PHYSICAL CHEMISTRY LABORATORY II

EXPERIMENT NUMBER: 8

NAME OF THE EXPERIMENT: Contact Angle

DATE OF THE EXPERIMENT:11/5/2023

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SECTION: Thursday Afternoon

DATA SHEET

Table 1. Contact angles which is measured for the Liquids

Liquid(Surface Tension)	Θ_1	Θ_2	Θ_3
Water (72,80 mN/m)	98,12	91,17	102,78
Octane (21.62 mN/m)	20,39	20,36	20,22
Dodecane(25.35 mN/m)	31,89	36,02	37,39
Octanol (27.50 mN/m)	34,49	43,61	43,79

CALCULATIONS

1) Mean of the θ_γ of the water,

$$\frac{\Theta_1+\Theta_2+\Theta_3}{3}=\frac{(98,12+91,17+102,78)}{3}=97,356$$

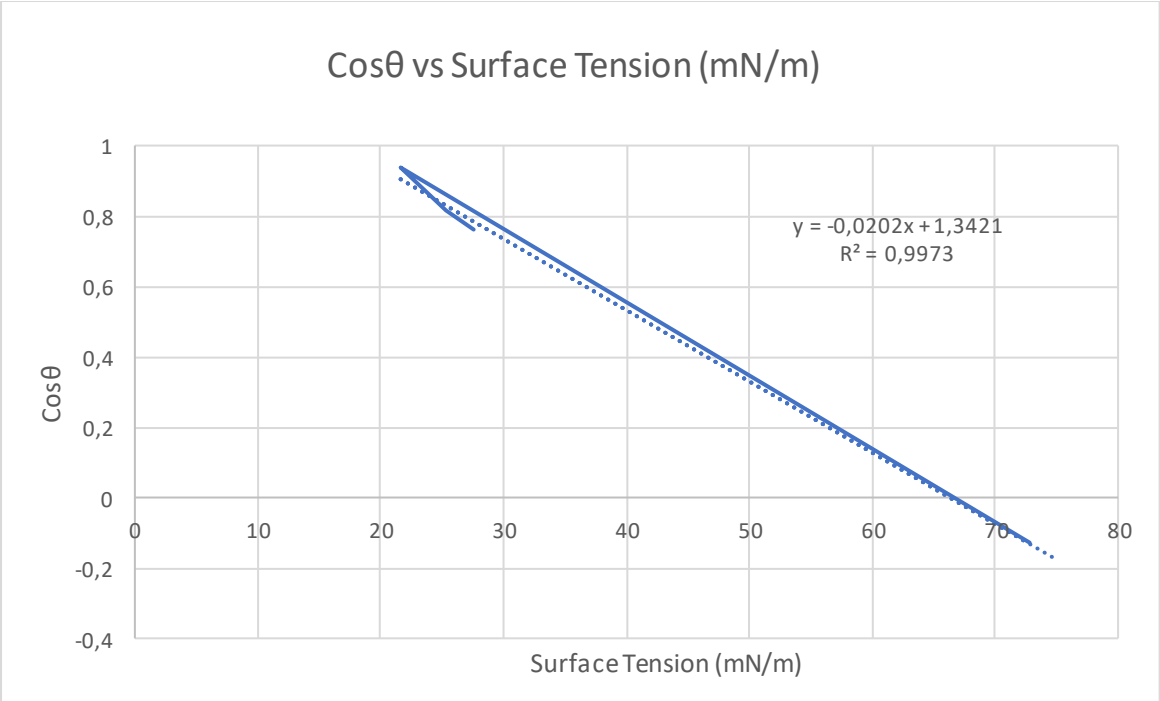
Same calculation process for other liquids then,

Table 1. Mean Contact angles for the Liquids

Liquid(Surface Tension)	Mean Contact Angle
Water (72,80 mN/m)	97,36
Octane (21.62 mN/m)	20,32
Dodecane(25.35 mN/m)	35,1
Octanol (27.50 mN/m)	40,63

2)

Graph 1. Zisman Plot for liquids with Teflon Surface



Equation from the graph, y = -0,0202x + 1,3421

Critical surface tension of Teflon when cosΘ =1 then

1= -0,0202x + 1,3421 from this calculation critical surface tension of Teflon is

X=16,9356=16,9

3) Percent Error:

$$\frac{Experimental\ Value - Theoretical\ Value}{Theoretical\ Value} \times 100 = \frac{(16{,}20 - 20)}{20} \times 100 = -19\%$$

QUESTIONS

1) Wetting the surface of the materials is related to their wettability properties. The wettability maesurement can be measured with critical surface tension and surface tension. For the material to wet the surface, the surface tension must be equal or less than the acute surface tension. The contact angle is the angle between the liquid on the surface and the surface and is less than 90 degrees. Must be small or equal. [1]

2) Materials with hydrophobic properties do not interact with water. The contact angle on surfaces with this feature is less than 90 degrees. Some plants do not interact with water, and water droplets do not adhere to their surfaces. These surfaces are hydrophobic. On the other hand, when some fabrics encounter water, the fabric surfaces interact with water and get wet. These surfaces are hydrophilic. .[2]

3) The properties of liquids affect the contact angle, which depends on the properties of the fluids. Young contact angle also proves this sitaution. As a result of using four different liquids on Teflon in the experiment, the change in contact angles also changes according to the properties of the liquids. The contact angle will increase as the forces between the molecules increase. .[3]

4) **Interface-free energy:** If the forces between molecules are unequal and there is an interface, this energy is defined. Adhesive properties are between unequal molecules.[4]

Surface free energy: It is the energy resulting from the comparison of the substance's mass and the surface phase's energy. .[4]

Surface Tension: It is the energy required to increase the surface of liquid substances. This energy is released because of intermolecular forces. .[4]

Critical surface energy: It expresses the wettability of solid surfaces. This energy is the consideration of hydrophobicity or hydrophilicity from surface properties. The Zisman Plot method is used to calculate the critical surface tension. .[4]

DISCUSSION

The purpose of this experiment is to observe the change of contact angles on the Teflon surface of four different liquids: Octanol, Dodecane, Octane, and Water. The wettability of the liquid on the Teflon surface is obtained because of measuring the contact angle.The increase in the wettability of the liquid is directly proportional to the rise in the contact angle. If it is desired to investigate the solid surface free energy and stickiness properties, the contact angle should be applied.The increase in stickiness is related to the decrease in the contact angle. In addition, the solid surface free energy increases with the reduction of the contact angle. If the contact angles are to be ordered from the highest value to the lowest value, the order will be Water, octanol, dodecane, and octane. The highest wettability is observed in the octane liquid. Because the contact angle is kept at least in this liquid on the Teflon surface.Interpretations are made based on this information for other liquids. Another reason that increases the contact angle is the increase in the surface tension of the liquid.

The device maesuring the contact angle was used in the experiment. To accuretely measure the team's angles of different liquids dropped on the Teflon surface, the Teflon surface should be cleaned with ethanol between maesurements, but it should be done with a sweeping force in one direction while the cleaning process is done. Otherwise, an electrostatic force will occu r on the Teflon surface, and this situation will not measure the contact angle. When liquids are dripped onto the character in the form of drops, the device should take a photograph at the right moment to take a measurement, and if the angles are not fully visible on the device, adjustments should be made. Liquids are transferred to the Teflon surface with a specially designed screw-in glass syringe. It is essential to be careful when using the syringe. Correcting or replacing the syringe in case of failure is extremely costly. The tip of the syringe should be cleaned at every fluid change.

Average contact angles are maesured by the surface tension of the liquids used in the experiment; the Zisman Graph, is used. The critical surface tension was 16.20 mN/m , for the Teflon surface, and the error was observed to be -19% in the experiment. The error may be because the,baseline setting is not set correctly or under optimum conditions. As a result, the measured contact angle will not be correct. If there was an increase in temperature in the ambient conditions where the experiment was carried out, this may have caused an error. If there is pollution on the surface or at the syringe tip, the value of the contact angle may be affected.

References

[1] Dezellus, O., & Eustathopoulos, N. (2010). Fundamental issues of reactive wetting by Liquid Metals. *Journal of Materials Science*, *45*(16), 4256–4264. https://doi.org/10.1007/s10853-009-4128-x

[2] Cassie, A. B., & Baxter, S. (1944). Wettability of porous surfaces. *Transactions of the Faraday Society*, *40*, 546. https://doi.org/10.1039/tf9444000546

[3] An essay on the cohesion of Fluids. (1805). *Philosophical Transactions of the Royal Society of London*, *95*, 65–87. https://doi.org/10.1098/rstl.1805.0005

[4] Good, R. J. (1992). Contact angle, wetting, and adhesion: A critical review. *Journal of Adhesion Science and Technology*, *6*(12), 1269–1302. https://doi.org/10.1163/156856192x00629