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“together we can and we will make a difference”

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ABSTRACT

The ultrasonic study of lanthanum chloride confirms that there is a significant interaction between the solute-solvent molecules in aqueous organic acid solution. The effect of atmospheric temperature on the solution of lanthanum chloride was studied with the help of ultrasonic velocity, viscosity and density and other parameters determined by using a single crystal interferometer at 30, 35and 40^{o}C. The main thrust of the study is to correlate the excess properties with the nature of interaction between the mixing components.

Keywords: *Lanthanum Chloride, Acetic Acid, Density Viscosity And Ultrasound Velocity etc.*

INTRODUCTION

Ultrasonic techniques have been used for studying ion solvent interactions in aqueous acetic acid and lanthanum chloride. When aqueous acetic acid is brought in contact with lanthanum chloride, they adhere strongly to the surface the nature of variation of derived acoustic and volumetric properties such as adiabatic compressibility, intermolecular free length, specific acoustic impedance and relative association from ultrasonic measurements at 30^{o}C, 35^{O}C and 40^{o}C[1]. The sign and magnitude these parameter have been used to interpret the experimental results in terms of ion solvent interactions between the components of the mixture.

Experimental

All used chemicals in the experiment are of analytical reagents (AR) grade and comparing with their densities with literature value checked the purity of chemicals[2-4]. The ultrasonic measurements of lanthanum chloride in aqueous acetic acid were carried out with a multi frequency ultrasonic interferometer (model F-18 Mittal Enterprises, New Delhi) at a frequency of 2 MHz the accuracy of velocity measurements is ± 0.05%[5-7].densities of pure liquid and liquid mixtures can be determined from the double walled bicappilary pycknometer[8-9] and viscosity was determined by suspended level cannon unbehlande type viscomiter[10].

Theory and Calculation-

Various acoustic and thermodynamic parameters like Isentropic

compressibility(β_S),intermolecular free length(L_f), specific acoustic impedance(Z), apparent molal compressibility (Φ_K), solvation number(S_n) and relative association (Ra) have been calculated 30,35 and 40^{o}C. Using ultrasonic velocity (U), density (p) and viscosity(η) of these solutions the help of following equations[11].

1. Isentropic Compressibility $(\beta_s) = \dfrac{1}{U^2\rho}$ ……(1)

2. Specific Acoustic Impedance $(Z) = U.\rho$ ……(2)

3. Intermolecular Free Length $(L_f) = K\sqrt{\beta_s}$ ……(3)

4. Relative Association $(R_A) = \dfrac{\rho}{\rho_o}\left[\dfrac{U_o}{U}\right]^{1/3}$ ……(4)

5. Solvation Number $(S_n) = \dfrac{n_1}{n_2}\ \dfrac{(1-\beta_s)}{\beta_{so}}$ ……(5)

6. Apparent Molal Compressibility

$$(\phi_K) = \frac{1000}{C\rho_o}(\rho_o\beta_s - \beta_{so}\rho) + \beta_{so} \frac{M}{\rho_o} \quad \text{......(6)}$$

Where p, p_o and Uo are the densities and ultrasonic velocities of solution and solvent respectively. K is Jacobson Constant, M molecular weight of solute, β_{So} is the isentropic compressibility of solvent, C is concentration in mole/litre. n_1 and n_2 are the number of moles of solvent respectively

Table-1 : Experimental data of lanthanum chloride in acetic acid at 30°C

C Mol/lit	U M/sec	ρ g/cm^3	η c.p.	$\beta_S \times 10^{12}$ cm^2/dyne	L_f A	Z × 10^5 g/s.cm	$\phi_K \times 10^9$ cm^2/dyne	Sn	Ra
0.0491	1496	1.0598	2.2011	42.16	0.0133	0.0159	-1115.45	80.4261	0.3369
0.0981	1499	1.0621	2.2026	41.90	0.0132	0.0159	-541.20	39.6851	0.3369
0.1472	1502	1.0642	2.2036	41.65	0.0131	0.0160	-352.43	26.0305	0.3367
0.1962	1505	1.0668	2.2048	41.39	0.0130	0.0161	-251.76	19.2327	0.3364
0.2453	1508	1.0697	2.2055	41.11	0.0129	0.0161	-196.41	15.0477	0.3361
0.2943	1511	1.0733	2.2068	40.81	0.0129	0.0162	-160.61	12.1818	0.3364
0.3434	1515	1.0769	2.2073	40.46	0.0128	0.0163	-134.51	10.1019	0.3366
0.3924	1518	1.0795	2.2088	40.20	0.0127	0.0164	-112.34	8.5688	0.3365
0.4415	1522	1.0832	2.2095	39.85	0.0126	0.0164	-96.81	7.3040	0.3362
0.4905	1525	1.0869	2.2118	39.56	0.0125	0.0165	-83.67	6.2777	0.3358

Table-2 : Experimental data of lanthanum chloride in acetic acid at 35°C

C Mol/lit	U M/sec	ρ g/cm^3	η c.p.	$\beta_S \times 10^{12}$ cm^2/dyne	L_f A	Z × 10^5 g/s.cm	$\phi_K \times 10^9$ cm^2/dyne	Sn	Ra
0.0491	1465	1.0584	2.1504	44.02	0.0140	0.0155	-1083.27	80.3867	0.3367
0.0981	1468	1.0608	2.1526	43.74	0.0139	0.0156	-528.10	39.6864	0.3368
0.1472	1472	1.0626	2.1545	43.43	0.0138	0.0156	-343.36	26.0637	0.3365
0.1962	1475	1.0649	2.1568	43.16	0.0137	0.0157	-249.99	19.1992	0.3365
0.2453	1478	1.0665	2.1587	42.92	0.0137	0.0158	-191.14	15.0907	0.3363
0.2943	1481	1.0686	2.1606	42.67	0.0136	0.0158	-153.46	12.2915	0.3363
0.3434	1484	1.0703	2.1627	42.43	0.0135	0.0159	-125.38	10.2887	0.3362
0.3924	1488	1.0725	2.1648	42.11	0.0134	0.0160	-107.05	8.6861	0.3359
0.4415	1491	1.0741	2.1668	41.88	0.0133	0.0160	-90.05	7.4800	0.3358
0.4905	1495	1.0768	2.1686	41.55	0.0132	0.0161	-79.76	6.3787	0.3357

Table-3 : Experimental data of lanthanum chloride in acetic acid at 40^{o}C

C Mol/lit	U M/sec	ρ g/cm^3	η c.p.	$\beta_S \times 10^{12}$ cm^2/dyne	L_f A	Z × 10^5 g/s.cm	$\phi_K \times 10^9$ cm^2/dyne	Sn	Ra
0.0491	1424	1.0580	2.1078	46.61	0.0150	0.0151	-1152.74	80.2115	0.3367
0.0981	1427	1.0599	2.1086	46.33	0.0149	0.0151	-557.32	39.5466	0.3366
0.1472	1431	1.0621	2.1095	45.98	0.0148	0.0152	-365.53	25.8820	0.3363
0.1962	1435	1.0638	2.1108	45.65	0.0147	0.0153	-266.86	19.0233	0.3359
0.2453	1438	1.0668	2.1116	45.33	0.0146	0.0153	-210.04	14.8141	0.3362
0.2943	1442	1.0693	2.1128	44.97	0.0144	0.0154	-172.67	11.9579	0.3360
0.3434	1445	1.0716	2.1136	44.69	0.0143	0.0155	-143.31	9.9204	0.3361
0.3924	1448	1.0739	2.1148	44.41	0.0143	0.0156	-121.22	8.3610	0.3361
0.4415	1452	1.0770	2.1155	44.04	0.0141	0.0156	-107.28	7.0434	0.3361
0.4905	1456	1.0803	2.1164	43.66	0.0140	0.0157	-96.44	5.9449	0.3362

RESULTS AND DISCUSSION

The measured properties in experiment like ultrasonic velocity (U), Density (p) and viscosity (η) are shown in table 1, 2 and 3. These data show that these three parameters increases with increase in concentration of lanthanum chloride in solution. This indicates that strong interaction observed at higher concentrations of lanthanum chloride and suggests more association between solute and solvent molecules in the system. The variations of ultrasonic velocity with concentration depend upon the concentration derivatives of density and compressibility. The results indicates that the ultrasonic velocity increases with decrease of intermolecular free length (Table-1) and viseversa[12].intermolecular free length (L_f), which is expected to decrease with mixing of two components, decrease with the increase in lanthanum chloride concentration. Rise in temperature generally increases the internal energy of the system by distorting the local structure, resulting in an increasing in intermolecular free length. The isentropic compressibility of lanthanum chloride solution decreases with increase in solute concentration (Table 1,2 and 3) the decrease in isentropic compressibility is based on the fact that the solute molecules in dilute solution ionize in metal cations and anions, these ionic particles are surrounded by a layer of solvent molecules, firmly bound and oriented towards the ions. The orientation of the solvent molecules around the ions is attributed to the influence of electrostatic field of ions and thus the internal pressure increases which lowers the compressibility of the solution[13]. The elevation of temperature from 30 to40 shows the same trend (Table 1, 2 and 3). Apparent molal compressibility (Φ_K) in each system shown in table (1, 2, 3), it is cleared that apparent molal compressibility has increases with increasing molar concentration. The shows that solvent effect is more dominating than the electrolyte, The specific acoustic impedance is a product of the density of the solution and the velocity has shown the reverse tends to that of intermolecular free length[14]. Thus the fact that increases in molar concentration at these three temperatures. The results indicate that the increase in intermolecular forces with the addition of solute forming aggregates of solvent molecules around solute ions and supports the strong solute-solvent interactions due to structural arrangement affected. Relative association[15] is affected by two factors (i) the breaking of the solvent molecules, (ii) the solvation of ion, the relative association decrease s with increase of concentration in the present investigation. It has been observed that relative association decrease with the concentration of lanthanum chloride but it is increase with the elevation of temperature indicating close association between solute and solvent. Solvation numbers (Sn) are calculated by Pssynsky equation[16-17] and results show that the solvation numbers are found to decrease in solute but it is increase with the elevation of temperature, which also showed close association between solute and solvent.

CONCLUSION

Based on the experimental data, it may be concluded that the ion solvent interaction in the liquid mixture of lanthanum chloride with aqueous acetic acid is significant and this interaction increases with increase in the temperature.

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