

PROPERTIES OF FLUID

Fluid Mechanics

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1-DENSITY (ρ):

Mass per unit volume
(density) $\rho = \frac{m}{v}$

- Compactness of a substance
- More mass / dense material

DENSITY

$$\rho = \frac{m}{v} = \frac{\text{kg}}{\text{m}^3} \quad (\text{S.I Unit})$$

$$\rho = \frac{m}{v} = \frac{\text{g}}{\text{cm}^3} \text{ or } \frac{\text{g}}{\text{cc}} \quad (\text{C.G.S Unit})$$

Units of density

$$\rho_{water} = 1000 \frac{\text{kg}}{\text{m}^3} \quad (4^{\circ} \text{C})$$

$$\rho_{air} = 1.225 \frac{\text{kg}}{\text{m}^3} \quad (15^{\circ} \text{C})$$

Density of water

$$\gamma = \frac{W}{v} = \frac{N}{m^3} \quad (\text{S.I Unit})$$

$$\gamma = \frac{m \cdot g}{v} \quad \text{or} \quad \rho \cdot g$$

Weight density (γ)

$$S.G = \frac{\text{density of fluid}}{\text{density of standard fluid}} \quad (\text{STP})$$

$$(S.G)_L = \frac{\text{density of liquid}}{\text{density of water at } 4^\circ\text{C}}$$

$$(S.G)_g = \frac{\text{density of gas}}{\text{density of air at stp} \quad 1.21 \frac{\text{kg}}{\text{m}^3}}$$

Specific gravity or relative density

- *it is the property of fluid surface*
- *It occurs at fluid interface*
- *All the liquid surfaces are under the influence of net downward cohesive force*
- *To overcome this downward tendency the molecules develop strong cohesive force with each other so the whole liquid surface appear like a thin film in tension which can resist a small load*

Surface tension

- *Mathematically surface tension is a tensile force which acts normal to the line of interface between two fluids*
- $\sigma = F / L \quad (N/m)$
- *It occurs at fluid interface*
- *All the liquid surfaces are under the influence of net downward cohesive force*
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Surface tension

- *Adhesive force :*

it is a surface force acting between two different surfaces, it occurs at the solid – liquid interface where these two surfaces are in contact

- *Cohesive force:*

Force acting between molecules of same medium

- *The magnitude of these forces is observed in liquids , in gases these forces are negligible*

Adhesive / cohesive forces

- **WETTING LIQUID** *If the adhesive force is greater than the cohesive force*
- **NON WETTING LIQUID** *If cohesive force is greater than adhesive force*
- *Mercury-glass is non wetting*
- *Generally denser fluids have higher adhesive force*

Wetting and non wetting liquids

- *Wetting liquid*
(Contact angle $\Theta < 90$)
- *Non wetting liquid*
(contact angle $\Theta > 90$)

Adhesive / cohesive forces

It is defined as the phenomenon of the rise or fall of liquid surface in small tube relative to adjacent level of liquid when the tube is held vertical

- *Capillary rise (wetting)*
- *Capillary depression (non-wetting)*

- $$h = \frac{4 \sigma \cos \theta}{\rho g d}$$

Capilarity

- *Resistance to flow of fluid*
- *cohesive force*
- *Inter molecular momentum transfer*

viscosity
