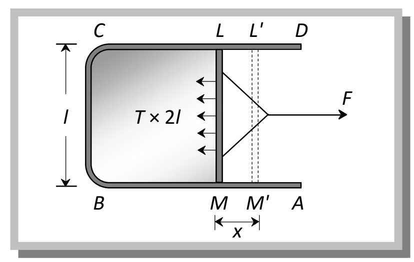
Surface Energy.

The molecules on the liquid surface experience net downward force. So to bring a molecule from the interior of the liquid to the free surface, some work is required to be done against the intermolecular force of attraction, which will be stored as potential energy of the molecule on the surface. The potential energy of surface molecules per unit area of the surface is called surface energy

Unit: Joule/m2 (S.I.) erg/cm2 (C.G.S.)

Dimension: [MT–2]

If a rectangular wire frame ABCD, equipped with a sliding wire LM dipped in soap solution, a film is formed over the frame. Due to the surface tension, the film will have a tendency to shrink and thereby, the sliding wire LM will be pulled in inward direction. However, the sliding wire can be held in this position under a force F, which is equal and opposite to the force acting on the sliding wire LM all along its length due to surface tension in the soap film.



If T is the force due to surface tension per unit length, then F = T × 2l

Here, l is length of the sliding wire LM. The length of the sliding wire has been taken as 2l for the reason that the film has got two free surfaces.

Suppose that the sliding wire LM is moved through a small distance x, so as to take the position $L'M'$. In this process, area of the film increases by 2l × x (on the two sides) and to do so, the work done is given by

$$W = F \times x = (T \times 2l) \times x = T \times (2lx) = T \times \Delta A$$

$\therefore$ $W = T \times \Delta A$ [ΔA = Total increase in area of the film from both the sides]

If temperature of the film remains constant in this process, this work done is stored in the film as its surface energy.

From the above expression $T = \frac{W}{\Delta A}$ or T = W [If ΔA = 1]

i.e. surface tension may be defined as the amount of work done in increasing the area of the liquid surface by unity against the force of surface tension at constant temperature.