WASTEWATER TREATMENT FORMULA SHEET

Basic Formulas – Pounds, Concentrations, and Purity

$$\text{Chemical (lb)} = \frac{\text{Flow (MGD)} \times 8.34 \times \text{Concentration (ppm)}}{\text{\% Purity}}$$

$$\text{Concentration (ppm)} = \frac{\text{Chemical Fed (lbs)} \times \text{\% Purity}}{\text{Flow (MGD)} \times 8.34}$$

[1] *Pollutant Load (lbs/day)* = Pollutant Flow (MGD) x 8.34 (lbs water/gal) x Concentration (mg/L)
[2] *Pounds of X (lbs)* = Volume (MG) x 8.34 (lbs water/gal) x Concentration of X (mg/L)
[8] Total Chlorine Residual: *TCR (mg/L)* = Dosage (mg/L) - Demand (mg/L)

Laboratory Formulas

[3] $\text{TDS (mg/L)} = \frac{\text{Weight of Dry Solids \& Dish (g)} - \text{Weight of Dish (g)}}{\text{Sample Volume (mL)}} \times 1{,}000{,}000\ \text{(mg/L)}$

[4] $\text{TSS (mg/L)} = \frac{\text{Weight of Cup, Filter, \& Solids (g)} - \text{Weight of Cup \& Filter (g)}}{\text{Sample Volume (mL)}} \times 1{,}000{,}000\ \text{(mg/L)}$

[5] $\text{VSS (mg/L)} = \frac{\text{Weight of Crucible, Filter, \& Ash (g)} - \text{Weight of Crucible \& Filter (g)}}{\text{Sample Volume (mL)}} \times 1{,}000{,}000\ \text{(mg/L)}$

[6] $BOD_5\ \text{(mg/L)} = (\text{Initial DO (mg/L)} - \text{Final DO (mg/L)}) \times \frac{\text{Volume of BOD Bottle (mL)}}{\text{Sample Volume (mL)}}$

[14] $\text{MLSS (mg/L)} = \frac{\text{Weight of Crucible, Filter, \& Solids (g)} - \text{Weight of Crucible \& Filter (g)}}{\text{Sample Volume (mL)}} \times 1{,}000{,}000\ \text{(mg/L)}$

[15] $\text{MLVSS (mg/L)} = \frac{\text{Weight of Crucible, Filter, \& Solids (g)} - \text{Weight of Crucible, Filter, \& Ash (g)}}{\text{Sample Volume (mL)}} \times 1{,}000{,}000\ \text{(mg/L)}$

[23] $\text{OUR (mg/L/hr)} = \frac{DO_1 - DO_2\ \text{(mg/L)}}{\text{Time 2 - Time 1 (min)}} \times \frac{60\ \text{min}}{1\ \text{hr}}$

[24] $\text{SOUR (mg/g/hr)} = \frac{\text{OUR (mg/L/hr)}}{\text{MLVSS (mg/L)}} \times 1{,}000\ \text{(mg/g)}$

Pond Loading and Removal Efficiency

[7] $\text{Removal Efficiency (\%)} = \frac{\text{Influent } BOD_5\ \text{(mg/L)} - \text{Effluent } BOD_5\ \text{(mg/L)}}{\text{Influent } BOD_5\ \text{(mg/L)}} \times 100\ \text{(\%)}$

[25] $\text{Organic Loading (lbs BOD/acre/day)} = \frac{\text{Flow (MGD)} \times BOD_5\ \text{(mg/L)} \times 8.34\ \text{(lbs water/gal)}}{\text{Area (acres)}}$

[26] $\text{Required Surface Area (acres)} = \frac{\text{Flow (MGD)} \times BOD_5\ \text{(mg/L)} \times 8.34\ \text{(lbs water/gal)}}{\text{Loading Rate (lb/acre x day)}}$

$$\text{Population Loading, Person/Acre} = \frac{\text{Population Served, Persons}}{\text{Pond Surface Area, Acres}}$$

Loading Formulas

[9] $SLR\ (gpd/ft^2) = \frac{\text{Flow (gpd)}}{\text{Clarifier Surface Area } (ft^2)}$

[10] $HRT\ (hrs) = \frac{\text{Tank Volume (MG)}}{\text{Flow (MGD)}}$

[11] $HRT\ (hrs) = \frac{\text{Tank Volume } (ft^3)}{\text{Flow (gpd)}} \times \frac{24\ hr}{day} \times \frac{7.48\ gal}{1\ ft^3}$

[13] $VLR\ (\text{lbs/day per } 1{,}000\ ft^3) = \frac{BOD_5\ \text{(lbs/day)}}{\text{Basin Volume } (1{,}000\ ft^3)}$

Sludge Formulas

[12] $\text{Pump Rate (gpm)} = \frac{\text{Volume of Sludge Pumped } (ft^3)}{\text{Pump Time (min)}} \times \frac{7.48\ gal}{1\ ft^3}$

[16] $SRT\ \text{(days)} = \frac{\text{MLSS in Aeration Basin (lbs)}}{TSS_2\ \text{Wasted (lbs/day)} + TSS_3\ \text{in Effluent (lbs/day)}}$

[17] $MCRT\ \text{(days)} = \frac{\text{MLVSS in Aeration Basin (lbs)}}{VSS_2\ \text{Wasted (lbs/day)} + VSS_3\ \text{in Effluent (lbs/day)}}$

[18] $SA\ \text{(days)} = \frac{\text{MLSS in Aeration Basin (lbs)}}{TSS_1\ \text{in Influent (lbs/day)}}$

[19] $F/M = \frac{\text{Food (lbs/day)}}{\text{Microorganisms (lbs)}}$ *or*

$$F/M = \frac{\text{Flow, MGD x 8.34 x DOD mg/L}}{\text{vol of Aeration Tank, MG x 8.34 x MLVSS, mg/L}}$$

[20] $SVI\ (mL/g) = \frac{\text{Settled Sludge Volume } (SSV_{30})\text{(mL/L)} \times 1{,}000\ \text{(mg/g)}}{\text{MLSS (mg/L)}}$

[21] $Q_{RAS}\ \text{(MGD)} = \frac{Q_{influent}\ \text{(MGD)} \times \text{MLVSS (mg/L)}}{VSS_2\ \text{(mg/L)} - \text{MLVSS (mg/L)}}$

[22] $Q_{RAS}\ \text{(MGD)} = \frac{Q_{influent}\ \text{(MGD)} \times SV_{30}\ \text{(mL)}}{1000 - SV_{30}\ \text{(mL)}}$

[27] $SRLT\ \text{(days)} = \frac{\text{Total Sludge Mass (lbs)}}{\text{Solids Removed Per Day (lbs/day)}}$

[28] $\text{Digester Loading (lbs/ft}^3\text{-day)} = \frac{\text{Volatile Solids (lbs/day)}}{\text{Digester Volume } (ft^3)}$

WASTEWATER TREATMENT FORMULA SHEET

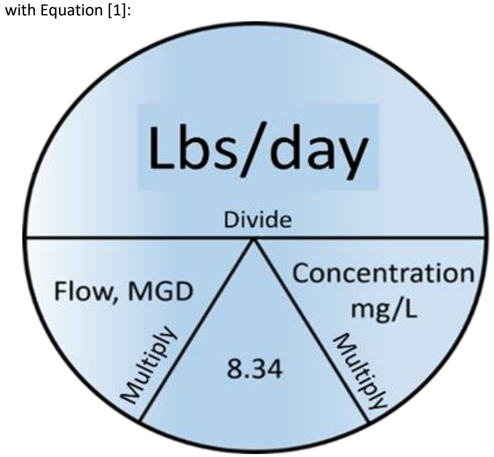
Parameter	Symbol	*FROM*	*TO*	Multiply by	Divide by
Length	L	inches	feet		12
		feet	inches	12	
		feet	yards		3
		feet	miles		5,280
		yards	feet	3	
		miles	feet	5,280	
Area	A	$inches^2$	$feet^2$		144
		$feet^2$	$inches^2$	144	
		$feet^2$	acres		43,560
		acres	$feet^2$	43,560	
Volume	V	$feet^3$	gallons	7.48	
		$feet^3$	pounds (of water)	62.4	
		gallons	$feet^3$		7.48
		gallons	pounds (of water)	8.34	
		pounds (of water)	$feet^3$	7.48	
		pounds (of water)	gallons		8.34
Flow rate	Q	cfs or ft^3/sec	gpm	448.8	
		cfs or ft^3/sec	MGD	0.6463	
		gpm	cfs or ft^3/sec		448.8
		gpd	MGD		1,000,000
		MGD	cfs or ft^3/sec		0.6463
		MGD	gpd	1,000,000	
Velocity	V	fps	feet/minute	60	
		fps	mph		1.467
Power		ft-lb/min	Hp		33,000
		ft-lb/min	kW		44,253
		Hp	kW		1.341
		Hp	ft-lb/min	33,000	
		kW	Hp	1.341	
		kW	ft-lb/min	44,253	
Time	t	seconds	minutes		60
		seconds	hours		3,600
		minutes	seconds	60	
		minutes	hours		60
		hours	seconds	3,600	
		hours	minutes	60	
		hours	days		24
		days	hours	24	
Pressure	P	psi	lb/ft^2	144	
		lb/ft^2	psi		144
Head	H	psi	feet	2.31	
		feet	psi		2.31

Shape	Area (ft^2)	Volume (ft^3)
Circle	= 0.785 x diameter x diameter	n/a
Cylinder	n/a	= 0.785 x diameter x diameter x height
Rectangle	= length x width	= length x width x height
Circumference	= 3.14 x diameter	n/a

The Pounds Formula Pie Chart

To use the diagram, cover the one section of the diagram that you don't know but want to know. Then use the uncovered parts of the diagram to solve the unknown.

For use with Equation [1]:



For use with Equation [2]: