

## 1. Density

Density is defined as the mass occupied by the fluid per unit volume at a given state of fluid. Density is also known as **Mass density**. It is expressed by **rho( $\rho$ )**. Mathematically we may write it as;

$$\rho = \frac{\text{Mass of fluid}}{\text{Volume of fluid}} = m/V$$

**Units of Density :-** Density has a Kg/m<sup>3</sup> unit in S.I system and gm/cm<sup>3</sup> unit in CGS System.

Density of water is **1000kg/m<sup>3</sup> at 1 atm & 4.4°C** & Density of mercury **13600kg/m<sup>3</sup> at 1atm & 25°C**.

The variation in the density of water with the change in temperature and pressure is so small or negligible that's why generally for the practical purpose it is considered as constant.





## 2. Specific Volume

It is defined as the ratio of **Volume to mass of fluid** or reciprocal of mass density is known as specific volume. It is useful for gaseous fluids that is compressible fluid. It is denoted by  $v$ .

$$v = 1/\rho = V/m = \text{Volume of fluid/mass of fluid}$$

**Unit of Specific volume:-** It has a unit of  $\text{m}^3/\text{kg}$  in SI system.

## 3. Specific weight or weight density

Specific weight of a fluid is defined as the ratio of amount of weight to volume of fluid in the gravitational field. It is denoted by **small w**.

$$w = \text{Weight of fluid/Volume of fluid} = \text{mass of fluid/volume of fluid}$$

$$w = \rho g$$

It may change from one location to another location because **it depends upon the acceleration due to gravity**.

**Unit of specific weight :-** It has a unit  $\text{N}/\text{m}^3$  in SI system.

Let's consider there is a block in which water present. It has density  $1000\text{kg}/\text{m}^3$  then the specific weight of water will be  $1000 \times 0.81 = 0810\text{N}/\text{m}^3$ .



## 4. Specific Gravity

Specific gravity is defined as the ratio of **density or specific weight of fluid to density or specific weight of standard fluid** is known as specific gravity or relative density. It is denoted by Letter **S**.

$$S = \rho_f / \rho_w$$

It is dimensionless quantity. **for liquid**, water is considered as the standard fluid and **for gases**, air is considered as the standard fluid. density of air is **1.23kg/m<sup>3</sup> at 1atm & 25°C**.

Specific gravity,  $S_w$ , of water is **1**

If some fluid has a **Specific gravity less than standard fluid** then that fluid will be **lighter or less dense as compared to standard fluid** and It will **float** over the standard fluid and If fluid has a **specific gravity has more than standard fluid** then that fluid will be **heavier or high dense** and it will **sink down** in the standard fluid.

## 5. Viscosity

It is defined as the property of fluid which offers the **resistance to flow** the fluid.





## Effect of Temperature on viscosity of fluid.

As the temperature of the liquid increases, viscosity of liquid decreases because the molecules in liquid are closely packed with each other and as temperature increases this closely packed structure breaks and viscosity decreases whereas in gases as temperature increases viscosity of fluid increases because in gases viscosity is a result of molecular momentum transfer. As the temperature increases, molecular activity increases in gases and so viscosity increases.

## Effect of pressure on viscosity of liquid

Viscosity is independent of pressure at low to moderate pressure but viscosity of liquid increases at high pressure due to increase in density.



## 6. Kinematic viscosity

kinematic viscosity is defined as the ratio of dynamic viscosity to the density of the fluid. It is denoted by the **small  $\nu$** .

$$\nu = \mu/\rho$$

Kinematic viscosity has a **SI unit is  $\text{m}^2/\text{sec}$ , MKS unit is  $\text{m}^2/\text{sec}$ , CGS unit is  $\text{cm}^2/\text{sec}$  or stoke**

## 7. Cohesive force

Cohesion is the property of the liquid because of which the liquid's molecules are attracted towards each other and **cohesive force** is an **intermolecular force of attraction** between two molecules of the **same substance**.

## 8. Adhesive force

Adhesion is that property of fluid which enables it to adhere to another body in contact. Adhesive force is an **intermolecular force of attraction** between two molecules of **different substance**.



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## 9. Wetting fluid and non wetting fluid

**Adhesive forces** are **stronger than** cohesion forces in the case of wetting fluid. So liquid will try to spread over the solid surface & **In non wetting fluids, Cohesive forces** are stronger than adhesive forces that is why liquid will try to contract (gather into droplet) itself.

## 10. Capillarity

The phenomenon of rise or fall of liquid in a very small diameter glass tube is called capillary tube. It is due to both adhesion and cohesion. The rise of liquid surface in capillary tube is called capillary and the fall of liquid surface is known as capillary depression. It is the application of surface tension (capillarity effect).

## 11. Surface tension

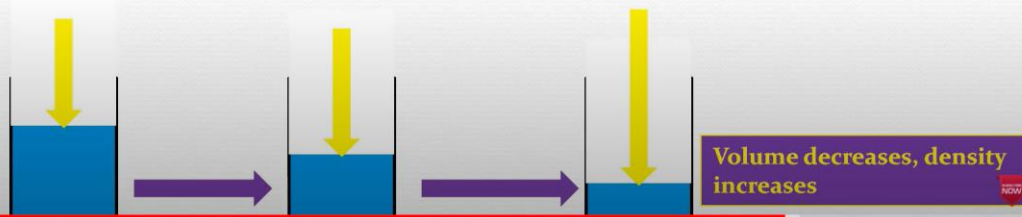
Surface tension is defined as the force required to maintain the unit length of the surface of a liquid that causes it to behave like an elastic sheet. It occurs at the interface of a liquid-free surface or at the interface of the two liquid surface. Surface tension forces are generally negligible in comparison with the pressure and gravitational force but it becomes quite significant when there is free surface and boundary dimensions are small.

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## 12. Compressibility

It is the property of fluid which is defined as the ability of fluid to change its volume under pressure. It contracts when pressure is applied and expands to its original volume when pressure removes. It is basically due to **change in mass density due to external pressure**. This change in mass density **in liquid is quite small** so neglected that's why liquid is considered as incompressible for practical purposes on the other hand the change in mass density is considered in gases and that's why it is compressible. Compressibility of fluid can be defined as the reciprocal of the bulk modulus of elasticity,  $K$ .

$$\beta = 1/K$$





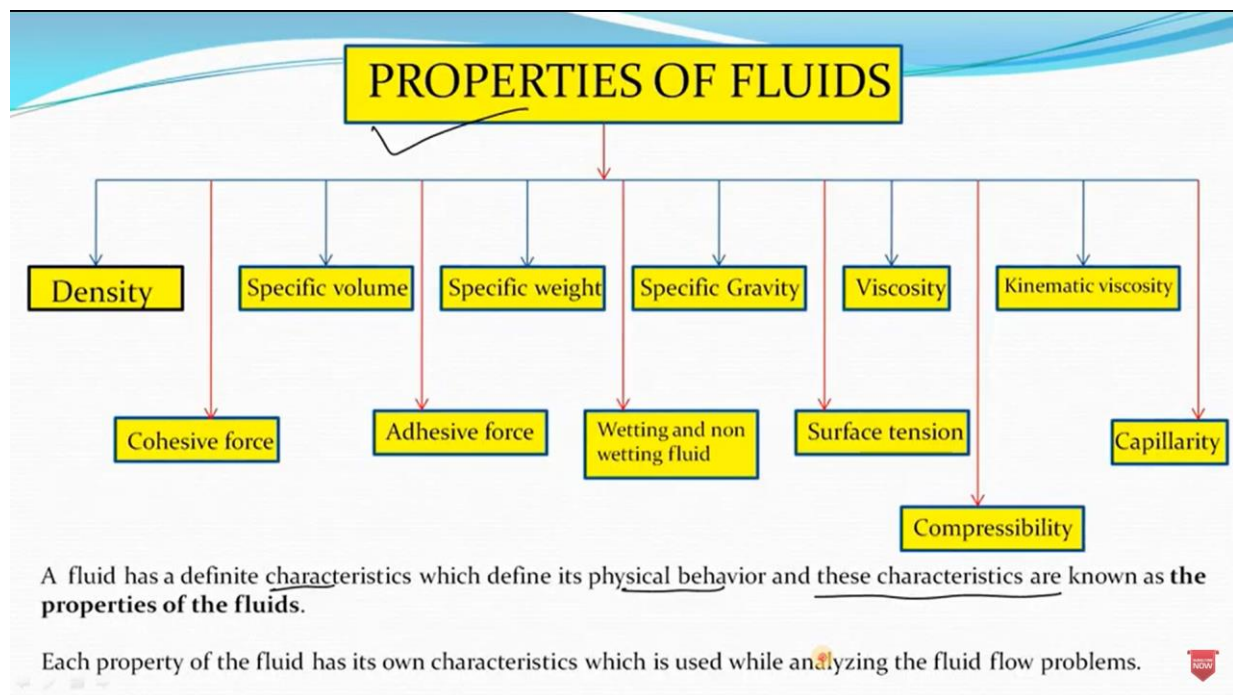
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## 13. Vapor pressure

Vapor pressure is the pressure exerts by the vapor molecules in the free surface in the closed container. as the temperature increase it is also increases.

## 14. Cavitation

It is the property of fluid when the formation of vapor bubbles start in a flowing fluid such that in a Pump, in a particular region where the pressure of the liquid is less than its vapor pressure and then sudden collapsing of these bubbles in the high pressure region harms the inside material of the system. that's why sometimes you will listen the annoying sounds from the system i.e pump while operation.



<https://www.youtube.com/watch?v=s1-wM4E9Ef8>