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ORIGINAL ARTICLE

Acoustic Properties of Antimony Iodide with Acetone, n-Propanol, n-Butanol

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ABSTRACT

Viscosity (η) density (ρ), ultrasonic velocity (U) intermolecular free length (L_f), molar sound velocity (R), solvation number (S_n) and relative association (R_a) Specific acoustic impedance (Z), isentropic compressibility (β_s), adiabatic compressibility (β) apparent molal compressibility (ϕ_k), and different molal volume ϕ_v The dependent of there properties on Significant Interaction between solute and solvent molecules.

Key words: *Ultrasonic velocity, antimony Iodide, acetone, n-propanol, n-butanol, ultrasonic interferometer, viscometer, solvation number, relative association isentropic compressibility (β_s), adiabatic compressibility (β) Adiabatic compressibility, specific acoustic impedance, Intermolecular free length.*

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INTRODUCTION

Measurement of ultrasonic velocity in aqueous[1,2], pure non-aqueous[3,4] and mixed[5-10], electrolytic solution give information about physico-chemical behaviour of liquid mixture such as molecular association and dissociation mixed[11]. Liquids rather than single pure liquid are of almost practical importance in most chemical and industrial processes as they provide a wide range of mixture of two or more components in varying proportions so as to permit continuous adjustment of the derived properties of the medium. The present paper is an investigation of the behaviour of binary solutions of antimony iodide with acetone, n-propanol, n-butanol with regard to adiabatic compressibility, intermolecular free length, specific acoustic impedance and relative association from ultrasonic measurement at 32ºC. Acoustic an important branch of science deals with the phenomena of sound. It has been termed as science of description, creation and comprehension of human experience. Ultrasound is the branch of acoustic science which deals with phenomena of frequency above the upper audible limit approximately 20,000 cycle/second, ultrasound wave frequencies above these range cannot be perceived by the human ear. The human ear range can perceive a vibration with in a definite range, 16 upto 20,000 cycle/second. The ultra sounds frequencies lie between 20 kilo cps to 500 kilo cycle/second are known as ultrasound waves sound waves with frequencies beyond 20,000 cycle/second are known as supersonic waves can travel through liquid & solids. Corlin (1960)[12]. Clickstlin (1960)[13] and crow & Ford (1955)[14], have made studies in application of low energy ultrasonic waves, low energy vibrations are mainly.

EXPERIMENT

Measurement of acoustic parameters such as ultrasonic velocity, specific acoustic impedance (Z), isentropic compressibility etc. are measured by analytical reagent (AR) grade. The purity of the used chemicals was checked by density determination at 32ºC, the values of density obtained tally with the literature values, Binary liquids mixtures of different known compositions were prepared in airtight-stoppered measuring flask to minimize the leakage of volatile liquids. The weighing was done using electronic balance with precision ± 0.01mg. The double walled bicapillary Pyknometer was used for the measurement of densities of solvents and solution with an accuracy of ± 0.0005gm/cm³. An ubbelohde viscometer, having frequency of 2MHz (Mittal Enterprises, New Delhi, Model: F-81) with an accuracy of ± 0.05%18-19, Detailed of Experimental techniques are given elsewhere[15-17].

THEORY AND CALCULATION

The various thermodynamic parameters such as density (ρ),viscosity (η), ultrasonic velocity (U), Isentropic compressibility (β_s), adiabatic compressibility (β), intermolecular free length (L_f), Specific acoustic impedance (Z), apparent molal compressibility (ϕ_k), solvation number (S_n) and relative association (R_a) have been calculated at 32°C, using of these solutions with the help of following equations.

$$Z = U \times \rho \quad .....(1)$$

$$L_f = K \times \beta^{-1/2} \quad ......(2)$$

$$\beta = U^2 \times \rho^{-1} \quad ......(3)$$

$$R_a = (\rho / \rho^0)(U^0 / U)^{1/3} \quad ......(4)$$

$$S_n = n_1 / n_2 (1 - \beta / \beta^0) \quad ......(5)$$

$$\phi_k = 1000(\rho^0 \beta - \beta^0 \rho) / C\rho^0 + (\beta^0 \times M) / \rho^0 \quad ......(6)$$

Where ρ, ρ^0 and U, U^0 are the densities and ultrasonic velocities of solution and solvent, respectively; K is Jacobson constant; M molecular weight of solute; β^0 and β the adiabatic compressibility of solvent, and solution, C is concentration in mole/Liter; while n_1 and n_2 are the number of moles of solvent and solute, respectively.

Table 1: System–Antimony iodide with acetone = Temp. 32ºC

Cmol/lit	ρ g/cm³	η c.p.	U m/sec	$\beta \times 10^{12}$ cm²/dyne	$Z \times 10^5$ g/s.cm	L_f	R_a	S_n
0.0015	0.7746	0.1409	1158	96.27	0.8918	0.6213	1.0019	1.77
0.0030	0.7736	0.2838	1170	94.18	0.9023	0.6170	1.0022	1.98
0.0046	0.7786	0.4368	1181	92.08	0.9146	0.6051	1.0023	2.03
0.0061	0.7800	0.5778	1190	90.53	0.9282	0.6024	1.0024	2.16
0.0077	0.7810	0.7171	1202	88.62	0.9387	0.6962	1.0026	2.29
0.0092	0.7830	0.8741	1210	87.23	0.9474	0.6915	1.0028	2.42
0.0107	0.7890	0.0237	1220	85.16	0.9624	0.5835	1.0030	2.56
0.0123	0.7906	1.1740	1232	83.37	0.9735	0.5783	1.0032	2.69
0.0138	0.7930	1.3280	1246	81.23	0.9879	0.5708	1.0033	2.82

Table 2: System–Antimoney Iodide with n-propanol = Temp. 32ºC 0.05ºC

Cmol/lit	ρ g/cm³	η c.p.	U m/sec	$\beta \times 10^{12}$ cm²/dyne	$Z \times 10^5$ g/s.cm	L_f	R_a	S_n
0.0030	0.7862	0.0115	1224	84.90	0.9623	0.5836	0.9838	2.6879
0.0060	0.7894	0.0242	1240	82.20	0.9788	0.5748	0.9856	2.7149
0.0090	0.7932	0.0363	1262	79.45	0.1001	0.5635	0.9874	2.7359
0.0120	0.7960	0.0478	1278	76.91	0.1017	0.5554	0.9894	2.7669
0.0150	0.8006	0.0606	1296	74.00	0.1037	0.5462	0.9912	2.7951
0.0180	0.8042	0.0727	1314	71.25	0.1056	0.5374	0.9932	2.8136
0.0211	0.8078	0.0836	1330	68.50	0.1074	0.5295	0.9950	2.8346
0.0241	0.8114	0.0969	1350	65.75	0.1095	0.5193	0.9970	2.8562
0.0271	0.8152	0.1100	1368	63.50	0.1115	0.5104	0.9988	2.8760

Table 3: System–Antimoney Iodide with n-butanol = Temp. 32ºC 0.05ºC

Cmol/lit	ρ g/cm³	η c.p.	U m/sec	$\beta \times 10^{12}$ cm²/dyne	$Z \times 10^{5}$ g/s.cm	L_f	R_a	S_n
0.0025	0.8066	0.0359	1286	74.96	0.1037	0.5483	1.0007	1.0096
0.0050	0.8074	0.0705	1294	73.96	0.1046	0.5447	1.0016	1.0759
0.0075	0.8086	0.1065	1302	72.95	0.1052	0.5409	1.0025	1.1079
0.0100	0.8100	0.1428	1308	92.05	0.1059	0.5376	1.0033	1.1085
0.0125	0.8120	0.1789	1316	75.05	0.1068	0.5339	1.0042	1.1095
0.0150	0.8140	0.2127	1322	70.04	0.1075	0.5300	1.0051	1.1197
0.0175	0.8160	0.2474	1330	69.05	0.1085	0.5263	1.0060	1.1263
0.0201	0.8226	0.2736	1336	68.01	0.1098	0.5223	1.0069	1.1414
0.0226	0.8244	0.3185	1344	67.04	0.1107	0.5186	1.0077	1.1421

RESULT AND DISCUSSION

We have measured ultrasonic parameters as ultrasonic velocity (U), density (ρ). viscosity are given in table 1, 2 and 3. These table shows their three parameters are increases with concentration of antimony iodide this indicate that strong intreaction observed at higher concentration of antimony iodide and suggested more association between solute and solvent molecule in the system. The variation of ultrasound velocity (U) with solute concentration (C) can be expressed in terms of the concentration derivatives of density (ρ) and adiabatic compressibility (β) by the relationship-

$$dU/dC = U/2[1/\rho(dP/dC)+1/\beta(d\beta/dC)]$$

The result indicates that the density increases while the adiabatic compressibility decreases with increasing solute concentration. The adiabatic compressibility is decreases as well as concentration increases of the solute and solvents. These solutions are surrounded by layer of solvent molecule, firmly bound and oriented towards the ions. The orientation of 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 i.e. the solution becomes harder to compress.

The inter molecular (L_f) is extracted to decrease as a result of mixing of the two components decreases with the increases in solute concentration. When inter molecular free length (L_f) decreases while specific acoustic impendence (Z) increases with increase the solute concentration (Table 1, 2 and 3) which can be explained on the basis of lyophobic interaction between the solute and solvent molecule, which increases the intermolecular distance leaving relatively wider gaps between the molecule and thus becoming the main cause impediment to the propagation of ultrasound waves and effect the structural arrangement.

Relative association is influence by two factors (1) the breaking up of the solvent molecules on addition of electrolyte to it and (ii) the solvation of ion that are simultaneously present; the former resulting in a decrease and later increase of relative association. In the present investigation, it has been observed that relative. Solvation number (S_a) are calculated using Passynsky equation and are listed in table (1, 2 and 3). The S_a values are found to increase with the increase in solute, which also suggested close association between solute and solvent.

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