Al-Mustaqbal University
College of Engineering and Engineering Technologies
Department of Chemical Engineering and Petroleum Industries

EXPERIMENTS(3)

SECOND CLASS

1 ND SEMESTER

PHYSICAL CHEMISTRY

LABORATORY

By

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Experiment No. (3): ***Determination of the Surface Tension for Liquids***

Object of Experiment:

Determine the surface tension of liquid and find the effect of the same parameter on it.

Theory:

The molecules at the surface of a liquid are attracted into the body of the liquid because the attraction of the underlying molecules is greater than the attraction by the vapor molecules on the other side of the surface. This in ward attraction causes the surface to contract if it can and gives rise to a force in the plane of the surface. Surface tension is responsible for the formation of spherical droplets, the rise of water in a capillary and the movement of a liquid through a porous solid. Solids also have surface tension, but it is harder to measure them. Crystals tend to form with the lowest surface tensions. The surface tension γ of a liquid is the force per unit length on the surface that opposes the expansion of the surface area.

The surface tension is:

$$\gamma = \frac{F}{2\,L}$$

1- Capillary tube method:

When the walls of tube wet with liquid, the liquid will rise inside, this is happening as are suit of an attempt to shrink the surface area as small as possible, the liquid is continuously rising until the equilibrium between the surface tension force and the gravity force is attended.

Procedure:

A- Two tubes used with different diameters (a, b)

1. Prove the tube (a) on to the ruler.
2. Fill small beaker with distilled water and immerse the ruler with tube (a) vertically.
3. Record high of the liquid in the tube.
4. Determined the surface tension of liquid by the following law:

$$\gamma = \frac{\rho\, h\, g\, r}{2 \cos \theta}$$

Where:

γ = Surface tension, g/sec.
ρ = Density of the liquid, g/cm^3.
h = Height of the liquid in the tube, cm.
g = Accelerate the ground, cm/sec^2.
r = Radius, cm.
θ = Angle adhesion.

B- Two tubes used with different diameter (a, b)

1- Prove the tube (a, b) on to ruler.
2- Fill the beaker with the liquid to be measuring surface tension.
3- Immerse the ruler with the tube vertically.
4- Record height of the liquid in the tubes.
5- Pour the liquid from the beaker and dry the tubes by air and then fill the beaker with distilled water and record its height.

6- Determined the surface tension of liquid by the following equation:

$$\frac{\gamma_1}{\gamma_2} = \frac{\rho_1 .\Delta h_{liquid}}{\rho_2 .\Delta h_{water}}$$

Where:

γ_1 = Surface tension of liquid, g/sec^2.

ρ_1= Density of liquid, g/cm^3.

Δh = Difference in height of liquid in two tubes, cm.

ρ_2 = Density of water, g/cm^3.

2- The Ring – Detachment Method.

The surface tension can be determined quickly and with sufficient accuracy by measuring the force required to detach a horizontal ring of platinum wire from the surface of the liquid.

Procedure:

1 -Fix the surface tension meter at zero in the air.

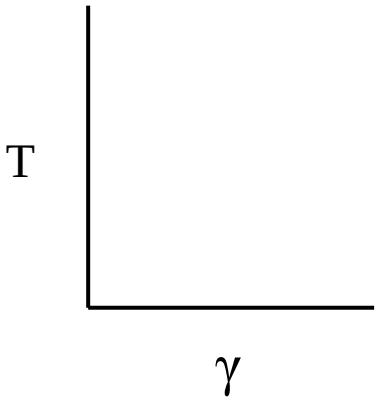
2- Immerse the ring in the liquid by raising the base animation up.

4- Move the base slowly notes the new surface between the ring and the surface of the liquid observed reading device.

5-Record the highest reading of the device after it separated from surface of the liquid ring which is the surface tension of the liquid.

6- Record the temperature of the liquid and the re-read the surface tension of the liquid at different temperatures (35, 45, and 55) ^{o}C.

7 – What the relation between surface tension with temperature.



Calculate :-

- Surface Tension

No.	γ (N/m)	h (m)	r (m)
1.		0.5 mm	0.1 cm
2.		0.8 mm	0.2 cm
3.		0.2 mm	0.25 cm

Discussion:

1. What is the concept of surface tension and how can it be defined?
2. . How can the concept of surface tension explain phenomena such as the formation of water droplets or the ability of some insects to walk on the surface of water?
3. How can temperature affect the surface tension of liquids?
4. Is there a difference in surface tension between different liquids? If so, what are the reasons?