Volumetric Properties of Amino Acid at Room Temperature

Shital Vijay Ambatkar, Proff. Urvashi Manik, Proff. Ramteke

Abstract- **The ultrasonic velocity (U), density (ρ) and viscosity (n) measurements have been carried out for D-Histidine in aqueous medium as a function of composition at 298K. Experimental data have been used to estimate the adiabatic compressibility (B), Molar volume(V_m), Relative association(R_A), Available volume(Va), Rao constant(Rc) and Wada's constant (W). The results are discussed in terms of structure-breaking effects of amino acids in the mixture.**

***Index Terms* - Amino acid, density, viscosity, velocity, adiabatic compressibility, molar volume, relative association, available volume, Rao constant, Wada's constants.**

I. Introduction

Ultrasonic velocity studies are extensively used to analyse the behavior of Electrolyte and nonelectrolyte solution in aqueous and nonaqueous solvent mixture. Ultrasonic studies have been made for simple carbohydrate in water but these studies in aqueous and nonaqeous medium are rare. Frank and kaulgud have studied the thermodynamic properties of several carbohydrates like ribose, galactose, monosaccharides and disaccharides in aqueous solution.

Volumetric, ultrasonic studies of these model compounds in aqueous medium of electrolytes provide information about solute-solvent and solute-solute interactions that can be of great in understanding the effect of these salts on biomolecules. Volumetric properties of solutes such as the partial molar volume, compressibility and expansibility, are know to sensitive to the degree and nature of solute hydration.Para amino benzoic acid grapheme and grapheme based material are current have an outstanding significance due to their fantabulous electronic and mechanical properties. Including especially high surface area.Internal pressure is the resultant of attractive and repulsive force between the molecules.

Ultransonic study on the amino acid with aqueous solution of electrolytes with Aqueous solution of electrolytes and non electrolytes provides useful information in understanding the behaviour of liquid system, intramoleculer and intermolecular association, complex formation and related structural change.

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It is well know that electrolytes can influence the solubility behaviour of amino acid.For this we have experimentally determined simultaneously the density, volumetric properties of amino acid ultrasonic velocity of given aqueous amino acid room temperature.

The volumetric properties of amino acid can be studied by determination of parameter like ultrasonic velocity, density, viscosity provide needful information of liquid system at room temperature.

II. EXPERIMENTAL DETAILS

All the chemicals used in present work are analytical (RA) reagent grade and spectroscopic (SR)reagent grade of minimum assay of 99.9% . The ultrasonic velocity was determined by using an ultrasonic Interferometer which is a simple device. The principle used in the measurement of velocity (V) is based on the accurate determination of the wavelength(λ) in the medium .Ultrasonic waves of known frequency(f) are produced by a quartz plate fixed at the bottom of the cell These waves are reflected by a movable metallic plat kept parallel to the quartz plate. If the separation between these two plates is exactly a whole multiple of the sound wavelength, standing waves are formed in the medium. This acoustic resonance gives rise to an electrical reaction on the generator driving the quartz plate and the anode current of the generator becomes maximum or minimum.

If the distance is now increased or decreased and the variation is exactly one half wavelengths (λ/2) or multiple of it ,anode current again becomes maximum or minimum. If the separation between quartz plate and metallic plate is changed by d between two successive maximum anode current, then

$$\mathbf{d} = \lambda/2$$

From the knowledge of wavelength (λ), the velocity (V) can be determined by the relation:

$$\mathbf{V} = \lambda * f$$

An Ostwald's Viscometer was used for the viscosity measurement .The time flow of solutions was measured with digital clock having an accuracy of 0.01sec. The density of solutions is determined by using a specific gravity density bottle with10 ml capacity.

III. THEORY

1) The adiabatic compressibility is defined as "the fractional decreases of volume per unit increase of pressure.

$\beta = 1/U^2\rho$

Where, U=velocities of the solutions

ρ= densities of the solutions

2) .Molar volume (V_m) is calculated by

$V_m = M_{eff}/\rho$

Where, M_{eff} = Effective mass,

P=density of solution

3) Available volume(V_a) is given by

$V_a = V_m (1\text{-}c/c)$

Where, c = weight of concentrations

4) Relative association (RA) is determine as

$R_A = (\rho/\rho_0\ )\ (u_o/u)^{1/3}$

5) Rao constant

$R = Vu^{1/3}$

6)Wada constant: (molar compressibility)

$W = V\beta_a^{-1/7}$

IV. RESULT AND DISSCUSSION

It is interesting to note that for D-Histidine in the aqueous medium the value of velocity, density, viscosity increases with increase in concentration of solutions. The increase in ultrasonic velocity (u) in the solution suggesting the possibility of a molar association in these liquid mixtures. The measured parameter like density (ρ) is a measure of solvent and ion solvent interaction. Increase of density with concentration indicates the increase of solute solvent interactions.

Increase in density with concentration is due to the shrinkage in the volume which in turn is due the presence of solute molecule and it further indicates structure making of solvent due to added solute.Viscosity measurement is important in understanding the structure as well as molecular occurring in the solution.

One can notice that from table the value of viscosity increase with increase in solute concentration. This increasing trend indicates the existence of molecular interaction occurring in the system.

Table 1.: Ultrasonic and allied parameters of potassium acceted in p- amino benzonic acid at 298^{0}K

Conc.	Velocity U (m/s)	Density P*10^3(kg/m^3)	Viscosity (n)	Molar Volume M^3/mol	Adiabatic Compressibility B_a(10^{-10}m^2/N)	Available Volume M^3/mol	Rao Const. (R)	Relative Assosiatio n R_A	Wada Const. (W)
0.1	1446.53	1.045828	1.003496	98.873335	4.569666	98.852149	1118.2056	2.59099	2134.9190
0.12	1448.97	1.048721	1.005369	99.016770	4.5417275	98.991244	1122.1577	2.595594	2139.8886
0.14	1457.14	1.048951	1.009628	99.159005	4.489954	99.129258	1124.1715	2.596234	2149.4766
0.16	1499.26	1.053102	1.069920	99167058	4.316133	99.13305	1130.9407	2.606457	2158.7931
0.18	1513.46	1.061192	1.090044	99.179580	4.113998	99.14385	1138.7025	2.626353	2173.8991
0.2	1539.59	1.062344	1.095221	99.207056	4.007055	99.164503	1145.5417	2.636353	2182.7102

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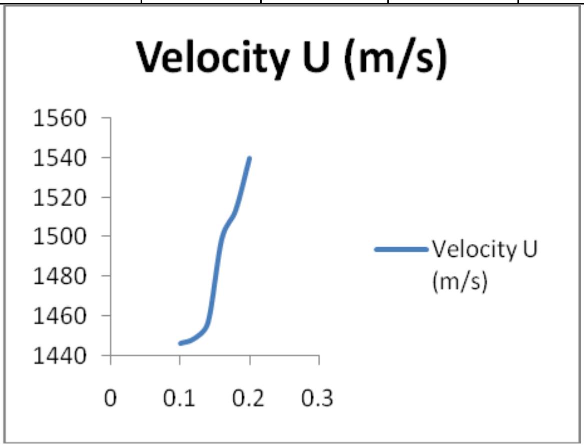
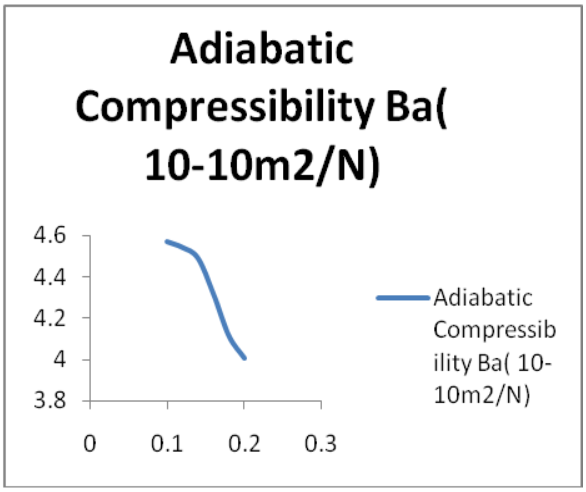
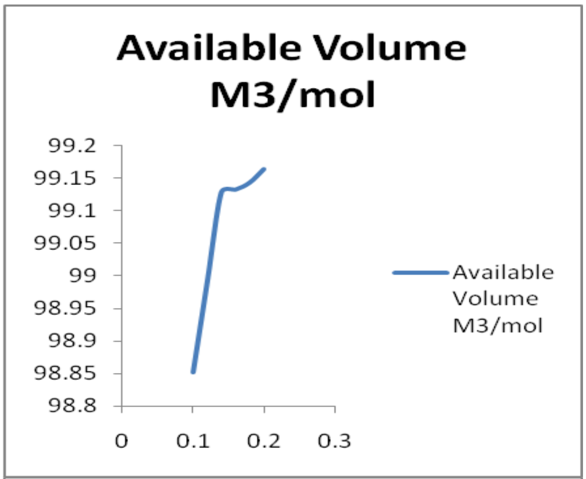
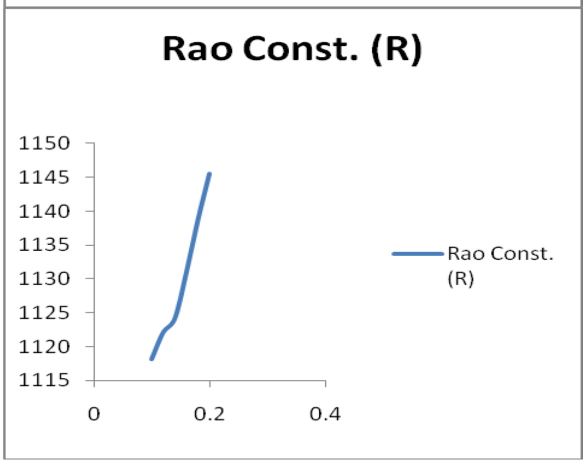
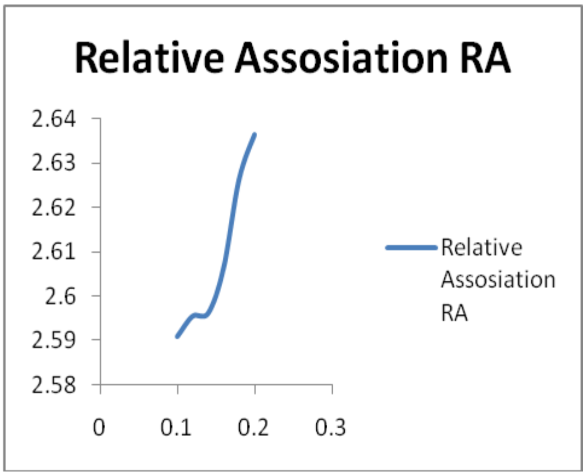
All the chemicals used in present work are analytical (RA) reagent grade and spectroscopic (SR)reagent grade of minimum assay of 99.9% . The ultrasonic velocity was determined by using an The variation of adiabatic compressibility (β) with molar concentration of potassium acceted shown in the table. It suggesting that the molar association is greater in potassium acceted. The increase in electrostriction compression of water around the solute results in large decrease in compressibility of solution at higher concentration. Apparent molar volume, Rao constant obtained for potassium acceted system which suggests electrostriction and hydrophilic interaction are occurring in this system indicating the presence of strong solute solvent interaction.

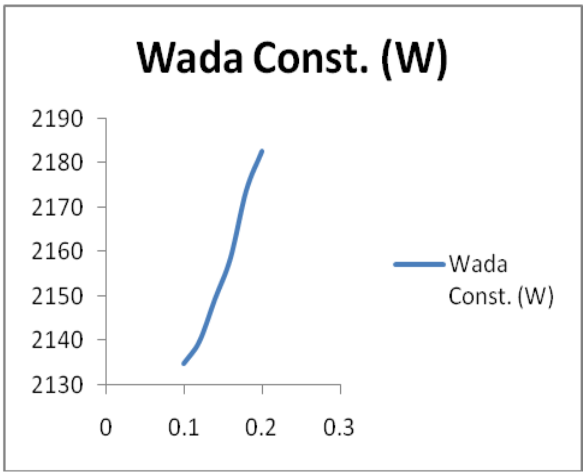












V. Conclusion

Intermolecular interaction of electrostriction and hydrophilic nature exist in the systems in the present paper. The existence of ion-solvent or solute solvent interactions resulting in attractive forces promotes the structure making tendency, while ion or solute solute interaction resulting dipole-dipole, induced dipole and electrostriction forces enhance the structure breaking properties .

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