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Flow of Liquids inside Packed Beds Formulas

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List of 12 Flow of Liquids inside Packed Beds Formulas

Flow of Liquids inside Packed Beds

1) Absolute Viscosity of Fluid by Ergun

$$\text{fx } \mu = \frac{D \cdot U_b \cdot \rho}{\text{Re}_{\text{pb}} \cdot (1 - \epsilon)}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

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

2) Density of Fluid by Ergun

$$\text{fx } \rho = \frac{\text{Re}_{\text{pb}} \cdot \mu \cdot (1 - \epsilon)}{D_{\text{eff}} \cdot U_b}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

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

3) Effective Particle Diameter by Ergun given Friction Factor

$$\text{fx } D_{\text{eff}} = \frac{f \cdot L \cdot U_b^2 \cdot (1 - \epsilon)}{g \cdot H_f \cdot \epsilon^3}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$\text{ex } 24.79214\text{m} = \frac{1.148 \cdot 1100\text{m} \cdot (0.05\text{m/s})^2 \cdot (1 - 0.75)}{9.8\text{m/s}^2 \cdot 0.0077\text{m} \cdot (0.75)^3}$$



4) Effective Particle Diameter by Ergun given Reynolds Number

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

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

5) Friction Factor by Beek

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 1.148148 = \frac{1 - 0.75}{(0.75)^3} \cdot \left(1.75 + 150 \cdot \left(\frac{1 - 0.75}{200} \right) \right)$$

6) Friction Factor by Ergun

$$fx \quad f = \frac{g \cdot D_{\text{eff}} \cdot H_f \cdot \epsilon^3}{L \cdot U_b^2 \cdot (1 - \epsilon)}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 1.157162 = \frac{9.8m/s^2 \cdot 24.99m \cdot 0.0077m \cdot (0.75)^3}{1100m \cdot (0.05m/s)^2 \cdot (1 - 0.75)}$$



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

$$fx \quad f = \frac{150}{Re_{pb}} + 1.75$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

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

8) Friction Factor by Kozeny-Carman 

$$fx \quad f = \frac{150}{Re_{pb}}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

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

9) Head of Fluid Lost Due to Friction 

$$fx \quad H_f = \frac{f \cdot L \cdot U_b^2 \cdot (1 - \epsilon)}{g \cdot D_{eff} \cdot \epsilon^3}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 0.007639m = \frac{1.148 \cdot 1100m \cdot (0.05m/s)^2 \cdot (1 - 0.75)}{9.8m/s^2 \cdot 24.99m \cdot (0.75)^3}$$

10) Mean Effective Diameter 

$$fx \quad D = \frac{6}{S_{vm}}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 25m = \frac{6}{0.24}$$



11) Reynolds Number of Packed Beds by Ergun

$$\text{fx } \text{Re}_{\text{pb}} = \frac{D_{\text{eff}} \cdot U_{\text{b}} \cdot \rho}{\mu \cdot (1 - \epsilon)}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

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

12) Superficial Velocity by Ergun given Reynolds Number

$$\text{fx } U_{\text{b}} = \frac{\text{Re}_{\text{pb}} \cdot \mu \cdot (1 - \epsilon)}{D_{\text{eff}} \cdot \rho}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } 0.05002\text{m/s} = \frac{200 \cdot 24.925\text{Pa}\cdot\text{s} \cdot (1 - 0.75)}{24.99\text{m} \cdot 997\text{kg/m}^3}$$








Variables Used

- ϵ Void Fraction
- D Diameter (Meter)
- D_{eff} Diameter(eff) (Meter)
- f Friction Factor
- g Acceleration due to Gravity (Meter per Square Second)
- H_f Head of Fluid (Meter)
- L 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

- **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 



Check other formula lists

- [Flow of Liquids inside Packed Beds Formulas](#) 

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