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Research Article

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Study of some important acoustical parameters of substituted-N,N'-bis(salicyliden)-arylmethanediamines in 60% DMF-Water at 300K

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ABSTRACT

The ultrasonic investigation plays an important role to study the molecular interactions in solutions. Some important acoustical parameters including Ultrasonic velocity, Density, Adiabatic compressibility (β_S), Intermolecular free length (L_f) and Specific acoustic impedance (Z) in binary mixture of 60% DMF-Water were studied at 300 K. The experimental data predicts the change in acoustical parameters as the concentration of solute changes.

Keywords: Substituted-N,N'-bis(salicyliden)-arylmethanediamines , acoustical parameters, molecular interactions .

INTRODUCTION

Vibrational frequencies greater than the upper limit of the audible range for humans that is, greater than about 20 kilohertz are generally referred as ultrasonic waves. The term "sonic" is applied to ultrasound waves of very high amplitudes. In the recent years studies of ultrasonic waves has attracted much of the researchers attention as it is associated with the wide range of applications. High-intensity ultrasound has achieved a variety of important applications like ultrasonic cleaning, which involves ultrasonic vibrations set up in small liquid tanks. Ultrasonic cleaning is very popular technique for jewelry and has also been used with such items as dentures, surgical instruments, and small machinery.

Acoustical properties such as adiabatic compressibility, Partial molal volume, intermolecular free length (L_f), apparent molal compressibility, specific acoustic impedance (Z), relative association (R_A), salvation number (Sn) and the molar polarization for substituted heterocyclic Lovastatin drug in DMSO at different temperatures were studied[1]. The acoustical properties of complex in water was studied[2]. The ultrasonic study of various drugs were performed by many researchers[3-7]. The acoustical properties of four different drugs in methanol was recorded and solute-solvent interaction was studied[8]. The structural properties of solution of lanthanide salt was studied with the help of their ultrasonic velocity[9]. The ultrasonic velocity of PEG-8000, PEG- study of acoustical properties of substituted heterocyclic compounds under suitable condition was reported[10]. The density (ρ), viscosity (η) and ultrasonic speed (U) of DMF solutions of halogenated symmetric double Schiff bases were determined at 308.15K[11]. The acoustical and thermodynamic properties of citric acid in water at different temperature were measured[12]. The different acoustical parameters of binary mixture of 1-propanol and water were noted[13]. Acoustical properties of Schiff base solutions in DMF was known[14]. Acoustical and molecular interaction of amide with aliphatic amines in benzene at different temperatures were reported[15]. Ultrasonic velocity, density and viscosity measurements of hydrates levofloxacin hemihydrate, tacrolimus monohydrate and lisinoprildihydrate at two different temperatures were known[16]. Ultrasonic studies in aqueous solutions of various drugs gives information regarding the molecular interactions reported by many researchers[17-21]. Ultrasound is found to be the most useful technique to study molecular interactions in solutions because close relation observed between ultrasonic velocity and chemical or structural characteristic of molecule of fluid[22-23]. Ultrasonic velocity, viscosity and density measurement of 2-chlorobenzaldehyde with iodine in hexane ternary solution has

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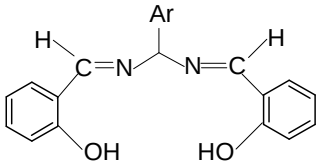
been done at 303K in different concentrations, which helps to study the molecular interaction in that ternary systems[24]. The density (ρ), viscosity (η) and ultrasonic speed (U) of 1, 4-dioxane solutions of symmetric double Schiff bases in 1, 4-dioxane solutions were determined at different temperature[25].

Ligand N,N'bis(salicyliden)-arylmethanediamines, have imine linkage. The organic molecules, having azomethine linkage (C=N), are prevalently known as Schiff bases after Hugo Schiff[26]. Schiff's bases are flexible ligands, also known as imine or azomethine, having spacious applications in various fields of human interests. They are widely used for industrial purposes and also exhibit a broad range of biological activities[27]. Schiff bases along with their bio-active complexes have been broadly studied over the past decade. Schiff bases and their complexes provide impending sites for bio-chemically active compounds. Literature survey reveals the Synthesis and the spectroscopic studies azo ligands obtained from 5-phenylazo-2-hydroxybenzaldehyde[28]. The physical characterization and biological evaluation of some Schiff base complexes with metals including Co, Cu, Ni were reported[29]. It is reported that azomethines show signs of a number of biological activities and plays an important role in the regulation of many biochemical processes[30]. A phenol based novel Schiff bases were found to exhibit the broad range of biological activities[31]. Thermal analysis along with the biological activity of supramolecular Schiff base complexes were also performed[32].

The present investigation deals with the study of acoustical parameters of substituted- N,N'bis(salicyliden)-arylmethanediamines of different concentration at 300k.



Ligand A (L_A) = *N,N'bis(salicyliden)-arylmethanediamine*
Ligand B (L_B) = *N,N'bis(salicyliden)-furylmethanediamine*
Ligand C(L_C) = *N,N'bis(salicyliden)-nitroarylmethanediamine*
Ligand D (L_D) = *N,N'bis(salicyliden)-anisylmethanediamine.*
L_A : Ar = $-C_6H_5$
L_B : Ar = $-C_4H_4O$
L_C : Ar = $-C_6H_5NO_2$
L_D : Ar = $-C_6H_5OCH_3$

EXPERIMENTAL SECTION

For the present investigation the chemicals of AR grade were used. The substituted bis schiff bases ligands used for the study were synthesized by standard method[33]. For the study of different acoustical parameters N,N-Dimethylformamide (DMF) is taken as solvent , which is a polar solvent and has wide applications in a variety of industrial process. With the help of precalibrated bicapillary pyknometer, the measurements of densities were performed. One pan digital balance (petit balance AD-50B) with an accuracy of + 0.001 gm was used for the all measurements. The doubly distilled water was used for the calibration of instruments .The Multifrequency Ultrasonic Interferometer (Model: MX-3, Mittal Enterprises, India) , is used in present investigation to measure ultrasonic velocities of liquid, with a high degree of accuracy. The speed of sound waves was obtained by using variable path crystal interferrometer with accuracy of + 0.03% and frequency 1MHz.

RESULTS AND DISCUSSION

The present study provides a valuable information regarding various acoustical parameters, including ultrasonic velocity (U), adiabatic compressibility (βs), intermolecular free length (Lf), specific acoustic impedance (Z),

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.

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

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

The ultrasonic velocity is calculated by using relation.

Ultrasonic velocity (U) = λ x Frequency x 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 (βs) = 1/ Us^2x ds (3)

Adiabatic compressibility (β_0) = 1/ U_0^2x d_0 (4)

Acoustic impedance (Z) = Us x ds (5)

Where, U_o and Us are ultrasonic velocity in solvent and solution respectively.

d_o and ds are density of solvent and solution respectively.

The apparent molal volume (ϕ_v) and apparent molal adiabatic compressibilities (ϕ_k) of substituted N,N'bis(salicyliden)-arylmethanediamine in solutions are determined from density (d_s) and adiabatic compressibility(β_s) of solution by following equations.

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

and

$\phi_k = [1000(\beta_s d_o-\beta_o d_s) / md_sd_o] + (\beta_s M / d_s)$ (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 compressibilities of pure solvent and solution respectively.

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

Relative association (R_A) = (d_s /d_o) x (U_o /U_s)$^{1/3}$ (9)

Solvation number (Sn) = ϕ_κ / β_o x (M/ d_o) (10)

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

K = (93.875+0.375 x T) x 10^{-8}

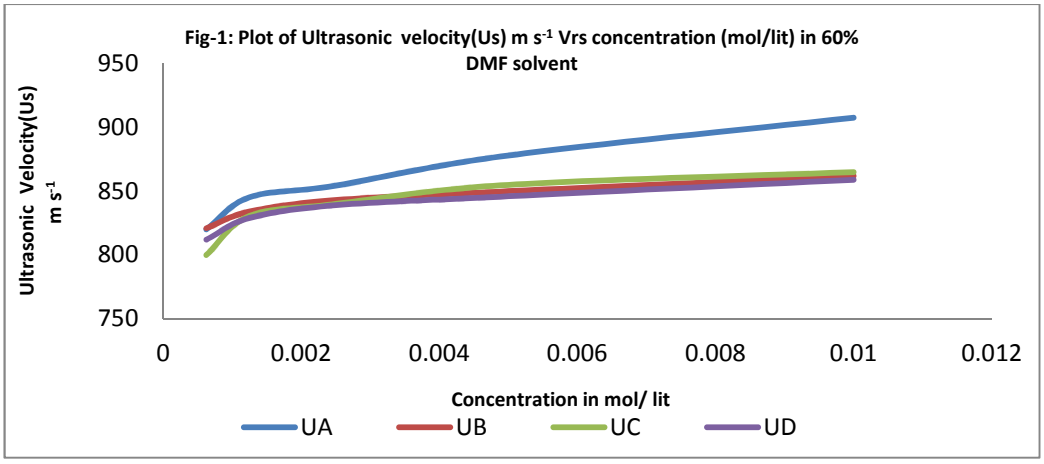
The result thus obtained i.e. the values of density, ultrasonic velocity, adiabatic compressibility (β_S), Specific acoustic impedance (Z) Intermolecular free length (L_f), in 60% of DMF-Water systems are summarized in table-1. It is observed that the density increases with increasing concentration of N,N'bis(salicyliden) arylmethanediamine drugs, because the increasing concentration of drug ,results in increase in number of solute molecules in a given volume, which causes shrinkage in volume of the solution and hence density is found to increased. These data helps to predict that the ultrasonic velocity decreases with decrease in concentration for all systems .Fig.1 represents the plot of the ultrasonic velocities .This may happens due to stong association involves dipole-induced dipole interaction between the component molecules. It is noted that, adiabatic compressibility decreases with increase in concentration of substituted drug in the solutions, fig.2 indicates the graphical representation. The adiabatic compressibility value decreases with increasing concentration indicates formation of strong hydrogen bonding between solute and solvent.

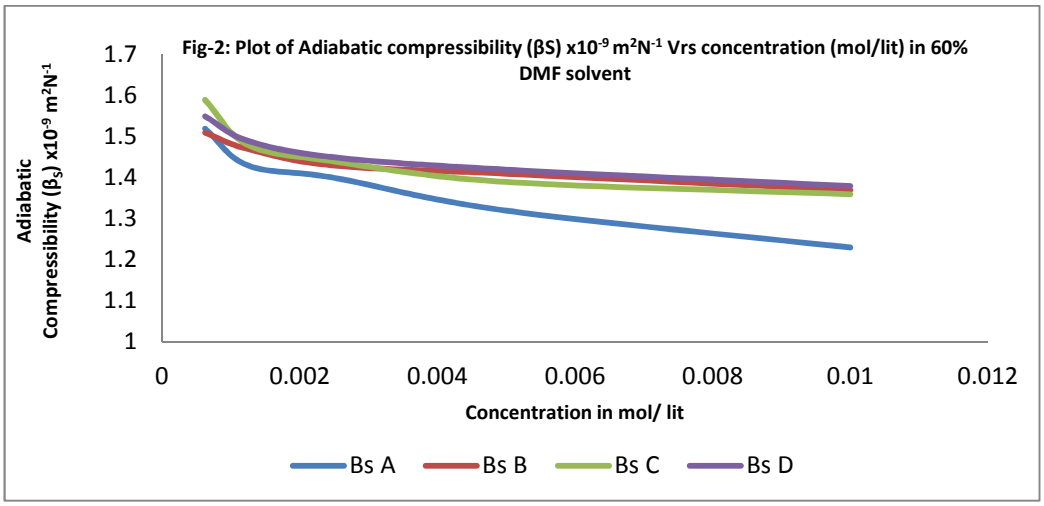
There is linear increase in the value of intermolecular free length(L_f), is observed on decreasing the concentration of substituted drug in various solution of binary mixture, represented in fig.3. The value of specific acoustic impedance (Z) decreases with decrease in concentration for all substituted-N,N'bis(salicyliden) arylmethanediamines in different percent solutions of DMF + water mixture showed in fig.4.

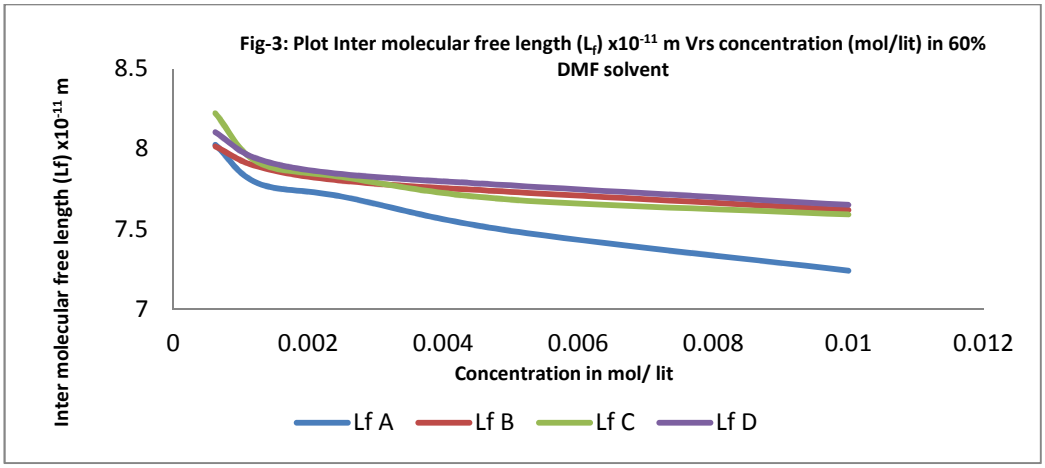
Table1: Ultrasonic velocity, density, Adiabatic compressibility (β_S), Intermolecular free length(L_f) and Specific acoustic impedance (Z) at different concentration of substituted-N,N'bis(salicyliden) arylmethanediamines in 60% (DMF+Water) solvent at 300K

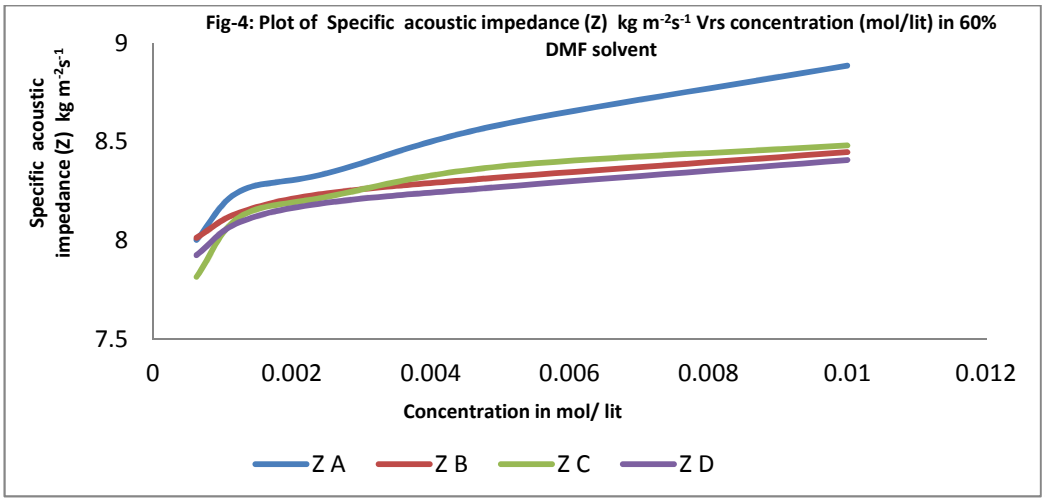
Conc. (m) (mol lit^{-1})	Density (ds) (kg m^{-3})	Ultrasonic velocity (Us) (m s^{-1})	Adiabatic compressibility (β_S) x10^{-9} (m^{2}N^{-1})	Intermolecular free length (L_f) x10^{-11}(m)	Specific acoustic impedance (Z) x10^5 (kg m^{-2}s^{-1})
Ligand L_A in 60% (DMF + Water) solvent					
0.01	979.05	907.6	1.2399	7.2406	8.8858
0.005	977.94	878.0	1.3264	7.4890	8.5863
0.0025	976.13	854.4	1.4033	7.7030	8.3400
0.00125	976.05	845.2	1.4342	7.7871	8.2495
0.000625	976.01	820.0	1.5237	8.0266	8.0032
Ligand L_B in 60% (DMF + Water) solvent					
0.01	979.98	862	1.3733	7.6200	8.4474
0.005	978.75	850	1.4141	7.7325	8.3193
0.0025	977.35	843	1.4397	7.8023	8.2390
0.00125	976.3	834	1.4726	7.8907	8.1423
0.000625	976.1	821	1.5199	8.0165	8.0137
Ligand L_C in 60% (DMF + Water) solvent					
0.01	980.56	865	1.3629	7.5914	8.4818
0.005	979.57	855	1.3964	7.6840	8.3753
0.0025	978.69	840	1.4480	7.8248	8.2209
0.00125	977.59	830.6	1.4827	7.9178	8.1198
0.000625	977.00	800	1.599	8.2231	7.8160
Ligand L_D in 60% (DMF +Water) solvent					
0.01	978.81	859	1.3845	7.6512	8.4079
0.005	977.7	846	1.4290	7.7732	8.2713
0.0025	976.32	839	1.4550	7.8436	8.1913
0.00125	976.31	829	1.4904	7.9383	8.0936
0.000625	976.09	812	1.5538	8.1054	7.9258

GRAPHICAL REPRESENTATION OF ACOUSTIC PARAMETERS IN 60% DMF-WATER SOLVENT









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REFERENCES

[1] **AN** Sonar; *Int. J. Innovative Drug Discovery*, **2015**, 5(2), 49.
[2] F Kawaizumi; K Matsumoto; H Nomura; *J. Phys. Chem.*, **1983**, 87(16), 3161.
[3] RK Prasad; SP Naidu; *Ind. J. Pure Appl.Phys.*, **2003**, 41, 686.
[4] JMadhuri; NJ Glory; RK Prasad; Proceeding of Eighteenth National Symposium on Ultrasonics VIT university ,Vellor, **2009**, 405.
[5] MM Iqbal; RE Verrall; *Can. J. Chem.*, **1989**, 67, 727.
[6] DV Jahangirdar; BR Arbad; AG Shankarvar; *J. Mol. Liq*., **1998**, 75, 33.
[7] DV Jahagirdar; BR Arbad; AG Shankarwar; *J. Pure Appl.Ultrason*., **1999**, 21,108.
[8] A Ali; AK Nain; *J. Pure Appl. Ultrason.*, **1994**, 16, 74.
[9] B Voleisiene; A Voleisis; *J. Ultrasound*, **2008**, 63(4), 7.
[10] VK Syal; A Chauhan; S Chauhan; *J. Pure Ultrasound*, **2005**, 27, 61.
[11] BJ Gangani; PH Parsania; *Arch. Appl. Sci. Res.*, **2015**, 7 (1), 10.
[12] A Tadkalkar; P Pawar; GK Bichile; *J. Chem. Pharm. Res.*, **2013**, 5(11), 762.
[13] SK Thakur; S Chauhan; *J. Chem. Pharm. Res.*, **2011**, 3(2), 657.
[14] S Baluja; KP Vaishnani; N Kachhadia; *Latin Am. Appl. Res*., **2010**, 40, 249.
[15] M Aravinthraj; S Venkatesan; DMeera**;** *J. Chem. Pharm. Res.*, **2011**, 3(2), 623.
[16] N Jayamadhuri; J Glory; KR Prasad; *Res. J. Pharm. Biol. Chem. Sci.*, **2012**, 3(2), 861**.**
[17] KR Prasad; KC Reddy; *J. Pure Appl.Ultrason*., **1987**, 9, 4.
[18] G Muralidharrao; KR Prasad; *J. Pure Appl. Ultrason*., **1992**, 14, 51.
[19] PS Naidu; G Muralidharrao; KR Prasad; *J. Pure Appl.Ultrason*., **1996**, 18, 37.
[20] C Muralikrishna; M.Phil. Disseratation Submitted to S.V.University,Tirupati **1978**.

[21] EL Ravimeher; Ph.D. Thesis Submitted to S.V.University, Tirupati, **1984**.
[22] BD Bhuva; NM Mehta; PH Parsania; *J. Solution Chem.*, **2011**, 40, 719.
[23] KP Vaishnani; S Baluja; *Russ. J. Phys. Chem.*, **2013**, 87(8), 1322.
[24] CS Selvi; S Ravichandran; C Thenmozhi; *Proc Indian Natn. Sci. Acad.*, **2013**, 79(3), 445.
[25] BJ Gangani; PH Parsania; *Der Chemica Sinica*, **2015**, 6(5), 28.
[26] H Schiff; *Justus Liebigs Ann. Chem*., **1864**, 131(1), 118.
[27] CM Silva ; DL Silva; A Fatima ; *J. Adv.Res*., **2011**, 2(1**)**, 1.
[28] S Atia; T Douadi; MA Noaimi; *J. Chem. Pharm. Res.*, **2015,** 7(4), 692.
[29] M Alias; H Kassum; C Shakir; *J. Association of Arab Universities for Basic Appl. Sci*., **2014**, 15, 28.
[30] P Przybylski; A Huczynski; F Bartl; *Curr. Org. Chem.*, **2009**, 13(2), 124.
[31] Sonmez; Mehmet; I Berber; *Eur. J. Med. Chem.*, **2010**, 45(5), 1935.
[32] S Omaima;NS Abdel-Kader; *Arabian J.Chem.*, **2015**.
[33] H Naeimi; K Rabiei; F Salimi; *Bull. Korean Chem. Soc*., **2008**, 29(12), 2445.