Important Flow of Liquids inside Packed Beds Formulas PDF

Formulas
Examples
with Units

List of 12
Important Flow of Liquids inside Packed Beds Formulas

1) Absolute Viscosity of Fluid by Ergun Formula

Evaluate Formula

Formula

$$\mu = \frac{D_o \cdot U_b \cdot \rho}{Re_{pb} \cdot (1 - \epsilon)}$$

Example with Units

$$24.925\,\text{Pa*s} = \frac{25\,\text{m} \cdot 0.05\,\text{m/s} \cdot 997\,\text{kg/m}^3}{200 \cdot (1 - 0.75)}$$

2) Density of Fluid by Ergun Formula

Evaluate Formula

Formula

$$\rho = \frac{Re_{pb} \cdot \mu \cdot (1 - \epsilon)}{D_{eff} \cdot U_b}$$

Example with Units

$$997.399\,\text{kg/m}^3 = \frac{200 \cdot 24.925\,\text{Pa*s} \cdot (1 - 0.75)}{24.99\,\text{m} \cdot 0.05\,\text{m/s}}$$

3) Effective Particle Diameter by Ergun given Frication Factor Formula

Evaluate Formula

Formula

$$D_{eff} = \frac{f_f \cdot L_b \cdot U_b^2 \cdot (1 - \epsilon)}{g \cdot H_f \cdot \epsilon^3}$$

Example with Units

$$24.7921\,\text{m} = \frac{1.148 \cdot 1100\,\text{m} \cdot 0.05\,\text{m/s}^2 \cdot (1 - 0.75)}{9.8\,\text{m/s}^2 \cdot 0.0077\,\text{m} \cdot 0.75^3}$$

4) Effective Particle Diameter by Ergun given Reynolds Number Formula

Evaluate Formula

Formula

$$D_{eff} = \frac{Re_{pb} \cdot \mu \cdot (1 - \epsilon)}{U_b \cdot \rho}$$

Example with Units

$$25\,\text{m} = \frac{200 \cdot 24.925\,\text{Pa*s} \cdot (1 - 0.75)}{0.05\,\text{m/s} \cdot 997\,\text{kg/m}^3}$$

5) Friction Factor by Beek Formula

Evaluate Formula

Formula

$$f_f = \frac{1 - \epsilon}{\epsilon^3} \cdot \left(1.75 + 150 \cdot \left(\frac{1 - \epsilon}{Re_{pb}}\right)\right)$$

Example

$$1.1481 = \frac{1 - 0.75}{0.75^3} \cdot \left(1.75 + 150 \cdot \left(\frac{1 - 0.75}{200}\right)\right)$$

6) Friction Factor by Ergun Formula

Evaluate Formula

Formula

$$f_f = \frac{g \cdot D_{eff} \cdot H_f \cdot \epsilon^3}{L_b \cdot U_b^2 \cdot (1 - \epsilon)}$$

Example with Units

$$1.1572 = \frac{9.8\,\text{m/s}^2 \cdot 24.99\,\text{m} \cdot 0.0077\,\text{m} \cdot 0.75^3}{1100\,\text{m} \cdot 0.05\,\text{m/s}^2 \cdot (1 - 0.75)}$$

7) Friction Factor by Ergun for Rep Value between 1 and 2500 Formula

Evaluate Formula

Formula

$$f_f = \frac{150}{Re_{pb}} + 1.75$$

Example

$$2.5 = \frac{150}{200} + 1.75$$

8) Friction Factor by Kozeny-Carman Formula

Evaluate Formula

Formula

$$f_f = \frac{150}{Re_{pb}}$$

Example

$$0.75 = \frac{150}{200}$$

9) Head of Fluid Lost Due to Friction Formula

Evaluate Formula

Formula

$$H_f = \frac{f_f \cdot L_b \cdot U_b^2 \cdot (1 - \epsilon)}{g \cdot D_{eff} \cdot \epsilon^3}$$

Example with Units

$$0.0076\,\text{m} = \frac{1.148 \cdot 1100\,\text{m} \cdot 0.05\,\text{m/s}^2 \cdot (1 - 0.75)}{9.8\,\text{m/s}^2 \cdot 24.99\,\text{m} \cdot 0.75^3}$$

10) Mean Effective Diameter Formula

Evaluate Formula

Formula

$$D_o = \frac{6}{S_{vm}}$$

Example with Units

$$25\,\text{m} = \frac{6}{0.24}$$

11) Reynolds Number of Packed Beds by Ergun Formula

Evaluate Formula

Formula

$$Re_{pb} = \frac{D_{eff} \cdot U_b \cdot \rho}{\mu \cdot (1 - \epsilon)}$$

Example with Units

$$199.92 = \frac{24.99\,\text{m} \cdot 0.05\,\text{m/s} \cdot 997\,\text{kg/m}^3}{24.925\,\text{Pa*s} \cdot (1 - 0.75)}$$

12) Superficial Velocity by Ergun given Reynolds Number Formula

Evaluate Formula

Formula

$$U_b = \frac{Re_{pb} \cdot \mu \cdot (1 - \epsilon)}{D_{eff} \cdot \rho}$$

Example with Units

$$0.05\,\text{m/s} = \frac{200 \cdot 24.925\,\text{Pa*s} \cdot (1 - 0.75)}{24.99\,\text{m} \cdot 997\,\text{kg/m}^3}$$

Variables used in list of Flow of Liquids inside Packed Beds Formulas above

- $\in$ Void Fraction
- D_{eff} Diameter(eff) *(Meter)*
- D_o Diameter of Object *(Meter)*
- f_f Factor of Friction
- g Acceleration due to Gravity *(Meter per Square Second)*
- H_f Head of Fluid *(Meter)*
- L_b Length of Packaged Bed *(Meter)*
- Re_{pb} Reynolds Number(pb)
- S_{vm} Mean Specific Surface
- U_b Superficial Velocity *(Meter per Second)*
- μ Absolute Viscosity *(Pascal Second)*
- ρ Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Flow of Liquids inside Packed Beds Formulas above

- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Dynamic Viscosity** in Pascal Second (Pa*s)
  Dynamic Viscosity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

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