

* Viscosity & their measurements :-

(6)

The force of friction which one layer of the liquid exerts on another layer of the liquid is called viscosity.

Let us suppose the velocity of three successive layers is $(u+du)$, u and $(u-du)$ respectively. The distance between two adjacent layers is dz . Thus the velocity of the layer at the distance dz is changed by a value of du .

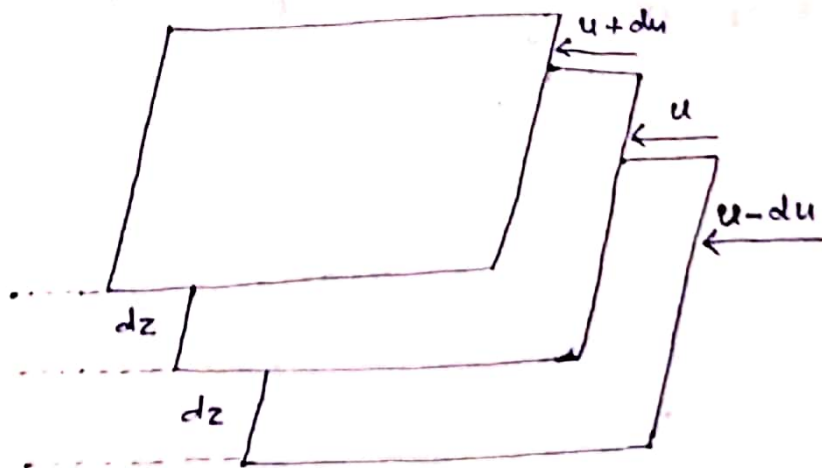
The velocity gradient is given by $\frac{du}{dz}$. ($du = \text{m/sec}$, $dz = \text{meter}$, $\frac{du}{dz} = \text{sec}^{-1}$).

A force is required to maintain the flow of layers. This force (f) is proportional to the area (A) of contact of layers and velocity gradient $\left(\frac{du}{dz}\right)$.

$$\therefore f \propto A \cdot \frac{du}{dz}$$

$$\text{or } f = \eta A \cdot \frac{du}{dz}$$

Where, η = proportionality constant called Coefficient of viscosity.



When, $\frac{dy}{dz} = 1 \text{ sec}^{-1}$

$$A = 1 \text{ m}^2$$

then $f = \eta$

Thus, Coefficient of viscosity may be defined as the force when velocity gradient is unity and the area of contact is unit area.

Unit of Viscosity :-

In CGS system :-

$$f = \eta A \frac{dy}{dz}$$

$$\text{or } \eta = \frac{f \times dz}{A \cdot dy} = \frac{\text{dynes} \times \text{cm}}{\text{cm}^2 \times \text{cm sec}^{-1}} = \text{dynes cm}^{-2} \text{ sec.}$$

The quantity dynes $\text{cm}^{-2} \text{ sec}$ is called One poise.

In SI Unit :-

$$\eta = \frac{f \times dz}{A \cdot dy} = \frac{\text{N m}}{\text{m}^2 \times \text{m sec}^{-1}} = \text{N m}^{-2} \text{ sec} = \text{Pa.s.}$$

Common units of viscosity are centipoise and millipoise.