

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 (RAS) 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 (WAS) Waste Activated Suspended Solids

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

Calculation	Description	Formula
Hydraulic Loading Rate Rotating Biological Contractor (RBC) Aeration tank (AT) Filter flow rate Filter backwash flow	flow divided by volume or area flow per unit of media surface area flow per unit volume forward flow per unit of surface area backwash flow per unit of surface area	$Q/(2 \times \pi \times r^2 \times N)(N = \text{No. of discs})$ $Q/(L \times W \times H) \text{ or } Q/(\pi \times r^2 \times D)$ $Q/(L \times W) \text{ or } Q/(\pi \times r^2) \text{ [units (m}^3\text{/hr)/m}^2\text{]}^*$ $Q_B/(L \times W) \text{ or } Q/(\pi \times r^2) \text{ [units (m}^3\text{/hr)/m}^2\text{]}^*$ *also expressed as m/hr or L/sec/m ²
Hydraulic Overflow Rate Weir overflow rate Surface overflow rate Chemical Feed Rate [L/Day]	flow per unit of weir length flow per unit of clarifier area Rate of additional based on % active and density	(Q/L) $Q/(L \times W) \text{ or } Q/(\pi \times r^2)$ $(DR \times Q / (\text{Conc [decimal]} \times \text{Den} \times 1000))$
Chlorine or Chemical Feed Rate Chlorine Dosage Chemical Feed Rate [L/Day]	Amount of Cl ₂ to be added/vol of water to be treated rate of additional based on % active and density	$C_1 V_1 = C_2 V_2$ $(\text{Conc [decimal]} \times \text{Vol (if liquid)} 1,000 / \text{Vol}_w \text{ [m}^3\text{]})$ $\text{or } (Wt \text{ [kg]} \times 1000) / \text{Vol}_w \text{ [m}^3\text{]}$ $(DR \times Q / (\text{Conc [decimal]} \times \text{Den} \times 1000))$
Organic Loading Raw water or sewage TSS to Clarifier BOD to Aeration Tank (AT) BOD to RBC TSS to Filter MLSS to Clarifier	amount or weight added/volume or area to which it is added usually (flow x concentration)/volume or area flow x TSS per unit area of clarifier influent BOD per unit of AT volume influent BOD per unit area of media surface influent TSS per unit area of filter surface internal flow x MLSS per unit area of clarifier	$(Q \times \text{TSS})/(L \times W) \text{ or } (Q \times \text{TSS})/(\pi \times r^2)$ $(Q \times \text{BOD}) / (L \times W \times H)$ $(Q \times \text{BOD}) / (2 \times \pi \times r^2 \times N)(N = \text{No. of discs})$ $(Q \times \text{TSS})/(L \times W) \text{ or } (Q \times \text{TSS})/(\pi \times r^2)$ $(Q_{\text{int}} \times \text{TSS})/(L \times W) \text{ or } (Q_{\text{int}} \times \text{TSS})/(\pi \times r^2)$

Calculation	Description	Formula
Wastewater Sludge Calculations		
Sludge Volume Index (SVI)	volume occupied by 1g of dry sludge inverse of SVI	$\frac{SSV \text{ (or SV-30)} \times 1000}{MLSS}$
Sludge Density Index (SDI)	BOD added to treatment system divided by amount of microorganisms in the systems	$\frac{Q \times BOD}{(MLVSS \times (V_{AT} + V_C))}$
F/M (food to microorganism ratio)	fraction of influent flow in sludge recycle	$Q_R = (Q \times MLSS) / (RASS - MLSS) \text{ or}$
Sludge Recycle rate	sludge to digester to maintain desired MLSS aka Sludge Age	$Q_R = Q / ((100 / ((MLSS\% \times SVI) - 1))$
Sludge Wasting rate		$Q_W = ((MLSS_I - MLSS_F) \times V_{AT}) / RASS$
Mean Cell Retention Time		$MCRT = \frac{MLSS \times (V_{AT} + V_C)}{(Q \times TSS_E) + (Q_W \times WASS)}$
Horsepower		
Brake Horsepower, Imperial	hp required to drive a pump	$BHP[hp] = \frac{Q[USgpm] \times H[ft] \times SG}{3960 \times \text{Pump Efficiency}}$
Brake Horsepower, Metric	hp required to drive a pump	$BHP[kw] = \frac{9.81Q \left[\frac{m^3}{sec} \right] \times H[m] \times SG}{\text{Pump Efficiency}}$
Efficiency		
Efficiency of treatment	input minus output as a percentage of input	$100 \times (BOD_I - BOD_E) / BOD_I$
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	$(100 \times \text{whp}) / \text{mhp}$