

ABC Formula/Conversion Table for Water Treatment, Distribution and Laboratory Exams

$$\text{Alkalinity, as mg CaCO}_3/\text{L} = \frac{(\text{Titrant Volume, mL})(\text{Acid Normality})(50,000)}{\text{Sample Volume, mL}}$$

$$\text{Amps} = \text{Volts/Ohms}$$

$$\text{Area of Circle} = (\pi/4) (\text{Diameter}^2) \text{ or } (\pi)(\text{Radius}^2)$$

$$\text{Area of Cone (lateral area)} = (\pi) (\text{Radius}) \sqrt{\text{Radius}^2 + \text{Height}^2}$$

$$\text{Area of Cone (total surface area)} = (\pi) (\text{Radius}) (\text{Radius} + \sqrt{\text{Radius}^2 + \text{Height}^2})$$

$$\text{Area of Cylinder (total outside surface area)} = [\text{Surface Area of End \#1}] + [\text{Surface Area of End \#2}] + [(\pi)(\text{Diameter})(\text{Height or Depth})]$$

$$\text{Area of Rectangle} = (\text{Length}) (\text{Width})$$

$$\text{Area of a Right Triangle} = \frac{(\text{Base})(\text{Height})}{2}$$

$$\text{Average (arithmetic mean)} = \frac{\text{Sum of All Terms}}{\text{Number of Terms}}$$

$$\text{Average (geometric mean)} = [(X_1)(X_2)(X_3)(X_4)(X_n)]^{1/n} \text{ The } n\text{th root of the product of } n \text{ numbers}$$

$$\text{Chemical Feed Pump Setting, \% Stroke} = \frac{(\text{Desired Flow})(100\%)}{\text{Maximum Flow}}$$

$$\text{Chemical Feed Pump Setting, mL/min} = \frac{(\text{Flow, MGD})(\text{Dose, mg/L})(3.785 \text{ L/gal})(1,000,000 \text{ gal/MG})}{(\text{Liquid, mg/mL})(24 \text{ hr/day})(60 \text{ min/hr})}$$

$$\text{Circumference of Circle} = (\pi) (\text{Diameter})$$

$$\text{Composite Sample Single Portion} = \frac{(\text{Instantaneous Flow})(\text{Total Sample Volume})}{(\text{Number of Portions})(\text{Average Flow})}$$

$$\text{Degrees Celsius} = (\text{Degrees Fahrenheit} - 32) (\frac{5}{9}) \text{ or } \frac{(\text{°F} - 32)}{1.8}$$

$$\text{Degrees Fahrenheit} = (\text{Degrees Celsius}) (\frac{9}{5}) + 32 \text{ or } (\text{Degrees Celsius}) (1.8) + 32$$

$$\text{Detention Time} = \frac{\text{Volume}}{\text{Flow}}$$

$$\text{Electromotive Force (E.M.F), volts} = (\text{Current, amps}) (\text{Resistance, ohms}) \text{ or } E = IR$$

$$\text{Feed Rate, lbs/day} = \frac{(\text{Dosage, mg/L})(\text{Capacity, MGD})(8.34 \text{ lbs/gal})}{(\text{Purity, decimal percentage})}$$

$$\text{Feed Rate, gal/min (Flouride Saturator)} = \frac{(\text{Plant capacity, gal/min}) (\text{Dosage, mg/L})}{(18,000 \text{ mg/L})}$$

$$\text{Filter Backwash Rise Rate, in/min} = \frac{(\text{Backwash Rate, GPM/sq ft}) (12 \text{ in/ft})}{(7.48 \text{ gal/cu ft})}$$

$$\text{Filter Drop Test Velocity, ft/min} = \frac{\text{Water Drop, ft}}{\text{Time of Drop, min}}$$

$$\text{Filter Flow Rate or Backwash Rate, gpm/sq ft} = \frac{\text{Flow, gpm}}{\text{Filter Area, sq ft}}$$

$$\text{Filter Yield, lbs/hr/sq ft} = \frac{(\text{Solids Loading, lbs/day}) (\text{Recovery, \% / 100\%})}{(\text{Filter operation, hr/day}) (\text{Area, sq ft})}$$

$$\text{Flow Rate, cfs} = (\text{Area, sq ft})(\text{Velocity, ft/sec}) \text{ or } Q = AV \quad \text{where: } Q = \text{flow rate, } A = \text{area, } V = \text{velocity}$$

$$\text{Force, pounds} = (\text{Pressure, psi}) (\text{Area, sq in})$$

$$\text{Gallons/Capita/Day} = \frac{\text{Volume of Water Produced, gpd}}{\text{Population}}$$

$$\text{Hardness, as mg CaCO}_3\text{/L} = \frac{(\text{Titrant Volume, mL}) (1,000)}{\text{Sample Volume, mL}} \quad \text{Only when the titration factor is 1.00 of EDTA}$$

$$\text{Horsepower, Brake (bhp)} = \frac{(\text{Flow, gpm}) (\text{Head, ft})}{(3,960) (\text{Decimal Pump Efficiency})}$$

$$\text{Horsepower, Motor (mhp)} = \frac{(\text{Flow, gpm}) (\text{Head, ft})}{(3,960) (\text{Decimal Pump Efficiency}) (\text{Decimal Motor Efficiency})}$$

$$\text{Horsepower, Water (whp)} = \frac{(\text{Flow, gpm}) (\text{Head, ft})}{3,960}$$

$$\text{Hydraulic Loading Rate} = \frac{\text{Total Flow Applied}}{\text{Area}}$$

$$\text{Hypochlorite Strength, \%} = \frac{(\text{Chlorine Required, lbs}) (100)}{(\text{Hypochlorite Solution Needed, gal}) (8.34 \text{ lbs/gal})}$$

$$\text{Leakage, gpd} = \frac{\text{Volume, gallons}}{\text{Time, days}}$$

$$\text{Mass, lbs/day} = (\text{Flow, MGD}) (\text{Concentration, mg/L}) (8.34 \text{ lbs/gal})$$

$$\text{Mass, lbs} = (\text{Volume, MG}) (\text{Concentration, mg/L}) (8.34 \text{ lbs/gal})$$

$$\text{Milliequivalent} = (\text{mL}) (\text{Normality})$$

$$\text{Molarity} = \frac{\text{Moles of Solute}}{\text{Liters of Solution}}$$

$$\text{Normality} = \frac{\text{Number of Equivalent Weights of Solute}}{\text{Liters of Solution}}$$

$$\text{Number of Equivalent Weights} = \frac{\text{Total Weight}}{\text{Equivalent Weight}}$$

$$\text{Number of Moles} = \frac{\text{Total Weight}}{\text{Molecular Weight}}$$

$$\text{Reduction in Flow, \%} = \frac{(\text{Original Flow} - \text{Reduced Flow})(100\%)}{\text{Original Flow}}$$

$$\text{Removal, \%} = \frac{(\text{In} - \text{Out})(100)}{\text{In}}$$

$$\text{Slope, \%} = \frac{\text{Drop or Rise}}{\text{Distance}} \times 100$$

$$\text{Solids, mg/L} = \frac{(\text{Dry Solids, grams})(1,000,000)}{\text{Sample Volume, mL}}$$

$$\text{Solids Concentration, mg/L} = \frac{\text{Weight, mg}}{\text{Volume, L}}$$

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lbs/gal}}{\text{Specific Weight of Water, lbs/gal}}$$

$$\text{Surface Loading Rate, gpd/sq ft} = \frac{\text{Flow, gpd}}{\text{Area, sq ft}}$$

$$\text{Three Normal Equation} = (N_1 \times V_1) + (N_2 \times V_2) = (N_3 \times V_3), \text{ where } V_1 + V_2 = V_3$$

$$\text{Two Normal Equation} = N_1 \times V_1 = N_2 \times V_2, \text{ where } N = \text{normality, } V = \text{volume or flow}$$

$$\text{Velocity, ft/sec} = \frac{\text{Flow Rate cu ft / sec}}{\text{Area, sq ft}} \text{ or } \frac{\text{Distance, ft}}{\text{Time, sec}}$$

$$\text{Volume of Cone} = (1/3) (\pi/4) (\text{Diameter}^2) (\text{Height})$$

$$\text{Volume of Cylinder} = (\pi/4) (\text{Diameter}^2) (\text{Height})$$

$$\text{Volume of Rectangular Tank} = (\text{Length}) (\text{Width}) (\text{Height})$$

$$\text{Watts (AC circuit)} = (\text{Volts}) (\text{Amps}) (\text{Power Factor})$$

$$\text{Watts (DC circuit)} = (\text{Volts}) (\text{Amps})$$

$$\text{Weir Overflow Rate, gpd/ft} = \frac{\text{Flow, gpd}}{\text{Weir Length, ft}}$$

$$\text{Wire-to-Water Efficiency, \%} = \frac{\text{Water Horsepower, HP}}{\text{Power Input, HP or Motor HP}} \times 100$$

$$\text{Wire-to-Water Efficiency, \%} = \frac{(\text{Flow, gpm})(\text{Total Dynamic Head, ft})(0.746 \text{ kw/hp})(100)}{(3,960)(\text{Electrical Demand, kilowatts})}$$

Alkalinity Relationships:

Alkalinity, mg/L as CaCO ₃			
Result of Titration	Hydroxide Alkalinity as CaCO ₃	Carbonate Alkalinity as CaCO ₃	Bicarbonate Concentration as CaCO ₃
P = 0	0	0	T
P < ½T	0	2P	T - 2P
P = ½T	0	2P	0
P > ½T	2P - T	2(T - P)	0
P = T	T	0	0

*Key: P – phenolphthalein alkalinity; T – total alkalinity

Conversion Factors:

1 acre = 43,560 square feet
1 acre foot = 326,000 gallons
1 cubic foot = 7.48 gallons
1 cubic foot = 62.4 pounds
1 cubic foot per second = 0.646 MGD
1 foot = 0.305 meters
1 foot of water = 0.433 psi
1 gallon = 3.79 liters
1 gallon = 8.34 pounds
1 grain per gallon = 17.1 mg/L
1 horsepower = 0.746 kW or 746 watts or 33,000 ft. lbs./min.
1 mile = 5,280 feet
1 million gallons per day = 694 gallons per minute
1 million gallons per day = 1.55 cubic feet per second (cfs)
1 pound = 0.454 kilograms
1 pound per square inch = 2.31 feet of water
1% = 10,000 mg/L
Π or pi = 3.14

Abbreviations:

cfs	cubic feet per second	MGD	million gallons per day
DO	dissolved oxygen	mL	milliliter
ft	feet	ppb	parts per billion
g	grams	ppm	parts per million
gpd	gallons per day	psi	pounds per square inch
gpg	grains per gallon	Q	flow
gpm	gallons per minute	SS	suspended solids
in	inches	TTHM	Total trihalomethanes
kW	kilowatt	TOC	total organic carbon
lbs	pounds	TSS	total suspended solids
mg/L	milligrams per liter	VS	volatile solids