Important Co-Relation of Dimensionless Numbers Formulas PDF

Formulas
Examples
with Units

List of 11
Important Co-Relation of Dimensionless Numbers Formulas

1) Fourier Number Formula

Evaluate Formula

Formula

$$F_o = \frac{\alpha \cdot \tau_c}{s^2}$$

Example with Units

$$0.293 = \frac{5.58\,\text{m}^2/\text{s} \cdot 2.5\,\text{s}}{6.9\,\text{m}^2}$$

2) Nusselt Number for Transitional and Rough Flow in Circular Tube Formula

Evaluate Formula

Formula

$$Nu = \left(\frac{f_{Darcy}}{8}\right) \cdot (Re - 1000) \cdot \frac{Pr}{1 + 12.7 \cdot \left(\left(\frac{f_{Darcy}}{8}\right)^{0.5}\right) \cdot \left((Pr)^{\frac{2}{3}} - 1\right)}$$

Example

$$17.2849 = \left(\frac{0.04}{8}\right) \cdot (5000 - 1000) \cdot \frac{0.7}{1 + 12.7 \cdot \left(\left(\frac{0.04}{8}\right)^{0.5}\right) \cdot \left((0.7)^{\frac{2}{3}} - 1\right)}$$

3) Nusselt Number using Dittus Boelter Equation for Cooling Formula

Evaluate Formula

Formula

$$Nu = 0.023 \cdot (Re)^{0.8} \cdot (Pr)^{0.3}$$

Example

$$18.8119 = 0.023 \cdot (5000)^{0.8} \cdot (0.7)^{0.3}$$

4) Nusselt Number using Dittus Boelter Equation for Heating Formula

Evaluate Formula

Formula

$$Nu = 0.023 \cdot (Re)^{0.8} \cdot (Pr)^{0.4}$$

Example

$$18.1528 = 0.023 \cdot (5000)^{0.8} \cdot (0.7)^{0.4}$$

5) Prandtl Number Formula

Evaluate Formula

Formula

$$Pr = c \cdot \frac{\mu_{viscosity}}{k}$$

Example with Units

$$0.7113 = 4.184\,\text{kJ/kg*K} \cdot \frac{1.02\,\text{Pa*s}}{6000\,\text{W/(m*K)}}$$

6) Prandtl Number using Diffusivities Formula

Evaluate Formula

Formula

$$Pr = \frac{\nu}{\alpha}$$

Example with Units

$$0.7168 = \frac{4\,m^2/s}{5.58\,m^2/s}$$

7) Reynolds Number for Circular Tubes Formula

Evaluate Formula

Formula

$$Re = \rho \cdot u_{Fluid} \cdot \frac{D_{Tube}}{\mu_{viscosity}}$$

Example with Units

$$5176.4706 = 400\,kg/m^3 \cdot 12\,m/s \cdot \frac{1.1\,m}{1.02\,Pa*s}$$

8) Reynolds Number for Non-Circular Tubes Formula

Evaluate Formula

Formula

$$Re = \rho \cdot u_{Fluid} \cdot \frac{L_c}{\mu_{viscosity}}$$

Example with Units

$$5129.4118 = 400\,kg/m^3 \cdot 12\,m/s \cdot \frac{1.09\,m}{1.02\,Pa*s}$$

9) Stanton Number given Fanning Friction Factor Formula

Evaluate Formula

Formula

$$St = \frac{\frac{f}{2}}{(Pr)^{\frac{2}{3}}}$$

Example

$$0.0058 = \frac{\frac{0.0091}{2}}{(0.7)^{\frac{2}{3}}}$$

10) Stanton Number using Basic Fluid Properties Formula

Evaluate Formula

Formula

$$St = \frac{h_{outside}}{c \cdot u_{Fluid} \cdot \rho}$$

Example with Units

$$4.9E\text{-}7 = \frac{9.8\,W/m^2*K}{4.184\,kJ/kg*K \cdot 12\,m/s \cdot 400\,kg/m^3}$$

11) Stanton Number using Dimensionless Numbers Formula

Evaluate Formula

Formula

$$St = \frac{Nu}{Re \cdot Pr}$$

Example

$$0.0051 = \frac{18}{5000 \cdot 0.7}$$

Variables used in list of Co-Relation of Dimensionless Numbers Formulas above

- **c** Specific Heat Capacity *(Kilojoule per Kilogram per K)*
- **D_{Tube}** Diameter of Tube *(Meter)*
- **f** Fanning Friction Factor
- **f_{Darcy}** Darcy Friction Factor
- **F_o** Fourier Number
- **$h_{outside}$** External Convection Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- **k** Thermal Conductivity *(Watt per Meter per K)*
- **L_c** Characteristic Length *(Meter)*
- **Nu** Nusselt Number
- **Pr** Prandtl Number
- **Re** Reynolds Number
- **s** Characteristic Dimension *(Meter)*
- **St** Stanton Number
- **u_{Fluid}** Fluid Velocity *(Meter per Second)*
- **α** Thermal Diffusivity *(Square Meter Per Second)*
- **$\mu_{viscosity}$** Dynamic Viscosity *(Pascal Second)*
- **ρ** Density *(Kilogram per Cubic Meter)*
- ν Momentum Diffusivity *(Square Meter Per Second)*
- τ_c Characteristic Time *(Second)*

Constants, Functions, Measurements used in list of Co-Relation of Dimensionless Numbers Formulas above

- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Thermal Conductivity** in Watt per Meter per K (W/(m*K))
  Thermal Conductivity Unit Conversion
- Measurement: **Specific Heat Capacity** in Kilojoule per Kilogram per K (kJ/kg*K)
  Specific Heat Capacity Unit Conversion
- Measurement: **Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K)
  Heat Transfer Coefficient 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
- Measurement: **Diffusivity** in Square Meter Per Second (m²/s)
  Diffusivity Unit Conversion

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