Important Measurement of Viscosity Viscometers Formulas PDF

Formulas
Examples
with Units

List of 30
Important Measurement of Viscosity Viscometers Formulas

1) Capillary Tube Viscometer Formulas

1.1) Cross-Sectional Area of Tube using Dynamic Viscosity Formula

Evaluate Formula

Formula

$$A = \frac{\frac{\mu}{t_{sec} \cdot \gamma_f \cdot D_{pipe}}}{32 \cdot A_R \cdot L_p \cdot \ln\left(\frac{h_1}{h_2}\right)}$$

Example with Units

$$0.2618\,\mathrm{m^2} = \frac{\frac{10.2\,\mathrm{P}}{110\,\mathrm{s} \cdot 9.81\,\mathrm{kN/m^3} \cdot 1.01\,\mathrm{m}}}{32 \cdot 10\,\mathrm{m^2} \cdot 0.10\,\mathrm{m} \cdot \ln\left(\frac{12.01\,\mathrm{cm}}{5.01\,\mathrm{cm}}\right)}$$

1.2) Diameter of Pipe given Dynamic Viscosity with Length Formula

Evaluate Formula

Formula

$$D_{pipe} = \left(\frac{Q}{\left(\pi \cdot \gamma_f \cdot H\right)} / \left(128 \cdot L_p \cdot \mu\right)\right)^{\frac{1}{4}}$$

Example with Units

$$0.0196\,\mathrm{m} = \left(\frac{55\,\mathrm{m^3/s}}{\left(3.1416 \cdot 9.81\,\mathrm{kN/m^3} \cdot 926.7\,\mathrm{m}\right)} / \left(128 \cdot 0.10\,\mathrm{m} \cdot 10.2\,\mathrm{P}\right)\right)^{\frac{1}{4}}$$

1.3) Diameter of Pipe given Kinematic Viscosity Formula

Evaluate Formula

Formula

$$D_{pipe} = \frac{\left(\left(\frac{\upsilon}{\left([g] \cdot H_t \cdot \pi \cdot t_{sec}\right)} / \left(128 \cdot L_p \cdot V_T\right)\right)\right)^{1}}{4}$$

Example with Units

$$0.0002\,\mathrm{m} = \frac{\left(\left(\frac{15.1\,\mathrm{m^2/s}}{\left(9.8066\,\mathrm{m/s^2} \cdot 12.02\,\mathrm{cm} \cdot 3.1416 \cdot 110\,\mathrm{s}\right)} / \left(128 \cdot 0.10\,\mathrm{m} \cdot 4.1\,\mathrm{m^3}\right)\right)\right)^{1}}{4}$$

1.4) Diameter of Pipe using Dynamic Viscosity with Time Formula

Evaluate Formula

Formula

$$D_{pipe} = \sqrt{\frac{\frac{\mu}{t_{sec} \cdot \gamma_f \cdot A}}{32 \cdot A_R \cdot L_p \cdot \ln\left(\frac{h_1}{h_2}\right)}}$$

Example with Units

$$1.0047\,\text{m} = \sqrt{\frac{\frac{10.2\,\text{P}}{110\,\text{s} \cdot 9.81\,\text{kN/m}^3 \cdot 0.262\,\text{m}^2}}{32 \cdot 10\,\text{m}^2 \cdot 0.10\,\text{m} \cdot \ln\left(\frac{12.01\,\text{cm}}{5.01\,\text{cm}}\right)}}$$

1.5) Dynamic Viscosity of Fluids in Flow Formula

Evaluate Formula

Formula

$$\mu = \left(\frac{t_{sec} \cdot A \cdot \gamma_f \cdot D_{pipe}}{32 \cdot A_R \cdot L_p \cdot \ln\left(\frac{h_1}{h_2}\right)}\right)$$

Example with Units

$$10.2064\,\text{P} = \left(\frac{110\,\text{s} \cdot 0.262\,\text{m}^2 \cdot 9.81\,\text{kN/m}^3 \cdot 1.01\,\text{m}}{32 \cdot 10\,\text{m}^2 \cdot 0.10\,\text{m} \cdot \ln\left(\frac{12.01\,\text{cm}}{5.01\,\text{cm}}\right)}\right)$$

1.6) Length of Pipe given Kinematic Viscosity Formula

Evaluate Formula

Formula

$$L_p = \frac{[g] \cdot H_t \cdot \pi \cdot t_{sec} \cdot \left(d_{pipe}^{\ 4}\right)}{128 \cdot V_T \cdot \upsilon}$$

Example with Units

$$0.0535\,\text{m} = \frac{9.8066\,\text{m/s}^2 \cdot 12.02\,\text{cm} \cdot 3.1416 \cdot 110\,\text{s} \cdot \left(1.01\,\text{m}^{\ 4}\right)}{128 \cdot 4.1\,\text{m}^3 \cdot 15.1\,\text{m}^2/\text{s}}$$

1.7) Length of Reservoir using Dynamic Viscosity Formula

Evaluate Formula

Formula

$$L_p = \frac{t_{sec} \cdot A \cdot \gamma_f \cdot D_{pipe}}{32 \cdot \mu \cdot A_R \cdot \ln\left(\frac{h_1}{h_2}\right)}$$

Example with Units

$$0.1001\,\text{m} = \frac{110\,\text{s} \cdot 0.262\,\text{m}^2 \cdot 9.81\,\text{kN/m}^3 \cdot 1.01\,\text{m}}{32 \cdot 10.2\,\text{P} \cdot 10\,\text{m}^2 \cdot \ln\left(\frac{12.01\,\text{cm}}{5.01\,\text{cm}}\right)}$$

1.8) Redwood Viscometer Formulas

1.8.1) Dynamic Viscosity given Velocity Formula

Evaluate Formula

Formula

$$\mu = \left(\frac{D_S^{\ 2}}{18 \cdot V_{mean}}\right)$$

Example with Units

$$10.2124\,\text{P} = \left(\frac{10\,\text{m}^{\ 2}}{18 \cdot 5.44\,\text{m/s}}\right)$$

1.8.2) Mean Velocity of Sphere given Dynamic Viscosity Formula

Evaluate Formula

Formula

$$V_{mean} = \left(\frac{D_S^2}{18 \cdot \mu} \right)$$

Example with Units

$$5.4466\,\text{m/s} = \left(\frac{10\,\text{m}^2}{18 \cdot 10.2\,\text{P}} \right)$$

1.9) SayBolt Universal Viscometer Formulas

1.9.1) Kinematic Viscosity given Time Formula

Evaluate Formula

Formula

$$\upsilon = 0.0022 \cdot \Delta t - \left(\frac{1.80}{\Delta t} \right)$$

Example with Units

$$15.0477\,\text{m²/s} = 0.0022 \cdot 1.9\,\text{h} - \left(\frac{1.80}{1.9\,\text{h}} \right)$$

2) Coaxial Cylinder Viscometers Formulas

2.1) Clearance given Torque exerted on Outer Cylinder Formula

Evaluate Formula

Formula

$$C = \mu \cdot \pi \cdot \pi \cdot \Omega \cdot \frac{r_1^4}{60 \cdot T_o}$$

Example with Units

$$15.6144\,\text{mm} = 10.2\,\text{P} \cdot 3.1416 \cdot 3.1416 \cdot 5\,\text{rev/s} \cdot \frac{12\,\text{m}^4}{60 \cdot 7000\,\text{kN*m}}$$

2.2) Dynamic Viscosity given Torque exerted on Outer Cylinder Formula

Evaluate Formula

Formula

$$\mu = \frac{T_o}{\pi \cdot \pi \cdot \Omega \cdot \frac{r_1^4}{60 \cdot C}}$$

Example with Units

$$10.1253\,\text{P} = \frac{7000\,\text{kN*m}}{3.1416 \cdot 3.1416 \cdot 5\,\text{rev/s} \cdot \frac{12\,\text{m}^4}{60 \cdot 15.5\,\text{mm}}}$$

2.3) Dynamic Viscosity given Total Torque Formula

Evaluate Formula

Formula

$$\mu = \frac{T_{Torque}}{V_c \cdot \Omega}$$

Example with Units

$$10.0851\,\text{P} = \frac{320\,\text{N*m}}{10.1 \cdot 5\,\text{rev/s}}$$

2.4) Dynamic Viscosity of Fluid Flow given Torque Formula

Evaluate Formula

Formula

$$\mu = \frac{15 \cdot T \cdot \left(r_2 - r_1 \right)}{\pi \cdot \pi \cdot r_1 \cdot r_1 \cdot r_2 \cdot h \cdot \Omega}$$

Example with Units

$$10.8582\,\text{P} = \frac{15 \cdot 500\,\text{kN*m} \cdot \left(13\,\text{m} - 12\,\text{m} \right)}{3.1416 \cdot 3.1416 \cdot 12\,\text{m} \cdot 12\,\text{m} \cdot 13\,\text{m} \cdot 11.9\,\text{m} \cdot 5\,\text{rev/s}}$$

2.5) Height of Cylinder given Dynamic Viscosity of Fluid Formula

Evaluate Formula

Formula

$$h = \frac{15 \cdot T \cdot \left(r_2 - r_1 \right)}{\pi \cdot \pi \cdot r_1 \cdot r_1 \cdot r_2 \cdot \mu \cdot \Omega}$$

Example with Units

$$12.6679\,\text{m} = \frac{15 \cdot 500\,\text{kN*m} \cdot \left(13\,\text{m} - 12\,\text{m} \right)}{3.1416 \cdot 3.1416 \cdot 12\,\text{m} \cdot 12\,\text{m} \cdot 13\,\text{m} \cdot 10.2\,\text{P} \cdot 5\,\text{rev/s}}$$

2.6) Height of Cylinder given Torque exerted on Inner Cylinder Formula

Evaluate Formula

Formula

$$h = \frac{T}{2 \cdot \pi \cdot \left(\left(r_1 \right)^2 \right) \cdot \tau}$$

Example with Units

$$5.9358\,\text{m} = \frac{500\,\text{kN*m}}{2 \cdot 3.1416 \cdot \left(\left(12\,\text{m} \right)^2 \right) \cdot 93.1\,\text{Pa}}$$

2.7) Radius of Inner Cylinder given Torque exerted on Inner Cylinder Formula

Evaluate Formula

Formula

$$r_1 = \sqrt{\frac{T}{2 \cdot \pi \cdot h \cdot \tau}}$$

Example with Units

$$8.4751\,\text{m} = \sqrt{\frac{500\,\text{kN*m}}{2 \cdot 3.1416 \cdot 11.9\,\text{m} \cdot 93.1\,\text{Pa}}}$$

2.8) Radius of Inner Cylinder given Torque exerted on Outer Cylinder Formula

Evaluate Formula

Formula

$$r_1 = \left(\frac{T_o}{\mu \cdot \pi \cdot \pi \cdot \frac{\Omega}{60 \cdot C}} \right)^{\frac{1}{4}}$$

Example with Units

$$11.978\,\text{m} = \left(\frac{7000\,\text{kN*m}}{10.2\,\text{P} \cdot 3.1416 \cdot 3.1416 \cdot \frac{5\,\text{rev/s}}{60 \cdot 15.5\,\text{mm}}} \right)^{\frac{1}{4}}$$

2.9) Radius of Inner Cylinder given Velocity Gradient Formula

Evaluate Formula

Formula

$$r_1 = \frac{30 \cdot V_G \cdot r_2 - \pi \cdot r_2 \cdot \Omega}{30 \cdot V_G}$$

Example with Units

$$12.4417\,\text{m} = \frac{30 \cdot 76.6\,\text{m/s} \cdot 13\,\text{m} - 3.1416 \cdot 13\,\text{m} \cdot 5\,\text{rev/s}}{30 \cdot 76.6\,\text{m/s}}$$

2.10) Radius of Outer Cylinder given Velocity Gradient Formula

Evaluate Formula

Formula

$$r_2 = \frac{30 \cdot V_G \cdot r_1}{30 \cdot V_G - \pi \cdot \Omega}$$

Example with Units

$$12.5385\,\text{m} = \frac{30 \cdot 76.6\,\text{m/s} \cdot 12\,\text{m}}{30 \cdot 76.6\,\text{m/s} - 3.1416 \cdot 5\,\text{rev/s}}$$

2.11) Shear Stress on Cylinder given Torque exerted on Inner Cylinder Formula

Evaluate Formula

Formula

$$\tau = \frac{T}{2 \cdot \pi \cdot \left(\left(r_1 \right)^2 \right) \cdot h}$$

Example with Units

$$46.4388\,\text{Pa} = \frac{500\,\text{kN*m}}{2 \cdot 3.1416 \cdot \left(\left(12\,\text{m} \right)^2 \right) \cdot 11.9\,\text{m}}$$

2.12) Speed of Outer Cylinder given Dynamic Viscosity of Fluid Formula

Evaluate Formula

Formula

$$\Omega = \frac{15 \cdot T \cdot \left(r_2 - r_1 \right)}{\pi \cdot \pi \cdot r_1 \cdot r_1 \cdot r_2 \cdot h \cdot \mu}$$

Example with Units

$$5.3227\,\text{rev/s} = \frac{15 \cdot 500\,\text{kN*m} \cdot \left(13\,\text{m} - 12\,\text{m} \right)}{3.1416 \cdot 3.1416 \cdot 12\,\text{m} \cdot 12\,\text{m} \cdot 13\,\text{m} \cdot 11.9\,\text{m} \cdot 10.2\,\text{P}}$$

2.13) Speed of Outer Cylinder given Torque exerted on Outer Cylinder Formula

Evaluate Formula

Formula

$$\Omega = \frac{T_o}{\pi \cdot \pi \cdot \mu \cdot \frac{r_1^{\;4}}{60 \cdot C}}$$

Example with Units

$$4.9634\,\text{rev/s} = \frac{7000\,\text{kN*m}}{3.1416 \cdot 3.1416 \cdot 10.2\,\text{P} \cdot \frac{12\,\text{m}^{\;4}}{60 \cdot 15.5\,\text{mm}}}$$

2.14) Speed of Outer Cylinder given Total Torque Formula

Evaluate Formula

Formula

$$\Omega = \frac{T_{Torque}}{V_c \cdot \mu}$$

Example with Units

$$4.9437\,\text{rev/s} = \frac{320\,\text{N*m}}{10.1 \cdot 10.2\,\text{P}}$$

2.15) Speed of Outer Cylinder given Velocity Gradient Formula

Evaluate Formula

Formula

$$\Omega = \frac{V_G}{\frac{\pi \cdot r_2}{30 \cdot \left(r_2 - r_1 \right)}}$$

Example with Units

$$8.9552\,\text{rev/s} = \frac{76.6\,\text{m/s}}{\frac{3.1416 \cdot 13\,\text{m}}{30 \cdot \left(13\,\text{m} - 12\,\text{m} \right)}}$$

2.16) Torque exerted on Inner Cylinder Formula

Evaluate Formula

Formula

$$T_{Torque} = 2 \cdot \left(\left(r_1 \right)^2 \right) \cdot h \cdot \tau$$

Example with Units

$$319.0723\,\text{N*m} = 2 \cdot \left(\left(12\,\text{m} \right)^2 \right) \cdot 11.9\,\text{m} \cdot 93.1\,\text{Pa}$$

2.17) Torque exerted on Inner Cylinder given Dynamic Viscosity of Fluid Formula

Evaluate Formula

Formula

$$T = \frac{\mu}{\frac{15 \cdot \left(r_2 - r_1 \right)}{\pi \cdot \pi \cdot r_1 \cdot r_1 \cdot r_2 \cdot h \cdot \Omega}}$$

Example with Units

$$469.69\,\text{kN*m} = \frac{10.2\,\text{P}}{\frac{15 \cdot \left(13\,\text{m} - 12\,\text{m} \right)}{3.1416 \cdot 3.1416 \cdot 12\,\text{m} \cdot 12\,\text{m} \cdot 13\,\text{m} \cdot 11.9\,\text{m} \cdot 5\,\text{rev/s}}}$$

2.18) Torque Exerted on Outer Cylinder Formula

Evaluate Formula

Formula

$$T_o = \mu \cdot \pi \cdot \pi \cdot \Omega \cdot \frac{r_1^{\ 4}}{60 \cdot C}$$

Example with Units

$$7051.6675\,\text{kN*m} = 10.2\,\text{P} \cdot 3.1416 \cdot 3.1416 \cdot 5\,\text{rev/s} \cdot \frac{12\,\text{m}^{\ 4}}{60 \cdot 15.5\,\text{mm}}$$

2.19) Total Torque Formula

Evaluate Formula

Formula

$$T_{Torque} = V_c \cdot \mu \cdot \Omega$$

Example with Units

$$323.6469\,\text{N*m} = 10.1 \cdot 10.2\,\text{P} \cdot 5\,\text{rev/s}$$

2.20) Velocity Gradients Formula

Evaluate Formula

Formula

$$V_G = \pi \cdot r_2 \cdot \frac{\Omega}{30 \cdot \left(r_2 - r_1 \right)}$$

Example with Units

$$42.7683\,\text{m/s} = 3.1416 \cdot 13\,\text{m} \cdot \frac{5\,\text{rev/s}}{30 \cdot \left(13\,\text{m} - 12\,\text{m} \right)}$$

Variables used in list of Measurement of Viscosity Viscometers Formulas above

- **A** Cross Sectional Area of Pipe *(Square Meter)*
- **A_R** Average Reservoir Area *(Square Meter)*
- **C** Clearance *(Millimeter)*
- **d_{pipe}** Pipe Diameter *(Meter)*
- **D_{pipe}** Diameter of Pipe *(Meter)*
- **D_S** Diameter of Sphere *(Meter)*
- **h** Height of Cylinder *(Meter)*
- **H** Head of the Liquid *(Meter)*
- **h_1** Height of Column 1 *(Centimeter)*
- **h_2** Height of Column 2 *(Centimeter)*
- **H_t** Total Head *(Centimeter)*
- **L_p** Length of Pipe *(Meter)*
- **Q** Discharge in Laminar Flow *(Cubic Meter per Second)*
- **r_1** Radius of Inner Cylinder *(Meter)*
- **r_2** Radius of Outer Cylinder *(Meter)*
- **T** Torque on Inner Cylinder *(Kilonewton Meter)*
- **T_o** Torque on Outer Cylinder *(Kilonewton Meter)*
- **t_{sec}** Time in Seconds *(Second)*
- **V_c** Viscometer Constant
- **V_G** Velocity Gradient *(Meter per Second)*
- **V_{mean}** Mean Velocity *(Meter per Second)*
- **V_T** Volume of Liquid *(Cubic Meter)*
- **γ_f** Specific Weight of Liquid *(Kilonewton per Cubic Meter)*
- **Δt** Time Interval or Time Period *(Hour)*
- **μ** Dynamic Viscosity *(Poise)*
- **T_{Torque}** Total Torque *(Newton Meter)*
- **υ** Kinematic Viscosity *(Square Meter per Second)*
- **Ω** Angular Speed *(Revolution per Second)*
- **τ** Shear Stress *(Pascal)*

Constants, Functions, Measurements used in list of Measurement of Viscosity Viscometers Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- 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.
- Functions: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Meter (m), Centimeter (cm), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Time** in Second (s), Hour (h)
  Time Unit Conversion
- Measurement: **Volume** in Cubic Meter (m³)
  Volume Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Dynamic Viscosity** in Poise (P)
  Dynamic Viscosity Unit Conversion
- Measurement: **Kinematic Viscosity** in Square Meter per Second (m²/s)
  Kinematic Viscosity Unit Conversion
- Measurement: **Angular Velocity** in Revolution per Second (rev/s)
  Angular Velocity Unit Conversion
- Measurement: **Torque** in Kilonewton Meter (kN*m), Newton Meter (N*m)
  Torque Unit Conversion

- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  Specific Weight Unit Conversion
- Measurement: **Stress** in Pascal (Pa)
  Stress Unit Conversion

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