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STUDIES OF ACOUSTIC PROPERTIES OF SUBSTITUTED SCHIFF'S BASES AT DIFFERENT PERCENTAGE OF DMF-WATER MIXTURE AT 305 $\pm$ 0.1K

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ABSTRACT

Limiting apparent molar volume and limiting apparent molar compressibility, solute-solute interaction parameters (Sv&Sk) Apparent molar volume (ϕv) apparent adiabatic compressibility (ϕk) at different percentage of DMF-Water mixture of substituted Schiff's bases have been evaluated from ultrasonic velocity and density at 305 $\pm$ 0.1K. The result have been interpreted in the light of solute-solvent and solute-solute interactions.

KEY WORDS

DMF - Dimethyl Formamide

Ligand (L_1) - 2 – Hydroxy -5-chloro-1-(α- phenyl imino) ethyl benzene

Ligand (L_2) - 2 – Hydroxy -5-chloro-1-(α-para methyl phenyl imino) ethyl benzene

INTRODUCTION

Ultrasonic waves, in recent years have a large number of practical applications. In the field of technology, the waves are being used to determine depth of sea, for directional signaling, for detection of flaws, ultrasonic drilling, mechanical cleaning of surface, soldering, etc. Medical applications included bloodless surgery, proper extraction of broken teeth, to restored the contracted fingers, for relieving neuralgic, and rheumatic pains, cardiology, gynecology, etc. Active research work is still in progress to study the effects of ultrasonic waves in mechanical, biological, chemical, physical and industrial fields. Present day applications of ultrasonic are emerging in the field of forensic, sciences, space research and in wars.

The structures, nature and prevailing conditions of solvents and solutes play an important role on resulting properties and interaction occurring in solutions.[1-4] With this consideration, the present work reports ultrasonic velocity and thermodynamic parameters of substituted Schiff's bases in different percentage of DMF-Water mixture at 305k.

It is to be noted that drug action can be achieved with a small amount of drugs as high concentration are rarely achieved in vivo. Therefore, drug transport and ion-solvent interaction are absent. It is natural to believe that the solvent modifies the structures of the drugs and even the structure of the solvent may be modified by the drugs. Thus, the information regarding the transport property of drugs and the ion-solvent and ion-ion interactions may be obtained from ultrasonic velocity measurements. A compilation of such data may be helpful for a possible correlation between drug activities and ultrasonic velocity measurements.

Sound velocity is a thermodynamic property of electrolytic solutions is determined.[5-7] In recent years ultrasonic velocity studied in many of the aqueous and non-aqueous electrolytic solution have led to new insight into the process of ion-ion and ion-solvent interactions. Wadi and Goyal have determined limiting apparent molal volumes (ϕ^0_v), salvations number (Sn) of electrolytes in aqueous medium.[8]

EXPERIMENTAL

The solution of substituted Schiff's bases were prepared in different percentage of DMF-Water solvent. A single crystals multi-frequency interferometer (M-82) operating at $2MH_2$ and Pyknometers with accuracies of 0.05% and ± 0.01kgm3 used for respective measurement of ultrasonic velocity and densities of solutions. The temperature was maintained at 305k by using thermostatic bath.

TABLE – 1

Acoustic Parameters at Different Percentages of DMF-water Mixtures

System : Ligand (L_1) Temp. =305± 0.1^{0}K

Medium : DMF-Water mixture Ultrasonic Frequency : 1 MHz

% of DMF	Density d x 10^3 (kg.m^{-3})	Ultrasonic Velocity Us (m.sec^{-1})	βS x10^{-10} (pa^{-1})	ϕv x 10^{-6} (m^{3}mol^{-1})	ϕk x 10^{-16} (m^{3}mol^{-1}pa^{-1})	Lf (A^0)	Relative Asso. R_A x 10^{-2}	Zx10^4 (kgm^{-2}Sec^{-1})
70	0.9646	1691.25	3.6244	-4.4898	770.6287	1.1458	100.3259	163.1379
75	0.9624	1671.20	3.7204	-4.4652	833.0443	1.1608	100.3284	160.8363
80	0.9603	1653.00	3.8111	-5.0456	907.1368	1.1749	100.3314	158.7376
85	0.9582	1631.00	3.9232	-5.6312	1145.9605	1.1921	100.3534	156.2824
90	0.9559	1611.75	4.0271	-6.2784	1331.2218	1.2078	100.3552	154.0672
95	0.9538	1590.50	4.1445	-6.8747	1605.5363	1.2253	100.3572	151.7019
100	0.9516	1569.86	4.2641	-7.5051	1766.491	1.2428	100.3621	149.3879

TABLE – 2

Acoustic Parameters at Different Percentages of DMF-water Mixtures

System : Ligand (L_1) Temp. =305± 0.1^{0}K

Medium : DMF-Water mixture Ultrasonic Frequency : 1 MHz

% of DMF	Density d x 10^3 (kg.m^{-3})	Ultrasonic Velocity Us (m.sec^{-1})	βSx10^{-10} (pa^{-1})	ϕv x 10^{-6} (m^{3}mol^{-1})	ϕk x 10^{-15} (m^{3}mol^{-1}pa^{-1})	Lf (A^0)	Relative Asso. R_A x 10^{-2}	Zx10^4 (kgm^{-2}Sec^{-1})
70	0.9652	1670.125	3.7144	-53.9327	993.3674	1.151995	100.8100	151.2005
75	0.9630	1650.500	3.8119	-54.7979	1017.4949	1.17508	100.8089	158.9431
80	0.9609	1632.000	3.9073	-55.6306	1075.9002	1.18969	100.8228	156.8026
85	0.9588	1610.600	4.0206	-56.4700	1114.1304	1.20682	100.8256	154.4243
90	0.9565	1591.250	4.1289	-57.3975	1180.0040	1.2229	100.8398	152.2031
95	0.9544	1570.750	4.2467	-58.2516	1212.8988	1.2403	100.8394	149.9124
100	0.9522	1550.000	4.3713	-59.1536	1283.5505	1.2583	100.8524	147.5910

TABLE – 3

Limiting values of apparent molar volume and adiabatic molal compressibility

System : Different % of DMF-Water mixtures.

System	ϕv x 10^{-6} (m^{3}mol^{-1})	ϕk x (m^{3}mol^{-1} pa^{-1})
Ligand (L1)	3.4697	-1815.1 x 10^{-16}
Ligand (L2)	-41.743	296.31 x 10^{-15}

RESULT & DISCUSSION

In present investigation, ultrasonic velocity and density of ligands have been studied at 0.01 M concentration of ligands at different percentage of DMF-water mixture. From these values, apparent molal volume (ϕv), apparent molal compressibility ϕk(s), adiabatic compressibility (βs), intermolecular free length (L_t), relative association (R_A), specific acoustic impedance (z) are calculated. The values of these acoustic parameters have been used to discuss the interactions of unlike molecule of solvents in presence of solute.

The values of acoustic parameters in different percentage of DMF-water mixture are presented in table 1 & 2. Limiting apparent modal compressibility ϕk^0 (s) and limiting apparent molal volume ϕ^0(v) at zero percentage have been determined and given in table 3.

It is observed that ϕk(s) values increase with decrease in the percentage of organic solvent and with decrease in concentration of ligands. Pankanti et al[9] have investigated apparent molal compressibility for amino acids in dioxane-water and acetone-water media. They have reported that ϕk (s) value decreases with increase in percentage of organic solvent. It could be observed that the positive values of ϕk (s) show the electrostatic force in the vicinity of ions, causing electrostatic solvation of ions.

The apparent molal volume (ϕv) are found to be decereased with increase in the percentage of organic solvent.

It could also be seen that intermolecular free length (L_1) increases with increase in the percentages of organic solvent. This may be due to the stronger interaction between ions and solvent molecules. It is seen that βs increases with increase in percentage of organic solvent. This may be due to departure of solvent molecules around the ions.[10]

The values of relative association (R_A) increase for ligands (L_1) and for ligand (L_2) irregular trend of R_A values is seen with increase in percentage of DMF-Water mixture. This may be due to the fact of different electron with drawing substituents present in different ligands.

The specific acoustic impedance (z) decrease with increase in percentage of organic solvent i.e. it varies linearly. Patil and Kaulgud[11] have observed non-linear variation of sound velocity and compressibility with respect to mole fraction.

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