South Dakota/ABC Formula/Conversion Table

$\text{Alkalinity, as mg } CaCO_3/L = \frac{\text{(Titrant Volume,mL)(Acid Normality)(50,000)}}{\text{Sample Volume,mL}}$

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

$\text{Area of Circle} = (0.785)(\text{Diameter})^2 \text{ or } (\pi)(\text{Radius})^2$

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

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

Area of Cylinder (total outside surface area)

$= \text{(Surface Area of End \#1)} + \text{(Surface Area of End \#2)} + ((\pi)(\text{Diameter})(\text{Height or Depth}))$

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

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

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

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

$\text{Biochemical Oxygen Demand (unseeded), in mg/L} = \frac{\text{(Initial DO, mg/L)} - \text{(Final DO, mg/L)}}{\left(\frac{\text{Sample Volume, mL}}{\text{Final Diluted Volume, mL}}\right)}$

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

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

$\text{Circumference of Circle} = (\pi)(\text{Diameter}) \text{ or } (2)(\pi)(R)$

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

$\text{Cycle Time, min} = \frac{\text{Storage Volume, gal}}{\text{Pump Capacity, gpm} - \text{Wet Well Inflow, gpm}}$

$\text{Degrees Celsius} = (\text{Degrees Fahrenheit} - 32)\left({}^5/_9\right) \text{or} \frac{\text{Deg F} - 32}{1.8}$

$\text{Degrees Fahrenheit} = (\text{Degrees Celsius})({}^9/_5)+32 \text{ or } (\text{Degrees Celsius})(1.8)+32$

$\text{Detention Time} = \frac{\text{Voume}}{\text{Flow}}$ Note: Units must be compatible.

$\text{Dosage, mg/L} = \frac{\text{(lbs chemical used)(\%)}}{\text{(MGD)(8.34 lbs/gal)}}$

$\text{Dosage, } \frac{mg}{L} = \frac{\text{(lbs, chemical per day)(120,000)(\%)}}{\text{Gallons of Water Treated}}$

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

$$\text{Feed Rate, gal/minute (Fluoride Saturator)} = \frac{\text{(Plant Capacity, gal/minute)(Dosage, mg/L)}}{\text{18,000 mg/L}}$$

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

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

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

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

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

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

$$\text{Food/Microorganism Ratio} = \frac{\text{BOD}_5\text{, lbs/day}}{\text{MLVSS, lbs}}$$

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

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

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

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

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

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

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

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

$$\text{Hydraulic Loading Rate,} \frac{\text{gpd}}{\text{sq}}\text{ft} = \frac{\text{Total flow Applied, gpd}}{\text{Area, sq ft}}$$

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

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

$$Mass, lbs = \frac{(gpm)(0.012)(dosage, mg/L)}{\%}$$

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

$$\text{Mean Cell Residence Time (MCRT) or Solids Retention Time, days} = \frac{(\text{Aeration Tank TSS,lbs})+(\text{Clarifier TSS,lbs})}{(\text{TSS wasted,lbs/day})+(\text{Effluent TSS,lbs/day})}$$

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

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

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

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

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

$$\text{Organic Loading Rate} = \frac{\text{Organic Load, lbs BOD}_5\text{/day}}{\text{Volume}}$$

$$\text{Organic Loading Rate for RBC, lbs BOD}_5\text{/day/1000 sq ft} = \frac{\text{Organic Load, lbs BOD}_5\text{/day}}{\text{Surface Area of Media, 1,000 sq ft}}$$

$$\text{Organic Loading Rate for Trickling Filters, lbs BOD}_5\text{/day/1000 cu ft} = \frac{\text{Organic Load,lbs BOD}_5\text{/day}}{\text{Volume,1000 cu ft}}$$

$$\text{Oxygen Uptake Rate/Oxygen Consumption Rate, (mg/L)/minute} = \frac{\text{Oxygen Usage,mg/L}}{\text{Time,minute}}$$

$$\text{Population Equivalent, Organic} = \frac{(\text{Flow, MGD})(\text{BOD, mg/L})(8.34\text{lbs/gal})}{\text{lbs BOD/day/person}}$$

Pounds of Chemical see Mass, lbs

$$\text{Recirculation Ratio for Trickling Filter} = \frac{\text{Recirculated Flow}}{\text{Primary Effluent Flow}}$$

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

$$\text{Reduction of Volatile Solids, \%} = \frac{(\text{In} - \text{Out})(100\%)}{\text{In} - (\text{In} \times \text{Out})}$$ All Information (In and Out) must be in decimal form

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

$$\text{Return Rate, \%} = \frac{(\text{Return Flow Rate})(100\%)}{\text{Influent Flow Rate}}$$

$$\text{Return Sludge Rate} \sim \text{Solids Balance} = \frac{(\text{MLSS})(\text{Flow Rate})}{\text{Return Activated Sludge Suspended Solids} - \text{MLSS}}$$

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

$$\text{Sludge Density Index} = \frac{100}{\text{SVI}}$$

$$\text{Sludge Volume Index, mL/g} = \frac{(\text{SSV}_{30}\text{, mL/L})(1{,}000\text{ mg/g})}{\text{MLSS, mg/L}}$$

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

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

$$\text{Solids Loading Rate, (lbs/day)/sq ft} = \frac{\text{Solids Applied, lbs/day}}{\text{Surface Area, sq ft}}$$

Solids Retention Time (SRT): see Mean Cell Residence Time (MCRT)

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

$$\text{Specific Oxygen Uptake Rate (OUR)/Respiration Rate, } \quad \text{(mg/g)/hr} = \frac{\text{OUR, mg/L/ min}(60\text{ min} \quad)}{\text{MLVSS, g/L (1 hr)}}$$

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

Three Normal Equation $= (N_1 \times V_1) + (N_2 \times V_2) = (N_3 \times V_3)$, Where $V_1 + V_2 = V_3$

Two Normal Equation $= N_1 \times V_1 = N_2 \times V_2$ where N=concentration (normality), V=Volume or flow

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

$$\text{Volatile Solids, \%} = \frac{(\text{Dry solids, g} - \text{Fixed solids, g})(100)}{\text{Dry Solids, g}}$$

Volume of Cone $= (1/3)(0.785)(\text{Diameter}^2)(\text{Height})$

Volume of Cylinder $= (0.785)(\text{Diameter}^2)(\text{Height})$ or $(3.14)(\text{Radius}^2)(\text{Height})$

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

Waste Milliequivlent $= (\text{mL})(\text{Normaility})$

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

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

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

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

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

Alkalinity Relationships			
Alkalinity as 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
$P < {}^{1}/_{2}T$	0	2P	T – 2P
$P = {}^{1}/_{2}T$	0	2P	0
$P > {}^{1}/_{2}T$	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 gallon

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

Population Equivalent, Hydraulic = 100 gallons/person/day

Population Equivalent = 0.17 lbs BOD/person/day

1 horsepower = 0.746 kW or 746 watts or 33,000 ft lbs/min

1 million gallons per day = 694 gallons per minute

1 million gallons per day = 1.55 cubic feet per second

1 mile = 5,280 feet

1 pound = 0.454 kilograms

1 pound per square inch = 2.31 feet of water

1 ton = 2,000 pounds

1% = 10,000 mg/L

π *or pi* = 3.14

Abbreviations:			
BOD	biochemical oxygen demand	ORP	oxygen reduction potential
CBOD	carbonaceous biochemical oxygen demand	OUR	oxygen uptake rate
cfs	cubic feet per second	ppb	parts per billion
COD	chemical oxygen demand	ppm	parts per million
DO	dissolved oxygen	psi	pounds per square inch
ft	feet	PE	population equivalent
F/M ratio	food to microorganism ratio	Q	flow
g	grams	RAS	return activated sludge
gpd	gallons per day	RBC	rotating biological contactor
gpg	grains per gallon	SDI	sludge density index
gpm	gallons per minute	SRT	sludge retention time
in	inches	SS	settleable solids
kW	kilowatt	SSV_{30}	settled sludge volume 30 minute
lbs	pounds	SVI	sludge volume index
mg/L	milligrams per liter	TOC	total organic carbon
MCRT	mean cell residence time	TS	total solids
MGD	million gallons per day	TSS	total suspended solids
mL	milliliter	TTHM	total trihalomethanes
MLSS	mixed liquor suspended solids	VS	volatile solids
MLVSS	mixed liquor volatile suspended solids	WAS	waste active sludge
OCR	oxygen consumption rate		