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Pumping Rate Formulas

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List of 11 Pumping Rate Formulas

Pumping Rate

Average Daily Influent Flow Rate

1) Average Daily Influent Flow Rate given Net Waste Activated Sludge

Open Calculator

fx $$Q_a = \frac{P_x}{8.34 \cdot Y_{obs} \cdot (S_o - S)}$$

ex $$0.0003\text{m}^3/\text{d} = \frac{20\text{mg/d}}{8.34 \cdot 0.8 \cdot (25\text{mg/L} - 15\text{mg/L})}$$

2) Average Daily Influent Flow Rate given Theoretical Oxygen Requirement

Open Calculator

fx $$Q_a = (O_2 + (1.42 \cdot P_x)) \cdot \left(\frac{f}{8.34 \cdot (S_o - S)}\right)$$

ex $$0.000252\text{m}^3/\text{d} = (2.5\text{mg/d} + (1.42 \cdot 20\text{mg/d})) \cdot \left(\frac{0.68}{8.34 \cdot (25\text{mg/L} - 15\text{mg/L})}\right)$$

3) Average Daily Influent Flow Rate using Recirculation Ratio

Open Calculator

fx $$Q_a = \frac{RAS}{\alpha}$$

ex $$1.204819\text{m}^3/\text{d} = \frac{10\text{m}^3/\text{d}}{8.3}$$

RAS Pumping Rate

4) RAS Pumping Rate from Aeration Tank

Open Calculator

fx $$\mathrm{RAS} = \frac{\mathrm{X} \cdot \mathrm{Q_a} - \mathrm{X_r} \cdot (\mathrm{Q_w}')}{\mathrm{X_r} - \mathrm{X}}$$

ex $$78.56\mathrm{m^3/d} = \frac{1200\mathrm{mg/L} \cdot 1.2\mathrm{m^3/d} - 200\mathrm{mg/L} \cdot 400\mathrm{m^3/d}}{200\mathrm{mg/L} - 1200\mathrm{mg/L}}$$

5) RAS Pumping Rate using Recirculation Ratio

Open Calculator

fx $$\mathrm{RAS} = \alpha \cdot \mathrm{Q_a}$$

ex $$9.96\mathrm{m^3/d} = 8.3 \cdot 1.2\mathrm{m^3/d}$$

WAS Pumping Rate

6) WAS Pumping Rate from Aeration Tank

Open Calculator

fx $$\mathrm{Q_w} = \frac{\mathrm{V}}{\theta_c}$$

ex $$142.8571\mathrm{m^3/d} = \frac{1000\mathrm{m^3}}{7\mathrm{d}}$$

7) WAS Pumping Rate from Return Line given RAS Pumping Rate from Aeration Tank

Open Calculator

fx $$\mathrm{Q_w} = \left(\left(\frac{\mathrm{X}}{\mathrm{X_r}}\right) \cdot (\mathrm{Q_a} + \mathrm{RAS})\right) - \mathrm{RAS}$$

ex $$57.2\mathrm{m^3/d} = \left(\left(\frac{1200\mathrm{mg/L}}{200\mathrm{mg/L}}\right) \cdot (1.2\mathrm{m^3/d} + 10\mathrm{m^3/d})\right) - 10\mathrm{m^3/d}$$

8) WAS Pumping Rate from Return Line given Wasting Rate from Return Line

Open Calculator

$$Q_w = \left(V \cdot \frac{X}{\theta_c \cdot X_r}\right) - \left(Q_e \cdot \frac{X_e}{X_r}\right)$$

$$399.9999\text{m}^3/\text{d} = \left(1000\text{m}^3 \cdot \frac{1200\text{mg/L}}{7\text{d} \cdot 200\text{mg/L}}\right) - \left(1523.81\text{m}^3/\text{d} \cdot \frac{60\text{mg/L}}{200\text{mg/L}}\right)$$

9) WAS Pumping Rate using Wasting Rate from Return Line when Concentration of Solid in Effluent is Low

Open Calculator

$$Q_w = V \cdot \frac{X}{\theta_c \cdot X_r}$$

$$857.1429\text{m}^3/\text{d} = 1000\text{m}^3 \cdot \frac{1200\text{mg/L}}{7\text{d} \cdot 200\text{mg/L}}$$

Wasting Rate

10) Wasting Rate from Return Line

Open Calculator

$$\theta_c = \frac{V \cdot X}{((Q_w') \cdot X_r) + (Q_e \cdot X_e)}$$

$$6.999999\text{d} = \frac{1000\text{m}^3 \cdot 1200\text{mg/L}}{(400\text{m}^3/\text{d} \cdot 200\text{mg/L}) + (1523.81\text{m}^3/\text{d} \cdot 60\text{mg/L})}$$

11) Wasting Rate from Return Line when Concentration of Solid in Effluent is Low

Open Calculator

fx $$\theta_c = \frac{V \cdot X}{(Q_w') \cdot X_r}$$

ex $$15\text{d} = \frac{1000\text{m}^3 \cdot 1200\text{mg/L}}{400\text{m}^3/\text{d} \cdot 200\text{mg/L}}$$

Variables Used

- **f** BOD Conversion Factor
- **O_2** Theoretical Oxygen Requirement *(Milligram per Day)*
- **P_x** Net Waste Activated Sludge *(Milligram per Day)*
- **Q_a** Average Daily Influent Flow Rate *(Cubic Meter per Day)*
- **Q_e** Effluent Flow Rate *(Cubic Meter per Day)*
- **Q_w** WAS Pumping Rate from Reactor *(Cubic Meter per Day)*
- **Q_w'** WAS Pumping Rate from Return Line *(Cubic Meter per Day)*
- **RAS** Return Activated Sludge *(Cubic Meter per Day)*
- **S** Effluent Substrate Concentration *(Milligram per Liter)*
- **S_o** Influent Substrate Concentration *(Milligram per Liter)*
- **V** Reactor Volume *(Cubic Meter)*
- **X** MLSS *(Milligram per Liter)*
- **X_e** Solid Concentration in Effluent *(Milligram per Liter)*
- **X_r** Sludge Concentration in Return Line *(Milligram per Liter)*
- **Y_{obs}** Observed Cell Yield
- **α** Recirculation Ratio
- **θ_c** Mean Cell Residence Time *(Day)*

Constants, Functions, Measurements used

- Measurement: **Time** in Day (d)
  Time Unit Conversion
- Measurement: **Volume** in Cubic Meter (m^3)
  Volume Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Day (m^3/d)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Mass Flow Rate** in Milligram per Day (mg/d)
  Mass Flow Rate Unit Conversion
- Measurement: **Density** in Milligram per Liter (mg/L)
  Density Unit Conversion

Check other formula lists

- **Pumping Rate Formulas**
- **Substrate Concentration Formulas**

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