Interferometric investigation of 4-ethylthiocarbamido- phenol in 60% mixed solvent media

R.D.Isankar[1], D.T.Tayade[2], A.B.Wadekar[3]
[1-2]Department of Chemistry, Government Vidarbha Institute of Science and Humanities, Amravati 444604 (M.S.) India.
[3]Department of Chemistry, S.D.M. Burungale Science and Art College Shegaon(MS)444203

Abstract:- Molecular and intermolecular interaction studied out by using ultrasonic interferometry. Recently ultrasonic velocity and density for solutions of 4-ethylthiocarbamidophenol (ETP) at different molar concentrations (at 0.1M, 0.075M, 0.050M and 0.025M)and 303 K, in 60% compositions of ethanol-water mixtures was investigated for determination of adiabatic compressibility (β), apparent molal compressibility (k), apparent molal volume (v), intermolecular free length (Lf), relative association (RA) 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-ethylthiocarbamidophenol (ETP), interferometric measurements, solute-solvent interactions.

I. INTRODUCTION

Since last few decades ultra sound and ultrasonic ineterferometric study play a vital role in the study of molecular interaction in liquid. This investigation has important to know the properties and significances of molecules. 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. A Thiocarbamido phenol nucleus has various significances in different industrial and life sciences. Valuable information regarding internal structure, molecular association, complex formation, internal pressure and stability[1] obtained from the study of ultrasonic parameters investigation in liquid phase[2-4], liquid mixture[5-6] and electrolyte solution[7-9]. Comparative study of intermolecular interaction by inteferometric measurements of α-bromoacetophenones and cumaran-3-ones in ethanol and dioxan solvents was studied by Aswale et al[10]. 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 CCl4, CS2 and C6H6 at 303.15K were investigated[12].

Ultrasonic investigation of an organic ligands solutions provide an excellent method of obtaining data on the ion solvent and solvent-solvent and structure breaking and making properties of solutes. Ultrasonic velocity and density for solutions of 4-ethylthiocarbamidophenol (ETP) at different molar concentrations and 303 K, in 60% compositions ethanol-water mixtures and adiabatic compressibility (β), apparent molal compressibility (k), apparent molal volume (v), intermolecular free length (Lf), relative association (RA) and specific acoustic impedance (Z). This investigation regarding to know effect of concentrations and temperature on various acoustical properties.

II. MATERIALS AND METHODS

All chemicals used in investigation are AR grade. Freshly prepared solution used during study. The solvents were purified by standard method. 0.1M, 0.075M, 0.050M and 0.025M solutions of ETP in 60% 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.

RESULTS AND DISCUSSION:- In the present investigation measurement of densities and ultrasonic velocities of ETP in 60% ethanol-water mixture had been carried out and given in Table No.1

Table-1.1: Average Ultrasonic Velocity of Water at 303K

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	24.7961	1.7622	1.37825	1403.617128
2	10	23.0307	3.7683	1.47545	
3	15	19.2723	3.6543	1.47385	
4	20	15.5178	3.7601	1.45217	
5	25	11.8177	3.7467	1.47081	
6	30	8.0709	3.7682	1.47541	
7	35	4.3126	2.7990	1.48773	
8	40	1.5235		10.48112	

Table-1.2: Average Ultrasonic Velocity of Pure Ethanol 303K (β_0)

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	15.3942	3.512	1.3731	1254.5	1028.42	4.723619993
2	10	11.8892	3.494	1.3691			
3	15	8.3942	3.162	1.2372			
4	20	5.2312	3.36	1.3151			
5	25	1.8712		5.3812			

Table-1.3: Average Ultrasonic Velocity of 60% Ethanol 303K(β_0)

Sr. No.	No. of Rotation of Screw	Micrometer Reading (mm)	Difference Between Reading (mm)	Distance Travelled By Screw in One Rotation	Average Ultrasonic Velocity (v0) (m/sec)	Density (d0) (Kg. m-3)	β0 x 10-10 (Pa-1)
1	**5**	**20.0445**	**3.6055**	**1.3542**	**1379.03**	**1022.5**	**4.952456082**
2	**10**	**16.3391**	**3.6254**	**1.4622**			
3	**15**	**12.6135**	**3.5906**	**1.44837**			
4	**20**	**8.923**	**3.5554**	**1.4342**			
5	**25**	**5.2674**		**5.88297**			

Table-1.4: Acoustic Parameters at Different Concentration of [ETP] at 303 K in 60% E-W

Conc. C (Mole/lit)	Average Ultrasonic Velocity V (m/sec)	Density d_s ($Kg.m^{-3}$)	$\beta s \times 10^{-10}$ (pa^{-1})	ϕ_V (m^3mol^{-1})	ϕ_k $\times 10^{-10}$	L_f (A_0)	R_A	$Z * 10^4$ ($Kgm^{-2} sec^{-1}$)
0.1	1722.737	1031.32	3.2455	0.1725	-11.747	0.0146	0.968	181.625
0.075	1608.517	1028.32	3.7245	0.2011	-9.5229	0.0154	0.988	169.304
0.050	1405.841	1025.22	4.8736	0.2395	7.1667	0.0172	1.005	158.081
0.025	1345.081	1019.43	5.3423	0.2879	20.796	0.0178	1.038	140.860

CONCLUSION

Table-1.4 showed resultant values of acoustic parameters of PTP at (0.1M, 0.075M, 0.050M and 0.025M) and 303K in 60% ethanol-water mixture, from Table-1.4 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: (Lf), Relative association: (RA) increases and Specific acoustic impedance: (Z) decreases along with decreasing concentration of ETP 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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