National Conference in Chemistry, Physics & Mathematics
International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
Volume 9, Issue 16, November-December-2022

Evaluation of Acoustical Parameters of Some Substituted Ketimine Drugs Under Different % Composition In 75 % Dichloromethane (DCM)–Water Mixture At 30⁰C.

Ganesh Andhale[1]*, Prabhakar Kute[2], Chandrashekhar Devkate[3], Satyanarayan Arde[4], Atish Mehetre[5]
[1]P. G. Department of Chemistry Jijamata Mahavidyalaya, Buldhana, Dist. Buldhana, Maharashtra, India
[2]Department of Chemistry, Pratishthan Mahavidylaya, Paithan, Dist. Aurangabad-431107, Maharashtra, India
[3]Indraraj Arts, commerce & Science College Sillod, Aurangabad 431112, Maharashtra, India
[4]Department of Chemistry Y.C. Warana Mahavidyalaya, Warananagar- 416113, Maharashtra, India
[5]Shri Shivaji Science College, Kannad Dist. Aurangabad, Maharashtra, India

ABSTRACT

In the present investigation ultrasonic velocity of binary mixture of aromatic substituted ketimines and dichloromethane (DCM) under different percentage composition at 30^0C were evaluated using ultrasonic interferometer having 2MHz frequency. The obtained data was used to investigate the different acoustical parameters such as adiabatic compressibility, apparent molar compressibility, acoustic impedance, relative association, solvation number and intermolecular free length. The result is interpreted in terms of molecular interaction such as dipole-dipole interaction through hydrogen bonding between components of mixtures.

Keywords: Ultrasonic velocity, Dichloromethane (DCM), adiabatic compressibility, ketimines etc.

I. INTRODUCTION

The various techniques available to study molecular interactions in liquid are nuclear magnetic resonance, microwave, ultraviolet and infrared spectroscopy, neutron and X-ray scattering and ultrasonic investigation. NMR technique reflects effect on the proton bearing molecules, whereas microwave absorption provides information through dielectric constant. Neutron and X-ray scattering help in the study of molecular motion. The spectroscopic techniques provide useful information of interactions when the interaction energies involved are large. Weak molecular interactions cannot be resolved from the observed spectra. Ultrasonic techniques reveal very weak intermolecular interactions due to its useful wavelength range. In the recent years, determination of ultrasonic velocity evaluates various parameters of liquids for studying molecular and structural properties. There is an intimate relationship between the ultrasonic velocity on chemical and structural characteristics of molecule of liquids; this gives a property of basic importance to ultrasonic velocity in molecular theory of liquids. At present, the ultrasonic and absorption studies especially in case of electrolyte solutions have led to new insight into the process of ion-association and complex-formation[1-2]. Many researchers such as M.S. Chouhan[3], S. Sasikumar[4], Shashi Kant[5], T. Sumathi[6], Chandami A. S.[7] and Azhagiri S.[8] have made ultrasonic study of electrolytic solutions and discussed about the variation of ultrasonic velocity with ion concentration. It has already been observed that extent of a lowering of compressibility and an increase in ultrasonic velocity with reference to that of water are proportionate to the number of ions existing in that medium. Most of the ultrasonic work in non-aqueous systems possesses an interpretation of solute-solvent interactions[9]. Solvation numbers have been obtained from the study of non-aqueous solutions by K.Kannagi et.al.[10], Harish Kumar[11].

In the present investigation, study of the interaction between solute-solute and solute-solvent of substituted ketimine in 75%, 80% and 85% (DCM+water) solvents by measuring ultrasonic velocity and density in different concentration of solute in different percentage of solvent has been done.

II. EXPERIMENTAL

All the chemicals used were of AR grade. The density measurements all the solutions were made with the precalibrated bicapillary pyknometer. All the weighings were made on one pan digital balance (petit balance AD-50B) with an accuracy of + 0.001 gm. The ultrasonic velocity was measured by using variable path crystal interferrometer (Mittal Enterprises, Model F-81) with accuracy of + 0.03 % and frequency 2MHz. The instrument was calibrated by measuring ultrasonic velocity of 75 % DCM-water mixture at 303 K. Elite thermostatic water 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 oC. The ligands used in the present study are

5- Bromo-2-hydroxy-4-chloro (p-methyl phenyl) ketimine (LA)

5- Bromo-2-hydroxy-4-chloro (p-amino phenol) ketimine (LB)

III. THEORY AND FORMULATION

The distance traveled by micrometer screw get one maximum in ammeter (D), from the value of D, wavelength of ultrasonic wave is calculated using relation.

$2D = \lambda$ …………. (1)

Where λ is wave length and D is distance in mm. The ultrasonic velocity is calculated by using relation.

Ultrasonic velocity $(U) = \lambda \times \text{Frequency} \times 10^3$ ………..(2)

Using the measured data some acoustical parameters have been calculated using the standard relations.

The adiabatic compressibility of solvent and solution are calculated by using 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 $(Z) = Us \times ds$ ……………………… (5)

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

The apparent molal volume (ϕ_v) and apparent molal adiabatic compressibilities ($\phi_{k(s)}$) of substituted ketimines in solutions are determined respectively, from density (d_s) and adiabatic compressibility(β_s) of solution using the equations

$\phi_v = (M/d_s) + [(d_o-d_s) 10^3] / md_sd_o$ .... (6) and

$\phi_{k(s)} = [1000(\beta_sd_o-\beta_od_s) / md_sd_o] + (\beta_s M / d_s)$ …………….. (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 compressibility's of pure solvent and solution respectively.

Intermolecular free length (Lf) = $K\sqrt{\beta s}$ …………… (8)

Relative association (RA) = $(ds /d0) \times (U0 /Us)^{1/3}$ .... (9)

Solvation number (Sn) = $\varphi^{\kappa} / \beta 0 \times (M/ d0)$ ………….. (10)

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

$K=(93.875+0.375 \times T)\times 10^{-8}$ …………….. (11)

Where T is temperature at which experiment is carried out. The present investigation is carried out at temperature (T = 303K).

Table 1: Ultrasonic velocity, density, adiabatic compressibility (βS), Specific acoustic impedance (Z) Intermolecular free length (Lf) in 75% DCM solvent at 303K.

Conc. (m) Moles lit^{-1}	Density (ds) Kg m^{-3}	Ultrasonic Velocity(Us) m s^{-1}	Adiabatic Compressibility (β_s) $\times 10^{-9}$ m^2N^{-1}	Inter molecular free length (Lf) $\times 10^{-11}$ m	Specific acoustic impedance (Z) $\times 10^5$ kg $m^{-2}s^{-1}$
Ligand LA in 75% (DCM +water) solvent					
0.01	1224.1	3630.4	6.1983	5.1660	4.44397
0.008	1223.9	3529.6	6.5622	5.3155	4.31741
0.006	1222.3	3433.6	6.9394	5.4661	4.19689
0.004	1221.8	3342.4	7.3287	5.6173	4.08241
0.002	1216.0	3273.6	7.6739	5.7399	3.98070
Ligand LB in 75% (DCM +water) solvent					
0.01	1220.5	3504.0	6.6732	5.3602	4.27663
0.008	1219.6	3438.4	6.9354	5.4645	4.19347
0.006	1219.6	3401.6	7.0862	5.5236	4.14859
0.004	1218.7	3337.6	7.3660	5.6316	4.06753
0.002	1217.8	3188.8	8.0755	5.8966	3.88332
Ligand LA in 80% (DCM +water) solvent					
0.01	1225.3	3604.8	6.2805	5.2001	4.41696
0.008	1224.4	3483.2	6.7316	5.3836	4.26483
0.006	1223.5	3302.4	7.4940	5.6805	4.04048
0.004	1222.5	3158.4	8.2000	5.9419	3.86114
0.002	1217.1	3072.0	8.7062	6.1190	3.73893
Ligand LB in 80% (DCM +water) solvent					
0.01	1221.7	3371.2	7.2022	5.5686	4.11859
0.008	1220.8	3243.2	7.7876	5.7905	3.95929
0.006	1220.7	3236.8	7.8191	5.8022	3.95116
0.004	1219.9	3201.6	7.9500	5.8504	3.91734
0.002	1218.5	3211.2	8.006	5.8706	3.90115

Ligand LA in 85% (DCM +water) solvent					
0.01	1226.5	3371.2	7.1740	5.5577	4.13477
0.008	1225.7	3249.6	7.7260	5.7676	3.98303
0.006	1224.6	3211.2	7.9190	5.8392	3.93243
0.004	1223.7	3188.8	8.0365	5.8823	3.90213
0.002	1218.3	3172.8	8.1538	5.9251	3.86542
Ligand LB in 85% (DCM +water) solvent					
0.01	1222.9	3320.0	7.4187	5.6517	4.06002
0.008	1221.9	3284.8	7.5848	5.7146	4.01369
0.006	1221.7	3236.8	7.1812	5.7998	3.95439
0.004	1220.9	3212.8	7.9351	5.8451	3.92250
0.002	1220.3	3192.0	8.0428	5.8846	3.89519

Plots of adiabatic compressibility βs of different ligand at different concentration in a 75%, 80%, 85% (DCM +water) solvent

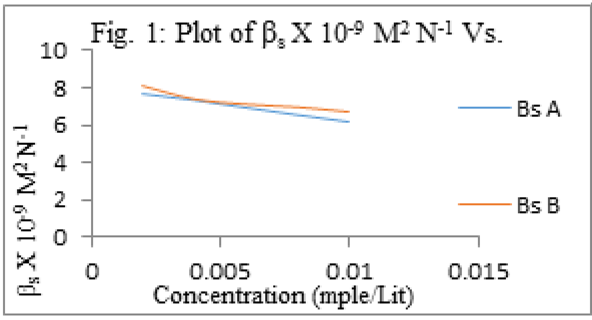


Fig. 1: Plot of β_s X 10^{-9} M^2 N^{-1} Vs.

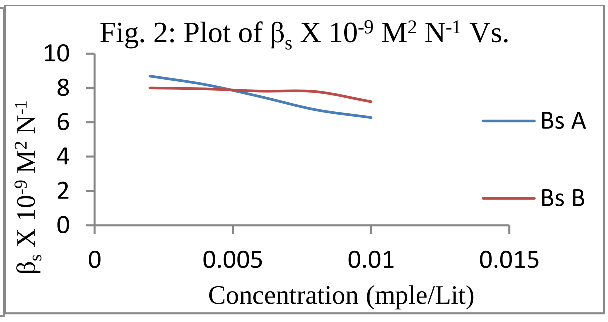


Fig. 2: Plot of β_s X 10^{-9} M^2 N^{-1} Vs.

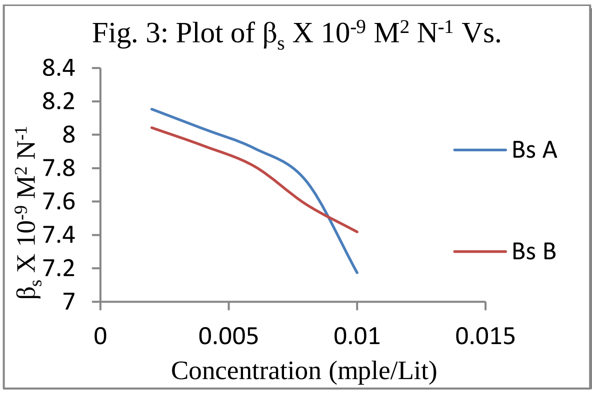


Fig. 3: Plot of β_s X 10^{-9} M^2 N^{-1} Vs.

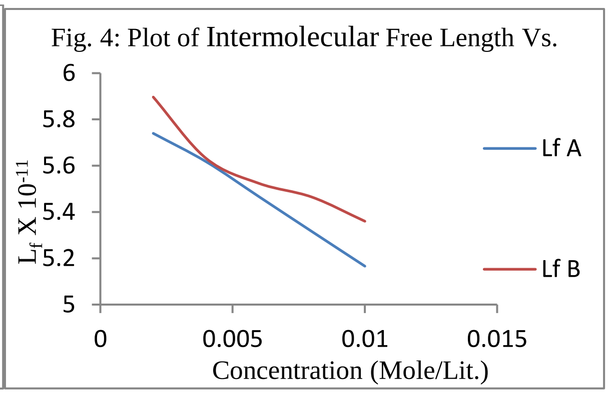


Fig. 4: Plot of Intermolecular Free Length Vs.

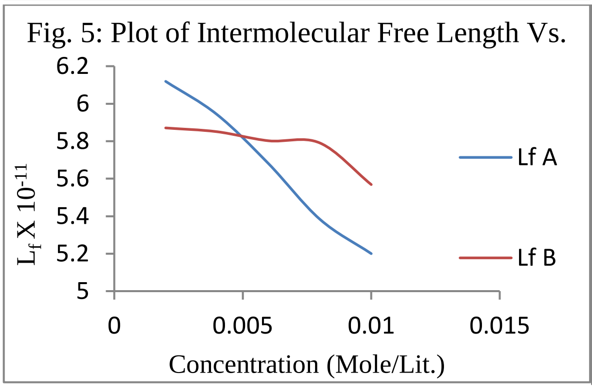


Fig. 5: Plot of Intermolecular Free Length Vs.

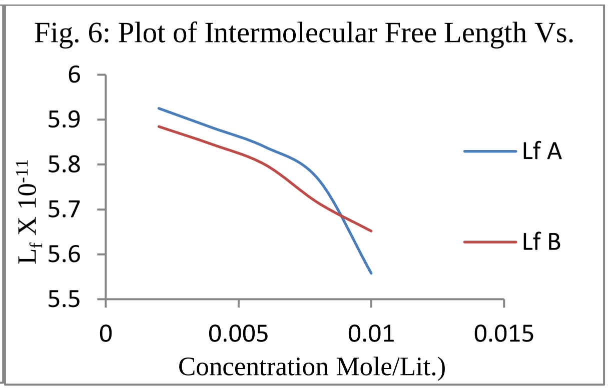


Fig. 6: Plot of Intermolecular Free Length Vs.

Fig. 7: Plot of Specific acoustic impendance

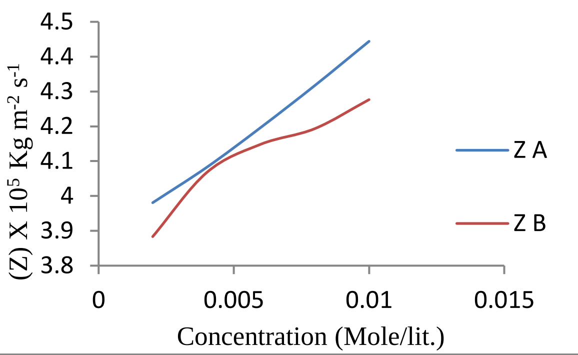


Fig. 8: Plot of Specific acoustic impendance

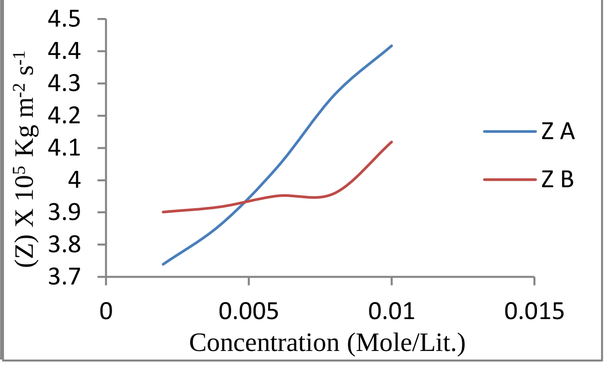


Fig. 9: Plot of Specific acoustic impendance

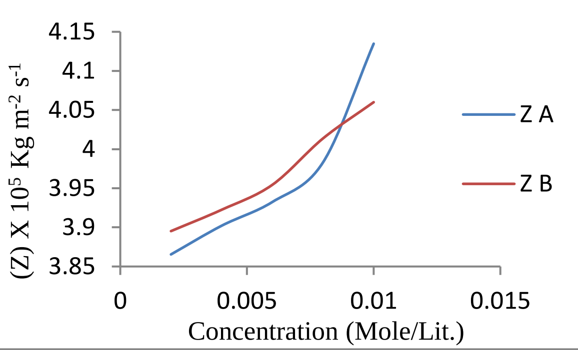


Fig. 10: Plot of Ultrasonic Velocity Us

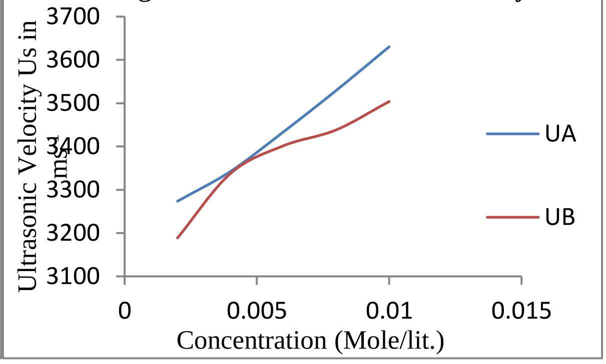


Fig.11: Plot of Ultrasonic Velocity Us in ms^{-1} Vs Concentration (Mole/lit.) in 80% DCM

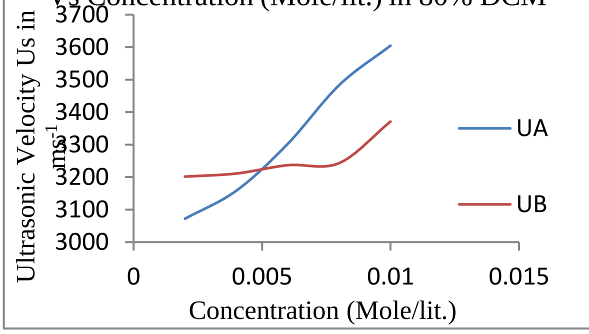
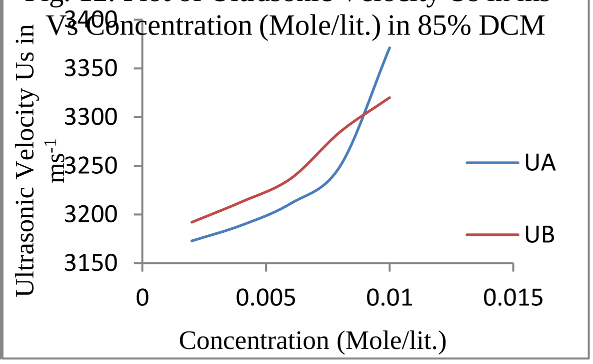


Fig. 12: Plot of Ultrasonic Velocity Us in ms^{-1} Vs Concentration (Mole/lit.) in 85% DCM



IV. RESULT AND DISCUSSION

In the present investigation, different acoustical parameters, such as ultrasonic velocity (U), adiabatic compressibility (βs), intermolecular free length (Lf), specific acoustic impedance (Z), of substituted chalconeimne in different percentage of DCM+water mixture at 303K have been studied. From table 1, it is found that ultrasonic velocity decreases with decrease in concentration for all systems. (Fig 10 to 12) This indicates that, there is significant interaction between ion and solvent molecules suggesting a structure promoting behavior of the added electrolyte. It was found that, intermolecular free length increases linearly on decreasing the concentration of substituted ketimines in different solution of DCM+water mixture (fig. 4 to 6). The intermolecular free length increase due to greater force of interaction between solute and solvent by forming hydrogen bonding. The value of specific acoustic impedance (Z) decreases with decrease in concentration for all substituted ketimines in different percent solutions of (DCM+water) mixture (fig.7 to 9). When concentration of electrolyte is decreased, the thickness of oppositely charged ionic atmosphere may increase due to decrease in ionic strength. The increase of adiabatic compressibility with decrease of concentration of solution may be due to the dispersion of solvent molecules around ions supporting weak ion-solvent interactions (fig. 1 to 3).

V. REFERENCES

[1] Horinaka H , Iwade T, Kanetaka Y, J. Appl. Phys., 42, (2003), 3287.

[2] Topchyan A, Tatarinov A, Sarvazyan N, Ultrasonic., 44(3), (2006), 259.

[3] M.S. Chouhan, K. Modi , B.D. Shrivastava, S.Patil, I. J. Sci. Res. Chem. Sci., 4(4), (2017), 1-4.

[4] S. Sasikumar, G. Meenakshi, I., J., Res. in Eng. and Tech., 04(02), (2015), 263-268.

[5] Shashi Kant, Parul, Kamini Sharma, Int. J. Chem. Tech. Research, 5(4), (2013), 1948-1958.

[6] T. Sumathi and M. Varalakshmi, Rasayan J. Chem. 3(3), (2010), 550-555.

[7] Chandami A. S., Hedaoo D. S. and Wadekar M. P., J. Chem. Pharm. Res., 8 (3), (2016), 646-651.

[8] Azhagiri S., Jayakumar S., Padmanaban R., Gunasekaran S., Srinivasan S., J. Sol. Chem., 38(4), (2009), 441-448.

[9] M.Thirunavukkarasu, N. Kanagathara, Int. J. Chem. Tech. Research. 4(1), (2012), 459-463.

[10] K. Kannagi, E. Jasmine, Vasantha Rani, J. Elixier Ultrasonic, 49, (2012), 10018-10023.

[11] Kumar H, Deepika, Int. J. Res. Phys. Chem., 2(3), (2012), 20.