Fluid Mechanics and Machineries- Viscosity, Kinematic Viscosity

VISCOSITY

Property of the fluid by which it offers resistance to shear or angular deformation.

$$\tau = \mu \frac{du}{dy} \qquad \Big\} \quad \text{Newtons Law of Viscosity.}$$

where

$\dfrac{du}{dy} =$ velocity gradient

$\mu . =$ Proportionality Constant (or) Co efficient of viscosity

$\tau \Rightarrow$ viscous resistance

Note:

• viscosity of liquid decreases, while applied temp

• For Gas viscosity decreases, while applied temp.

Unit: SI system $\dfrac{Ns}{m^2}$

$1 \, Poise = \dfrac{1}{10} \dfrac{Ns}{m^2}$

Viscosity

Dynamic viscosity

$$\mu = \frac{\tau}{\left(\frac{du}{dy}\right)}$$

$$\mu = \frac{\left(\frac{N}{m^2}\right)}{\left[\frac{\left(\frac{m}{s}\right)}{m}\right]}$$

$$\mu = \frac{Ns}{m^2}$$

$$\boxed{\mu = Pa \cdot S}$$

Unt = paise

Specific Viscosity

Ratio of the viscosity of fluid to the viscosity of water at 20°C

water has a viscosity of 1 cp at 20°C

Kinematic Viscosity

$$\nu = \frac{\mu}{\rho}$$

Dimensional formla

$$\nu = \left[\frac{M}{LT}\right] + \left[\frac{M}{L^3}\right]$$
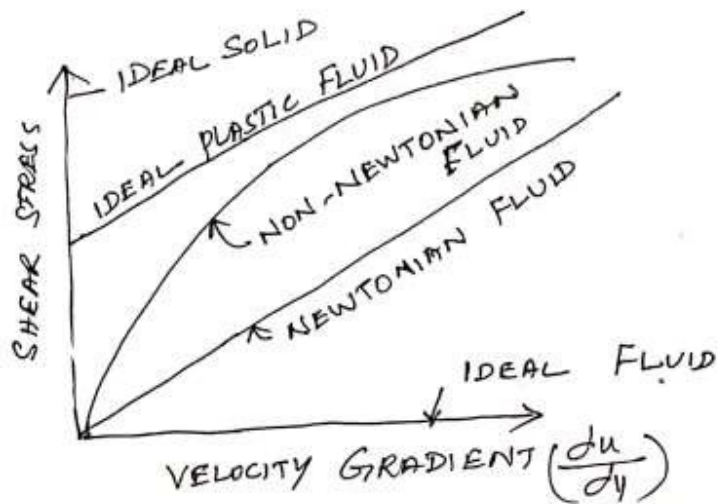
$$\nu = \left[\frac{L^2}{T}\right]$$

Unt: Stoke
Centi stoke

$$\nu_{water} = 1 \ c.St$$
$$= 1 \times 10^{-6} \ m^2/s$$

$$\nu_{air} = 15 c.St$$
$$= 15 \times 10^{-6} m^2/s$$

Types of FLUID:

1. Ideal Fluid   2. Real fluid   3. Newtonian fluid

4. Non- Newtonian fluid   5. Ideal plastic fluid.

1. Ideal Fluid:
          A fluid, which is uncompressible and is having no viscosity, is known as an ideal fluid. Ideal fluid is only an imaginary fluid as all the fluids, which exist, have some viscosity.

2. Real Fluid:
          A fluid, which possesses viscosity is. known as real fluid all the fluids in actual Practice are real fluids

3. Newtonian Fluids:

A real fluid in which the shear stress is directly proportional to the rate of Shear Strain or velocity gradient) is known as Newtonian fluid. obeys Newton law of viscosity.

4. Non-Newtonian fluid

A real fluid, in which the Shear Stress is not proportional to the rate of shear strain known as Non Newtonian fluid

5. Ideal plastic Fluid

A fluid, in which shear stress is more than the yield value and shear stress is proportional to the rate of shear strain (velocity gradient) known as ideal plastic fluid.