\frac{\text{(product TDS, mg/ L}}{\text{feedwater TDS, mg/L}} \right) \text{X } 100\%$

10. Recovery, % $= \left(\frac{\text{product flow}}{\text{feed flow}} \right) \text{ X } 100\%$

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) $\left(\frac{106}{100} \right)$

FLUORIDATION

1. Fluoride ion purity, % = $\frac{\text{(molecular wt. of F in compound) (100\%)}}{\text{molecular wt. of compound}}$

2. Feed rate, lbs / day = $\frac{\text{(flow, MGD) (desired F, mg/L) (8.34 lbs / gal) (100\%)}}{\text{(acid sol'n, \%) (purity \%)}}$

3. Feed rate, gal / day = $\frac{\text{feed rate, lbs / day}}{\text{chemical sol'n, lbs / gal}}$

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

5. Feed rate, lbs / day = $\frac{\text{Fluoride, lbs / day}}{\text{fluoride, lbs / lb of commercial chemical}}$

LABORATORY

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

2. Langelier Index (L.I.) = pH – pHs

DISINFECTION

Chlorine Demand, mg/L = Chlorine Dosage, mg/L – Chlorine Residual, mg/L

Chlorine Dosage, mg/L = Chlorine Demand, mg/L + Chlorine Residual, mg/L