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**Research Article**

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# Ultrasonic study of substituted azomethine drugs in binary mixture

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**ABSTRACT**

*The molecular interactions in the binary mixtures were analyzed by ultrasonic measurements using interferometric method. The experimental data of density, ultrasonic velocity(U), intermolecular free length(Lf), specific acoustic impedance(Z), relative association(RA) of substituted azomethine in binary mixture (70% DMF+ water) over the entire composition range at 300K have been investigated. The results obtained in this study have been interpreted in terms of different interactions among solute–solute and solute–solvent.*

**Key words:** substituted azomethine, ultrasonic velocity, density, acoustic parameter.

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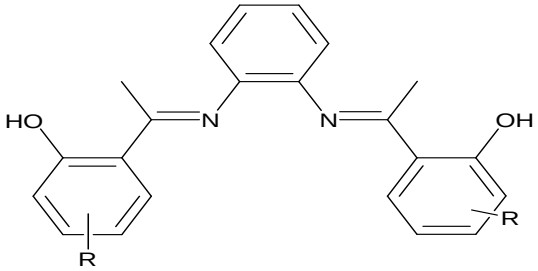
## INTRODUCTION

Substituted azomethine have significant importance in chemistry. The biological, analytical, clinical, analytical, corrosion science, pharmacological[1], and industrial applications of their complexes make highly versatile. Azomethine functional group containing compounds have a broad range of biological activities such as anti-bacterial, antimalarial, anti-fungal, anticancer, anti-tuberculosis, anti-viral, anti-inflammatory, anti-HIV, insecticidal[2].

In the recent year, an ultrasonic wave has acquired the status of an important tool for the study of structure and properties of matter in basic science. Ultrasonic techniques are best suited for physico-chemical studies of a system. Ultrasonic techniques reveal very weak intermolecular interactions due to its useful wavelength range. In the recent years, measurements of the ultrasonic velocity are helpful to interpreted solute-solvent, ion-solvent interaction in aqueous and non aqueous medium[3]. Thermodynamic study, adiabatic compressibility, free length and molar volume in ternary liquid systems were reported[4-6]. Ultrasonic investigation and molecular interaction of drugs in binary mixture are studied by many chemist[7-9].

In the present investigation the measurement of ultrasonic velocity and density in different concentration of solute in 70%(DMF+water) solvent has done. Also the present attempt is made to study the other acoustical parameters such as intermolecular free length (Lf), specific acoustic impedance (Z), relative association (RA), of substituted azomethine in 70% of (DMF+water) mixture at different concentrations of ligand. The different substituted azomethine ligand used for present work as-

***$L_1$*** *=2,2'-(benzene-1,2diylbis[nitrilo(1E)eth-1-yl-1-ylidene]-dibenzene-1,4-diol*
***$L_2$*** *= 2,2'-(benzene-1,2diylbis[nitrilo(1E)eth-1-ylidene)bis(4-nitrophenol)*
***$L_3$****=4'4-(benzene-1,2diylbis[nitrilo(1E)eth-1-yl-1-ylidene]bis(2,-chloro phenol)*
***$L_4$****=4'4-(benzene-1,2diylbis[nitrilo(1E)eth-1-yl-1-ylidene]bis(2,6dichloro phenol)*




## EXPERIMENTAL SECTION

All chemicals of AR grade were used. The substituted azomethine drug will be synthesized by standard method[1].The precalibrated bicapilary pyknometer was used for measurement of densities of pure solvent and solutions of various concentrations at constant temperature. All the weighing's were made on one pan digital balance (petit balance AD_50B) with an accuracy of ±(0.001)gm. Variable path crystal interferometer (Mittal Enterprises, Model MX-3) with accuracy of ± (0.03)% and frequency 1MHzwas used for measurement of ultrasonic velocity. In the present work, a steel cell fitted with a quartz crystal of variable frequency was employed. The instrument was calibrated by measuring ultrasonic velocity of water at 25$^{o}$C. A special thermostatic arrangement was done for density and ultrasonic velocity measurements. 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)$^{o}$C.

**Calculation**

The sound velocity of one ligand was measured in the concentration range of $1x10^{-1}$ to $6.25x10^{-4}$M in 70%(DMF+water) mixture.

wavelength of ultrasonic wave is calculated using relation.

$$2D = \lambda \quad (1)$$

Where λ is wave length and D is distance in mm.

The ultrasonic velocity is calculated by using relation.

$$\text{Ultrasonic velocity (U)} = \lambda \text{ x Frequency x } 10^3 \quad (2)$$

Some acoustical parameters have been calculated using the standard relations.

The adiabatic compressibility (βs) of solvent and solution are calculated by using equations

$$\text{Adiabatic compressibility solution } (\beta s) = 1/ Us^2 x\ ds \quad (3)$$

$$\text{Adiabatic compressibility solvent } (\beta_0) = 1/ U_0^2 \text{ x } d_0 \quad (4)$$

$$\text{Acoustic impedance (Z)} = Us \text{ x } ds \quad (5)$$

Where, $U_0$, $d_0$, βo and Us, ds, βs are ultrasonic velocity, density and adiabatic compressibility of solvent and solution respectively.

$$\text{Intermolecular free length (Lf)} = K\sqrt{\beta s} \quad (6)$$

$$\text{Relative association (RA)} = (ds /d_0) \text{ x } (U_0 /Us)^{1/3} \quad (7)$$

Where, K is Jacobson's constant[1] is calculated by using relation

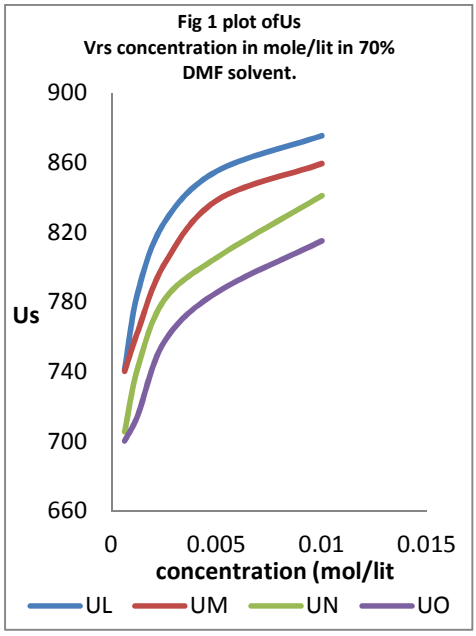
$K=(93.875+0.375xT)x10^{-8}$ (8)

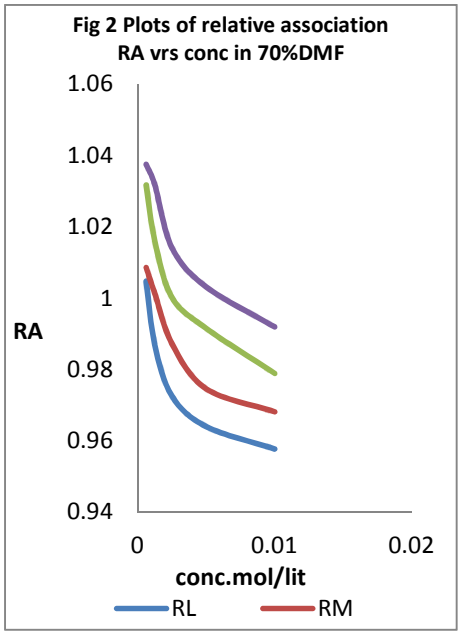
where T is temperature at which experiment is carried out.

**Table1: Ultrasonic velocity, density, relative association(RA), Intermolecular free length (Lf), Specific acoustic impedance (Z) in 70% DMF solvent at 298K**

| Conc. (m) Moles $lit^{-1}$ | Density (ds) Kg $m^{-3}$ | Ultrasonic Velocity(Us) m $s^{-1}$ | Relative association (RA) | Inter molecular free length (Lf) $x10^{-11}$ m | Specific acoustic impedance (Z) $x10^{5}$ kg $m^{-2}s^{-1}$ |
|---|---|---|---|---|---|
| | | | **L1** | | |
| 0.01 | 974.84 | 875.6 | 0.9577 | 7.5214 | 8.5356 |
| 0.005 | 973.61 | 855.2 | 0.9640 | 8.0838 | 7.9368 |
| 0.0025 | 970.81 | 825.6 | 0.9726 | 8.3158 | 7.7043 |
| 0.00125 | 969.00 | 785.6 | 0.9869 | 8.5299 | 7.5039 |
| 0.000625 | 967.66 | 741.6 | 1.0047 | 8.7068 | 7.3464 |
| | | | **L2** | | |
| 0.01 | 979.45 | 859.6 | 0.9681 | 76434 | 8.4193 |
| 0.005 | 977.81 | 838.4 | 0.9746 | 7.8432 | 8.1979 |
| 0.0025 | 975.83 | 801.6 | 0.9872 | 8.2116 | 7.8222 |
| 0.00125 | 973.67 | 763.2 | 1.0013 | 8.6343 | 7.4310 |
| 0.000625 | 970.81 | 740.4 | 1.0085 | 8.9133 | 7.1878 |
| | | | **L3** | | |
| 0.01 | 983.24 | 841.2 | 0.9789 | 7.7955 | 8.2710 |
| 0.005 | 981.67 | 805.6 | 0.9915 | 8.1465 | 7.9083 |
| 0.0025 | 980.15 | 781.2 | 1.0002 | 8.4075 | 7.6569 |
| 0.00125 | 978.98 | 742.4 | 1.06161 | 8.8522 | 7.2679 |
| 0.000625 | 977.29 | 705.6 | 1.0317 | 9.3219 | 6.8957 |
| | | | **L4** | | |
| 0.01 | 985.93 | 815.2 | 0.9919 | 8.0332 | 8.0373 |
| 0.005 | 984.88 | 785.6 | 1.0031 | 8.3403 | 7.7372 |
| 0.0025 | 983.53 | 757.2 | 1.0141 | 8.6590 | 7.4472 |
| 0.00125 | 981.84 | 715.2 | 1.0318 | 9.1754 | 7.0222 |
| 0.000625 | 980.32 | 700.4 | 1.0374 | 9.3766 | 6.8661 |

## RESULTS AND DISCUSSION

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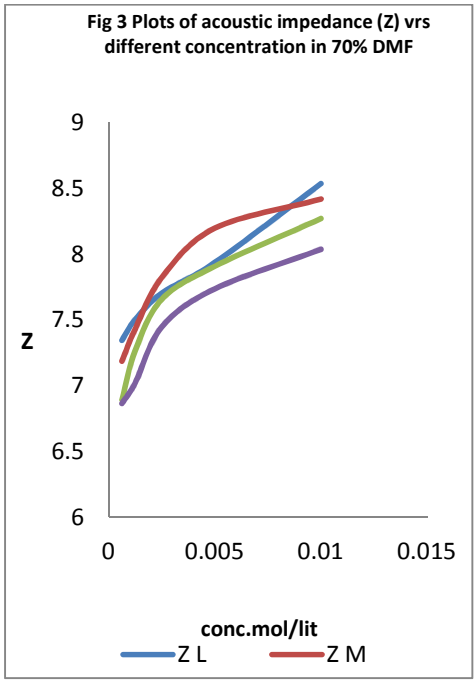


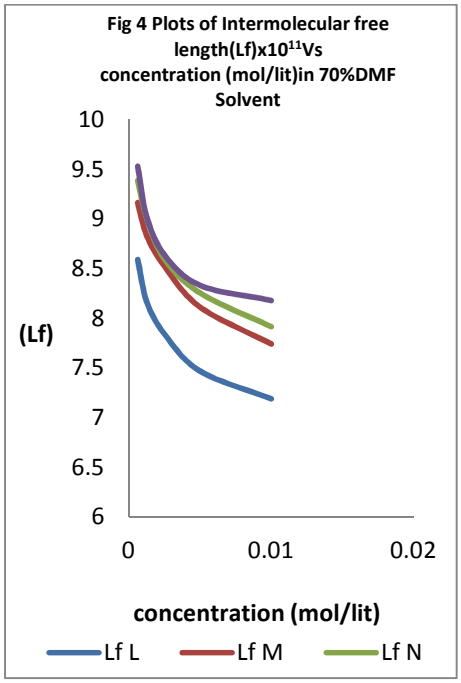


It is observed that the ultrasonic velocity decreases with decrease in concentration for all ligand systems represented in the table-1and graphical representation in fig-1.This indicates that, there is significant interaction between ion and solvent molecules. The ultrasonic velocity found to be greater in case of electron donating substituent on ring as compared to the ring deactivating substituents. The intermolecular free length increases linearly on decreasing the concentration of substituted azomethine in different solution of DMF+water mixture shown in (fig-3). The greater force of interaction between solute and solvent by forming hydrogen bonding and less interaction between two solute molecules may be responsible for linear increase of intermolecular free length. From the above result it was concluded that the specific acoustic impedance(Z) decreases with decrease in concentration for all substituted azomethinein 70%(DMF+water) mixture(fig-4). The value of mostly depends on concentration of solute in solution. It is observed that relative association increases in all systems (fig.2) with decrease in concentration of ligand. As the relative association is concentration dependent properties, for higher concentration greater the value of relative association and vice versa, thus it is concluded that there is weak interaction between solute and solvent.

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