

EOCP Formulae, Conversions, and Abbreviations

Conversion Factors and Constants	Dimensions	Abbreviations
π (Pi) = 3.14 1 BTU = 1.055 kilojoule 1ft-lb = 1.356 joule 1 ha = 10,000 m ² 1 horsepower (electric) = 0.746 kw 1 joule = 0.738 foot pounds (ft-lb) 1 kilojoule = 0.9478 BTU 1 inch of water = 0.249 kpa 1 kpa = 4.015 inches of water 1 kpa = 0.145 PSI (or psi) 1psi = 6.895 kpa 1 kpa = 0.102 metre of water 1 meter of water = 9.807 kpa 1 litre of water = 1 kg 1 kw = 1.34 horsepower (electric) 1m ³ (cu m) = 1,000 litres (L)	A Area B Base (of a triangle) C Circumference (of a circle) D Depth H Height L Length P Perimeter W Width d Diameter r radius	BHP or bhP Brake horsepower BOD Biochemical oxygen demand BOD _E Biochemical oxygen demand of the effluent BOD _I Biochemical oxygen demand of the influent Conc Concentration (mg/L, %, or as decimal) Den Density (g/cm ³) DR (Dose) Dosing Concentration (expressed as mg/L) H Head (usually expressed in feet or metres) MLSS Mixed Liquor Suspended Solids MLSS _F Mixed Liquor Suspended Solids (Final) MLSS _I Mixed Liquor Suspended Solids (Initial) MLSS% MLSS expressed as percentage MLVSS Mixed Liquor Volatile Suspended Solids MHP or mhp Motor horsepower % Chem Percentage of active ingredient Q Flow rate Q _B Filter backwash flow Q _{Int} Internal flow within plant Q _W Sludge wastage flow RASS Return Activated Suspended Solids SG Specific Gravity SSV or SV-30 Settled Sludge Volume (after 30 min) TSS Total Suspended Solids TSS _E Total Suspended Solids in effluent Vel Velocity Vol Volume V _{AT} Volume of Aeration Tank V _C Volume of Clarifier Vol _W Volume of Water WHP or whp Water horsepower WASS Waster Activated Suspended Solids

Calculation	Description	Formula
Length Circumference of a circle Perimeter of a rectangle or a square	$\pi \times \text{diameter}$ $2 \times (\text{length} + \text{width})$	$C = \pi \times d$ or $2 \times \pi \times r$ $P = 2 \times (L + W)$
Areas Area of a circle Area of a rectangle Area of a triangle Surface area of a sphere (an air bubble)	$\pi \times \text{radius} \times \text{radius}$ $\text{length}(L) \times \text{width}(W)$ $\frac{1}{2} \times \text{base}(B) \times \text{height}(H)$	$A = \pi \times r^2$ or $\pi \times d^2/4$ $A = L \times W$ $A = 0.5 \times B \times H$ $A = 4 \times \pi \times r^2$ or $\pi \times d^2$
Volume Volume of a rectangular tank Volume of a cylindrical tank Volume of a pipe Volume of a cone Volume of a lagoon Volume of a sphere (an air bubble)	$\text{length} \times \text{width} \times \text{height (or depth)}$ $\text{area} \times \text{height (or depth)}$ $\text{cross-sectional area} \times \text{length}$ $\frac{1}{3} \times \text{area} \times \text{height}$ $\text{average of top and bottom areas} \times \text{height}$	$\text{Vol} = L \times W \times H$ $\text{Vol} = \pi \times r^2 \times H$ $\text{Vol} = \pi \times r^2 \times L$ $\text{Vol} = \frac{1}{3} \times \pi \times r^2 \times H$ $\text{Vol} = ((L_T + L_B)/2) \times ((W_T + W_B)/2) \times D$ $\text{Vol} = \frac{4}{3} \times (\pi \times r^3)$ or $(\pi \times d^3)/6$
Rate of Flow (Q) Flow in an open channel Velocity in an open channel Flow in a pipe Velocity in a pipe	$\text{volume per unit of time}$ $\text{width} \times \text{depth} \times \text{velocity}$ $\text{flow rate per unit of area}$ $\text{cross-sectional area} \times \text{velocity}$ $\text{flow rate per unit of area}$	(usually expressed as L/sec or m ³ /hr) $Q = W \times D \times \text{Vel}$ $\text{Vel} = Q/(W \times D)$ $Q = \pi \times r^2 \times \text{Vel}$ $\text{Vel} = Q/(\pi \times r^2)$
Detention Time (DT) Detention time in a pipe Detention time in a tank	$\text{volume divided by flow}$ $\text{area} \times \text{length}/\text{flow}$ $\text{area} \times \text{depth}/\text{flow}$	$(\pi \times r^2 \times L)/Q$ $(L \times W \times H)/Q$ or $(\pi \times r^2 \times L)/Q$

Calculation	Description	Formula
Hydraulic Loading Rate	flow divided by volume or area	
Rotating Biological Contractor (RBC)	flow per unit of media surface area	$Q/(2 \times \pi \times r^2 \times N)$ (N = No. of discs)
Aeration tank (AT)	flow per unit volume	$Q/(L \times W \times H)$ or $Q/(\pi \times r^2 \times D)$
Filter flow rate	forward flow per unit of surface area	$Q/(L \times W)$ or $Q/(\pi \times r^2)$ [units (m ³ /hr)/m ²]*
Filter backwash flow	backwash flow per unit of surface area	$Q_B/(L \times W)$ or $Q/(\pi \times r^2)$ [units (m ³ /hr)/m ²]* *also expressed as m/hr or L/sec/m ²
Hydraulic Overflow Rate		
Weir overflow rate	flow per unit of weir length	(Q/L)
Surface overflow rate	flow per unit of clarifier area	$Q/(L \times W)$ or $Q/(\pi \times r^2)$
Chemical Feed Rate [L/Day]	Rate of additional based on % active and density	$(DR \times Q / (\text{Conc} [\text{decimal}] \times \text{Den} \times 1000))$
Chlorine or Chemical Feed Rate		
Chlorine Dosage	Amount of Cl ₂ to be added/vol of water to be treated	$(\text{Conc} [\text{decimal}] \times \text{Vol}(\text{if liquid}) / \text{Vol}_w [\text{m}^3])$ or $(\text{Wt} [\text{kg}] \times 1000) / \text{Vol}_w [\text{m}^3]$
Chemical Feed Rate [L/Day]	rate of additional based on % active and density	$(DR \times Q / (\text{Conc} [\text{decimal}] \times \text{Den} \times 1000))$
Organic Loading	amount or weight added/volume or area to which it is added usually (flow x concentration)/volume or area	
Raw water or sewage TSS to Clarifier	flow x TSS per unit area of clarifier	$(Q \times \text{TSS})/(L \times W)$ or $(Q \times \text{TSS})/(\pi \times r^2)$
BOD to Aeration Tank (AT)	influent BOD per unit of AT volume	$(Q \times \text{BOD}) / (L \times W \times H)$
BOD to RBC	influent BOD per unit area of media surface	$(Q \times \text{BOD}) / (2 \times \pi \times r^2 \times N)$ (N = No. of discs)
TSS to Filter	influent TSS per unit area of filter surface	$(Q \times \text{TSS})/(L \times W)$ or $(Q \times \text{TSS})/(\pi \times r^2)$
MLSS to Clarifier	internal flow x MLSS per unit area of clarifier	$(Q_{\text{int}} \times \text{TSS})/(L \times W)$ or $(Q_{\text{int}} \times \text{TSS})/(\pi \times r^2)$

Calculation	Description	Formula
Wastewater Sludge Calculations		
Sludge Volume Index (SVI)	volume occupied by 1g of dry sludge	SSV (or SV-30)/MLSS
Sludge Density Index (SDI)	inverse of SVI	100/SVI
F/M (food to microorganism ratio)	BOD added to treatment system divided by amount of microorganisms in the systems	$(Q \times \text{BOD}) / (\text{MLVSS} \times (V_{AT} + V_C))$
Sludge Recycle rate	fraction of influent flow in sludge recycle	$Q_R = (Q \times \text{MLSS}) / (\text{RASS} - \text{MLSS})$ or $Q_R = Q / ((100 / ((\text{MLSS}\% \times \text{SVI}) - 1)) - 1)$
Sludge Wasting rate	sludge to digester to maintain desired MLSS	$Q_W = ((\text{MLSS}_I - \text{MLSS}_F) \times V_{AT}) / \text{RASS}$
Mean Cell Retention Time	aka Sludge Age	$\text{MCRT} = \frac{\text{MLSS} \times (V_{AT} + V_C)}{(Q \times \text{TSS}_E) + (Q_W \times \text{WASS})}$
Horsepower		
Brake Horsepower, Imperial	hp required to drive a pump	$\text{BHP}[\text{hp}] = \frac{Q[\text{USgpm}] \times H[\text{ft}] \times \text{SG}}{3960 \times \text{Pump Efficiency}}$
Brake Horsepower, Metric	hp required to drive a pump	$\text{BHP}[\text{kw}] = \frac{9.81Q \left[\frac{\text{m}^3}{\text{sec}} \right] \times H[\text{m}] \times \text{SG}}{\text{Pump Efficiency}}$
Efficiency		
Efficiency of treatment	input minus output as a percentage of input	$100 \times (\text{BOD}_I - \text{BOD}_E) / \text{BOD}_I$
Motor efficiency	motor output energy as a % of input electrical energy	$(100 \times \text{bhp}) / \text{mhp}$
Pump efficiency	water output energy as a % of input motor energy	$(100 \times \text{whp}) / \text{bhp}$
Overall efficiency	water output energy as a % of input electrical energy	$(100 \times \text{whp}) / \text{mhp}$