SURFACE TENSION

Inter-Molecular force

The forces between the molecules of the substances are called intermolecular forces.

Types of intermolecular forces

(i) **Force of adhesion or adhesive force**: If is the force of attraction acting between the molecules of different substances.

(ii) **Force of cohesion or cohesive force**. : The force of attraction amongst the molecules of the same substance.

1. SURFACE TENSION : Surface tension is the molecule property of free liquid surfaces, by virtue of which it behaves like a stretched elastic membrane with a tendency to contact so as to occupy minimum surface area.

2. To Measure surface tension:

Surface tension of a liquid can be measured as the force per unit length on an imaginary line drawn on the liquid surface, which acts perpendicular to the line on its either side at every point and parallel to the liquid the surface.

$$S = \frac{F}{L} \quad units : Nm^{-1}$$

Dimensional formula ML^0T^{-2}

3. Surface Energy:

The potential energy per unit area of the surface film is called surface energy

Surface Energy =

$$\frac{\text{Work done in increa sing surface area}}{\text{Increase in surface area}}$$

4. Surface tension of a liquid is numerically equal to its surface energy.

5. Capillary tube: A tube of very fine bore.

6. Capillarity: Rise or fall of a liquid in a tube of very fine bore is called capillarity.

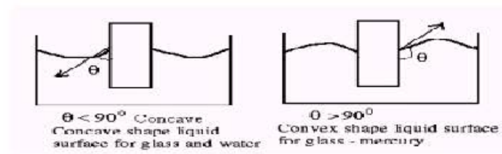
(i) The fine pores of a blotting paper act like capillary tubes. Ink rises in them leaving the paper dray

(ii) A towel soaks water on account of capillarity action

(iii) Oil rises in the long narrow spaces between the threads of a wick, because they acts as fine capillaries.

7. Angle of contact:

The angle between the tangent to the liquid surface and tangent to the solid surface at point of contact inside the liquid in know as angle of contact.



(i) depends upon the nature of the liquid and solid in contact

(ii) depends upon the medium which exists above the free surface of liquid.

(iii) Is independent of the inclination of the solid to liquid surface.

(iv) Is fixed for a given pair of solid and liquid ad surrounding medium.

Important Points:

1. The angle of contact changes with the pair of solid and liquid
2. For pure water and glass angle of contact as zero.
3. Angle of contact increases on increasing temperature.
4. Angle of contact changes on adding impurities to liquids
5. If angle of contact is less the 90^0
   a. The liquid wets the solid surface
   b. The liquid spreads on solid surface
   c. There is a capillary rise
   d. The liquid meniscus is concave.
6. If the angle of contact in greater then 90^0.
   a. The liquid does not wet the solid surface
   b.The liquid does not spread on solid surface
   c. There is a capillary dip.
   d. The liquid meniscus is convex up.
7. **IMPORTANT FORMULAE**
   Formula to determine surface tension by capillarity method.

$$S = \frac{hrdg}{2\cos\theta}$$

h : capillary height.

r : radius of bore
d : density of liquid
θ : Angle of contact.

8. **Formation of big drop by a number of smaller drops :** when n small drops each of radius r are combined to form a big drop of radius R, then surface area decreases. Therefore energy releases.
Energy evolved in merging :
$$W = 4\pi r^2 S\left[n - n^{2/3}\right]$$

9. **Splitting of a bigger drop in to small drops :** When a big drop of radius r splits in to n small drop of same radius then surface area increases therefore energy absorbs.
Work done $W = 4\pi r^2 S\left[n - n^{2/3}\right]$.

10. Excess pressure inside a soap bubble
$P_i - P_0 = \Delta P = \dfrac{4S}{r}$, where 'r' is the radius of the bubble

11. Excess pressure inside a liquid drop
$P_i - P_0 = \Delta P = \dfrac{2S}{r}$ where 'r' is the radius of the drop

12. As temperature increases surface tension decreases exept in the case of molten copper and cadmium