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Ultrasonic Behviour And Study Of Molecular Interactions Of Chalcone In Dioxane At Different Concentrations And In Different Percentages Of Dioxane- Water Mixture

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Abstract: *Ultrasonic velocity and density measurement of chalcone 3-bromo-2-hydroxy-5- methyl-furyl chalcone(3Br2H5MeFuC) in dioxane-water mixture have been carried out in the concentration range $1x10^{-2}$ - $5x10^{-2}$ mole dm^{-3} and in different percentages of dioxane-water mixtures. The experimental data have been used to calculate various acoustical parameters such as adiabatic compressibility (β_s), apparent molal volume(ϕ_v), apparent molal compressibility($\phi_{k(s)}$), intermolecular free length (L_f), specific acoustic impedence (Z_s) and relative association (R_A). The results have been interpreted in terms of solute-solvent and solute-solute interactions.*

I. Introduction:

The study of molecular interactions on liquids provide valuable information regarding internal structure, molecular association, complex formation, internal pressure etc. Various techniques are there to study them such as NMR, microwave, ultraviolet, and infrared spectroscopy, neutron and X-ray scattering and ultrasonic investigation. Ultrasonic investigation has been the subject of exhaistive research and it finds extensive application in characterizing physico-chemical behaviour and solute-solvent interactions[1]. Recently[2], apparent molal volume, adabatic compressibility, intermolecular free length, specific acoustic impedence and relatve assocation of substituted azoles in N,N-dimethylformaldehide in different concentrations and at different temperatures have been investigated. The present attempt is made to determine the densities and ultrasonic velocities of above ligand in 70% dioxane-water mixtures at fixed concentrations of solute (1x 10^{-2} M) for predicting the solution properties.

II. Experimental:

All the chemical used were of A.R. grade. The solvents were purified by standard procedures. The solute was synthesized by standard methods. Density measurements were made by bicapillary pyknometer. The accuracy in density measuerment was found to be ±0.001 g/ml. The velocity of ultrasonic wave was determined by variable path single crystal interferometer (Mittal Enterprise, Model Mx-3) of 1 MHz with accuracy of ±0.03%. The temperature was maintained at 305K with an accuracy of 0.1.The apparent molal volume (ϕ_v) and apparent molal adiabatic compressibility ($\phi_{k(s)}$) have been determined respectively from density (ds) and adiabatic compressibility (β_s) of solution by using eqs. (1) and (2) respectively.

$$\phi v = \frac{M}{ds} + \frac{[do - ds]\ x\ 10\ 3}{m.do.ds}$$

where d_o and d_s represent densities of solvent and solution respectively, m is the molality of solution and M is molecular weight of solute.

$$\emptyset k(s) = \frac{[\beta s do - \beta o ds] \times 103}{m.do.ds} + \frac{\beta s M}{ds}$$

where βo and βs are adiabatic compressibilities of solvent and solution respectively and are calculated by,

$$\beta s = \frac{1}{U2o.do}, \beta s = \frac{1}{U2s.ds}$$

where Uo and Us are ultrasonic velocities of solvent and solution respectively. The ultrasonic velocity (U) is given by U = λ x Frequency, where λ is wave length of ultrasonic wave. Specific acoustic impedance (Z_s), relative association (R_A) and intermolecular free length (L_f) are the functions of ultrasonic velocity are given by[3] :

Lf = K x $\sqrt{\beta_s}$, where K is Jacobson's constant.

III. Results and Discussion:

In the present investigation different acoustic parameters such as adiabatic compressibility (βs), apparent molal volume (ϕ_v), apparent molal compressibility ($\phi_{k(s)}$) and acoustic impedance (Z_s), relative association (R_A) and intermolecular free length (L_f) of the solutions in different dioxane-water mixture and at different concentrations of solute are determined at 305 K and presented in Table 1.It is observed from the table that the values of β_s decrease with decrease in percentage of dioxane in different percentages of dioxane-water mixture at fixed concentrations of solute (1 x 10^{-2} M) and with increase in concentrations in 70% dioxane-water mixture. The decrease of β_s with increase in concentration of solute may be due to aggregation of solvent molecules around the ions, supporting strong ion-solvent interactions[4].

Table 1

(a) Acoustic Parameters of (3Br2H5MeFuC) in different percentage of dioxane-water mixture

Dioxane (%)	Ultrasonic velocity Us (m/sec) x 10^3	Density d_s (g.m^{-3}) x10^6	Adiabatic compressibility β_s (bar^{-1})x10^{-10}	Intermolecular free length L_f(A^o)x10^2	Apparent molal volume $\emptyset_v$(m^3/mole)x10^{-6}	Apparent molal compressibility $\emptyset_{k(s)}$ (m^{3}mol^{-1}bar^{-1})x10^{-10}	Relative association (R_A)	Specific acoustic impedance Z_s (kg m^{-2}s^{-1})x10^6
100	1.3481	1.0246	5.3711	44.1089	111.86	-11.2926	0.9697	1.3812
90	1.4201	1.0297	4.8162	41.7683	86.38	-16.3000	0.9638	1.4622
80	1.4401	1.4401	4.6680	41.1207	53.87	-19.8200	0.9595	1.4877
75	1.6201	1.6201	3.6282	36.5215	40.95	-1.0190	1.0056	1.6764
70	1.6600	1.6600	3.5042	35.6270	26.03	-32.5930	0.9986	1.7190
60	1.7001	1.7001	3.3335	34.7490	4.348	-6.0962	0.9933	1.7647

(b) Acoustic Parameters of ((3Br2H5MeFuC) in different concentrations of solutein 70% dioxane-water mixture.

Concentration of ligand(m)(mole/dm^3)	Ultrasonic Velocity Us (m/sec) x 10^3	Density d_s (g.m^{-3}) x 10^6	Adiabatic compressibility β_s (bar^{-1}) x 10^{-10}	Intermolecular free length L_f(A_o) x 10^2	Apparent molal volume ϕ_v (m^3 mol^{-1} bar^{-1}) x 10^{-6}	Apparent molal compressibility $\phi_{k(s)}$ (m^{3}mol^{-1}bar^{-1}) x 10^{-10}	Relative association (R_A)	Specific acoustic impedance Z_s (kgm^{-2}s^{-1}) x 10^6
1 x 10^{-2}	1.4921	1.0347	4.3412	39.6552	171.876	5.8836	1.0259	1.5439
2 x 10^{-2}	1.5000	1.0364	4.2882	39.4124	135.207	2.7067	1.0259	1.5546
3 x 10^{-2}	1.5001	1.0380	4.2814	39.3811	123.304	1.7956	1.0274	1.5572
4 x 10^{-2}	1.5041	1.0405	4.2484	39.2290	96.786	1.2688	1.0289	1.5657
5 x 10^{-2}	1.5081	1.0429	4.2164	39.0810	83.910	0.9555	1.0298	1.5727

The negative values of ($\phi_{k(s)}$) at different percentage of dioxane water mixture,can be postulating that polar-OH group interacts with surrounding organic solvent-water mixtures through dipole-dipole interaction in such a way that the surroundind water looses its own compressibility to certain extent.. The values of ($\phi_{k(s)}$) increases with decreases inconcentrations of solute indicating decrease in solute-solvent interactions and increase in electrostrictive solvation of ions. The positive values of ϕ_v at all compositions and percentage of dioxane are showing that the interactions are insensitive to solvent. It is seen that intermolecular free length (L_f) increases with increase in percentage of dioxane indicating weak interaction between ion and solvent molecules. This also implies increase in number of free ions showing ionic dissociation but weak ion-ion interactions. The specific acoustic impedance (Z_s) values decreases with increase in percentage of dioxane. It also supports weak ion-solvent interaction and electrostictive solvation of ion, also the acousticimpedance increases with increase in concentration of solute. The R_A values decreases with decrease in percentage of dioxane.The values of ϕ_v, L_f decreases with increase in concentrations of solute. This may be due to decreasing intermolecular interactions with addition of solute forming aggregate of solvent.

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References :

[1] R.S.Watane and P.B.Raghuwanshi:Der Pharma Chemica,2014, 6(4) 162-168;R.P.Verma and Surendra
[2] Kumar: Indian J. Pure Appl. Phys., 2000,28,96; A. Ali, N. Tiwari, A.K. Nain and V. Chakravort:, Indian J.
[3] Phys., 2000,78B, 351; V.K. Syal, S. Chauhan and Uma Kumari,: Indian J. Pure Appl. Phys., 2005, 43,
[4] 844; A.G. Aswar, P.G. Rohankar and V.R. Choudhar:, Indian J. Chem., Sec.A, 2001,40,860.
[5] A.N.Sonar,N.S.Pawar and M.D.Khairnar:Int.J.Appl.Bio.and Pharrma.tech,2011,2(3),291-295.
[6] 2. eepali P. Gulawade, M.L. Narwade and K.N. Wadodkar,: Indian J. Chem. Sect. A,
[7] 2004,43,2102; Deepali P. Gulwade, M.L. Narwade and S.A. Wadal,: Indian J. Chem.
[8] Sect. A, 2005,44,1183; S.D.Thakur, D.T. Mahajan and M.L. Narwade,: Indian J.
[9] Chem. Soc., 2007,84,480-482.
[10] 3. V. Rajendran,: J.Pure Appl. Ultrason., 1995,17,65.
[11] 4. J. D. Pandey, A. Shukla, R.D. Rai and K.J. Mishra,: J. Chem.Engg. Data, 1989,34,29;
[12] S.D. Thakur, D.T. Mahajan and M.L. Narwade,: Indian J. Chem.Soc., 2007,84,480-
[13] 482.