Surface Tensions on Different Droplets

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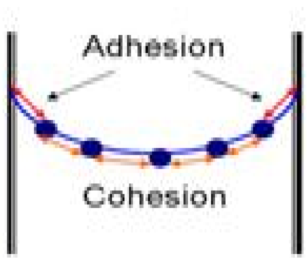
Abstract- *Pressure force in a hallow bubble is more as compared to the pressure force in the droplet and liquid jet and even the adhesive if more as compared to cohesion.*

Keywords- Droplet, Membrane, Molecules, Pressure force, Tensile force,

I. INTRODUCTION

It is defined as the tensile force acting on the surface of a liquid in contact with a gas or on the surface between two immiscible liquids such that the contact surface behaves like a membrane under tension. It MKS unit is kg /m and in SI units as N/m.

Figure: -Surface tension



Adhesion>Cosesion
Figure: - Adhesion and cohesion

Due to molecular attraction, liquids possess certain properties such as,

(a) Cohesion,
(b) Adhesion.

Cohesion:

It is due to the inter-molecular attraction between molecules of the same liquid. That means it is a tendency of the liquid to remain as one assemblage of particles.

Adhesive:

It means the attraction between the molecules of a liquid and the molecules of a solid boundary surface in contact with the liquid.

The property of cohesion enables a liquid to resist tensile stress, while adhesive enables it to stick to another body.

Surface tension:

Surface tension is due to cohesion between liquid particles at the surface, whereas capillarity is due to both cohesion and adhesion.

Surface Tension on Liquid Droplet:

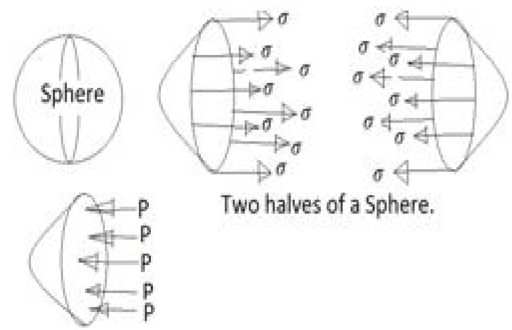


Figure: - Forces on droplet.

Consider a small spherical droplet of a liquid of radius ‘r’. On the entire surface of the droplet, the tensile force due to surface tension will be acting.

Let σ= Surface tension of yhe liquid,
P = Pressure intensity inside then droplet,
d = Diameter of droplet.

Let the droplet is cut into two halves. The forces acting on one half will be,

(a) Tensile force due to surface tension acting around the circumference of the cut portion as shown in figure.
Tensile force = $\sigma \times$ Circumference
Tensile force = $\sigma \times \pi d$----- - (1)
(b) Pressure force = p x $\frac{\pi}{4}$ x d^2---- (2)

Equating equation (1) and (2), we get

$$\sigma \times \pi d = p \times \frac{\pi}{4} \times d^2$$

$$\therefore p = \frac{4\sigma}{d}$$

The above equation shows that with the decrease of diameter of the droplet. Pressure intensity inside the droplet increases.

Surface Tension on a Hollow Bubble:

A hollow bubble like a soap bubble in air has two surfaces in contact with air, one inside and other outside. Thus two surfaces are subjected to surface tension.

In such cases,

$P \times \frac{\pi}{4} \times d^2 = 2 \times \sigma \times \pi d$

$P = \frac{8\sigma}{d}$

Surface Tension on a liquid jet:

A hollow bubble like a soap bubble in air has two surfaces in contact with air, one inside and other outside. Thus two surfaces are subjected to surface tension.

In such cases,

$P \times \frac{\pi}{4} \times d^2 = 2 \times \sigma \times \pi d$

$P = \frac{8\sigma}{d}$

Consider a liquid jet of diameter'd' ad length 'L' as shown in figure,

Let P = Pressure intensity inside the liquid jet above the outside pressure,

σ = Surface tension of the liquid.

Consider the equilibrium of the semi jet,

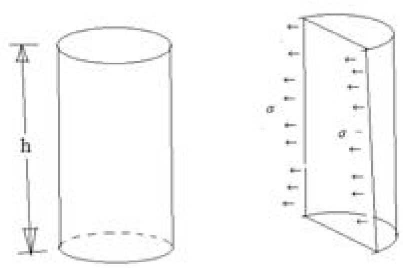


Figure: - Forces on liquid jet

We have

Force due to pressure = P x area of semi jet = P x L x d

Force due to surface tension = σ x 2L

Equating the forces, we have

P x L x d = σ x 2L

$P = \frac{\sigma \times 2L}{l \times d} = \frac{2\sigma}{d}$

III. CONCLUSION

It is observed that the pressure force in hallow bubble is four times larger than the pressure force of liquid jet and two times than pressure force in drop let.

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