Intermolecular Interaction Of Phenolic Compound By Ultrasonic Measurements

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***Abstract*— Recently ultrasonic velocity and density for solutions of 4-(p-chloro)phenylthio carbamidophenol (PTP) at different molar concentrations and 303 K, in 80% compositions ethanol-water mixtures was investigated for determination of adiabatic compressibility (β), apparent molal compressibility (ϕ_k), apparent molal volume (ϕ_v), intermolecular free length (L_f), relative association (R_A) and specific acoustic impedance (Z). These properties were studied to solute-solute and solute-solvent interaction in solvent, which provide important and versatile information regarding internal structure, molecular association.**

***Key words*—4-(p-Chloro)phenylthiocarbamidophenol (PTP), interferometric measurements, solute-solvent interactions.**

I. INTRODUCTION

Since last five decades it was observed that many evolutions and new concepts in engineering, applied, industrial, mechanics, agricultural, medicinal, forensic sciences and space research were developed and updated through ultra sound and ultrasonic wave's measurements. Ultrasonic is a branch of science, which deals with waves of high frequencies. Ultrasonic technique is used for the study of molecular interaction in liquids. During designing and working of any type of machine various frictions and use of solvent must be consider by mechanical engineer. It was also observed various phenolic analogues were used in various engineering sciences and created their own identity and importance in applied, industrial and life sciences. The study of molecular interactions in liquids phase provides valuable information regarding internal structure, molecular association, complex formation, internal pressure and stability[1]. Ultrasonic parameters are extensively used to study molecular interactions in pure solute[2-4], liquid mixture[5-6] and electrolyte solution[7-9]. Aswale et al[10] investigated the comparative study of intermolecular interaction by inteferometric measurements of α-bromoacetophenones and cumaran-3-ones in ethanol and dioxan solvents. Acoustical studies on ternary mixture of toluene in cyclohexane and nitrobenzene at 308 K was studied[11]. Ultrasonic velocity and density of binary liquid mixture of diethyl ether with three non-polar solvents such as CCl_4, CS_2 and C_6H_6 at 303.15K were investigated[12].

Now-a-days dynamic studies in the research of ultrasonic are continuously going on due to its gigantic scope in applied and biological sciences. Taking all these things into consideration, the present investigation was carried out for the determination of ultrasonic velocity and density for solutions of PTP at different molar concentrations and 303 K, in 80% compositions ethanol-water mixtures and adiabatic compressibility (β), apparent molal compressibility (ϕ_k), apparent molal volume (ϕ_v), intermolecular free length (L_f), relative association (R_A) and specific acoustic impedance (Z) were determined/

II. MATERIALS AND METHODS

AR grade chemicals were used during present investigation. Freshly prepared solution used during study. The solvents were purified by standard method. 0.1M, 0.075M, 0.050M and 0.025M solutions of PTP in 80% ethanol-water mixture were prepared. Ethanol was purified by standard procedure[13]. Densities were measured with the help of bicapillary pyknometer (10.1 % kg m^{-3}). Pyknometer used is of Borosil make, Weighing were made on Citizen CY 104 one pan digital balance (± 0.0001 gm). A special thermostatic arrangement was done for density and ultrasonic velocity measurements. Elite thermostatic bath was used, in which continuous stirring of water was carried out with the help of electric stirrer and temperature variation was maintained within ± 0.1 ^{0}C. The speed of sound waves was obtained by using variable path, Single crystal interferometer (Mittal Enterprises, Model MX-3) with accuracy ± 0.03% and frequency 1 MHz was used in the present work. The densities and ultrasonic velocity of liquids in ethanol solvent were measured at 303 K for the calculation of intermolecular free length and the value of Jacobson's constant[14] (K = 631) was taken.

III. RESULTS AND DISCUSSION

In the present investigation measurement of densities and ultrasonic velocities of PTP in 80% ethanol-water mixture had been carried out and given in Table No.1

Table-1: Average Ultrasonic Velocity of Water at 303 K.

Sr. No.	*No. of Rotation of Screw*	*Micrometer Reading (mm)*	*Difference Between Reading (mm)*	*Distance Travelled By Screw in One Rotation*	*Average Ultrasonic Velocity (m/sec)*
1	5	26.4705	1.6105	0.61465	
2	10	24.8642	5.5300	2.18285	
3	15	19.3372	3.0708	1.20041	
4	20	16.2664	4.4071	1.73277	1398.708956
5	25	11.8593	4.5219	1.78301	
6	30	7.3374	4.0715	1.6004	
7	35	3.2659	2.0059	1.17213	
8	40	1.2663		10.45377	

Table-2: Average Ultrasonic Velocity of ethanol at 303 K.

Sr. No.	*No. of Rotation of Screw*	*Micrometer Reading (mm)*	*Difference Between Reading (mm)*	*Distance Travelled By Screw in One Rotation*	*Average Ultrasonic Velocity (v_0) (m/sec)*	*Density (d_0) (Kg. m^{-3})*	*$\beta_0 \times 10^{-10}$ (Pa^{-1})*
1	5	15.2623	4.9016	1.9321			
2	10	10.3686	2.0211	0.7845			
3	15	8.3374	3.1108	1.2161	1243.64	1030.00	5.843517555
4	20	5.2265	3.3795	1.3199			
5	25	1.8569		5.4374			

Table-3: Average Ultrasonic Velocity of 80% ethanol at 303 K.

Sr. No.	*No. of Rotation of Screw*	*Micrometer Reading (mm)*	*Difference Between Reading (mm)*	*Distance Travelled By Screw in One Rotation*	*Average Ultrasonic Velocity (v_0) (m/sec)*	*Density (d_0) (Kg. m^{-3})*	*$\beta_0 \times 10^{-10}$ (Pa^{-1})*
1	5	18.3974	4.1260	1.7221			
2	10	14.2705	4.0143	1.7442			
3	15	10.2664	4.0000	1.6720	1291.66	1028.5	5.687112030
4	20	6.2664	1.7625	0.7771			
5	25	4.5044		5.6294			

Table No. 4: Acoustic Parameters of 80% ethanol-water mixtures at Different Concentration of at 303K

Conc. C (Mole/lit)	*Average Ultrasonic Velocity (m/sec)*	*Density d_s ($Kg.m^{-3}$)*	*$\beta s x 10^{-10}$ (pa^{-1})*	*ϕ_V ($m^3 mol^{-1}$)*	*ϕ_k $x10^{-10}$*	*L_f (A_0)*	*R_A*	*$Z * 10^4$ ($Kgm^{-2} sec^{-1}$)*
0.1	1392.797	1031.02	4.9313	0.2899	-0.2278	0.017	1.011	140.400
0.075	1200.837	1028.42	6.6206	0.3158	21.5715	0.019	1.059	120.191
0.050	1058.137	1023.72	8.5317	0.3146	62.3638	0.021	1.099	104.958
0.025	974.7271	1021.42	10.252	0.3369	118.626	0.023	1.126	96.1438

IV. CONCLUSION

Table-4 showed resultant values of acoustic parameters of PTP at (0.1M, 0.075M, 0.050M and 0.025M) and 303K in 80% ethanol-water mixture, from Table-4 it was concluded that Ultrasonic Velocity: (Us) , Density: (ds) decreases while Adiabatic compressibility: (βs), Apparent molar volume: (φv), Apparent molar compressibility: (φk), Intermolecular free length: (L_f), Relative association: (R_A) and Specific acoustic impedance: (Z) increases along with decreasing concentration of L_2 at 303 K. By using ultrasonic interferometric study Us , ds, βs, φv, φk, Lf, RA, z etc. acoustic properties were determined, which explain how these interactions occur and responsible for breaking and making of the structure in the solution.

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