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STUDIES OF ACOUSTIC PROPERTIES OF AMINO ACID IN 10% SODIUM BENZOATE AT 303.15K.

A. N. Sonar*

Shri V.S. Naik College, Raver.

***Corresponding Author: Dr. A. N. Sonar**
Shri V.S. Naik College, Raver.

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ABSTRACT

Acoustical properties have been measured for aspartic acid in aqueous sodium benzoate at different temperature. The measurement have been perform to evaluate acoustical parameter such as adiabatic compressibility (βs), Partial molal volume (ϕ_v), intermolecular free length (L_f), apparent molal compressibility (ϕ_κ), specific acoustic impedance (Z), relative association (R_A), salvation number (Sn) and also studied the molar polarization.

KEY WORD: Molar polarization, polarizability constant, Ultrasonic velocity, intermolecular free length, relative association.

INTRODUCTION

Amino acids are common components of all organisms. Protein of all species made from the amino acids. Protein plays many different biological roles in living systems. One particularly important function is to serve as the building blocks of proteins. The recent data about viscosity, density, ultrasonic velocity and other physical parameter to study interaction within the system, acoustic parameter and transport properties of aqueous amino acids electrolytes[1] are very helpful to obtain data about various types of interactions in solutions. Mirikar et al have been studied the solution properties of liquid system consisting of polar as well as non polar components find applications in industrial and technology processes.[2]

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] Fumio Kawaizumi[4] have been studied the acoustical properties of complex in water. Jahagirdar et. al. has studied the acoustical properties of four different drugs in methanol and he drawn conclusion from adiabatic compressibility. The four different drugs compress the solvent methanol to the same extent but it shows different solute-solvent interaction due to their different size, shape and structure.[5] Meshram et. al. studies the different acoustical properties of some substituted Pyrazolines in binary mixture acetone-water and observed variation of ultrasonic velocity with concentration.[6] Palani have investigated the measurement of ultrasonic velocity and density of amino acid in aqueous magnesium acetate at constant temperature.[7] The ion-dipole interaction mainly depends on ion size and polarity of solvent. The strength of ion-dipole attraction is directly proportional to the size of the ions, magnitude of dipole. But inversely proportional to the distance between ion and molecules. Voleisines has been studied the structural properties of solution of lanthanide salt by measuring ultrasonic velocity.[8] Syal et.al. has been studied the ultrasonic velocity of PEG-8000, PEG- study of acoustical properties of substituted heterocyclic compounds under suitable condition.[9] Tadkalkar et.al. have studied the acoustical and thermodynamic properties of citric acid in water at different temperature.[10] Mishra et.al. have investigated ultrasonic velocity and density in non aqueous solution of metal complex and evaluate acoustic properties of metal complex.[11] M. Arvinthraj et.al. have determined the acoustic properties for the mixture of amines with amide in benzene at 303K-313K. They also determined thermodynamic parameters.[12] S.K. Thakur et.al. have studied the different acoustical parameters of binary mixture of 1-propanol and water.[13]

After review of literature survey the detail study of aspartic acid in aqueous sodium nitrate under identical set of experimental condition is still lacking. It was thought of interest to study the acoustical and thermodynamic properties of substituted heterocyclic drug under suitable condition.

EXPERIMENTAL

The constant temperature was maintained by circulating water through the double wall measuring cell, made up of glass. The flow time was also measured by using digital clock (0.01 Sec).The aspartic acid in aqueous sodium nitrate is used in the present study. The density was determined by using specific gravity bottle by relative measurement method with accuracy ± $1x10^{-5}$ gm/cm^3. The ultrasonic velocity was measure by using ultrasonic interferometer having frequency 3MHz (Mittal Enterprises, Model No F-82). The constant temperature is mentioned by circulating water through the double wall measuring cell made up of steel.

In the present investigation different parameters such as adiabatic compressibility (βs), apparent molal volume (ϕ_v), intermolecular free length (L_f), apparent molal compressibility (ϕ_κ), specific acoustic impedance (Z), relative association (R_A), Solvation number (S_n) were studied.

$$Adiabetic\ comprressibility(\beta o) = \frac{1}{Uo^2 do}$$

$$Adiabetic\ comprressibility(\beta s) = \frac{1}{Us^2\, ds}$$

$$\text{Apparent molal volume}(\phi_v) = \left(\frac{M}{ds}\right) x\ \frac{(d_o - d_s)x10^3}{m\ x\ d_s\ x\ d_o}$$

$$\text{Apparent molal compressibility}(\phi_k) = 1000x\ \frac{(\beta_s d_o - \beta_o d_s)x10^3}{m\ x\ d_s\ x\ d_o} + \frac{\beta_s M}{d_o}$$

$$\text{Specific acoustic impedance }(Z) = U_s d_s$$

$$\text{Intermolecular free length }(L_f) = K\sqrt{\square}ds$$

$$\text{Relative association }(R_A) = x\ 1\left(\frac{d_s}{d_o}\right)^{1/3}$$

$$\text{Solvation number}(Sn) = \frac{\phi_k}{\beta_o\left(\frac{M}{d_o}\right)}$$

RESULTS AND DISCUSSION

In the present investigation, different thermodynamic parameters, such as adiabatic compressibility (βs), Partial molal volume (ϕ_V), intermolecular free length (L_f), apparent molal compressibility (ϕ_κ), specific acoustic impedance (Z), relative association (R_A), salvation number(Sn).

From table-1, these found that ultrasonic velocity increases with increase in temperature. Such an increase in ultrasonic velocity clearly shows that molecular association is being takes place in these mixtures. Variation of ultrasonic velocity in solution depends upon the increase or decrease of molecular free length after mixing the component, based on a model for sound propagation proposed by Eyring and Kincaid.[13] It was found that, intermolecular free length decreases linearly on increasing the temperature of solution. The intermolecular free length decrease due to less force of interaction between solute and solvent by forming hydrogen bonding. This was happened because there is less significant interaction between ions and solvent molecules suggesting a structure promoting behavior of the added electrolyte. This may also indicates that increase in number of free ions showing the occurrence of ionic association due to stronger ion-ion interaction. The value of specific acoustic impedance (Z) increases with increase in temperature. The increase of adiabatic compressibility is decrease with increase in temperature may be due to loss of solvent molecule around ions, this supporting stronger ion-solvent interaction. This indicates that there is not significant solute-solvent interaction. The decrease in adiabatic compressibility following a increase in ultrasonic velocity showing there by stronger intermolecular interaction.

From table-2, it is observed that apparent molal volume increases with increase in temperature indicates the existence of weak ion-solvent interaction. The values of apparent molal volume are all positive values indicate the presence of weak solute solvent interaction.[14] The value of apparent molal compressibility is decrease with increase in temperature. It shows weak electrostatic attractive force in the vicinity of ions. It can be concluded that weak molecular association is found in solution. The value of relative association increases with increase in temperature of system. It is found that there is strong interaction between solute and solvent.

The Solvation number increase with increase in temperature due to weak solute-solvent interaction. There is regular decrease in solvation number with increase temperature indicates the decrease in size of secondary layer of Solvation. The Solvation number in all system decreases with increase in temperature indicates the solvent molecule forms weak coordination bond in primary layer.

Table-1: Ultrasonic velocity, density, adiabatic compressibility (β_S), Specific acoustic impedance (Z) Intermolecular free length (L_f) at different temperature.

Temperature(K)	Density(ds) Kg m-^{3}	Ultrasonic velocity (Us) m s^{-1}	Adiabatic compressibiliy (β_S) x$10^{-10}m^2N^{-1}$	Intermolecular free length (L_f) x10^{-11}m	Specific acoustic impedance (Zx10^6)kg m^{-2} s^{-1}
298.15	1123.48	1567.12	3.6244	3.8289	1.7606
303.15	1120.98	1574.84	3.5969	3.8144	1.7654
308.15	1116.82	1583.67	3.5702	3.8002	1.7687
313.15	1113.81	1591.52	3.5446	3.7865	1.7727
318.15	1109.97	1601.26	3.5137	3.7699	1.7774

Table-2: Relative association (R_A), apparent molal compressibility (ϕ_κ), Apparent molal volume (ϕ_v), Solvation number (S_n).

Temp. (K)	Apparent molal volume (ϕ_v) m^3mole^{-1}	Apparent molal compressibility □□ϕ_κ□x10^{-11} m^2 N^{-1}	Relative association (R_A)	Adiabatic compressibiliy (β_o) x$10^{-10}m^2N^{-1}$	Solvation number (S_n)
298	0.1184	4.31941	1.00710	3.6244	1.03888
303	0.1187	4.29706	1.00695	3.6024	1.039887
308	0.1192	4.27898	1.00691	3.5716	1.043807
313	0.1195	4.26118	1.00686	3.5430	1.045045
318	0.1199	4.23826	1.00655	3.5144	1.049175

CONCLUSION

In the present study mentions the experimental data for ultrasonic velocity, density at different temperature for substituted heterocyclic drug in ethyl alcohol. From experimental data calculated acoustical parameters and studied to explanation solute-solvent interaction and ion-ion / solute-solute interaction are existing between aspartic acid and solvent mixture. From experimental data it can be conclude that weak solute-solvent interaction in all systems.

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