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Analysis of Transport Properties and Acoustical Parameters of Sulphanilamide in Non- Aqueous Medium

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Abstract; *Sulphanilamide is the parent compound of all the sulpha-durgs which is important in urinary tract infections and meningococcal meningitis profilaxes. Ultrasonic velocity measurements are highly sensitive to molecular interactions and used to provide qualitative informations about the physical nature and strength of the molecular /inter-ionic interactions. In the present work, non-aqueous solutions of Sulphanilamide have been prepared with different concentrations and the experiments were carried out from a low temperature of 5^0c to a high temperature of 55^0c. The ultrasonic velocity data combined with density and viscosity provides the standard means for determining the internal pressure, free volume and acoustical parameters. The various interactions occurring in the solutions are interpreted interms of ion-ion and ion-solvent interactions. An attempt is made to identify the entry of solvate into the samples and the entry of drug molecules into the solvate which supports to identify the molecular structure.*
Keywords : *Acoustical parameters, free volume, Internal pressure, ion-solvent interactions ,ion-ion interactions.*

I. Introduction

Sulphanilamide compounds identified as chemotherapeutic agents, possess broad spectrum of biological properties [1].Study of non –aqueous solutions is interesting for the physical understanding of the ion –solvent interactions. The passage of ultrasonic waves through solutions and liquids disturb the equilibrium between solute and solvent molecules. The velocity of such a wave is a thermodynamic quantity and is related to the physio – chemical properties of the medium[2].The velocity of ultrasonic waves in a medium and several other acoustic parameters which are dependent on it, helps to determine the overall response of the medium and about the nature of interactions between the molecules of the medium[3,4].Ultrasonic velocity of a liquid/solution is fundamentally related to the binding forces between the adequately employed in understanding the nature of molecular interaction in pure liquids[5,6,7].
The present work dealt with the ultrasonic investigations and acoustical study of (sulfanilamide) sulphanilamide in formamide .

II. Experimental Technique

The solutions of different molalities of sulphanilamide are prepared with AR grade formamide.Density of the solution is measured with 25ml of specific gravity bottle by a Digital balance of accuracy of .0001gm/cc. Cannonfenske viscometer is used for the viscosity measurements, and the time is noted by stop watch with an accuracy of ± 0.1sec. Mittal's interferometer of frequency to 2MHz, with an accuracy of ± 2 m/s is used.

. Internal pressure (π_i) and free volume (v_f) and acoustical parameters are evaluated by the following formulae.
(i) Internal pressure (π_i) = $bRT\ [k\eta/u]^{1/2}\rho^{2/3}/M^{7/6}$ atms
(ii) Free volume (v_f) = $[\ M_{eff}\ u/k\eta]^{3/2}$cc
(iii) Adiabatic compressibility (β) = $[1/u^2\rho]$ cm^2/dynes
(iv) Specific acoustic impedance (Z) = ρu (Rayl)
(v) Intermolecular free length (L_f) = $K_T\ (\beta_{ad}{}^{1/2})A^0$

III . Results and Discussion

In the present study internal pressure, exhibits an increasing trend with respect to increasing molalities as shown in fig (1).Internal pressure is a measure of cohesive energy of the system hence these variations may be due to the structure making nature of the solute in the solvent . It implies that there is a strong solute- solvent interaction taking place in the solution[8].The dependence of parameter on temperature has also been used to explain the strength of interactions with change in temperatures[9,10].The internal pressure decreases with rise in temperature of the solution. Since when the temperature is increased, there is a tendency for the ions to move for away from other ,reducing the possibility of interaction, which may further reduce the cohesive forces and ultimately leads to a decrease in internal pressure[11].The variations of V_f with molalities as shown in fig (2) also confirm the structure making nature of the solute in the solvent.

The adiabatic compressibility increases with decrease in molality and rise in temperature [12]as shown in fig (3). When the salt is added to the solvent ,the compressibility is lowered. This lowering is attributed to the influence of the electrostatic field of the ions on the surrounding solvent molecules. such a decrease may be due to (i) an increase in the number of incompressible molecule[13,14,15] (ii) structural changes occurring in the solution .This may be due to the association taking place between the molecules. When the temperature increases, the associated groups of molecules breakdown increasingly and the forces of attraction between the molecules decrease. This leads to an increase in the adiabatic compressibility of the system[16]. The linear increase in specific acoustic impendence with the molalities at a given temperature is observed in the solution as shown in fig (4). This linear increase due to the effect of strong solute-solvent interaction[17]existing in the solutions. The specific acoustic impedance is available as 18.39Rayl at $25^0c^*$of formamide from the literature[18]. In the present investigation ,the inter-molecular free length of solutions is found to decrease with respect to the various molality and increases with temperature. These changes reveal the fact that there is a strong interaction exist between the solute and solvent[19]. When the salt is added to a solvent ,the strength of the interaction increases as intermolecular free length decreases, with the molality changes [20]are shown in the fig (5).

IV. Figures&Tables

TABLE(1) Internal pressure (atms)

Molality(m)	5°c	15°c	25°c	35°c	45°c	55°c
0.001	19448	15828	14076	12895	12087	10933
0.005	19843	16591	14080	12983	12239	10992
0.01	19658	16774	13943	12867	12090	10703
0.015	19779	16493	14002	12934	12117	10786
0.02	19376	16535	13916	12842	11875	10582

TABLE (2)FreeVolume (CC)

Molality(m)	5°c	15°c	25°c	35°c	45°c	55°c
0.001	.0076	0.0150	0.0242	0.0369	0.0557	0.0791
0.005	.0075	0.0140	0.0233	0.0356	0.0517	0.0767
0.01	.0073	0.0138	0.0225	0.0346	0.0489	0.0743
0.015	.0070	0.0133	0.0219	0.0340	0.0480	0.0724
0.02	.0069	0.0130	0.0208	0.0331	0.0473	0.0707

TABLE(3)Adiabatic compressibilityx10^{-11} (cm^2/dynes)

Molality(m)	5°c	15°c	25°c	35°c	45°c	55°c
0.001	3.23	3.28	3.41	3.52	3.62	3.69
0.005	3.19	3.27	3.35	3.45	3.59	3.66
0.01	3.16	3.24	3.32	3.39	3.55	3.61
0.015	3.14	3.22	3.28	3.36	3.51	3.58
0.02	3.13	3.20	3.28	3.33	3.44	3.54

TABLE (4) Specific acoustic impedance (Rayl)

Molality(m	5°c	15°c	25°c *	35°c	45°c	55°c
0.001	18.85	18.65	18.22	17.87	17.55	17.34
0.005	18.96	18.66	18.45	18.02	17.63	17.40
0.01	19.05	18.74	18.54	18.21	17.74	17.53
0.015	19.13	18.85	18.60	18.27	17.84	17.61
0.02	19.15	18.90	18.68	18.36	18.01	17.71

TABLE(5)Intermolecular free length (A^0)

Molality(m)	5°c	15°c	25°c	35°c	45°c	55°c
0.001	1.071	1.106	1.156	1.195	1.231	1.260
0.005	1.065	1.104	1.142	1.184	1.225	1.255
0.01	1.060	1.100	1.134	1.173	1.218	1.247
0.015	1.055	1.095	1.133	1.169	1.211	1.241
0.02	1.054	1.092	1.128	1.164	1.200	1.234

Fig:1 Internal pressure (atms)

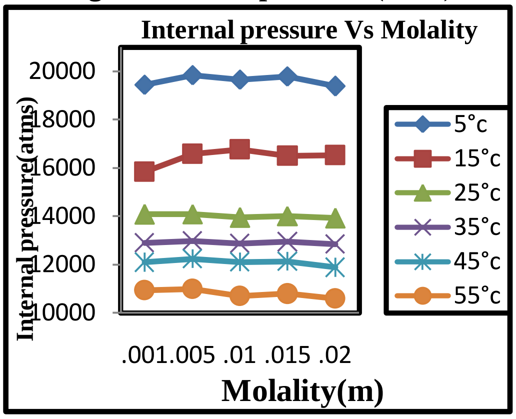


Fig:2 Free Volume (cc)

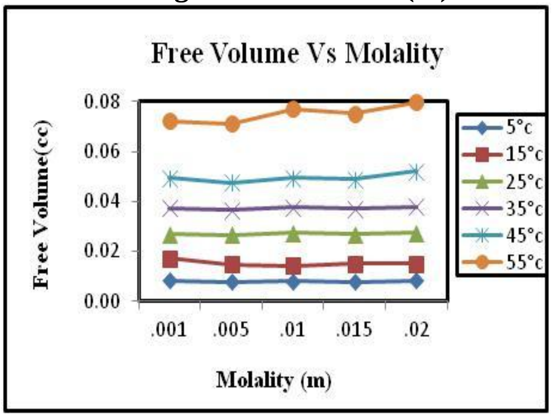


Fig: 3 Adiabatic compressibility (cm^2/dyne)

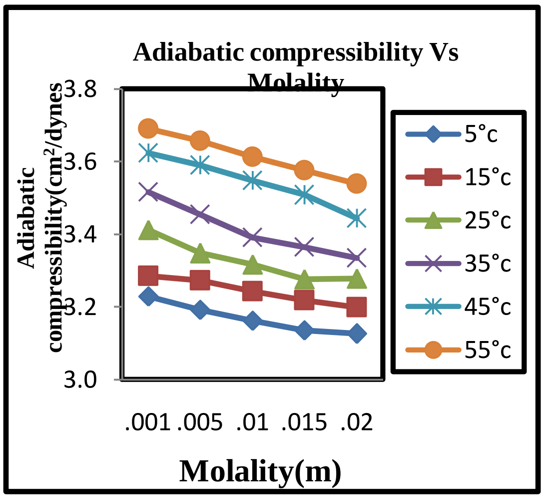


Fig: 4. Specific acoustic impedance (Rayl)

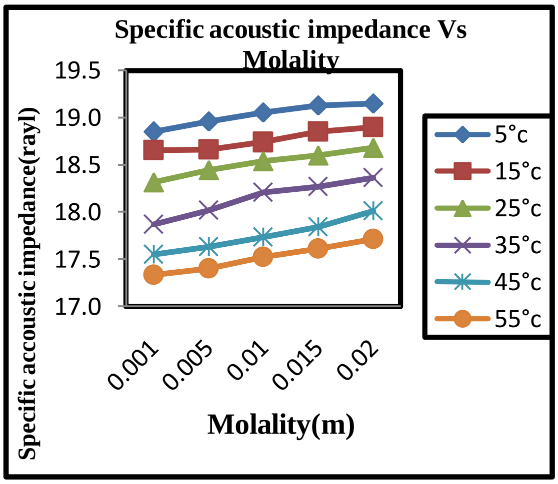
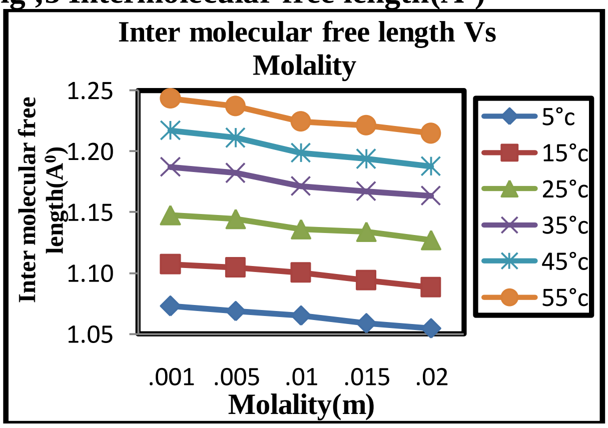


Fig ;5 Intermolecular free length(A^0)



V. Conclusion

Sulfanilamide is a potent antibiotic because this drug undergoes metabolic alterations in tissues [21] .The detailed study of acoustic parameters suggests that there is a molecular association existing between the molecules of the solution. The addition of solute into the solvent brings about a strong solute-solvent interaction in the solution.

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