

## ABC Canadian Formula/Conversion Table for Wastewater Treatment, Industrial, Collection and Laboratory Exams

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

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

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

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

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

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

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

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

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

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

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

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

$$\text{Chemical Feed Rate, mL/min} = \frac{(\text{Flow, m}^3/\text{day})(\text{Dose, mg/L})}{(\text{Chemical Feed Density, g/cm}^3) (\text{Active Chemical, \%})(1,440)}$$

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

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

$$\text{Cycle Time, min.} = \frac{\text{Storage Volume, m}^3}{\text{Pump Capacity, m}^3/\text{minute} - \text{Wet Well Inflow, m}^3/\text{minute}}$$

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

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

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

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

$$\text{Feed Rate, kg/day} = \frac{(\text{Dosage, mg/L})(\text{Flow Rate, m}^3/\text{day})}{(\text{Purity, Decimal Percentage})(1,000)}$$

$$\text{Filter Backwash Rate, L/m}^2 \text{ sec} = \frac{\text{Flow, L/sec}}{\text{Filter Area, m}^2}$$

$$\text{Filter Backwash Rise Rate, cm/min} = \frac{\text{Water Rise, cm}}{\text{Time, minute}}$$

$$\text{Filter Yield, kg/m}^2 \text{ hr} = \frac{(\text{Solids Concentration, \%})(\text{Sludge Feed Rate, L/hr})(10)}{(\text{Surface Area of Filter, m}^2)}$$

Flow Rate,  $\text{m}^3/\text{sec} = (\text{Area, m}^2) (\text{Velocity, m/sec})$  or  $Q = AV$  where:  $Q =$  flow rate,  $A =$  area,  $V =$  velocity

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

Force, newtons = (Pressure, pascals) (Area,  $\text{m}^2$ )

$$\text{Litres/Capita/Day} = \frac{\text{Volume of Wastewater Produced, L/day}}{\text{Population}}$$

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

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

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

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

$$\text{Hydraulic Loading Rate, m}^3/\text{m}^2 \text{ day} = \frac{\text{Total Flow Applied, m}^3/\text{day}}{\text{Area, m}^2}$$

$$\text{Leakage, Lpd} = \frac{\text{Volume, L}}{\text{Time, days}}$$

$$\text{Mass, kg} = \frac{(\text{Volume, m}^3)(\text{Concentration, mg/L})}{1000}$$

$$\text{Mass Flux, kg/day} = \frac{(\text{Volume, m}^3 / \text{day})(\text{Concentration, mg/L})}{1000}$$

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

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

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

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

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

$$\text{Organic Loading Rate, kg/ m}^3 \text{ days} = \frac{\text{Organic Load, kg BOD}_5/\text{day}}{\text{Volume}}$$

$$\text{Organic Loading Rate-RBC, kg/ m}^2 \text{ days} = \frac{\text{Organic Load, kg BOD}_5/\text{day}}{\text{Surface Area of Media, m}^2}$$

$$\text{Organic Loading Rate-Trickling Filter, kg/ m}^3 \text{ days} = \frac{\text{Organic Load, kg BOD}_5/\text{day}}{\text{Volume, m}^3}$$

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

$$\text{Population Equivalent, Organic} = \frac{(\text{Flow, m}^3/\text{day})(\text{BOD, mg/L})}{(1,000)(.077 \text{ kg BOD/day/person})}$$

$$\text{Power, kW} = \frac{(\text{Flow, L/sec})(\text{Head, m})(9.8)}{1,000}$$

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

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

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

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

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

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

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

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

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

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

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

$$\text{Solids Loading Rate, kg/day/m}^2 = \frac{\text{Solids Applied, kg/day}}{\text{Surface Area, m}^2}$$

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

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, kg/L}}{\text{Specific Weight of Water, kg/L}}$$

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

$$\text{Surface Loading Rate or Surface Overflow Rate, Lpd/m}^2 = \frac{\text{Flow, Lpd}}{\text{Area, m}^2}$$

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

$$\text{Velocity, m/second} = \frac{\text{Flow Rate, m}^3 / \text{sec}}{\text{Area, m}^2} \text{ or } \frac{\text{Distance, m}}{\text{Time, second}}$$

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

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

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

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

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

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

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

$$\text{Weir Overflow Rate, Lpd/m} = \frac{\text{Flow, Lpd}}{\text{Weir Length, m}}$$

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

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

**Conversion Factors:**

1 acre = 4046.9 square metres	1 horsepower = 0.746 kW or 33,000 foot-pounds/minute
1 cubic metre = 1,000 kilograms	1 metre head = 9.8 kPa
1 cubic metre = 1,000 litres	1 pound = 0.454 kilograms
1 cubic metre = 219.97 Imperial gallons	1 pound per square inch = 6.89 kPa
1 cubic metre per second = 19.01 MIGD	1 square metre = 1.19 square yards
1 foot = 0.305 metre	1% = 10,000 mg/L
1 gallon = 3.79 litres	Π or pi = 3.14
1 hectare = 10,000 square metres	
Population Equivalent, hydraulic = 378.5 litres/person/day	
Population Equivalent, organic = 0.077 kg BOD/person/day	

**Abbreviations:**

BOD	biochemical oxygen demand	MLVSS	mixed liquor volatile suspended solid
CBOD	carbonaceous biochemical oxygen demand	OCR	oxygen consumption rate
cm	centimetre	ORP	oxygen reduction potential
COD	chemical oxygen demand	OUR	oxygen uptake rate
DO	dissolved oxygen	PE	population equivalent
F/M ratio	food to microorganism ratio	ppb	parts per billion
g	grams	ppm	parts per million
kPa	kilopascals	Q	flow
kg	kilograms	RAS	return activated sludge
kW	kilowatt	RBC	rotating biological contactor
L	litres	SDI	sludge density index
Lpd	litres per day	SRT	solids retention time
Lpm	litres per minute	SS	settleable solids
m	metres	SSV <sub>30</sub>	settled sludge volume 30 minute
MCRT	mean cell residence time	SVI	sludge volume index
mg/L	milligrams per litre	TOC	total organic carbon
MIGD	million Imperial gallons per day	TS	total solids
mL	milliliter	TSS	total suspended solids
MLD	million litres per day	VS	volatile solids
MLSS	mixed liquor suspended solids	WAS	waste activated sludge