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RESEARCH ARTICLE

AIM: Determine the Ultrasonic Velocity and Related Parameters at Various Temperature in Aromatic Amine with Alcohol

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ABSTRACT

Determine the ultrasonic velocity (U), viscosity (η), density (ρ) of β-naphthylamine in ethanol has been studied at various temperatures and atmospheric pressure by using a single crystal interferometer at frequency of 2MHz. The parameter and concentration were used in calculating Isentropic compressibility (®$_s$), intermolecular free length (L_f), specific acoustic impedance (Z), relative association (R_a), solvation number (S_n), Wadas constant (B) the result indicate that there are significance interaction between solute and solvent.

Key words: *Ultrasonic velocity (U), β-naphthylamine, ethanol, Isentropic compressibility (®$_s$), specific acoustic Impedance (Z), Intermolecular free length (L_f), Wadas constant (B)*

INTRODUCTION

Acoustic deals with the phenomenon of sound in liquid.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 cycles/second, ultrasound wave frequencies above these ranges cannot be perceived by the human ear. The human ear range can perceive a vibration within a definite range, 16 upto 20,000 cycles/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 that can travel through liquid & solids.

Determination of ultrasonic velocity and viscosity of β-naphthylamine in ethanol at various temperatures. The present work will cover both theoretical and practical progress made in the field of ion solvent and solute interaction as well as the development and application of new experimental methods and techniques to the acoustic and discuss properties of β- naphthylamine in ethanol ion solvent interaction[1-10] is always attractive because the solvent molecule can orient their dipole in the direction.

The present paper is an investigation of the behavior of binary solution β-naphthylamine in ethanol with regards Isentropic compressibility (®$_s$), specific acoustic Impedance (Z)] Wadas constant (B), relative association (R_a), solvation number (S_n) from ultrasonic measurement at 30ºC, 35ºC, 40ºC.

EXPERIMENT

All Chemicals were of analytical reagents (AR) grade. The purity of the used chemicals was checked by density determination at 30ºC, 35ºC, 40ºC. The values of density obtained tally with the literature values. Binary liquids mixtures of different known compositions were prepared in airtight-stoppered measuring flasks to minimize the leakage of volatile liquids. The weighting was done using electronic balance with precision ±0.01 mg. The double walled capillary pycnometer was used for the measurement of densities of solvents and solutions[11-13] with an accuracy of ±

0.0005 gm/cm[3]. An ubbelohde viscometer, having frequency of 2 MHz (Mittal Enterprises, New Delhi, Model: F-81) with an accuracy of ± 0.05%[14-15]. Details of experimental techniques are given elsewhere[14-17].

THEORY AND CALCULATION

Determination of different thermodynamic parameters such as ultrasonic velocity (U), density (ρ), viscosity (η), Isentropic compressibility (®$_s$), intermolecular free length (L_f), Specific acoustic impedance (Z), solvation number (S_n) and relative association (R_a), Wadas constant (B) have been calculated at 30ºC, 35ºC, 40ºC using of these solutions with the help of following equations.

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

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

$$\beta s = \frac{1}{V^2 . \rho} \quad ......(3)$$

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

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

$$B = (\overline{M} / \rho) \beta_S^{-1/7} \quad ......(6)$$

Where 〉, 〉^{0} and U, U^0 are the densities and ultrasonic velocities of solution and solvent, respectively; B is Wadas constant; M molecular weight of solute; (®$_s$), is the Isentropic 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: Measured parameters of β-naphthyl Amine in ethanol (temp. 30ºC)

Cmo/lit	ρ g/mole	η c.p.	U m/sec	®$_s$ cm²/dyne.10^{12}	$Z \times 10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.7978	0.0132	1198	87.34	0.9558	0.5896	28.31	1.01	0.30
0.02	0.8088	0.0257	1208	84.73	0.9770	0.5808	28.12	1.02	0.64
0.03	0.8191	0.0382	1218	82.29	0.9977	0.5724	27.95	1.03	1.02
0.04	0.8304	0.0506	1229	79.73	1.0206	0.5634	27.76	1.05	1.45
0.05	0.8416	0.0633	1240	77.28	1.0436	0.5546	27.58	1.06	1.92
0.06	0.8529	0.0754	1251	74.92	1.0670	0.5461	27.40	1.07	2.44
0.07	0.8642	0.0878	1262	72.66	1.0906	0.5378	27.23	1.08	2.98
0.08	0.8456	0.1003	1273	72.98	1.0764	0.5390	27.88	1.09	3.39
0.09	0.8868	0.1126	1284	68.40	1.1387	0.5218	26.89	1.10	4.18
0.10	0.8981	0.1251	1295	66.40	1.1630	0.5141	26.73	1.11	4.82

Table 2: Measured parameters of β-naphthyl Amine in ethanol (temp. 35ºC)

Cmol/lit	ρ g/mole	η c.p.	U m/sec	®$_s$ cm²/dyne.10^{12}	$Z \times 10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.7931	0.0111	1177	91.02	0.9335	0.6072	28.33	1.01	0.04
0.02	0.8015	0.0207	1186	88.70	0.9506	0.5994	28.20	1.01	0.14
0.03	0.8099	0.0306	1195	86.46	0.9678	0.5918	28.08	1.03	0.28
0.04	0.8188	0.0407	1205	84.11	0.9867	0.5837	27.96	1.03	0.48
0.05	0.8280	0.0505	1215	81.81	1.0060	0.5757	27.82	1.04	0.73
0.06	0.8369	0.0605	1225	79.63	1.0252	0.5679	27.70	1.05	1.03
0.07	0.8460	0.0706	1235	77.50	1.0448	0.5603	27.58	1.06	1.37
0.08	0.8552	0.0805	1245	75.44	1.0647	0.5528	27.45	1.07	1.75
0.09	0.8639	0.0902	1255	73.49	1.0842	0.5456	27.34	1.08	2.17
0.10	0.8732	0.1002	1265	71.57	1.1046	05384	27.22	1.09	2.63

Table 3: Measured parameters of β-naphthyl Amine in n-propanol (temp. 40ºC)

Cmol/lit	ρ g/mole	η c.p.	U m/sec	®s cm²/dyne.10¹²	$Z \times 10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.7862	0.0097	1145	97.02	0.9002	0.6328	28.32	1.01	0.03
0.02	0.7916	0.0185	1150	95.52	0.9103	0.6279	28.26	1.01	0.09
0.03	0.7968	0.0273	1155	94.08	0.9203	0.6231	28.21	1.02	0.18
0.04	0.8021	0.0362	1161	92.49	0.9312	0.6179	28.16	1.02	0.31
0.05	0.8074	0.0450	1167	90.94	0.9422	0.6127	28.12	1.03	0.48
0.06	0.8127	0.0539	1173	89.43	0.9533	0.6075	28.07	1.03	0.67
0.07	0.8181	0.0627	1179	87.94	0.9645	0.6024	28.02	1.04	0.89
0.08	0.8233	0.0716	1185	86.50	0.9756	0.6975	27.98	1.04	1.51
0.09	0.8285	0.0804	1191	85.09	0.9867	0.5926	27.93	1.05	1.43
0.10	0.8339	0.0892	1197	83.69	0.9982	0.5877	27.89	1.05	1.74

RESULT AND DISCUSSION

The measurement of acoustic parameters viz. ultrasonic velocity (U), density (〉), viscosity (∣) are given in the table-1, table-2 and table-3. These tables indicate that concentration(C), Isentropic compressibility (®s), Wadas constant (B) parameters increases with increasing concentration of β-naphthylamine this shows that strong interaction observed at higher concentration of β-naphthylamine suggests more association between solute and solvent molecules in the system. The variation of ultrasonic velocity (U) with solute concentration (C) can be expressed in the terms of concentration derivatives of density and Isentropic compressibility (®s).

when the Intermolecular free length(L_f) increases while specific acoustic impedance (Z) decreases with increasing concentration (C) of solute are shows in the table1, table-2,table3 as well as with increase in temperature 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 impediments to the propagation of ultrasound waves and effect the structural arrangements. The specific acoustic impedance, a product of the density of the solution and the velocity has shown the reverse trend to that of Intermolecular free length (L_f). Thus the fact that increasing of velocity as well as Isentropic compressibility (®s) increases in the system, while intermolecular free length (L_f) increases as well as Wadas constant (B) Decreases.

In the system of β-naphthylamine with ethanol shows that the Relative association (R_a) is influence by two factors- (i) The breaking up of solvent molecules on addition of electrolyte to it and (ii) the solvation of ions 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 association values decreases as well as concentration increases. Similar results have been reported in the literature; solvation numbers (S_n) are calculated using the Passynaky equation and are listed in tables. The (S_n) values are found to decrease with the increased solute which also suggested close association between solute and solvent.

REFERENCES

1. Orlega J. and Susial P.: Can. J. Chem. 67, 1120 (1989).
2. Jain DVS and Dhar N.S.: Ind. J. Tech. 30, 630 (1992).
3. Singh S., Prasad N., Kushwaha M., Sivanarayan K. and Prakesh S.: Ind. J. Pure & Appl. Phys. 18, 254 (1980)
4. Rattan V.K., Sukhmehar S. and Rajni M.C.: Ind. J. Tech., 31, 37 (1993).
5. Reddy M.A.: J. Acoust. Soc. India, 24VIII, 1980
6. Hemmes P., Mayerki A.A., Buckin V.A. and Sarvazyn: J. Phy. Chem. 84, 699 (1980).
7. Singh A. and Saxcena M.V.: J. Mole Liq., 25, 81 (1982).
8. Prasad R.: Ind J. Phys. 19(1945)47.
9. Gupta M., Chauhan M. and Shukla J.P.: Adv. mole Relax Int. Process, (1981).

10. Saxcena S.K. and Saxcena M.C.: Ind. J. Pure & Appl. Phys. 19, 550 (1981).
11. A.K. Gupta, G.K. Yadav and K. Krishna: J. Ind. Council Chem. 17, 32 (2004).
12. R. Mehra and A.K. Gaur: J. Chem. Engg. Data. 53, 683 (2008).
13. A.K. Dash and R. Paikaray: Acoustical study in binary liquid mixture containing dimethyl acetamide using ultrasonic and viscosity probes. Der chem. Sinica, 5(1): 81-88 (2014).
14. Rohankar P.G. and Aswar: Ind. J. Chem. 41A, 312 AS (2002).
15. Das D., Ray S.K. and Hazra K.K.: Ind. J. Chem. 41A, 1812 (2002).
16. Sacco A. and Giglio A.D.: Z. Phys. Chem. N.F., 136, 145 (1983) Dell Att., A. & Lawrence
17. Saxcena, Indu Kumar and Vijay Devi Rikkam: Determination and Density of solvent mixture by magnetic float densitometer and study value change and some acoustical parameters from ultrasonic velocity, Golden Research Through 2015, 4(9): 1-12.