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RESEARCH ARTICLE

Ultrasonic Velocity and Thermodynamic Behaviour of α-Naphthylamine with n-Praponol

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ABSTRACT

Measurement of viscosity (η) density (ρ), ultrasonic velocity (U) of α-naphthylamine in n-propanol have been studies at various temperatures and atmosphere pressure by using a single crystal interferometer at frequency of 2MHz. The parameter and concentration were used to calculating Isentropic compressibility (β_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), α-naphthylamine, n-propanol, Isentropic compressibility (β_s), specific acoustic Impedance (Z), Intermolecular free length (L_f), Wadas constant (B)*

INTRODUCTION

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.

The present paper is an investigation of the behaviour of binary solution α-naphthylamine in n-propanol with regards Isentropic compressibility (β_s), specific acoustic Impedance (Z)] Wadas constant (B), relative association (R_a), solvation number (S_n) from ultrasonic measurement at 30ºC, 35ºC, 40ºC.

Determination of ultrasonic velocity and viscosity of α-naphthylamine in n-propanol at various temperature 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 α-naphthylamine in n-propanol ion solvent interaction[1-10] is always attractive because the solvent molecule can orient their dipole in the direction.

EXPERIMENT

Determination of acoustic parameters we used analytical reagent (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 flask to minimize the leakage of volatile liquids. The weighting was done using electronic balance with precision ±0.01 mg. The double walled bicapillay pyknometer was used for the measurement of densities of solvents and solutions[12-13] 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]. Detailed of experimental techniques are given elsewhere[16-17].

THEORY AND CALCULATION

Determination of thermodynamic parameters such as density (ρ), viscosity (η), ultrasonic velocity (U), Isentropic compressibility (β_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.

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

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

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

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

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

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

Where ρ, ρ^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; β_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 α-naphthyl Amine in n-propanol (temp. 30ºC)

Cmo/lit	ρ g/mole	η c.p.	U m/sec	β_s cm²/dyne.10¹²	$Z\times10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.8191	0.0047	1227	81.09	1.0050	0.5682	39.70	1.01	0.28
0.02	0.8278	0.0088	1241	78.44	1.0273	0.5588	39.51	1.01	1.07
0.03	0.8365	0.0130	1250	76.51	1.0456	0.5519	39.27	1.02	2.14
0.04	0.8452	0.0171	1259	74.64	1.0641	0.5451	39.05	1.03	3.56
0.05	0.8539	0.0213	1261	73.65	1.0768	0.5415	38.76	1.04	4.92
0.06	0.8626	0.0254	1269	71.99	1.0946	0.5353	38.54	1.05	6.84
0.07	0.8713	0.0250	1278	70.27	1.1135	0.5289	38.32	1.06	9.11
0.08	0.8800	0.0337	1287	68.61	1.1326	0.5226	38.11	1.07	11.67
0.09	0.8887	0.0378	1296	66.99	1.1518	0.5164	37.91	1.07	14.49
0.10	0.8974	0.0415	1305	65.43	1.1711	0.5104	73.30	1.08	17.57

Table 2: Measured parameters of α-naphthyl Amine in n-propanol (temp. 35ºC)

Cmol/lit	ρ g/mole	η c.p.	U m/sec	β_s cm²/dyne.10¹²	$Z\times10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.7972	0.0043	1205	86.39	0.9606	0.5915	40.43	1.01	0.02
0.02	0.8028	0.0080	1211	94.94	0.9722	0.5866	40.29	1.01	0.07
0.03	0.8078	0.0116	1217	83.58	0.9831	0.5819	40.17	1.02	0.15
0.04	0.8163	0.0154	1223	82.17	0.9950	0.5769	40.03	1.02	0.25
0.05	0.8194	0.0129	1230	80.67	1.0079	0.5716	39.89	1.03	0.38
0.06	0.8252	0.0228	1237	79.20	1.0208	0.5664	39.76	1.03	0.54
0.07	0.8310	0.0264	1244	77.76	1.0338	0.5612	39.62	1.04	0.72
0.08	0.8368	0.0301	1251	76.36	1.0468	0.5561	39.49	1.04	0.92
0.09	0.8426	0.0338	1257	75.11	1.0591	0.5516	39.35	1.05	1.14
0.10	0.8484	0.0375	1264	73.77	1.0724	05467	39.23	1.05	1.39

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

Cmol/lit	ρ g/mole	η c.p.	U m/sec	β_s cm²/dyne.10¹²	$Z\times10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.7868	0.0037	1182	90.97	0.9300	0.6123	40.67	1.00	0.02
0.02	0.7902	0.0067	1188	89.67	0.9388	0.6079	40.62	1.01	0.06
0.03	0.7932	0.0097	1193	88.58	0.9463	0.6042	40.58	1.01	0.12
0.04	0.7969	0.0126	1199	87.29	0.9555	0.5998	40.52	1.01	0.21
0.05	0.8006	0.0156	1205	86.02	0.9447	0.5954	40.46	1.02	0.32
0.06	0.8083	0.188	1211	84.78	0.9740	0.5911	40.40	1.02	0.44
0.07	0.8080	0.217	1217	83.56	0.9833	0.5868	40.35	1.02	0.59
0.08	0.8117	0.247	1223	82.37	0.9927	0.5826	40.29	1.02	0.76
0.09	0.8154	0.276	1229	85.19	1.0021	0.5784	40.23	1.03	0.95
0.10	0.8191	0.306	1235	80.04	1.0116	0.5743	40.17	1.03	1.16

RESULT AND DISCUSSION

The determination of acoustic parameters viz. ultrasonic velocity (U), density (ρ), viscosity (η) are given in the table 1, 2 and 3. These travels shows that some parameters increases with increasing concentration of α-naphthylamine this indicates that strong interaction observed at higher concentration of α-naphthylamine and suggested more association between solute and solvent molecule in the system. The variation of ultrasonic velocity (U) with solute concentration (C) can be expressed in the term of concentration derivatives of density and Isentorpic compressibility (β_s).

The Intermolecular free length increases while specific acoustic impedance (Z) decreases with increasing concentration (C) of solute are shows in the tables 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 (β_s) increases in the system, while intermolecular free length (L_f) increases as well as Wadas constant (B) Decreases.

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 number (S_n) are calculated using Passynaky equation and are listed in tables. The (S_n) values are found to decrease with the increase solute which also suggested close association between solute and solvent.

REFERENCES

1. Hemmes P., Mayerki A.A., Buckin V.A. and Sarvazyn (1980): J. Phy. Chem. 84, 699.
2. Singh A. and Saxcena M.V. (1982): J. Mole Liq., 25, 81.
3. Prasad R. (1945): Ind J. Phys. 19: 47.
4. Gupta M., Chauhan M. and Shukla J.P. (1981): Adv. mole Relax Int. Process.
5. Saxena S.K. and Saxena M.C. (1981): Ind. J. Pure & Appl. Phys. 19, 550.
6. Orlega J. and Susial P. (1989): Can. J. Chem. 67, 1120.
7. Jain D.V.S. and Dhar N.S. (1992): Ind. J. Tech. 30, 630.
8. Singh S., Prasad N., Kushwaha M., Sivanarayan K. and Prakesh S. (1980): Ind. J. Pure & Appl. Phys. 18, 254.
9. Rattan V.K., Sukhmehar S. and Rajni M.C. (1993): Ind. J. Tech., 31, 37.
10. Reddy M.A. (1980): J. Acoust. Soc. India, 24VIII.
11. Rohankar P.G. and Aswar (2002): Ind. J. Chem. 41A, 312 AS.
12. Das D., Ray S.K. and Hazra K.K. (2002): Ind. J. Chem. 41A, 1812.
13. Sacco A. and Giglio A.D. (1983): Z. Phys. Chem. N.F., 136, 145, Dell Att., A. & Lawrence.
14. Saxcena, Indu Kumar and Vijay Devi Rikkam (2015): Determination and Density of solvent mixture by magnetic float densitometer and study value change and some acoustical parameters from ultrasonic velocity, Golden Research Through, 4(9): 1-12.
15. Gupta A.K., Yadav G.K. and Krishna K. (2004): J. Ind. Council Chem. 17, 32.
16. Mehra R. and Gaur A.K. (2008): J. Chem. Engg. Data. 53, 683.
17. Dash A.K. and Paikaray R. (2014): Acoustical study in binary liquid mixture containing dimethyl acetamide using ultrasonic and viscosity probes. Der chem. Sinica, 5(1): 81-88.