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"Study the effect of addition of some selected solute on the surface tension of solvent and measurement of the surface tension of carbonated beverages"

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Abstract:

This workincluded an experiment for comparative study of effect of addition of solute on surface tension of solvent by using simple experimental technique. In this experiment we used the Traube's stalagmometer instrument to measure thesurface tensionof sample liquids. The solutions of different concentrations of Na_2CO_3, NaCl, C_{12} H_{22} $O_{11}$and washing detergentwas prepared for measurements. For the preparation ofsolution water was used assolvent.Some carbonated beverages, oil and ethanol was also experimented with stalagmometer and surface tension of each solution was measured by drop number method.

Keywords: Surfacetension, Concentration, Solute, Solvent, Stalagmometer.

Introduction:

[1]Surface tension is an important physical property of liquids; it determines the behavior of liquids in various process and phenomenon like rate of evaporation of liquid, interaction of liquid with biological interfaces and hence surface tension plays important role in pharmaceutical and biomedical application to develop new efficient medicinal drugs. Many chemical reactions and physical process is takes place in presence of various liquids which plays vital role in reactions and hence it is necessary to know the physical properties of those particular liquids to check feasibility and some other conditions of reactions. It is a force in dyne per centimeter acting on the surface at right angle. The surface tension in the liquids is arises due to the presence of intermolecular forces of attraction like hydrogen bonding, London-London force, induced dipole forces of attraction etc.[2]Hence the surfaces of some liquids appears concave shape and shape of water drops becomes spherical in nature. The temperature minimize surface tension of liquids because temperature affect on intermolecular bonding present in liquids by changing kinetic energy of molecules.[3]The scientist W.Ramsay and J.Shields gave the equation $\Upsilon(M/\rho)^{2/3} = h\,(t_c\text{-}t\text{-}6)$ showing relationship between surface tension of liquids and temperature.

[4]According the review of literature the surface tension of liquid is alter by the addition of small amount of solute. The solute which changes the surface tension of liquid is known as surfactant and the percent decrease or increase of surface tension is depends upon the concentration of surfactants.Sodium carbonate is selected in present study because it having important applications in the number of industrial processes.Similiarly sodium chloride also plays in the biological and physicochemical reactions in body of living organisms.[5]Sucrose also plays an important role in biochemical reactions and important for physical health of human being therefore it is important to know the physical properties of sucrose and effect of percentage of sugar in water.[6]According review of literature the surface tension of water is increases by addition of sucrose.

Materials: All the chemicals is easily available in any laboratory of chemistry, chemical used for experiment was already available in our college laboratory

Experimental Method:

Experiment was done in four phases.

Phase I: In first phase the densities ofsome selected beverages was measured. To measure the densities of each liquids specific gravity bottle of 25 ml was used.

Phase II: In second phase the densities of pure water and prepared solutions of different concentrations was measured at room temperature.

Phase III: In third phase the number of drops formed by each beverage was counted, as the liquid travel from upper meniscus marking to lower meniscus marking on stalagmometer at room temperature.

Phase IV: In fourth phase the number of drops formed by each solution of different concentrations was counted, as the liquid travel from upper meniscus marking to lower meniscus marking on stalagmometer at room temperature.

Calculations:

Calculation of density of liquids by using the general formula.
Density (ρ) = Mass (m) / Volume (v)
[7]Calculation was done by using the equation $\Upsilon_1/\ \Upsilon_2 = (n_2d_1/n_1d_2)$ the surface tension was measured. (Where Υ_1 is surface tension of standard reference liquid, Υ_2 is the surface tension of experimental liquids, n_1 is a number of drops of standard reference liquid, n_2 is a number of drops of experimental liquids, $d_1$isthe density of standard reference liquid and d_2 is the density of experimental liquids).

Result and Discussion:

Table 1: Measured densities and surface tension of selected solutions of various concentrations.

Sr.No	Experimental Solutions(Solvent+ Solute)	Concentration in percentage by weight	Measured Density(ρ) in g cm^{-3}	Surface tension (Υ) in dyne cm^{-1}
1.	$H_2O + Na_2CO_3$	5%	1.02	65.49
2.	$H_2O + Na_2CO_3$	10%	1.07	67.12
3.	$H_2O + Na_2CO_{3+}$	15%	1.11	68.37
4.	$H_2O + Na_2CO_3$	20%	1.14	70.53
5.	$H_2O + Na_2CO_3$	25%	1.18	75.56
6.	H_2O +NaCl	5%	1.02	70.53
7.	H_2O +NaCl	10%	1.06	70.89
8.	H_2O +NaCl	15%	1.08	69.45
9.	H_2O +NaCl	20%	1.12	66.88
10.	H_2O +NaCl	25%	1.15	64.09
11.	$H_2O + C_{12}\ H_{22}\ O_{11}$	5%	1.00	75.56
12.	$H_2O + C_{12}\ H_{22}\ O_{11}$	10%	1.02	80.56
13.	$H_2O + C_{12}\ H_{22}\ O_{11}$	15%	1.04	75.60
14.	$H_2O + C_{12}\ H_{22}\ O_{11}$	20%	1.07	77.78
15.	$H_2O + C_{12}\ H_{22}\ O_{11}$	25%	1.08	78.51
16.	H_2O + Detergent	5%	1.0	15.83

Table 2: Measured densities and surface tension of selected liquids.

Sr. No	Experimental liquids	Measured Density (ρ) in g cm^{-3}	Surface tension (ϒ) in dyne cm^{-1}
1.	Spite	1.01	78.50
2.	Limonata	1.03	71.25
3.	Jeera masala Aasav	1.05	65.73
4.	Thums-up	1.01	64.77
5.	Sarso oil	0.92	25.90
6.	Ethanol	0.79	22.75

Conclusion:

From experimental observationsit is concludethat, the densities of liquids are increases by increasing the concentration of solute and surface tension is also changed changing concentration. In case of sodium carbonate surface tension is increased by increasing concentration and in case of sodium chloride the surface tension was decreased by increasing concentration by percent weight. Sucrose increases the surface tension of water. Detergent minimizes the surface tension of water so rapidly as compare to other solute and therefore it affect the rate of evaporation of water.Thedensities of almost all carbonated beverages are equal but there is difference observed in their surface tension. Thedensities of oil and ethanol arelessthan other liquids but their surface tension also very less than other.

References:

[1] K. Han, O. E. Woghiren, and R. Priefer, "Surface tension examination of various liquid oral, nasal, and ophthalmic dosage forms," *Chemistry Central Journal*, vol. 10, no. 1, p. 31, Dec. 2016, doi: 10.1186/s13065-016-0176-x.

[2] "Why is surface tension important?" https://www.linkedin.com/pulse/why-surface-tension-important-susanna-lauren (accessed Feb. 27, 2023).

[3] "Analysis of accuracy of burette in determination of surface tension of liquids and study of its variation with detachment time and inclination angle," *IJCA*, vol. 59, no. 11, Nov. 2020, doi: 10.56042/ijca.v59i11.36247.

[4] W. L. Hsin, Y.-J. Sheng, S.-Y. Lin, and H.-K. Tsao, "Surface tension increment due to solute addition," *Phys Rev E Stat Nonlin Soft Matter Phys*, vol. 69, no. 3 Pt 1, p. 031605, Mar. 2004, doi: 10.1103/PhysRevE.69.031605.

[5] S. Z. Navarro and F. P. Llamas, "The importance of sucrose for cognitive functions; knowledge and behaviour".

[6] A. Docoslis, R. F. Giese, and C. J. van Oss, "Influence of the water–air interface on the apparent surface tension of aqueous solutions of hydrophilic solutes," *Colloids and Surfaces B: Biointerfaces*, vol. 19, no. 2, pp. 147–162, Dec. 2000, doi: 10.1016/S0927-7765(00)00137-5.

[7] M. Thakur and H. Wadhwa, "Experimenting with stalagmometer and viscometer on day to day drinking liquids".