Annals of Natural Sciences
Vol. 6(1), March 2020: 22-25
Journal's URL: http://www.crsdindia.com/ans.html
Email: crsdindia@gmail.com

e-ISSN: 2455-667X

Annals of Natural Sciences

ORIGINAL ARTICLE

Ultrasonic Velocity and Related Parameter of Coniine with Alcohols

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ABSTRACT

Ultrasound velocity (U) density (ρ), viscosity (η) of Coniine with methanol and ethanol have been studies at various temperatures and atmosphere pressure by using a single crystal interferometer at frequency of 2MHz. The parameters and calculations were used to calculating Isentropic compressibility (β_s), intermolecular free length (L_f), specific acoustic impedance (Z), Molar volume (V_m) Wadas constant (B), Shear's relaxation time (τ_s) and other related parameters.

Key words: *Ultrasonic velocity (U), Coniine (methanol and ethanol), Isentropic compressibility (β_s), specific acoustic Impedance (Z), Intermolecular free length (L_f), Molar volume (V_m), Chear's relaxation time (τ_s), Wadas constant (B).*

Received: 24th Jan. 2020, Revised: 10th Feb. 2020, Accepted: 16th Feb. 2020

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How to cite this article:
Singh M. (2020): Ultrasonic Velocity and Related Parameter of Coniine with Alcohols. Annals of Natural Sciences, Vol. 6[1]: March, 2020: 22-25.

INTRODUCTION

Ultrasonic studies find extensive applications in characterizing aspects of the physico-chemical behaviour of liquid mixtures such as molecular interactions, association and dissociation. Study of propagation of ultrasonic waves in liquids is a well-known and established method for the study of physical properties of media.

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 of Coniine with methanol and ethanol with regards Isentropic compressibility (β_s), specific acoustic Impedance (Z), Wadas constant (B), Molar volume (V_m), Shear's relaxation time (τ_s) from ultrasonic measurement at 30ºC and 35ºC.

Determination of ultrasonic velocity and viscosity of Coniine in methanol and 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 Coniine in methanol and ethanol ion solvent interaction[1-10] is always attractive because the solvent molecule can orient their dipole in the direction.

EXPERIMENT

Measurement of acoustic parameters we used analytical reagent (AR) grade. The purity of the used chemicals was checked by density determination at 30ºC and 35ºC. 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[11-12] with an accuracy of ± 0.0005 gm/cm³. An ubbelohde viscometer, having frequency of 2 MHz (Mittal Enterprises, New Delhi, Model: F-81) with an accuracy of ± 0.05%[13-14]. Detailed of experimental techniques are given elsewhere[15-16].

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), Wadas constant (B), Molar volume (V_m) and Shear's relaxation time (τ_s) have been calculated at 30ºC and 35ºC using of these solutions with the help of following equations.

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

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

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

$$\tau_s = \frac{4}{3}.\eta.\beta_s \quad ......(4)$$

$$B = \left(\overline{M}/\rho\right)\beta s^{-1/7} \quad ......(5)$$

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 and τ_s Shear's relaxation time.

Table 1: Measure parameters of Coniine with methanol at 30ºC

Mole fraction of Coniine	Ultrasound velocity m/sec.	Density gm/mole	Specific acoustic impedance (C.G.S.). 10^{-5}	Isentropic compressibility (β_s)	Molar volume mol/mole	Intermolecular free length (Aº)	Viscosity (C.P.)	Wada constant (B)	Shear's relaxation time $(\tau s \times 10^{-11})$
0.0000	1092	0.7816	0.8535	107.29	40.99	0.6536	0.5270	21.0197	0.7539
0.1599	1118	0.8164	0.9127	98.00	57.85	0.6246	0.7261	30.0491	0.9487
0.2999	1150	0.8364	0.9619	90.40	72.36	0.5999	0.9047	38.0203	1.0906
0.4234	1180	0.8556	1.0096	83.94	84.44	0.5781	1.0599	44.8432	1.1862
0.5332	1209	0.8718	1.0540	78.47	94.83	0.5589	1.1959	50.8481	1.2513
0.6315	1235	0.8891	1.0980	73.74	103.48	0.5418	1.3061	55.9808	1.2842
0.7199	1262	0.9019	1.1382	69.62	111.32	0.5264	1.3960	60.7207	1.2958
0.7999	1289	0.9119	1.1754	66.00	118.43	0.5126	1.4696	65.0944	1.2933
0.8727	1316	0.9183	1.2085	62.88	125.13	0.5003	1.5333	69.2533	1.2855
0.9391	1341	0.9265	1.2424	60.02	130.83	0.4888	1.5926	72.8714	1.2745
1.0000	1359	0.9394	1.2766	57.64	135.19	0.4790	1.5864	75.7571	1.2192

Table 2: Measure parameters of Coniine with methanol at 35ºC

Mole fraction of Coniine	Ultrasound velocity m/sec.	Density gm/mole	Specific acoustic impedance (C.G.S.). 10^{-5}	Isentropic compressibility (β_s)	Molar volume mol/mole	Intermolecular free length (Aº)	Viscosity (C.P.)	Wada constant (B)	Shear's relaxation time $(\tau s \times 10^{-11})$
0.0000	1068	0.7789	0.8319	112.56	41.13	0.6752	0.4742	20.9487	0.7117
0.1599	1097	0.8057	0.8839	103.14	58.62	0.6464	0.6664	30.2266	0.9164
0.2999	1122	0.8366	0.9387	94.95	72.34	0.6202	0.8402	37.7458	1.0637
0.4234	1152	0.8548	0.9847	88.15	84.52	0.5976	0.9937	44.5723	1.1679
0.5332	1185	0.8649	1.0249	82.34	95.59	0.5775	1.1290	50.9031	1.2394
0.6315	1213	0.8786	1.0657	77.35	104.72	0.5598	1.2365	56.2640	1.2754
0.7199	1240	0.8910	1.1048	72.99	112.68	0.5437	1.3243	61.0493	1.2889
0.7999	1268	0.8992	1.1402	69.17	120.11	0.5293	1.3952	65.5732	1.2867
0.8727	1293	0.9091	1.1755	65.79	126.40	0.5162	1.4590	69.5026	1.2800
0.9391	1321	0.9136	1.2069	62.72	132.68	0.5041	1.5209	73.4567	1.2720
1.0000	1343	0.9216	1.2377	60.16	137.80	0.4936	1.5790	76.7494	1.2666

Table 3: Measure parameters of Coniine with ethanol at 30ºC

Mole fraction of Coniine	Ultrasound velocity m/sec.	Density gm/mole	Specific acoustic impedance (C.G.S.).10^{-5}	Isentropic compressibility (β_s)	Molar volume mol/mole	Intermolecular free length (Aº)	Viscosity (C.P.)	Wada constant (B)	Shear's relaxation time $(\tau s \times 10^{-11})$
0.0000	1182	0.7841	0.9268	91.28	53.74	0.6028	1.7220	28.2012	2.0959
0.2509	1208	0.8374	1.0116	81.83	75.74	0.5708	1.7260	40.3712	1.8833
0.4297	1244	0.8589	1.0685	75.23	91.52	0.5473	1.7427	49.3675	1.7482
0.5636	1272	0.8749	1.1129	70.64	1102.83	0.5303	1.7536	55.9737	1.6517
0.6677	1292	0.8897	1.1495	67.33	111.05	0.5177	1.7485	60.8606	1.5697
0.7509	1308	0.9016	1.1793	64.83	117.41	0.5080	1.7302	64.6971	1.4956
0.8189	1321	0.9124	1.2053	62.81	122.25	0.5000	1.7000	67.7224	1.5236
0.8755	1334	0.9789	1.2270	61.09	126.59	0.4932	1.6673	70.3474	1.3581
0.9234	1346	0.9248	1.2448	59.68	130.30	0.4874	1.6378	72.6515	1.3033
0.9644	1352	0.9348	1.2638	58.52	132.63	0.4827	1.6082	74.1595	1.2549
1.0000	1359	0.9394	1.2766	57.64	135.19	0.4790	1.5864	75.7571	1.2192

Table 4: Measure parameters of Coniine with ethanol at 30ºC

Mole fraction of Coniine	Ultrasound velocity m/sec.	Density gm/mole	Specific acoustic impedance (C.G.S.). 10^{-5}	Isentropic compressibility (β_s)	Molar volume mol/mole	Intermolecular free length (Aº)	Viscosity (C.P.)	Wada constant (B)	Shear's relaxation time $(\tau s \times 10^{-11})$
0.0000	1169	0.7915	0.9253	92.45	53.24	0.6120	1.5415	27.8868	1.9002
0.2509	1212	0.8149	0.9877	83.54	77.84	0.5817	1.5677	41.3638	1.7462
0.4297	1241	0.8398	1.0422	77.32	93.60	0.5596	1.6063	50.2937	1.6560
0.5636	1265	0.8567	1.0837	72.94	105.02	0.5436	1.6351	56.9016	1.5903
0.6677	1283	0.8708	1.1172	69.76	113.46	0.5316	1.6471	61.8673	1.5321
0.7509	1302	0.8768	1.1416	67.28	120.73	0.5220	1.6446	66.1755	1.4752
0.8189	1214	0.8872	1.1658	65.28	125.82	0.5142	1.6283	69.2626	1.4172
0.8755	1325	0.8952	1.1861	63.63	130.07	0.5077	1.6101	71.8620	1.3660
0.9234	1332	0.9059	1.2067	62.22	133.02	0.5020	1.5940	73.7282	1.3223
0.9644	1338	0.9142	1.2232	61.10	135.62	0.4975	1.5874	75.3651	1.2932
1.0000	1343	0.9216	1.2377	60.14	137.80	0.4936	1.5790	76.7494	1.2666

RESULT AND DISCUSSION

The determination of ultrasonic velocity (U), density (ρ), viscosity (η) and relative acoustic parameters are given in the table 1, 2, 3 and 4. These travels shows that some parameters ultrasonic velocity (U), density (ρ), acoustic Impedance (Z), Isentropic compressibility (β_s), intermolecular free length (L_f), Wada constant (B), Shear's relaxation times (τ_s) are increases with increasing concentration of Coniine this indicate that strong interaction observed at higher concentration of Coniine 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 also specific acoustic impedance (Z) increases 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 viscosity has shown the same 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 but Shear's relaxation times (τ_s) decreases as well as concentration increases.

The other computed parameters like as Wada's constant and Shear's relaxation time are reported on the table 1 to 4. Wada constant increases on increasing mole fraction of Coniine while Shear's relaxation times decreases on increasing mole fraction of Coniine.

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