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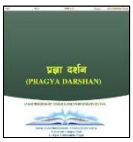

EXPERIMENTAL STUDY OF SURFACE TENSION OF HYDROCARBON LIQUID (PETROL) CARBONATED LIQUID (DEW) AND DRINKING WATER AT ROOM TEMPERATURE

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Abstract

This experiment has been made to measure the surface tension of drinking water, carbonated liquid (Dew) and hydrocarbon liquid (Petrol) with the help of simple techniques capillary raise method. In this method capillary tube is used with known radius and dipped vertically in to liquid and experimentally measured the surface tension of Dew and Petrol. The results of surface tension have been predicted the given liquids reciprocal to radius of capillary tube.

***Keywords**: petrol; dew; water and surface tension*

1. Introduction

The surface tension is the ability of a liquid (Drinking Water, Petrol and Dew) to stay in its fixed shape and the pattern of behavior of liquid surface move back and reduce surface area. Experimental process of capillary rise technique is used to determine surface tension of Dew, Petrol and Water. Experiment has been observed that when a liquid rises in the tube, the weight of dew, Petrol and Water column are exerted by upward force of tension along the circumference of contact of water dew, petrol & tube. This experiment has measured the weight of the column of the liquids (Water, Petrol, Dew) of density ρ inside the tube kept it upright force of tension acting along circumference of contact water petrol and dew and capillary. Here, the surface tension of liquid by capillary technique have been measured and experiment revived (Agrawal & Menon, 1984, Bing et al., 2017).

An adhesive force of liquid (Drinking Water, Petrol and Dew) is greater than the cohesive force. If touching base angle is less than 90^0, then the top surface is obtained concave shape. However, when the adhesive force a lesser amount of than the cohesive force, then liquids depresses or reduces in height, as in the case of mercury in a glass capillary. If the contact angle is greater than 90^0, the meniscus is convex.

An exterior tension of Water, Petrol, and Dew, were examined. Surface energy (Dechoz & Roze, 2004, De Greer & Eaton, 1977, Drelich et al., 2002, Gheribi & Chartrand, 2019, and Ghoufi et al., 2016) may be detected in the process that the surface of a liquid tends to reduces its own area, forming a smooth, round shape when possible. The external tension of Dew,Petrol and Water are function of temperature of liquid (Hall & Pugsley, 2020, Kalová & Mareš, 2018 and Khan et al., 2020). The energy essential to rise the external area of a fluid by unit of area is known as external tension. The external tension of consumption water was found to be higher than that of Petrol and Dew (Khan et al., 2020, Krefting, 2018 and Mańko et al., 2017). The surface tension of Dew,Petrol and Dew have crucial and wide range of applications (Misak, 1968, Neelakandan, 2020/2021 and Nielsen, 1998).

2. Experimental Method

To measure the external tension of Water, Petrol & Dew, capillary rise technique has been used. It is simple and most accurate it obtains the result. It is originated on the detail that when a clean capillary was dampened by the Water, Petrol and Dew, is bowl-shaped in to a fluids and the liquids increases in the tube. The rise of the Water, Petrol and Dew in the capillary could be implicit if it is hypothetical that a thin film of the liquid detects to the wall of the tube. The raise to which the fluids column surges is reliant on on the surface tension dragging the liquids ascendant. Steadiness is got when the force of surface tension is stable by the force of gravity on the support of liquid. Experimental setup technique shown in fig.1.

In capillary rise method experiment setup, the height h of a meniscus in a round glass capillary tube with inner diameter d is measured. If the capillary tube diameter is small compared to the tube height, the meniscus has an almost spherical shape and cosine of the contact angle between meniscus and capillary tube is unity. This experiment is not suitable for liquid-liquid interfaces (Sachs & Meyn, 1995, Wohlfarth, 2008, and Yaws, 2014).

The capillary rise formula can be derived by balancing forces on the liquids (Water, Petrol, Dew) column. The weight of the Dew, Water and Petrol are given by $\pi r^2 h\rho g$. This weight of Liquid is balanced by the upward force due to surface tension by $2\pi r\, T\cos\theta$. The formula can be derived by,

$2\pi r\, T\cos\theta = \rho\pi r^2\, hg$

Now, the surface tension of liquids (Water, Petrol, Dew) can be calculated by using following formula. This method is most accurate techniques to measure the surface tension,

Surface Tension (T) = $\frac{\rho rgh}{2}$ (1)

The modified form of surface tension of given liquid is given by

T = $\frac{\rho rgh}{2}(1+\frac{r}{3h}$ -A $\frac{r^2}{h^2}$+B$\frac{r^3}{h^3}$) (2)

Where, A and B are constant and their values are given, A = -0.12 and B = 0.13

Surface tension of given liquid with constant value is given by

T = $\frac{\rho rgh}{2}$ (1 + $\frac{r}{3h}$ - 0.12 $\frac{r^2}{h^2}$ + 0.13$\frac{r^3}{h^3}$) (3)

cos θ =1

r = radii of capillary tube

h= height of liquids (Water, Petrol, Dew)

g= acceleration due to gravity

ρ=density of liquids (Water, Petrol and Dew)

The drink water, carbonated liquid (Dew) and hydrocarbon liquid (Petrol) having their densities 1gm/cm^3 , 1.02gm/cm^3 and 0.80gm/cm^3 respectively.

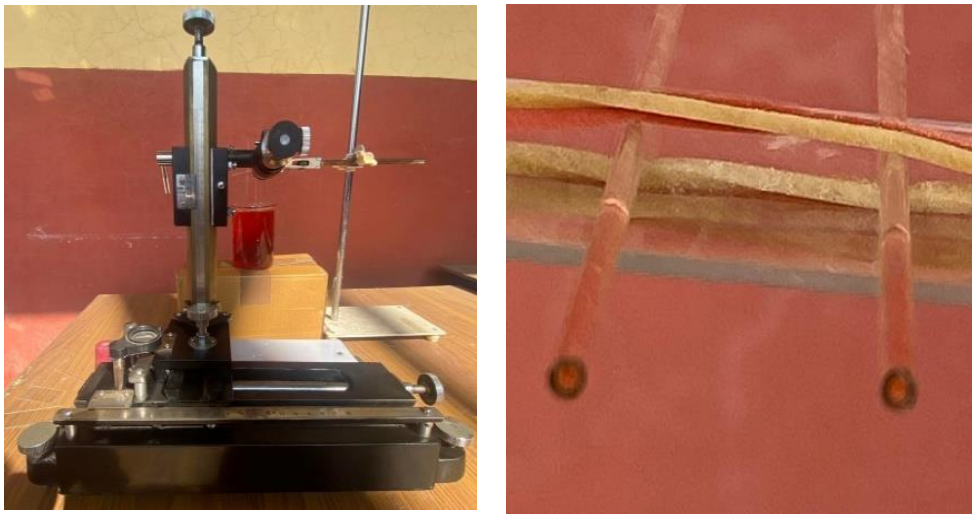

Fig.1: Experimental setup for measuring surface tension by capillary rise method.

1. Measured Calculations and Consequences Analysis

The surface tension of liquid (Drinking Water, Petrol and Dew) can be resolute with the assistance of assumed assessment of height & radii for two capillaries distinctly. Now the value of height & radius can be found from table 1 and 2 correspondingly. The premeditated values of surface tension of Dew, Petrol and Water are given in table 3. Experimental and standard value of surface tension of drink Water, carbonated liquid (Dew) and hydrocarbon liquid (Petrol) with temperature are shown in table 4.

Table 1: Height of given liquid h in capillary tube

Liquid	Tube	Microscope reading of lower meniscus			Microscope reading lower tip of the needle			Height of the liquid h(cm)
		M. Scale	V.Scale	Total Scale	M. Scale	V. Scale	Total Scale	
Water	1	7.07	0.005	7.075	3.95	0.005	3.955	3.120
	2	6.55	0.009	6.559				2.604
Dew	1	4.90	0.011	4.911	3.25	0.011	3.261	1.65
	2	4.550	0.017	4.567				1.306
Petrol	1	5.86	0.005	5.865	4.0	0.015	4.015	1.85
	2	5.56	0.005	5.565				1.55

Table 2: Radii of tubes (r)

S.No.	Tubes	Scale inner left wall of the Capillary	Scale inner right wall of the Capillary	Radius of the capillary tube r=d/2
1	1	14.746	14.838	0.046
2	2	5.106	5.212	0.053

Table 3: Surface tension (T) of drinking Water, Dew & Petrol

S.No.	Liquid	Tubes	Radius of the capillary tube r (cm)	Height of the Liquid; h(cm)	Surface tension of the liquid, (dyne/cm)	Mean of the Surface Tension (T)
1	Water	1	0.046	3.120	70.33	69.42
		2	0.053	2.604	67.63	
2	Dew	1	0.046	1.65	29.01	27.74
		2	0.053	1.306	26.46	
3	Petrol	1	0.046	1.85	33.56	32.88
		2	0.053	1.55	32.20	

Table 4: Experimental and standard value of surface tension of Water, Dew and Petrol with temperature

S.No.	Sample Liquid	Experiment Data (dyne/cm)	Standard Data (dyne/cm)	Room Temperature (℃)
1	Water	69.42	72	21
2	Dew	27.74	31.98	21
3	Petrol	32.88	28.52	21

The surface tension of Water, Petrol and Dew are calculated by using the above equations (1) and (3) respectively. The radii of capillaries tubes are 0.046 cm and 0.053 cm respectively. The technique resolute and typical value of external tension of Water, Petrol and Dew are foreseen in table 3 and 4 correspondingly and values were nearly equal to standard data.

2. Results and Discussion

With the help of the above data this experiment has found that the surface tension of drink water, carbonated liquid (Dew) and hydrocarbon liquid (Petrol) can be experimentally measured by capillary rise method. The surface tensions of given liquid are predicted in fig.2 and fig.3 respectively. In those diagrams the values of surface tension of drink water found to be higher than other liquid due to their relatively high attraction of water molecule to each other and molecular structure interatomic bond force of liquids. Water being polar molecule. Petrol being hydrocarbon liquid and Dew is the carbonated liquid.

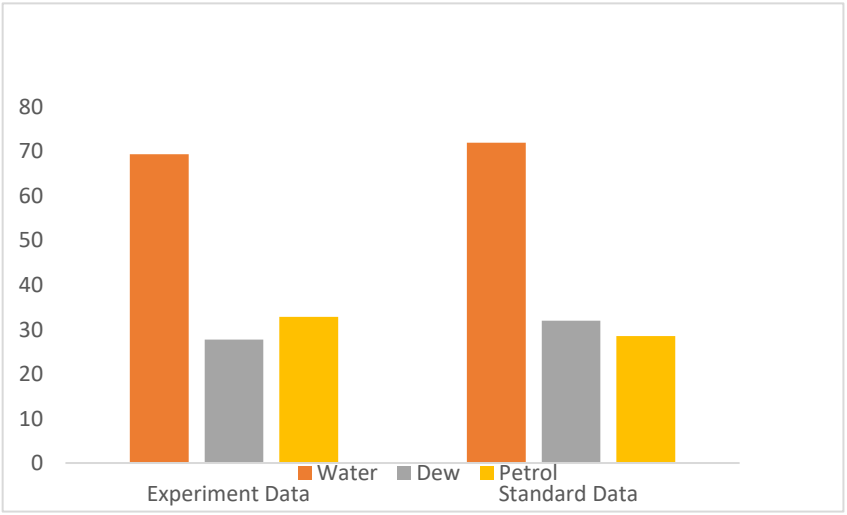

Fig.2: The surface tension of different liquids (Water, Petrol and Dew)

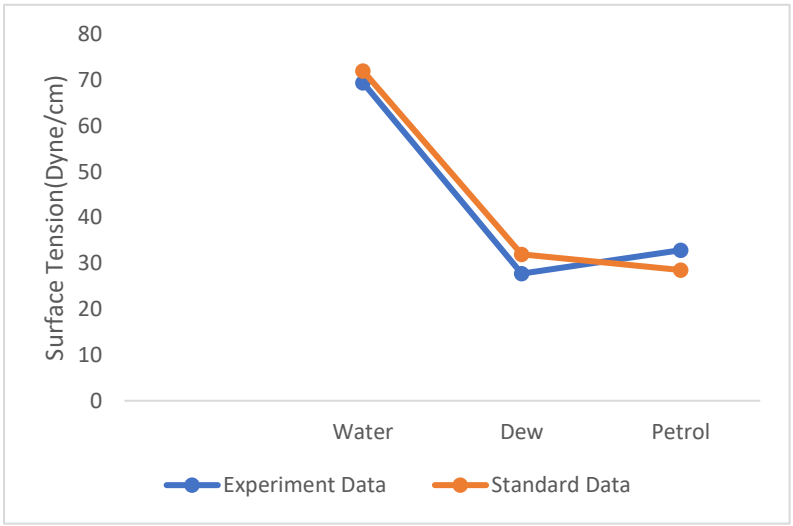

Fig.3: The surface tension of different liquids with standard and experimental result

3. Conclusion

In conclusion, the capillary rise method according to the result collected from the experiments, proved that those surface tensions exist and reduced, which promotes capillary action. This is due to fact that lower surface tension causes lower intermolecular tensions, which means lower cohesive forces. Capillary action will be increased as a result the findings of this laboratory investigation were crucial in our further understanding of surface tension and capillary action. The results instead the calculated surface tension is nearly equal to the standard value of liquid's (Drinking Water, Petrol and Dew). In this experiment, water, as a polar molecule, it has a higher surface tension the pure water with nothing added to it had most surface tension. Overall, these results were successful in providing insight into capillary action behavior and surface tension of liquids.

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