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INVESTIGATIONS IN ACOUSTIC PARAMETERS OF DIFFERENT CHLORO SUBSTITUTED AZETIDIN-2-ONE AT DIFFERENT CONCENTRATION AND TEMPERATURE IN 90% (ETOH+WATER) SOLVENT

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ABSTRACT

Ultrasonic velocity and density measurements have been carried out for solutions of 3-Chloro-4(4-hydroxyphenyl)-1-(-4-nitrophenyl)azetidin-2-one **(C_1)** and 3-Chloro-1(4-hydroxyphenyl)-4-phenylazetidin-2-one**(C_3)** in ethanol and watar solvents at 303.15 K .This data have been used to determine various acoustic/thermodynamic parameters viz. adiabatic compressibility (β_S), apparent molar compressibility (φ_k), apparent molar volume (φ_v), intermolecular free length (Lf), relative association (RA) and specific acoustic impedance (Z). Molecular solute-solvent, solute- solute interactions in the system is determined by these properties.

Keywords*: Ultrasonic velocity, Acoustical properties, Molecular interactions, 3-Chloro-4(4-hydroxyphenyl)-1-(-4-nitrophenyl)azetidin-2-one* ***(C_1)*** *and 3-Chloro-1(4-hydroxyphenyl)-4-phenylazetidin-2-one****(C_3)****.*

I. INTRODUCTION

Ultrasonic techniques are used to study of the physico-chemical studies of a system and molecular interactions occurring in EtOH-Water mixtures. S. V.Tambakhe et al. carried out conductometric and ultrasonic studies of substituted aryl bisthiourea in binary solution at 300k temperature[1].H P Dahikar et al. carried out molecular interaction study of β- benzoyl propionic acid in ethanol at 298k using acoustic parameters[2].Molecular and intermolecular interaction investigated by using ultrasonic interferometry by R D Isankar et al. [3].Ultrasonic velocity, viscosity and density of alcohol in n-hexane at various temperatures in the range of 303.15 - 318.15K was observed by Santhi et al.[4].M. K. Praharaj et al. was studied the thermodynamic and transport properties of ternary liquid mixture at different frequencies[5]. G. Nath have investigated interaction in the binary mixture of acetone with bromobenzene and chlorobenzene by computing the various acoustic parameters such as acoustic impedance (Z), isentropic compressibility (β), intermolecular free length (Lf) and their excess values at different frequencies (1 MHz, 3 MHz and 5 MHz) using a multi frequency ultrasonic Interferometer over the entire range of mole fraction at temperature 303.16 K[6].The acoustical properties like adiabatic compressibility (βs), apparent molal volume (Φv), apparent molal compressibility (ΦK), intermolecular free length (Lf), specific acoustic impedance (Z) and relative association (RA) of some substituted pyrazoles viz. [5-(2-hydroxyphenyl)-3-(pyridin-3-yl)-4-(benzoyl)]-pyrazol, [5-(2-hydroxyphenyl)- 3-(3-nitrophenyl)-4-(3-pyridinoyl)]-pyrazol, [5-(2-hydroxyphenyl)-3-(3-nitrophenyl)-(4-benzoyl)]-pyrazol and [5- (2-hydroxyphenyl)-3-(phenyl)-4-(3-pyridinoyl)]-pyrazol have been calculated from measured sound velocities (U) and densities (d) of their solutions of 0.01M concentrations in different percentage of dioxane-water mixture at 298.15 K was dertmined by Deosarkar et al [7]. viscometric, refractrometric and interferometric measurements of synthesized *N*-(4-hydroxy-6-methyl-1,3,5-triazin-2-yl)-*N*'-phenylthiocarbamide have been investigated at 25°C in 60% dioxane-water system at various concentrations by A. M. Kshirsagar et al.[8].alambe et al. have been investigated density (d), acoustcal parameters such as adiabatic compressibility (βs), apparent molar volume (φv), apparent molar compressibility (φk), intermolecular free length (Lf), relative association (RA) and specific acoustic impedance (z) and ultrasonic velocity (u) values in the solvent CCl_4 containing 2-hydroxy substituted chalcone dibromide using 0.01 M concentration at 297 K [9]. Acoustic properties of substituted chalcone dibromides using 0.01 M concentration in ethanol at 303K were studied by Watane et al. [10]. Interaction between solute-solute and solute-solvent interaction of substituted imidazolinone in 70% (DMF+water) solvents by measuring ultrasonic velocity and density in different concentration of solute at 298K was determined by Wadekar et al. [11].Pathare et al. have been carried out Ultrasonic velocity and density measurement

of chalcone - 3-bromo-2-hydroxy-5- methyl-4-chloro chalcone in dioxane-water mixture in the various concentration and in different percentages of dioxane-water mixtures[12]. Acoustical parameters, Density, ultrasonic velocity of pure dioxane (Dx) and Substituted Coumarinsin different percent of Dx–water mixture have been investigated by A. U. Mandakmareet al. at 303.15 K [13]. Wadekar et al. investigated the acoustical properties of substituted 2-oxo-2-H-chromene-3-carbohydrazide derivatives in 70% DMF-water at 305K[14].Bante et al. have determined ultrasonic behaviour of some chalcones of p-chlorobezaldehyde, salicylaldehyde, & benzaldeyde and also their mixtures[15]. R Trabelsi et al have been measured ultrasonic velocity in isobutyric acid - water binary mixtures over the temperature range from 300.15 to 313.15 K[16]. Ultrasonic velocity and density measurements of 2-hydroxy – 5– bromo – N – (m - hydroxyphenyl) - chalconeimines in dioxane – water mixtures, in the concentration range 1×10^{-2} -5×10^{-2} - mol dm^{-3} and in different percentage of dioxane water mixtures have been studied by Patil et al. [17].S. Aswale et al.investigated in acoustic parameters of substituted thiocarbamidoacetophenones[18]. Nehete et al.was carried out ultrasonic behavior and study of molecular interaction of schiff base ligand i1n different percentage of ethanol-water mixture at 303 K [19].

II. METHOD & MATERIAL

All chemicals used to synthesize different chloro substituted azetidin-2-one are A.R.Grade in this present investigation attempt is made to understand behaviour of 3-Chloro-4(4-hydroxyphenyl)-1-(-4-nitrophenyl)azetidin-2-one **(C_1)** and 3-Chloro-1(4-hydroxyphenyl)-4-phenylazetidin-2-one**(C_3)** For evaluating the acoustic properties. The very pure and analytical grade solvent and extra pure double distilled water is used.The dencities of pure solvent and solutions are determined by using specific gravity bottle. The ultrasonic velocity measurements were made using a crystal controlled variable path ultrasonic interferometer.

III. CALCULATION

Adiabatic compressibility (β), Apparent molal volume (Φv), Apparent molal compressibility (Φks), Intermolecular free length (Lf), Specific acoustic impedance (Z) and Relative association (R) were calculated by using following equations

Adiabatic compressibility $(\beta s) = 1/ Us^2 x\ ds$ ……(3)
Adiabatic compressibility $(\beta_0) = 1/ U_0^2 x\ d_0$ …… (4)
Acoustic impedance (Z) = Us x ds …….. (5)

Where U_0, Us are ultrasonic velocity in solvent and solution respectttively. d_0 and ds are density of solvent and solution respectively

$\phi_v = (M/d_s) + [(d_o-d_s)\ 10^3] / m d_s d_o$ ..... (6) and
$\phi_{k(s)} = [1000(\beta_s d_o-\beta_o d_s) / m d_s d_o] + (\beta_s M / d_s)$ …….(7)

where, d_o and d_s are the densities of the pure solvent and solution, respectively. m is the molality and M is the molecular weight of solute. β_o and β_s are the adiabatic compressibilities of pure solvent and solution respectively.

Intermolecular free length (Lf) = $K\sqrt{\beta s}$ …… (8)
Relative association (RA) = (ds /d0) x $(U0 /Us)^{1/3}$ .....(9)
Solvation number (Sn) = $\varphi^{\kappa} / \beta 0$x (M/ d0) …… (10)

The value of Jacobson's constant is calculated by using relation

$K=(93.875+0.375xT)x10^{-8}$ ……..(11)

where T is temperature at which experiment is carried out.

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IV. RESULT & DISCUSSION

Table 1.Acoustic Parameters of 3-Chloro-4(4-hydroxyphenyl)-1-(-4-nitrophenyl)azetidin-2-one (C_1) in 90%EtOH-Water system at 293K,298K and 303K.

Temp.	Conc. Moles/lit	Average Velocity (U_S) m/sec	Density (ds) Kg m^{-3}	(β_S) $x10^{-10}$ m^2N^{-1}	(φ_v) m^3mole^{-1}	(φ_k) $x10^{-10}$ m^2N^{-1}	(Lf) $x10^{-11}$ m	RA	(Z)$x10^5$ kg $m^{-2}s^{-1}$	Solvation number (Sn)
293K	0.1	1484.22	1050.13	4.3227	0.672	1.6005	4.2362	1.1565	15.58	0.5470
	0.075	1465.86	1046.03	4.4490	0.885	1.6482	4.2976	1.1567	15.33	0.5633
	0.05	1430.16	1042.02	4.6919	1.310	1.7398	4.4134	1.1618	14.90	0.5946
	0.025	1406.63	1038.02	4.8689	2.586	1.8065	4.4958	1.1638	14.60	0.6174
298K	0.1	1497.55	1050.08	4.2463	0.694	1.5816	4.2372	1.1636	15.72	0.5438
	0.075	1473.11	1045.36	4.4081	0.912	1.6431	4.3172	1.1648	15.39	0.5650
	0.05	1436.87	1041.95	4.6485	1.354	1.7343	4.4333	1.1706	14.97	0.5963
	0.025	1412.72	1037.33	4.8302	2.668	1.8033	4.5191	1.1720	14.65	0.6200
303K	0.1	1524.89	1049.72	4.0968	0.716	1.5345	4.1999	1.1645	16.00	0.5237
	0.075	1500.45	1044.69	4.2517	0.941	1.5936	4.2786	1.1652	15.67	0.5439
	0.05	1464.21	1040.87	4.4812	1.395	1.6813	4.3925	1.1704	15.24	0.5738
	0.025	1440.06	1036.64	4.6516	2.754	1.7464	4.4753	1.1722	14.92	0.5960

Table 2.Acoustic Parameters of 3-Chloro-1(4-hydroxyphenyl)-4-phenylazetidin-2-one(C_3) in 90%EtOH-Water system at 293K,298K and 303K.

Temp.	Conc. Moles/lit	Average Velocity (U_S) m/sec	Density (ds) Kg m^{-3}	(β_S) $x10^{-10}$ m^2N^{-1}	(φ_v) m^3mole^{-1}	(φ_k) $x10^{-10}$ m^2N^{-1}	(Lf) $x10^{-11}$ m	RA	(Z)$x10^5$ kg $m^{-2}s^{-1}$	Solvation number (Sn)
293K	0.1	1382.68	1030.12	5.077	0.5398	1.6149	4.5912	1.161	14.24	0.6428
	0.075	1364.32	1026.01	5.236	0.7088	1.6664	4.6623	1.162	13.99	0.6633
	0.05	1328.62	1022.01	5.542	1.0469	1.7661	4.7969	1.167	13.57	0.7029
	0.025	1305.09	1018.11	5.766	2.0616	1.8388	4.8928	1.170	13.28	0.7319
298K	0.1	1396.01	1030.01	4.981	0.5587	1.5938	4.5895	1.168	14.37	0.6382
	0.075	1371.57	1025.29	5.184	0.7325	1.6601	4.6820	1.169	14.06	0.6647
	0.05	1335.33	1021.88	5.488	1.0851	1.7593	4.8171	1.176	13.64	0.7045
	0.025	1311.18	1017.26	5.717	2.1322	1.8345	4.9169	1.178	13.33	0.7346
303K	0.1	1423.35	1029.59	4.794	0.5777	1.5420	4.5433	1.168	14.65	0.6129
	0.075	1398.91	1024.56	4.987	0.7571	1.6057	4.6340	1.169	14.33	0.6382
	0.05	1362.67	1020.73	5.276	1.1204	1.7006	4.7661	1.175	13.90	0.6759
	0.025	1338.52	1016.50	5.490	2.2063	1.7713	4.8622	1.177	13.60	0.7040

In the present investigation different acoustic parameters such as adiabatic Compressibility (βs), apparent molal volume (Φv), apparent molal compressibility (Φk(s)), acoustic impedance (Zs), relative association (RA) and intermoleculer free length (Lf) of the solutions in different concentration of different compound at 293k,298k and 303 k which is presented in table 1& 2. Existence of molecular association between the components of the liquid mixtures can be understood from the decrease in ultrasonic velocity (U) with decreasing concentration of compounds. The values of adiabatic compressibility (βs) increase with decrease in the concentration of compounds and decreases with increasing the temperature which may be due to departure of solvent molecules around the ions.
The apparent molar volumes (ϕv) found to be increase with decrease in the concentration of compounds along with increasing the temperature. It is observed that (ϕk) values and intermolecular free length (Lf) increase with decrease in the concentration of compounds, this may be due to the weak interaction between ions and solute molecules, which suggest the structure promoting behavior of solute. It is also observed that (ϕk) values and intermolecular free

length (Lf) decreases with increasing the temperature. The values of relative association (RA) of compounds increase with decrease in the concentration of compounds but increases with increasing the temperature, which may be due to breaking up of solvent molecules on increasing the temperature. Specific acoustic impedance (Z) decreases linearly with decrease in concentration of compounds and increasing with increasing temperature.

V. CONCLUSION

Density, viscosity and ultrasonic velocity have been measured for different concentration of 3-Chloro-4(4-hydroxyphenyl)-1-(-4-nitrophenyl)azetidin-2-one **(C_1)** and 3-Chloro-1(4-hydroxyphenyl)-4-phenylazetidin-2-one**(C_3)** at 293k,298k and 303 k. Ultrasonic velocity of synthesized molecule of different concentration depends on the intermolecular free length. It is also observed that continuous increase of adiabatic compressibility and free length is due to weak specific molecular interaction between compounds and solvent mixture molecules.

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