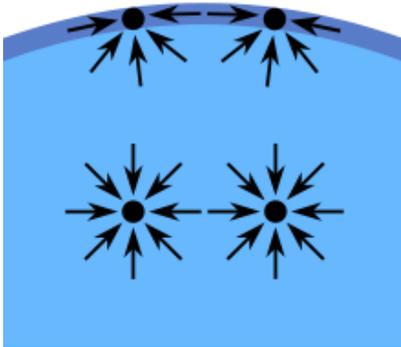


Question:

What is surface tension? What are its SI units? Explain the factors, which influence the magnitude of the surface tension.

Answer:



Surface tension is a contractive tendency of the surface of a liquid that allows it to resist an external force.

On the left you can see the diagram of the forces on molecules of a liquid

The cohesive forces among liquid molecules are responsible for the phenomenon of surface tension. In the bulk of the liquid, each molecule is pulled equally in every direction by neighboring liquid molecules, resulting in a net force of zero.

The molecules at the surface do not have other molecules on all sides of them and therefore are pulled inwards.

This creates some internal pressure and forces liquid surfaces to contract to the minimal area.

As a result of surface area minimization, a surface will assume the smoothest shape it can.

So,

- Surface tension, represented by the symbol γ is defined as the force along a line of unit length, where the force is parallel to the surface but perpendicular to the line. One way to picture this is to imagine a flat soap film bounded on one side by a taut thread of length, L . The thread will be pulled toward the interior of the film by a force equal to $2\gamma L$ (the factor of 2 is because the soap film has two sides, hence two surfaces).

Surface tension is therefore measured in forces per unit length. Its SI unit is newton per meter but the cgs unit of dyne per cm is also used. One dyn/cm corresponds to 0.001 N/m.

- An equivalent definition, one that is useful in thermodynamics, is work done per unit area. As such, in order to increase the surface area of a mass of liquid by an amount, δA , a quantity of work, $\gamma\delta A$, is needed. This work is stored as potential energy.

Consequently surface tension can be also measured in SI system as joules per square meter and in the cgs system as ergs per cm^2 .

Since mechanical systems try to find a state of minimum potential energy, a free droplet of liquid naturally assumes a spherical shape, which has the minimum surface area for a given volume.