OCT Academy

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WATER FORMULA & CONVERSION SHEET

GENERAL

1. **Mass,**Lbs / Day = (Vol, MGD) x (Conc.,mg/l) x (8.34 lbs / gal)

2. **Dosage**,Mg /L = (Feed, lbs / day)
(Vol, MGD) x (8.34 lbs/gal)

3. **Rectangular Tank**
Volume, cu.ft. = (Length, ft) x (Width, ft) x (Height,ft)
i) **Vol, Gals** =Multiply the above by the factor 7.48 gal /cu.ft

4. **Circular Tank**
Volume, cu.ft = (0.785) x (D^2,ft) x (Height or depth,ft)
i) **Vol,Gals** =Multiply the above by the factor 7.48 gal /cu.ft

5. **Conical Base**
Volume, cu ft.=(0.785) x (D^2, ft) x (Height or Depth,ft)
3
i) **Vol,Gals** = Multiply the above by the factor 7.48 gals / cu.ft

6. **Trapezoid, Volume, cu. ft.** = (B_1 + B_2) x Height, ft x Length, ft.
2

7. **Removal**,% = (In - Out) x 100
In

8. **Decimal Fraction** = (Percent)
100

GPCD means Gallons Per Capita Per Day. A capita is one (1) person

9. **Gals/Day of Water Consumption (Demand/Day)** = (Population) x (Gals/Capita/Day)

Consumption Averages, per capita:

1.	**Winter**	**-170 GPCD**
2.	**Spring**	**-225 GPCD**
3.	**Summer**	**-325 GPCD**

11. **Supply, Days (Full to Tank Dry)** = (Vol, Gals / day)
Population Served) x (GPCD)

12. **GPM** = (Volume, gallons)
(Pumping Time, min.)

13. **Time, min** = (Volume, gallons)
(Pumping Rate, GPM)

14. **Supply, Hrs. (Full to Tank Dry)** =(Storage Volume, Gals.)
(Flow In, GPM - Flow out, GPM) x 60 min/hr.

Chlorine Feed, Dosage / Demand / Residual:

Gas Chlorine Feed, Lbs/day

1. **Lbs/Day** = (Vol, MGD) X (Conc., mg/l) x (8.34 lbs/gal)
Dosage, mg/l = (Lbs/day)
(MGD) X (8.34 lbs/ gal)

65% HTH FEED, Lbs/day - Calcium Hypochlorite

2. **HTH, lbs/Day** = (Vol, MGD) X (CONC., MG/L) X (8.34 lbs/gal)
0.65
Dosage, mg/l =(Lbs/day x 0.65)
(MGD) x (8.34 lbs/gal)

5-1/4% Liquid Chlorine - Sodium Hypochlorite

3. **Lbs/Gal** = (Solution Percentage) x 8.34 lbs/gal
100
GPD = (vol, MGD x (conc., mg/l) x 8.34 lbs/gal
(Lbs/gal)

Dosage / Demand / Residual

4. **Dosage, mg/l** = (Demand, mg/l) + (Residual, mg/l)

5. **Demand, mg/l** = (Dosage, mg/l) - (Residual, mg/l)

6. **Residual, mg/L** = (Dosage, mg/l) - (Demand, mg/l)

PUMPS & PUMPING

1.**Hydraulics:**
Head, Ft. = (2.31 ft/psi) x (psi)
Psi = (0.433 psi/ft) x (Head, ft)
Force, Lbs = (0.785) (D_1,ft)^2 x 144 sq. in/sq.ft x PSI

2. Pumping Rate:
Fill rate, GPM = (Tank Volume, Gals)
(time, minutes)

Fill Time, min = (Tank, Volume, Gals)
(Fill Rate, GPM)

Pumping: Water Hp = (GPM) x (Head, ft)
(3,960)

Brake Hp. = (GPM) x (Head, ft)
(3,960 x (%, Effic.)

%, Effic. = (GPM) x (Head, ft) x 100
(3,960 x Brake Hp.)

GPM = (Brake Hp.) x (3,960) x (%, Effic.)
(Head, ft)

% Pump Efficiency = (GPM) X (Head, FT) X 100
(BHp) X (3,960)

% Overall Effic. = (Motor, % Effic x Pump % Effic)

PUMPING COST
Cost per day= /
(Brake Hp.) x (0.746 Kw/Hp.) x (Operating, Hrs.) x (c Kw - Hr.)

Draw Down,ft. = Pumping level, ft - Static level, ft.

CHEMICAL FEED & STRENGTH OF SOLUTION

5. **Chemical Feed Pumps:**
GPD = ml / min x 1,440 min / day
1,000 ml / L x 3.785 L / gal

6. **Chemical Feed rate:**
ml / min = GPD x 1,000 ml / L x 3.785 L / gal
1,440 min / day

7. **% Percent of Chemical in Solution from Dry Stock** = (Dry Chemical, Lbs) x 100
(Water wt.,lbs.) + (Dry wt. Chemical, Lbs)

8. **Mixture Strength, %**
(Vol 1. Gals) x (Strength 1, %) + (Vol 2, Gals) x (Strength 2, %)
(Volume 1, Gals + Volume 2, Gals)

9. **Two-Normal Equations**

a) $C_1 V_1 = C_2 V_2$

b) $\frac{Q_1}{V_1} = \frac{Q_2}{V_2}$ (Ratio and Proportion)

10 **Three - Normal Equation**

a) $(V_1 C_1) + (V_2 C_2) = (V_3 C_3)$

b) $\frac{Q_1}{V_1} = \frac{Q_2}{V_2}$

$\frac{Q_2}{V_2} = \frac{Q_3}{V_3}$ (Ratio and Proportion)

SEDIMENTATION TANKS & CLARIFIERS:

1. **Surface Loading Rate, GPD / sq. ft.** $= \frac{\text{(Total Flow, GPD)}}{\text{(Surface Area, sq.ft)}}$
2. **Detention Time, Hrs.** $= \frac{\text{(Volume, gals) x (24 Hrs. / day)}}{\text{Total 24 Hr. Flow, Gals/day}}$
3. **Flow, GPD** $= \frac{\text{(Volume, Gals) x (24 Hrs./day)}}{\text{(Detention Time, Hrs.)}}$
4. **Circumference, ft.** = 3.141 π x Diameter, ft.
5. **Weir Overflow Rate, GPD / ft** $= \frac{\text{(Flow, GPD)}}{\text{(Weir, Length,ft)}}$
6. **Solids Loading Rate, lbs/day/sq.ft** $= \frac{\text{(Solids into Clarifier, lbs / day)}}{\text{(Surface Area, sq. ft)}}$
7. **Sludge Solids, Lbs** =(Flow, gals x 8.34 lbs / gal) x (Sludge,%)
8. **Raw Sludge Pumping, GPM** $= \frac{\text{(Settleable Solids, ml/L) x (Plant Flow, GPM}}{\text{(1,000 ml / L)}}$
9. **Sludge Volume Index, mg/l (SVI)** $= \frac{\text{(Settled Sludge Volume, ml/l) x (1,000 mg/G)}}{\text{(Suspended Matter, mg/l)}}$
10. **mg/l** $= \frac{\text{(ml x 1,000,000)}}{\text{(ml Sample)}}$

FILTRATION:

1. **Filter Flow Rate:**
   Filteration Rate, GPM = (Filter Area, sq.ft.) x (GPM/SQ.FT)
2. **filtration Rate, Gpm/sq. ft.)** $= \frac{\text{(Flow Rate, GPM)}}{\text{(Filter Area, sq.ft)}}$
3. **Filtration Rate,GPD** =(Filter Area, sq. ft.) x (GPM/sq.ft.) x 1,440 Min / day
4. **Backwash Rate:**
   Backwash Pumping = (Filter Area, sq.ft.) x (Backwash Rate, GPM/sq.ft)

5. **Filter Backwash:**
   Backwash Volume, = (Filter Area, sq.ft) x (Backwash Rate, gpm) x (time, min)
   Backwash Rate GPM/ sq.ft. $= \frac{\text{(Backwash Volume, GPM)}}{\text{(Filter Area, sq.ft)}}$
   Backwash, GPM = (Area, sq.ft.) x **(Height, Rise/Fall/Drop**, ft/Min) x (7.48 gals/cu.ft)
6. **Rate of Rise,**
   GPM/sq.ft. = (Height, Rise/Fall, Drop,ft/min) x (7.48 gals/cu.ft.)

Velocity:

1. Q,cfs = (Area, sq. ft.) x (Velocity, fps)
2. Velocity, fps $= \frac{\text{(Q,cfs)}}{\text{(Area, sq. ft.)}}$
3. Area, sq. ft. $= \frac{\text{(Q, cfs)}}{\text{(Velocity, fps)}}$
4. Flow Conversions
   Flow, GPM = (Q,cfs) x (448.8 GPM/cfs)
5. Q, Cfs $= \frac{\text{(Flow, GPM)}}{\text{(448.8 GPM/cfs)}}$
6. Pipe Diameter, Inches $= \sqrt{\frac{\text{(Area, sq. ft.)}}{\text{(0.785)}}}$ x 12 inches/ft

Ion Exchange:

1. Calcium Hardness as mg/l $CaCO_3$ = (2.5) x (Calcium, mg/l)
2. Magnesium Hardness as mg/l $CaCO_3$ = (4.1) x (Magnesium,mg/l)
3. Total Hardness = Calcium + Magnesium Hardness as $CaCO_3$
4. Convert Hardness from mg/l to grains / gallon:
   Grains/gallon $= \frac{\text{(Total Hardness, mg/l)}}{\text{(17.1 mg /l / Grain)}}$
5. Total Exchange Capacity,
   Kilograins =(Resin Cap., kilograins / cu.ft.) x (Vol, Cu.ft.)
6. Total Grains capacity = Kilograins x 1,000
7. Gals of Soft Water per Service Run $= \frac{\text{(Total Exchange Capacity, Kilograns)}}{\text{(Total Hardness as } CaCo_3 \text{ Grains / gallon}}$
8. By-Pass Water, GPD $= \frac{\text{(Flow, GPD) X (Effuent Harness, Gr/Gal)}}{\text{(Influent Hardness , Gr/Gal)}}$
9. by-pass Water, % $= \frac{\text{(Discharge Hardness, mg/l)}}{\text{(Initial Hardness, mg / l)}}$ x 100
10. Salt, lbs $= \frac{\text{(Capacity, Grains) x (Salt, lbs)}}{\text{(1,000 Grains)}}$
11. Brine, Gals $= \frac{\text{(Salt Needed, lbs)}}{\text{(Salt, lbs / gallon)}}$
12. Hardness Removed,
    Grains $= \frac{\text{(Influent Hardness, mg/l - Effluent Hardness, mg/l)}}{\text{(17.1 mg / l / Grain)}}$

Jar Testing:

1. Dosage, mg/l $= \frac{\text{(Stock ml) x 1,000 mg/gram x (Conc., Grams/L)}}{\text{(Sample Size, ml)}}$
2. Grams/Liter $= \frac{\text{(mg / l x 1,000 ml)}}{\text{(ml x 1,000 mg / l)}}$
3. Alum Reacting,
   mg/l $= \frac{\text{(1.0 mg / l Alum) x (Raw Alk., mg/l - Alk. Present, mg/l)}}{\text{(0.45 mg / l Alkalinity)}}$
4. Alkalinity Dosage,
   mg / l = (Total Alum, mg / l - Alum Reacting, mg/l_)

Laboratory:

1. TSS (mg/l) =
   $\frac{\text{Paper WT. and Dried Solids (g) - Paper wt.(g)}}{\text{(Milliliter [ml] of Sample)}}$ x 1,000,000
2. Total Solids,
   mg/l $= \frac{\text{(Residue, mg) x 1,000}}{\text{(ml Sample)}}$
3. Total Alkalinity, Mg / l $= \frac{\text{(mls of titrant x Normality x 50,000)}}{\text{(mls of Sample)}}$
4. Langelier Index = (pH -pH Saturated)
5. Concentrations:
   (Conc. 1) x (Volume 1) = (Conc. 2) x (Volume 2)
6. mg/l $= \frac{\text{(ml x 1,000,000)}}{\text{(ml sample)}}$
   mg/l = ml x 1,000 ml / L
7. mg / l Total Solids $= \frac{\text{(Residue, mg)}}{\text{(ml Sample)}}$ x 1,000
8. Temperature:
   F° = C° x 1.8) + 32°
   C° $= \frac{\text{(F° - 32°)}}{\text{(1.8)}}$

CONVERSION FACTORS	
7.48 gallons / cu.ft	1,000 mL / liter
1 cubic foot of water = 62.4 lbs.	1,000 ug / mg/L
8.34 lbs / gallon	12 inches / foot
1,440 minutes / day	2.31 ft / psi
448.8 GPM / CFS	0.433 psi / 1ft water
1.55 cfs / MGD	694.4 GPM/MGD
Ac-ft = 325,851 gallons	0.746 Kw / BHp
1,000 mg / gram	33,000 ft lbs / min per 1 Hp
3.785 Liter / gallon	746 watts /1 Hp
3,785 mL / gallon	1 part per million =1 mg / L
10,000 mg/L = 1%	27 cubic feet = 1 cubic yard