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

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

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

SEDIMENTATION AND 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. = $\frac{\text{influent flow, gal / day}}{\text{surface area, sq. ft.}}$

3. Solids loading, lbs / day / sq. ft. = $\frac{\text{solids applied, lbs / day}}{\text{surface area, sq. ft.}}$

4. Efficiency, % = $\frac{\text{(in) - (out)}}{\text{(in)}} \times 100\%$

5. Hydraulic loading, gal / day / sq.ft. = $\frac{\text{flow rate, gal / day}}{\text{surface area, sq. ft.}}$

6. Trickling Filter Organic loading, lbs CBOD /day / 1000 cu. Ft. = $\frac{\text{CBOD applied, lbs /day}}{\text{vol. of media in 1000 cu. Ft.}}$

7. Soluble CBOD, mg/L = total CBOD, mg/L - (K x suspended solids, mg/L)
(where K = 0.5 to 0.7 for most domestic wastewaters)

8. RBC Organic Loading, lbs CBOD/day/1000 sq.ft. = $\frac{\text{soluble CBOD applied, lbs/day}}{\text{Surface area of media, 1000 sq.ft.}}$

ACTIVATED SLUDGE

1. SVI = $\frac{\text{30 min settling, mL/L}}{\text{MLSS, mg/L}}$ x 1,000

2. SDI = $\frac{100}{\text{SVI}}$

3. Solids inventory, lbs = (Tank cap, MG) x (MLSS, mg/L) x (8.34 lbs / gal)

4. Sludge age, days = $\frac{\text{solids under aeration, lbs}}{\text{solids added, lbs / day}}$

5. F/M = $\frac{\text{(inf CBOD, mg/L) x (Flow, MGD) x (8.34 lbs / gal)}}{\text{(Aeration tank cap, MG) x (MLVSS, mg/L) x (8.34 lbs / gal)}}$

6. MCRT = $\frac{\text{solids inventory, lbs}}{\text{(effluent solids, lbs) + (WAS solids, lbs)}}$

7. WAS, lbs / day = $\frac{\text{(Solids inventory, lbs)}}{\text{MCRT, days}}$ - (Solids lost in effluent, lbs / day)

8. WAS flow, MGD = $\frac{\text{WAS, lbs/day}}{\text{(WAS, mg/L) x (8.34 lbs / gal)}}$

9. Change, WAS rate, MGD = $\frac{\text{(current solids inventory, lbs) - (desired solids inventory, lbs)}}{\text{WAS, mg/L x 8.34 lbs / gal}}$

10. Return sludge rate, MGD = $\frac{\text{(set. Solids, mL) x (flow, MGD)}}{\text{(1,000 mL) - (set. solids, mL)}}$

SLUDGE DIGESTION

1. Dry solids, lbs = $\frac{\text{(raw sludge, gal)} \times \text{(raw sludge, \% solids)} \times \text{(8.34 lbs / gal)}}{100\ \%}$

2. VS pumped, lbs / d = $\frac{\text{(ret. Sludge, gal / day)} \quad \text{(ret. sludge solids, \%)} \quad \text{(ret. sludge vol., \%)} \quad \text{(8.34 lbs / gal)}}{(100\%) \quad (100\%)}$

3. Seed Sludge, lbs volatile solids = $\frac{\text{VS pumped, lbs VS / day}}{\text{loading factor, lbs VS / day / lb VS in digester}}$

4. Seed Sludge, gal = $\frac{\text{seed sludge, lbs volatile solids}}{\text{(seed sludge, lbs / gal)} \times \frac{\text{(solids \%)}}{100\%} \times \frac{\text{(VS \%)}}{100\%}}$

5. Lime req'd, lbs = (sludge, MG) x (volatile acids, mg/L) x (8.34 lbs / gal)

6. Reduction of Volatile Solids, % = $\frac{\text{(in - out)} \times 100\%}{\text{in - (in x out)}}$

7. VS destroyed, lbs / day / cu. ft. = $\frac{\text{(VS added, lbs / day)} \quad \text{(VS reduction, \%)}}{\text{(digester volume, cu. ft.)} \quad (100\%)}$

8. Gas production, cu. ft. / lb VS = $\frac{\text{gas produced, cu. ft. / day}}{\text{VS destroyed, lbs / day}}$

HORSEPOWER, FORCE, CHEMICAL PUMPS

1. Water HP = $\frac{\text{(flow, gal / min)} \times \text{(head, ft)}}{3{,}960}$

2. BHP = $\frac{\text{(flow, gal / min)} \times \text{(head, ft.)}}{(3{,}960 \times \text{Pump Efficiency, \%})}$

3. Motor HP = $\frac{\text{(flow, gal / min)} \times \text{(head, ft)}}{(3{,}960) \times (\text{Pump Efficiency, \%}) \times (\text{Motor Efficiency, \%})}$

4. Upward force, lbs = 62.4 lbs / cu. ft. x ground water height over tank bottom, ft x area, sq.ft.

5. Side wall force, lbs = (31.2 lbs / cu. ft.) x $(\text{height, ft})^2$ x (length, ft)

6. Chemical sol=n, lbs / gal = $\frac{\text{(sol'n \%)} \times \text{(8.34 lbs / gal)}}{100\%}$

7. Feed pump flow, gal / day = $\frac{\text{chemical feed, lbs / day}}{\text{chemical solution, lbs / gal}}$

8. Scale setting, % = $\frac{\text{(desired flow, gal / day)} \quad (100\ \%)}{\text{maximum feed rate, gal / day}}$

9. Brake Horsepower = $\frac{\text{(Power to elec. motor) (Motor Eff.)}}{\text{.746 kw/Hp}}$
Hp

10. Pump Efficiency, % = $\frac{\text{Water Horsepower, Hp x 100\%}}{\text{Brake Horsepower, Hp}}$

11. Total Dynamic Head, ft. = Static Head, ft. + Friction Losses, ft.

12. Static Head = Suction Lift, ft. + Discharge Head, ft.

LAB PROCEDURES AND MEASUREMENTS

1. TSS, mg/L = $\frac{\text{(RDD - DD)}}{\text{sample vol, mL}}$ x 1 M

2. VSS, mg/L = $\frac{\text{(RDD - FDD)}}{\text{sample vol, mL}}$ x 1 M

where: RDD = dried residue + dish + disc (filter), grams
DD = dish + disc, grams
FDD = fired residue + dish + disc, grams
1 M = 1,000,000

3. VSS, % = $\frac{\text{volatile solids, mg/L}}{\text{total suspended solids, mg/L}}$ x 100%

4. CBOD sample size, mL = $\frac{\text{1,200}}{\text{estimated CBOD, mg/L}}$

5. Seed correction, mg/L, for 1 mL seed = $\frac{\text{seed initial D.O. - seedf final D.O.}}{\text{mL seed added}}$

6. CBOD, mg/L = $\frac{\text{[(initial DO - Final DO) - seed correction factor] x (bottle volume, mL)}}{\text{sample volume, mL}}$

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