International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 7, Issue 1 (January 2018), PP. 64-66

Surface And Interfacial Tension For Various Liquids

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Abstract: Interfacial Tension is a property of the interface between two immiscible phases. When the phases are both liquid, it is termed interfacial tension; when one of the phases is air, it is termed surface tension. The surface tension and interfacial tension are important parameters which should be measured in the oil and gas industry. There are several methods available for the measurement of surface and interfacial tension, one such tensiometer is the du Noüy tensiometer. This method utilizes the interaction of a platinum ring with the surface of the liquid. The ring is submerged below the interface by moving the stage where liquid container is placed. After immersion, the stage is gradually decreased and the ring pulls up the meniscus of the liquid. Eventually the meniscus would tear from the ring. Prior to this event, the volume (and thus the force exerted) of the meniscus passes through the maximum value and begins to drop before the actual tearing event.

Keywords: Surface Tension, Interfacial Tension, du Noüy Tensiometer, Meniscus

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Date of Submission: 12 -01-2018 Date of acceptance: 31-01-2018

I. INTRODUCTION

A liquid exists as a liquid because of the attractive forces between molecules. These are called intermolecular forces, or van der Waals' forces. Molecules within the liquid are surrounded by other molecules and are attracted in every direction with equal force. Molecules exposed to the surface are unstable because the attractive forces are not equal and they are drawn away from the surface. As a result the liquid tends to contract the surface area until equilibrium is reached. That happens when the surface reaches its minimum. These intermolecular forces which contract the surface are called Surface Tension.

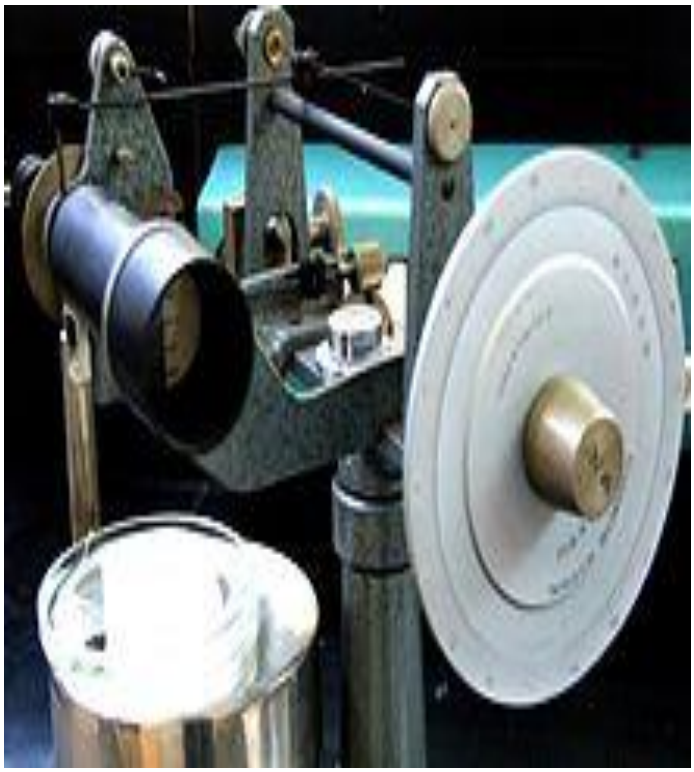
There are many conditions that affect the Surface Tension (ST) of liquids.

- Temperature - Increasing temperature lowers ST
- Surfactant - Surface acting agents lower ST
- Impurities - Change ST
- Oxidation - Changes ST
- Chemical Quality - Detected by different ST

Interfacial tension is the Gibbs free energy per unit area of interface at fixed temperature and pressure. Interfacial tension occurs because a molecule near an interface has different molecular interactions than an equivalent molecule within the bulk fluid. Surfactant molecules preferentially position themselves at the interface and thereby lower the interfacial tension. Interfacial or surface tension exists when two phases are present. These phases can be gas/oil, oil/water, or gas/water. Interfacial tension is the force that holds the surface of a particular phase together and is normally measured in dynes/cm.

II. METHODOLOGY

The du Noüy tensiometer uses a platinum ring which is submersed in a liquid. As the ring is pulled out of the liquid, the force required is precisely measured in order to determine the surface tension of the liquid. This method requires that the platinum ring be nearly perfect; even a small blemish or scratch can greatly alter the accuracy of the results. A correction for buoyancy must be made. This method is considered less accurate than the plate method but is still widely used for interfacial tension measurement between two liquids.



A du Noüy tensiometer

The du Noüy ring method is the technique by which the surface tension of a liquid can be measured. The method involves slowly lifting a ring, often made of platinum, from the surface of a liquid. The force, F, required to raise the ring from the liquid's surface is measured and related to the liquid's surface tension, γ:

$$F = 2\Pi . (r_i + r_a) . \gamma$$

where r_i is the radius of the inner ring of the liquid film pulled and r_a the radius of the outer ring of the liquid film.As the platinum ring is pulled out of the liquid, the force required to detach it from the liquid surface is precisely measured. This force is related to the liquid surface tension. The platinum ring should be very clean without blemishes or scratches because they can greatly alter the accuracy of the results. Usually the correction for buoyancy must be introduced for liquid surface tension determination.

The total force needed to detach the ring Wtot equals the ring weight Wr and the surface tension multiplied by 2 because it acts on the two circumferences of the ring (inside and outside ones).

III. RESULTS AND DISCUSSION

S.No	Sample	Surface Tension	Interfacial Tension
1	Water	62 Dynes/Cm	-
2	Kerosene	25 Dynes/Cm	-
3	Petrol	19 Dynes/Cm	-
4	Kerosene And Water	-	22 Dynes/Cm
5	Petrol And Water	-	22 Dynes/Cm

IV. CONCLUSION

The interfacial tension plays an important role in many processes and phenomena where different phases touch one another: The interfacial tension affects the emulsifiability and the tendency for the phases to separate. If the interfacial tension is reduced by means of surfactants, the organic phase can be mobilized after flooding with water. The ageing of a hydrophobic liquid often goes hand in hand with a reduction in the interfacial tension with water. In such cases, measurement of the interfacial tension is an important quality test, for example with transformer oil. In the case of solid-liquid phase boundaries, the interfacial tension affects the long-term stability of the interface contact, for example with gluing and coating processes.

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Amr Gazem. "Surface And Interfacial Tension For Various Liquids." International Refereed Journal of Engineering and Science (IRJES), vol. 07, no. 01, 2018, pp. 64–66