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B. Sc (part-I) Hons

Viscosity and Co-efficient of viscosity

Viscosity:- When a liquid flows slowly and steadily over a fixed horizontal surface, the layer in contact with the fixed surface is stationary and the velocity of layers increases with distance from the fixed surface. Each layer finds to accelerate the lower layer to bring it to own velocity and tends to retard the upper layer and slow it down velocity. In other words layer of the liquid tend to destroy their relative motion.

This property of a liquid by virtue of which it tends to destroy the relative motion between its layer is called viscosity and the force that tends to destroy the relative motion is called the viscous force or the internal frictional force.

Co-efficient of viscosity:- According to Newton the viscous force acting tangentially to a layer is proportional to

(i) Area of the layer, A

(ii) velocity of the layer, $(-V)$ the negative sign indicates that the force acts in opposite direction.

(iii) $\frac{1}{x}$. where x is the distance of the layer from the fixed surface.

Thus

$$F \propto -\frac{AV}{x}$$

$$\text{or } F = -\eta \frac{AV}{x}$$

where η is the constant depending upon the nature of the liquid. It is called the co-efficient of the viscocity of the liquid.

The quantity $\frac{V}{x}$ is the rate of increase of velocity with distance from the fixed surface and by calculus it is $\frac{dv}{dx}$

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

putting $A = 1m^2$, $\frac{dv}{dx} = 1 s^{-1}$

we have $F = \eta$

Thus co-efficient of viscosity of a liquid may be defined as the tangential force per unit area required to maintain unit velocity gradient.