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VARIATION OF CONCENTRATION OF DEXTRAN WITH GLYCINE AT 308 K AND AT FREQUENCY 5MHZ

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Abstract

The density (ρ) viscosity (η) and ultrasonic speed (U), at 308 K have been measured in the systems of different concentration of dextran with glycine in aqueous medium. The ultrasonic seed have been measured by using ultrasonic interferometer at frequency of 5MHz in different concentration of dextran with glycine in aqueous medium. The acoustic parameters such as "free volume, internal pressure, absorption coefficient, Rao's constant and Wada's constant" are calculated using the measured parameters ρ, η and U. The variation of acoustic parameters with different concentration of dextran with glycine leads to the analysis of molecular motion and various types of inter-molecular interaction and their strength of the constituent between solute (dextran) and solvent (glycine 2(M)).

Key words: Dextran, ultrasonic speed, acoustic parameter, inter-molecular interaction and ultrasonic interferometer

Introduction

The ultrasonic technique, is being mostly used in the study of molecular interaction in liquid state due to their simplicity and accuracy. As these techniques are nondestructive, it plays an important tool for basic research in Physics, Chemistry, Material Science, Biology, medical science and forensic science[1-2]. The acoustical parameters were used to research various types of interactions, molecular motion and different forms of interaction and their effects, affected by the size of the pure component and the mixtures [3].

The present investigation is related on acoustical properties of dextran with glycine. The acoustical parameters such as "free volume(Vf), internal pressure(πi), absorption coefficient or attenuation coefficient(α), Rao's constant(R) and Wada's constant(W)" of dextran at various concentration i.e. "0.1%, 0.25%, 0.50%, 0.75% and 1% " in solvent glycine at constant temperature and frequency at 308 K and 5 MHz respectively have been calculated.

Pasteur isolated dextran, synthesized by bacteria polysaccharide, In the medical field, it is widely used, primarily as a supplementary material that reduces blood viscosity and prevents blood clots from forming. Wide-ranging applications of dextran and its derivatives for medical, industrial and research purposes have been motivated by ultrasonic investigation of the acoustic parameters of dextran [4].

Glycine is an organic compound with the formula $HO_2CCH_2NH_2$. As the body uses glycine to make proteins, and widely used in the biological activity of our body.

Materials and Methods

Materials

The dextran (m.w 70,000 Da) having concentrations ranges "0.1%, 0.25%, 0.50%, 0.75% and 1%" with 2(M) glycine solution ,prepared in freshly prepared distilled water[5].

Measurements

The ρ by using pycnometer, η by Ostwald viscometer and U by ultrasonic interferometer instruments of the solution were measured, in a temperature controlled water bath [6-7].

Theoretical aspect

Thermo acoustic parameters were determined using standard formula using these experimental data such as ρ, η and and estimated using standard formula [8].

Results and Discussion

Table 1 Values of ρ and η of solution.

T (kelvin)	Concentration									
	0.10%		0.25%		0.50%		0.75%		1%	
	ρ Kg.m^{-3}	η 10^{-3} N.s.m^{-2}	ρ Kg.m^{-3}	η 10^{-3} N.s.m^{-2}	ρ Kg.m^{-3}	η 10^{-3} N.s.m^{-2}	ρ Kg.m^{-3}	η 10^{-3} N.s.m^{-2}	ρ Kg.m^{-3}	η 10^{-3} N.s.m^{-2}
308	1051.89	0.957	1053.47	0.985	1054.261	1.023	1055.05	1.087	1055.85	1.118

Table 2 Values of'U' at frequency 5 MHz and V_f of solution at 308K temperature.

Conc.	(U) m/s	V_f (x10^{-3} m^3·mol^{-1})
0.10%	1613.0	7.818
0.25%	1614.8	7.491
0.50%	1615.5	7.089
0.75%	1617.8	6.479
1%	1618.0	6.215

Table 3 Values of 'π_i' and 'α' of solution.at 308K temperature

Conc.	π_i (×10^3 N·m^{-2})	α (x10(np·m^{-1})
0.10%	121.88	23.02
0.25%	123.75	23.62
0.50%	126.11	24.47
0.75%	130.02	25.93
1%	131.89	26.64

Table 4 Values of 'R' and 'W' of solution at 308 K temperature

Conc.	R (m^3/mole)(m/s)$^{1/3}$(10^{-3})	W (m^3/mole)(N/m^2)$^{1/7}$(10^{-1})
0.10%	111.492	211.938
0.25%	111.364	211.730
0.50%	111.298	211.622
0.75%	111.266	211.570
1%	111.188	211.443

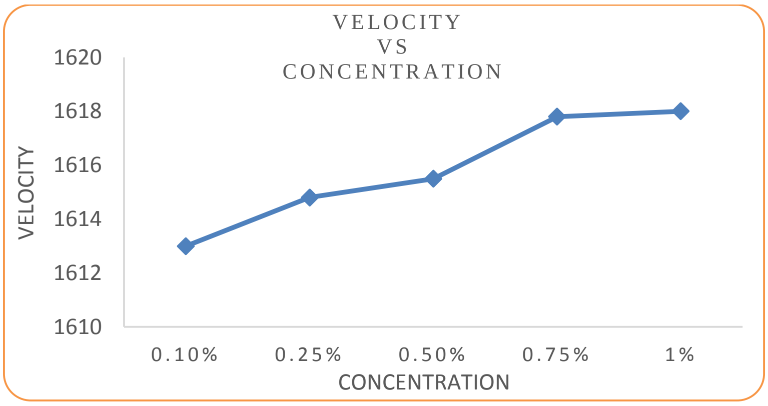

Fig.-1 Plot of velocity with concentration

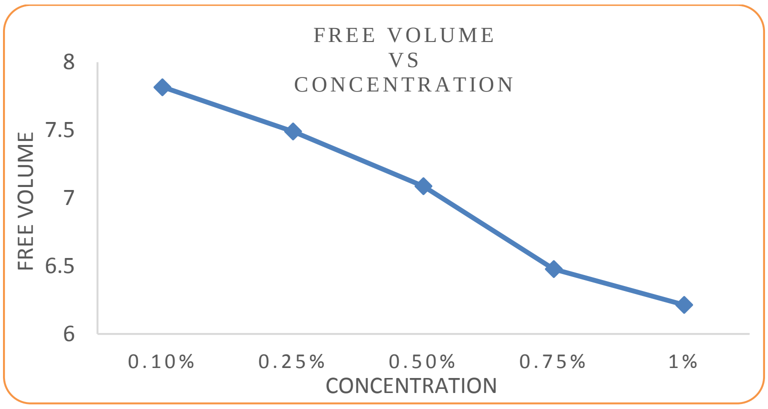

Fig.-2 Plot of free volume with concentration

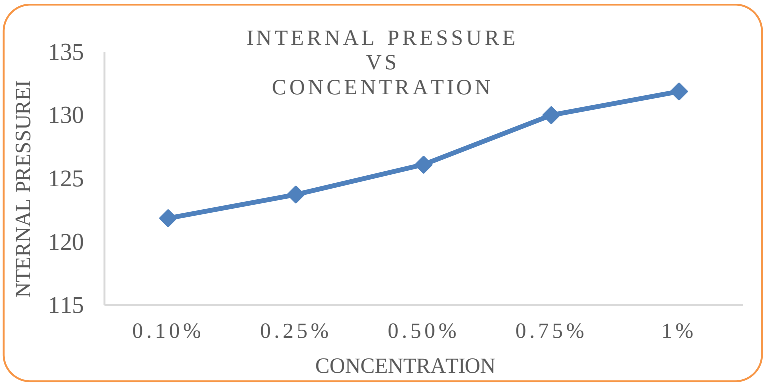

Fig.-3 Plot of internal pressure with concentration

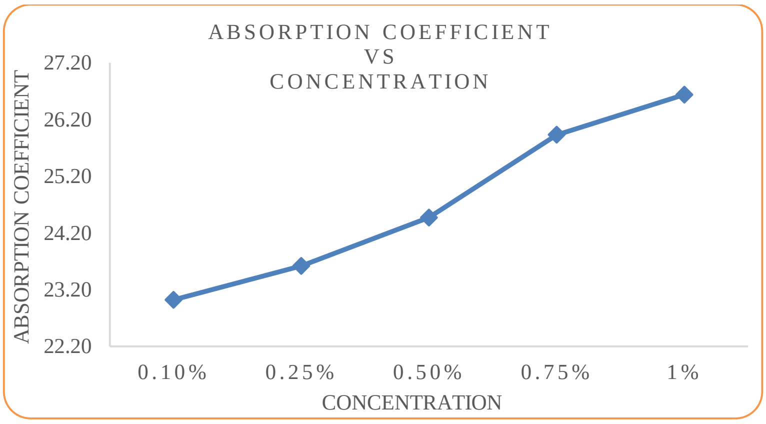

Fig.-4 Variation of absorption coefficient with concentration

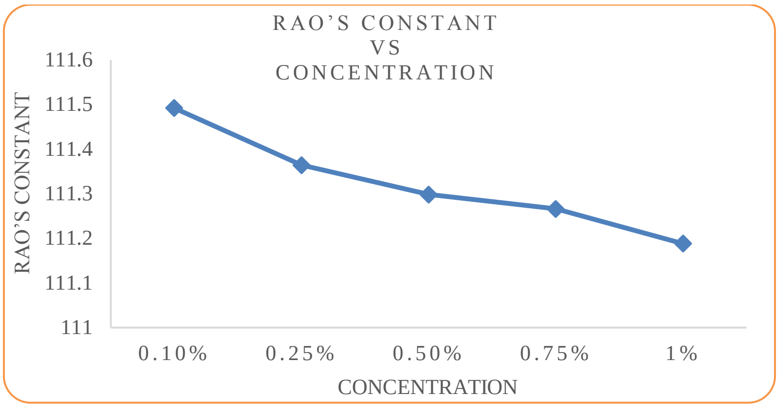

Fig.-5 Plot of Rao's constant with concentration

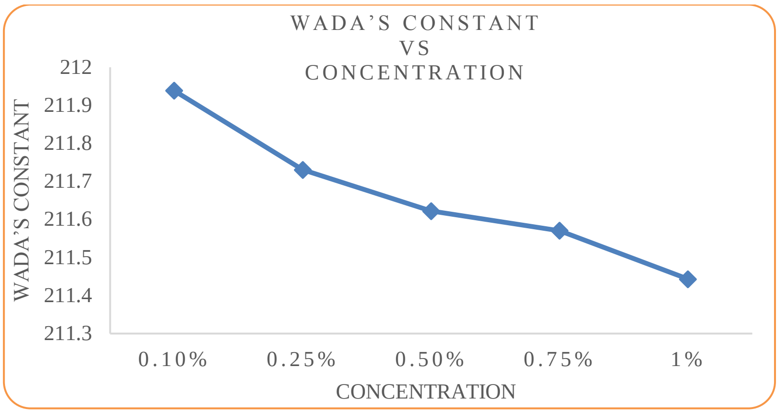

Fig.-6 Plot of Wada's constant with concentration

Fig-1 as the concentration of dextran in glycine increases, the ultrasonic speed increases. at constant temperature and frequency. This trend suggests that dipole – induced dipole interaction in higher concentration of dextrn in glycine solution[9].

Fig-2 and Fig-3 respectively contains the plots of free volume and internal pressure versus concentration. 'V_f ' decreases and 'π_i' increases as the concentration of dextran in glycine increases (vol. percent), suggesting an interaction with the molecules of the liquid portion. With increased concentration, the decrease in free volume and internal pressure (πi) increases mean that the molecules are organised in such a way that the void space is less accessible, demonstrating that compressibility decreases. Internal pressure in binary solution is a measure of intermolecular attraction between the component molecules[10]. The internal pressure (π_i) increases with increase in concentration suggests that, possibility of strong intermolecular attraction of the type dipole-dipole or hydrogen bonding or complex formation. As excepted the free volume shows an exact revers trend with internal pressure[11].

Fig-5 with increased concentration, the 'α', which is a feature of the medium, increases. As concentration increases, as it is proportional to the square of the frequency, the absorption coefficient increases quickly.[12] The increase in the 'α'with an increase in concentration means that the molecules are organised in such a way that the void space is less available, indicating a decrease in V_f.

'R' and 'W' constant are both an important part of studying the nature of molecular interactions. It is noted that with the increased concentration, 'R' and 'W' decreases are seen in Fig-5 and Fig-6, respectively[13-14]. This suggests a similar packaging of interaction-indicating solvent and solvent molecules.

Conclusion

For various concentrations of dextran in (2M) glycine, different acoustic parameters are tested, holding the frequency and temperature constant. Increases in 'η' and 'π_i' with concentration suggest solute solvent activity in the solution and are higher. With increasing concentration, the 'V_f ', 'R' and 'W' steady decrease. This shows that there is solute solvent activity in the system and confirms the evidence shown by internal pressure variation. The results show that the thermo-acoustic parameters describe the unique solute-solvent interactions.

The thermodynamic and acoustic parameters indicate that the solution has a molecular relation. The incorporation of solute into the solvent often contributes to a greater solvent-solute interaction in the solution.

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