Surface Tension

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Introduction :

• **Surface tension** is the elastic tendency of a fluid surface which makes it acquire the least surface area possible. Surface tension allows insects (e.g. water striders), usually denser than water, to float and stride on a water surface.

• At liquid–air interfaces, surface tension results from the greater attraction of liquid molecules to each other (due to cohesion) than to the molecules in the air (due to adhesion)

Surface tension has the dimension of force per unit length, or of energy per unit area. The two are equivalent, but when referring to energy per unit of area, it is common to use the term surface energy, which is a more general term in the sense that it applies also to solids.

• In materials science, surface tension is used for either surface stress or surface free energy.

- (a) Fig Water beading On a leaf
- (b) Fig Water strider walking on the water surface

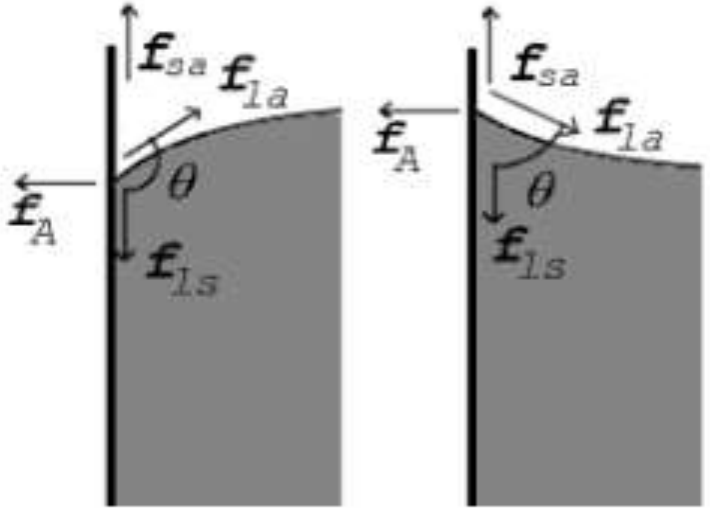
• **Surface Tension:**

• Free surface of a liquid has tendency to contract in surface area is called **surface tension.**

• **SI unit** of Surface tension: **N/m. or (J/m²).**

• Its Dimension is $[M^0L^1T^{-2}]$.

• **Angle of Contact** : The angle measured from the side of the liquid, between the tangent to the solid surface inside the liquid and tangent to the free liquid surface at the point of contact between solid and liquid surfaces



Capillary Rise Method:

- Total upward force = R cos θ circumference of the tube
- (i.e) F = 2πr R cos θ or F = 2πr T cos θ This upward force

is responsible for the capillary rise. As the water column is in equilibrium, this force acting upwards is equal to weight of the water column acting downwards.

- F = w.
- T = hgrρ/2cosΘ
- h = 2TCosΘ/ρgr

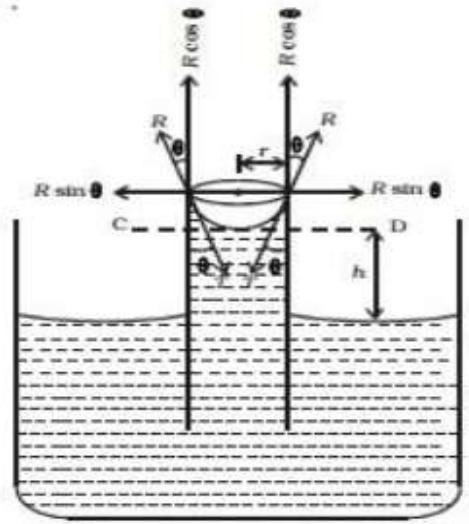


Fig. Surface tension by capillary rise method

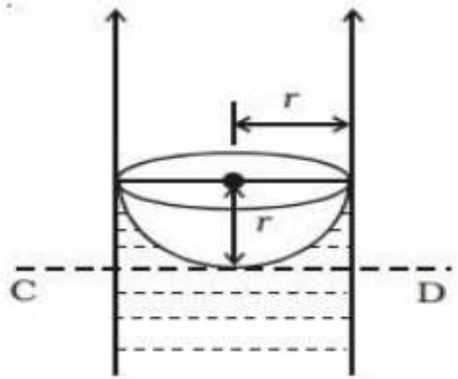


Fig. Liquid meniscus

- The radius of the capillary tube is determined using the travelling microscope. If ρ is the density of water then the surface tension of water is given by
- $T = hr\rho g / 2\cos\theta$, $\theta = 0^{\circ}$, $\cos 0 = 1$.
- $T = hr\rho g / 2$
- where g is the acceleration due to gravity.

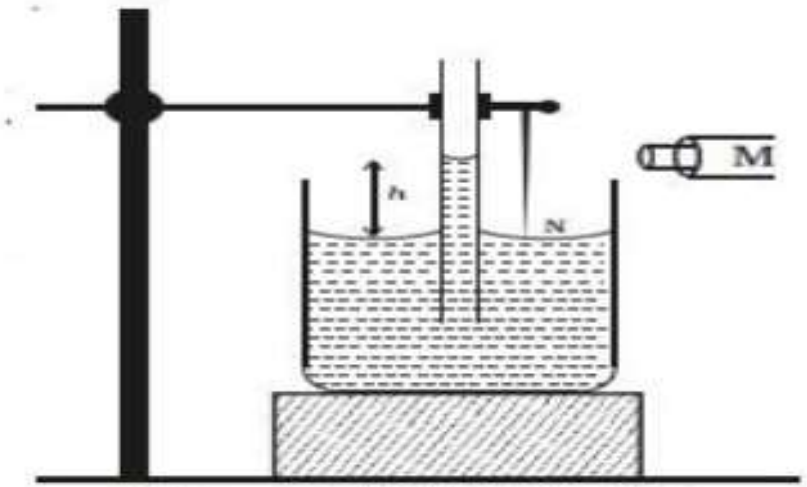


Fig. Surface tension by capillary rise method

• Application of surface tension:

• Surface tension of soap solution is less, it can spread over large areas and wash clothes more effectively, since the dirt particles stick to the soap molecules.

• In soldering, addition of flux reduces the surface tension of molten tin. Hence, it spreads.

• Antiseptics like dettol have low surface tension, so that they spread faster.

• Surface tension prevents water from passing through the pores of an umbrella.

• A duck is able to float on water as its feathers secrete oil that lowers the surface tension of water.