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ORIGINAL ARTICLE

Acoustic and Viscous Study of Aromatic Amine with Organic Solvent (Methanol)

Mahendra Singh and M.K. Sharma
Department of Chemistry, Agra College Agra, U.P.
Email: mahendrasinghyadav000@gmail.com

ABSTRACT

Wind is emerging as one of the most potential source of alternate energ Viscosity (η) density (ρ), ultrasonic velocity (U) of p-toludine in methanol have been studies at 30º, 35º, 40ºC 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), p-toludine, methanol, isentropic compressibility (β_s), specific acoustic impedance (Z), intermolecular free length (L_f), Wadas constant (B).*

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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.

Determination of ultrasonic velocity and viscosity of p-toludine in methanol at various temperature 30ºC, 35ºC, 40ºC. 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 p-toludine in methanol ion solvent interaction[1-12] is always attractive because the solvent molecule can orient their dipole in the direction.

The present paper is an investigation of the behaviour of binary solution of p-toludine in methanol with regards isentropic compressibility (β_s), specific acoustic impedance (Z) and relative association (R_a), solvation number (S_n) from ultrasonic measurement at 30ºC, 35ºC, 40ºC.

EXPERIMENT

All chemical were used of 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[13-14] 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%[15-16]. Detailed of experimental techniques are given elsewhere[17].

THEORY AND CALCULATION

Different 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 30^{o}C, 35ºC, 40ºC using of these solutions with the help of following equations.

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

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

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

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

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

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

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^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: Measured parameters of p-toludine with methanol (temp. 30ºC)

Cmo/lit	ρ g/mole	η c.p.	U m/sec	β_s cm^2/dyne.10^{12}	$Z \times 10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.7972	0.1243	1108	102.18	0.8833	0.6378	21.08	1.02	0.04
0.02	0.8171	0.2470	1118	98.56	0.9075	0.6264	20.85	1.03	0.14
0.03	0.8248	0.3697	1128	95.29	0.9304	0.6159	20.66	1.04	0.28
0.04	0.8391	0.4926	1139	91.86	0.9557	0.6047	20.45	1.06	0.48
0.05	0.8583	0.6151	1150	88.10	0.9870	0.5922	20.15	1.08	0.75
0.06	0.8675	0.7379	1161	85.52	1.0072	0.5835	20.06	1.09	1.03
0.07	0.8817	0.8606	1172	82.57	1.0334	0.5733	19.87	1.10	1.36
0.08	0.8959	0.9833	1183	79.76	1.0598	0.5635	19.69	1.12	1.37
0.09	0.9101	1.0543	1194	77.07	1.0867	0.5539	19.51	1.13	2.14
0.10	0.9243	1.1256	1205	74.51	1.1138	0.5446	19.34	1.14	2.57

Table 2: Measured parameters of p-toludine with methanol (temp. 35ºC)

Cmol/lit	ρ g/mole	η c.p.	U m/sec	β_s cm^2/dyne.10^{12}	$Z \times 10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.7918	0.0904	1080	108.28	0.8551	0.6623	21.05	1.01	0.03
0.02	0.8007	0.1793	1090	105.12	0.8728	0.6525	20.94	1.02	0.11
0.03	0.8091	0.2682	1100	102.14	0.8900	0.6425	20.84	1.03	0.22
0.04	0.8184	0.3570	1111	98.99	0.9092	0.6332	20.74	1.03	0.38
0.05	0.8277	0.4459	1122	95.97	0.9287	0.6235	20.63	1.04	0.58
0.06	0.8370	0.5348	1133	93.07	0.9483	0.6140	20.52	1.05	0.82
0.07	0.8463	0.6237	1144	90.29	0.9682	0.6047	20.42	1.06	1.09
0.08	0.8556	0.7126	1155	87.61	0.9882	0.5957	20.32	1.07	1.39
0.09	0.8649	1.8014	1166	85.04	1.0085	0.5859	20.22	1.08	1.72
0.10	0.8742	1.7903	1177	82.57	1.0289	0.5783	20.12	1.09	2.08

Table 3: Measured parameters of p-toludine with methanol (temp. 40ºC)

Cmol/lit	ρ g/mole	η c.p.	U m/sec	β_s cm²/dyne.10¹²	$Z \times 10^5$ g/s.cm	L_f (A)	Wadas constant (B)	R_a	S_n
0.01	0.7851	0.0718	1046	116.42	0.8212	0.6856	21.02	1.00	0.03
0.02	0.7901	0.1426	1053	114.15	0.8320	0.6789	20.99	1.01	0.09
0.03	0.7949	0.2124	1060	111.96	0.8426	0.6724	20.96	1.01	0.18
0.04	0.8002	0.2831	1068	109.56	0.8546	0.6651	20.92	1.02	0.31
0.05	0.8057	0.3535	1076	107.20	0.4669	0.6579	20.88	1.02	0.47
0.06	0.8111	0.4200	1084	104.92	0.8792	0.6509	20.85	1.03	0.65
0.07	0.8164	0.4943	1092	102.57	0.8915	0.4446	20.82	1.03	0.87
0.08	0.8219	0.5648	1100	100.55	0.9041	0.6372	20.78	1.03	1.12
0.09	0.8273	0.6352	1108	98.46	0.9166	0.6305	20.74	1.04	1.39
0.10	0.8327	0.7050	1121	95.57	0.9335	0.6212	20.73	1.04	1.75

RESULT AND DISCUSSION

The measured 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 p-toludine this indicates that strong interaction observed at higher concentration of p-toludine 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 decreases with increasing concentration of solute are shows in the tables which can be explained on the basis of lyphobic 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. Thus the fact that increase of velocity as well as isentropic compressibility increases in the system, while intermolecular free length 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.

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