Important Sludge Recycle and Rate of Returned Sludge Formulas PDF

Formulas
Examples
with Units

List of 12
Important Sludge Recycle and Rate of Returned Sludge Formulas

1) Mixed Liquor Suspended Solid MLSS Formulas 📕

1.1) MLSS given Sludge Recirculation Ratio Formula 📕

Evaluate Formula 📕

Formula

$$X = \frac{\alpha \cdot X^R}{1 + \alpha}$$

Example with Units

$$1200 \, _{mg/L} = \frac{1.5 \cdot 2000 \, _{mg/L}}{1 + 1.5}$$

1.2) MLSS given Sludge Volume Index and Recirculation Ratio Formula 📕

Evaluate Formula 📕

Formula

$$X' = \frac{1}{SVI \cdot (1 + \alpha)}$$

Example with Units

$$2.6667 \, _{mg/L} = \frac{1}{150 \, _{mL/g} \cdot (1 + 1.5)}$$

1.3) MLSS given SVI and Sewage Discharge Formula 📕

Evaluate Formula 📕

Formula

$$X' = \frac{\frac{\left(\frac{Q_{r''}}{Q_{S'}}\right) \cdot (10^6)}{SVI}}{1 + \left(\frac{Q_{r''}}{Q_{S'}}\right)}$$

Example with Units

$$857.3387 \, _{mg/L} = \frac{\frac{\left(\frac{100 \, _{m^3/d}}{9000 \, _{m^3/s}}\right) \cdot (10^6)}{150 \, _{mL/g}}}{1 + \left(\frac{100 \, _{m^3/d}}{9000 \, _{m^3/s}}\right)}$$

2) Sewage Discharge Formulas 📕

2.1) Sewage Discharge given MLSS and SVI Formula 📕

Evaluate Formula 📕

Formula

$$Q_S = \frac{Q_{r'}}{\frac{X}{\left(\frac{10^6}{SVI_S}\right) - X}}$$

Example with Units

$$9.9923 \, _{m^3/s} = \frac{0.518 \, _{m^3/d}}{\frac{1200 \, _{mg/L}}{\left(\frac{10^6}{0.5 \, _{L/g}}\right) - 1200 \, _{mg/L}}}$$

2.2) Sewage Discharge given Sludge Recirculation Ratio Formula 📕

Evaluate Formula 📕

Formula

$$Q_S = \frac{Q_r}{\alpha}$$

Example with Units

$$10 \, _{m^3/s} = \frac{15 \, _{m^3/s}}{1.5}$$

3) Sludge Recirculation Ratio Formulas

3.1) Sludge Recirculation Rate given MLSS and SVI Formula

Formula

$$Q_{r'} = Q_s \cdot \left(\frac{X}{\left(\frac{10^6}{SVI_s} \right) - X} \right)$$

Example with Units

$$0.5184\,\text{m}^3/\text{d} = 10\,\text{m}^3/\text{s} \cdot \left(\frac{1200\,\text{mg/L}}{\left(\frac{10^6}{0.5\,\text{L/g}} \right) - 1200\,\text{mg/L}} \right)$$

Evaluate Formula

3.2) Sludge Recirculation Rate given Sludge Recirculation Ratio Formula

Formula

$$Qr' = \alpha \cdot C_s$$

Example with Units

$$15.552\,\text{m}^3/\text{d} = 1.5 \cdot 0.12\,\text{mg/L}$$

Evaluate Formula

3.3) Sludge Recirculation Ratio Formula

Formula

$$\alpha = \frac{Q_r}{Q_s}$$

Example with Units

$$1.5 = \frac{15\,\text{m}^3/\text{s}}{10\,\text{m}^3/\text{s}}$$

Evaluate Formula

3.4) Sludge Recirculation Ratio given Sludge Volume Index Formula

Formula

$$\alpha = \left(\frac{SSV}{X'} \right) \cdot 1000$$

Example with Units

$$1.5053 = \left(\frac{1.29\,\text{mg/L}}{857\,\text{mg/L}} \right) \cdot 1000$$

Evaluate Formula

4) Sludge Volume Index Formulas

4.1) MLSS given Sludge Volume Index Formula

Formula

$$X = \frac{V_{ob} \cdot 1000}{SVI}$$

Example with Units

$$1204.6667\,\text{mg/L} = \frac{180.7 \cdot 1000}{150\,\text{mL/g}}$$

Evaluate Formula

4.2) Sludge Volume Index Formula

Formula

$$SVI = \left(V_{ob} \cdot \frac{1000}{X} \right)$$

Example with Units

$$150.5833\,\text{mL/g} = \left(180.7 \cdot \frac{1000}{1200\,\text{mg/L}} \right)$$

Evaluate Formula

Formula

$$SVI_s = \frac{\left(\dfrac{Q_r}{Q_s}\right)}{\left(\dfrac{Q_r}{Q_s}\right) \cdot X + X}$$

Example with Units

$$0.5\,\text{L/g} = \frac{\left(\dfrac{15\,\text{m}^3\text{/s}}{10\,\text{m}^3\text{/s}}\right)}{\left(\dfrac{15\,\text{m}^3\text{/s}}{10\,\text{m}^3\text{/s}}\right) \cdot 1200\,\text{mg/L} + 1200\,\text{mg/L}}$$

Variables used in list of Sludge Recycle and Rate of Returned Sludge Formulas above

- C_s Sewage Concentration *(Milligram per Liter)*
- Q_r Recirculation Flow *(Cubic Meter per Second)*
- $Q_{r'}$ Sludge Recirculation Rate given MLSS *(Cubic Meter per Day)*
- $Q_{r''}$ Recirculation Flow given MLSS *(Cubic Meter per Day)*
- Q_s Sewage Discharge *(Cubic Meter per Second)*
- Qr' Recirculation Flow given Recirculation Ratio *(Cubic Meter per Day)*
- Qs' Sewage Discharge given MLSS *(Cubic Meter per Second)*
- **SSV** Settled Sludge Volume *(Milligram per Liter)*
- **SVI** Sludge Volume Index *(Milliliter per Gram)*
- SVI_s Sludge Volume Index given Sewage Discharge *(Liter per Gram)*
- V_{ob} Sludge Volume
- **X** MLSS *(Milligram per Liter)*
- **X'** MLSS given Recirculation Ratio *(Milligram per Liter)*
- $X^{'}$ Mixed Liquor Suspended Solids *(Milligram per Liter)*
- X^R MLSS in Returned or Wasted Sludge *(Milligram per Liter)*
- **α** Recirculation Ratio

Constants, Functions, Measurements used in list of Sludge Recycle and Rate of Returned Sludge Formulas above

- Measurement: **Volumetric Flow Rate** in Cubic Meter per Day (m³/d), Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion ↗
- Measurement: **Density** in Milligram per Liter (mg/L)
  Density Unit Conversion ↗
- Measurement: **Specific Volume** in Milliliter per Gram (mL/g), Liter per Gram (L/g)
  Specific Volume Unit Conversion ↗

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