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Class : 11th Physics
Chapter- 10 : Mechanical Properties of Fluids

Mechanical Properties of Fluids

Venturimeter
Device used to measure the rate of flow of liquid. Volume of liquid flowing per second.

$$Q = a_1 a_2 \sqrt{\frac{2h\rho_m g}{\rho\left(a_1^2 - a_2^2\right)}}$$

Toricell's Low
Velocity of efflux of liquid through an orifice

$$V = \sqrt{2gh}$$

Applications
- Lift of an aircraft wing.
- Sprayer or atomizer
- Blowing off the roofs during windstorm.

Stroke's law $F = 6\eta vr$

Opposing force between different layers of fluid in relative motion

Viscous drag $F = -\eta A \frac{dv}{dx}$

η = coefficient of viscosity

For an incompressible non-viscous streamline, irrotational flow of fluid,

$$P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$$

Streamline : In liquid flow when the Velocity is less than critical velocity, each particle of the liquid passing through a point travels along the same path and same velocity as the preceding particles.

Turbulent : When velocity of liquid flow is greater than critical velocity and particles follow zig-zag path.

- Bernoulli's principal
- Viscosity
- Flow of fluids
- Formulae
- Laws of Fluids

- Surface tension $S = \frac{F}{l}$
- Surface Energy $= \frac{\text{work done in increasing area}}{\text{increase in surface area}} = \frac{W}{\Delta A}$
- Capillary rise or fall, $h = \frac{2S\cos\theta}{r\rho g}$
- Excess Pressure inside a drop (liquid)

$$P_{excess} = \frac{2S}{R}$$

- Excess Pressure inside a bubble (soap)

$$P_{excess} = \frac{4S}{R}$$

That can flow like liquids and gases

Equation of continuity
$m = a_1 v_1 \rho_1 = a_2 v_2 \rho_2$
for an incompressible liquid, $\rho_1 = \rho_2$ then $a_1 v_1 = a_2 v_2$
or $av = \text{constant}$

Pascal's law : The pressure exerted at any point on an enclosed liquid is transmitted equally in all direction.

$$\text{Pressure}(P) = \frac{\text{thrust}(F)}{\text{area}(A)} = \lim_{\Delta A \to 0} \frac{\Delta F}{\Delta A} = \frac{\beta F}{dA}$$

Pressure exerted by a liquid column of height h, $(p) = h\rho g$

Atmospheric Pressure(Pa)
Pressure (atm) exerted by the atmosphere. At sea level, 1 atm = pressure exerted by 0.76m of Hg = hpg = 0.76 × 13.6 × 10 × 9.8 = 1.013 × 10 Nm2 = 101.3kPa

Absolute Pressure(P)
Total or actual pressure at a point. Absolute pressure = atmospheric pressure + gauge pressure

Gauge Pressure(Pg)
Difference between the absolute pressure at a point and the atmospheric pressure.
Pg = absolute pressure (P) – atmospheric pressure (Pa)