Important Rayleigh and Reynolds Number Formulas PDF

Formulas
Examples
with Units

List of 16
Important Rayleigh and Reynolds Number Formulas

1) Bingham Number Formula

Evaluate Formula

Formula

$$B_n = \frac{S_{sy} \cdot L_c}{\mu_a \cdot v}$$

Example with Units

$$7.0125 = \frac{4.25\,\text{N/m}^2 \cdot 9.9\,\text{m}}{0.1\,\text{Pa*s} \cdot 60\,\text{m/s}}$$

2) Bingham Number of Plastic Fluids from Isothermal Semi-circular Cylinder Formula

Evaluate Formula

Formula

$$B_n = \left(\frac{\zeta_o}{\mu_B}\right) \cdot \left(\left(\frac{D_1}{g \cdot \beta \cdot \Delta T}\right)\right)^{0.5}$$

Example with Units

$$7.0102 = \left(\frac{1202\,\text{Pa}}{10\,\text{Pa*s}}\right) \cdot \left(\left(\frac{5\,\text{m}}{9.8\,\text{m/s}^2 \cdot 3.0\,\text{K}^{-1} \cdot 50.0\,\text{K}}\right)\right)^{0.5}$$

3) Diameter of rotating cylinder in fluid given Reynolds number Formula

Evaluate Formula

Formula

$$D = \left(\frac{Rew \cdot v_k}{\pi \cdot w}\right)^{\frac{1}{2}}$$

Example with Units

$$3.9088\,\text{m} = \left(\frac{0.6 \cdot 4\,\text{MSt}}{3.1416 \cdot 5.0\,\text{rad/s}}\right)^{\frac{1}{2}}$$

4) Inertia force given Reynolds number Formula

Evaluate Formula

Formula

$$F_i = Re \cdot \mu$$

Example with Units

$$500000\,\text{N} = 5000 \cdot 100\,\text{N}$$

5) Kinematic viscosity given Reynolds number based on rotational speed Formula

Evaluate Formula

Formula

$$v_k = w \cdot \pi \cdot \frac{D^2}{Rew}$$

Example with Units

$$3.982\,\text{MSt} = 5.0\,\text{rad/s} \cdot 3.1416 \cdot \frac{3.9\,\text{m}^2}{0.6}$$

6) Modified Rayleigh number given Bingham number Formula

Evaluate Formula

Formula

$$Ra' = \frac{Ra_c}{1 + B_n}$$

Example

$$0.0094 = \frac{0.075}{1 + 7.01}$$

7) Rayleigh Number Formula

Evaluate Formula

Formula

$$Ra_c = G \cdot Pr$$

Example

$$0.609 = 0.87 \cdot 0.7$$

8) Rayleigh number based on length for annular space between concentric cylinders Formula

Evaluate Formula

Formula

$$Ra_l = \frac{Ra_c}{\frac{\left(\left(\ln\left(\frac{d_o}{d_i}\right)\right)^4\right)}{\left(L^3\right) \cdot \left(\left(d_i^{-0.6}\right) + \left(d_o^{-0.6}\right)\right)^5}}$$

Example with Units

$$0.258 = \frac{0.075}{\frac{\left(\left(\ln\left(\frac{0.26\,m}{35\,m}\right)\right)^4\right)}{\left(3\,m^3\right) \cdot \left(\left(35\,m^{-0.6}\right) + \left(0.26\,m^{-0.6}\right)\right)^5}}$$

9) Rayleigh number based on turbulence for annular space between concentric cylinders Formula

Evaluate Formula

Formula

$$Ra_c = \left(\frac{\left(\left(\ln\left(\frac{d_o}{d_i}\right)\right)^4\right) \cdot \left(Ra_l\right)}{\left(L^3\right) \cdot \left(\left(d_i^{-0.6}\right) + \left(d_o^{-0.6}\right)\right)^5}\right)$$

Example with Units

$$0.0727 = \left(\frac{\left(\left(\ln\left(\frac{0.26\,m}{35\,m}\right)\right)^4\right) \cdot \left(0.25\right)}{\left(3\,m^3\right) \cdot \left(\left(35\,m^{-0.6}\right) + \left(0.26\,m^{-0.6}\right)\right)^5}\right)$$

10) Rayleigh number based on turbulence for concentric spheres Formula

Evaluate Formula

Formula

$$Ra_c = \left(\frac{L \cdot Ra_l}{\left(\left(D_i \cdot D_o \right)^4 \right) \cdot \left(\left(\left(D_i^{-1.4} \right) + \left(D_o^{-1.4} \right) \right)^5 \right)} \right)^{0.25}$$

Example with Units

$$0.3333 = \left(\frac{3\,\text{m} \cdot 0.25}{\left(\left(0.005\,\text{m} \cdot 0.05\,\text{m} \right)^4 \right) \cdot \left(\left(\left(0.005\,\text{m}^{-1.4} \right) + \left(0.05\,\text{m}^{-1.4} \right) \right)^5 \right)} \right)^{0.25}$$

11) Reynolds Number given Graetz Number Formula

Evaluate Formula

Formula

$$Re_L = Gr \cdot \frac{L}{Pr \cdot D}$$

Example with Units

$$879.1209 = 800 \cdot \frac{3\,\text{m}}{0.7 \cdot 3.9\,\text{m}}$$

12) Reynolds number given Inertia and Viscous Force Formula

Evaluate Formula

Formula

$$Re = \frac{F_i}{\mu}$$

Example with Units

$$5000 = \frac{500000\,\text{N}}{100\,\text{N}}$$

13) Reynolds number given Peclet number Formula

Evaluate Formula

Formula

$$Re = \frac{Pe}{Pr}$$

Example

$$5000 = \frac{3500}{0.7}$$

14) Reynolds Number given Rotational Speed Formula

Evaluate Formula

Formula

$$Rew = w \cdot \pi \cdot \frac{D^2}{v_k}$$

Example with Units

$$0.5973 = 5.0\,\text{rad/s} \cdot 3.1416 \cdot \frac{3.9\,\text{m}^2}{4\,\text{MSt}}$$

15) Rotational speed given Reynolds number Formula

Evaluate Formula

Formula

$$w = \frac{Rew \cdot v_k}{\pi \cdot D^2}$$

Example with Units

$$5.0226\,\text{rad/s} = \frac{0.6 \cdot 4\,\text{MSt}}{3.1416 \cdot 3.9\,\text{m}^2}$$

16) Viscous force given Reynolds number Formula

Evaluate Formula

Formula

$$\mu = \frac{F_i}{Re}$$

Example with Units

$$100\,\text{N} = \frac{500000\,\text{N}}{5000}$$

Variables used in list of Rayleigh and Reynolds Number Formulas above

- ΔT Change in Temperature *(Kelvin)*
- B_n Bingham Number
- **D** Diameter *(Meter)*
- D_1 Diameter of Cylinder 1 *(Meter)*
- d_i Inner Diameter *(Meter)*
- D_i Inside Diameter *(Meter)*
- d_o Outer Diameter *(Meter)*
- D_o Outside Diameter *(Meter)*
- F_i Inertia Force *(Newton)*
- **g** Acceleration due to Gravity *(Meter per Square Second)*
- **G** Grashof Number
- **Gr** Graetz Number
- **L** Length *(Meter)*
- L_c Characteristic Length *(Meter)*
- **Pe** Peclet Number
- **Pr** Prandtl Number
- **Ra'** Modified Rayleigh Number
- Ra_c Rayleigh Number(t)
- Ra_l Rayleigh Number
- **Re** Reynolds Number
- Re_L Reynolds Number Based on Length
- **Rew** Reynolds Number(w)
- S_{sy} Shear Yield Strength *(Newton per Square Meter)*
- **v** Velocity *(Meter per Second)*
- v_k Kinematic Viscosity *(Megastokes)*
- **w** Rotational Speed *(Radian per Second)*
- **β** Coefficient of Volumetric Expansion *(Per Kelvin)*
- ζ_o Fluid Yield Stress *(Pascal)*
- **μ** Viscous Force *(Newton)*
- μ_a Absolute Viscosity *(Pascal Second)*

Constants, Functions, Measurements used in list of Rayleigh and Reynolds Number Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **ln**, ln(Number) *The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Pressure** in Newton per Square Meter (N/m²), Pascal (Pa) *Pressure 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: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Temperature Difference** in Kelvin (K) *Temperature Difference Unit Conversion*
- Measurement: **Dynamic Viscosity** in Pascal Second (Pa*s) *Dynamic Viscosity Unit Conversion*
- Measurement: **Kinematic Viscosity** in Megastokes (MSt) *Kinematic Viscosity Unit Conversion*
- Measurement: **Angular Velocity** in Radian per Second (rad/s) *Angular Velocity Unit Conversion*
- Measurement: **Coefficient of Linear Expansion** in Per Kelvin (K⁻¹) *Coefficient of Linear Expansion Unit Conversion*

- μ_B Plastic Viscosity *(Pascal Second)*

Download other Important Free convection PDFs

- Important Effective Thermal Conductivity and Heat Transfer Formulas
- Important Nusselt Number Formulas
- Important Rayleigh and Reynolds Number Formulas

Try our Unique Visual Calculators

- Percentage of number
- LCM calculator
- Simple fraction

Please SHARE this PDF with someone who needs it!

This PDF can be downloaded in these languages

English Spanish French German Russian Italian Portuguese Polish Dutch

9/18/2024 | 11:30:57 AM UTC