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RESEARCH ARTICLE

PHYSICO-CHEMICAL ANALYSIS ON BINARY LIQUID MIXTURE OF AMINO ACETICACID AND SALTS

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ABSTRACT

The effect of ultrasonic characterization on the behavior of interaction between amino acetic acid and inorganic salt (Like: sodium chloride and potassium chloride solutions) at four district temperature was studied.The impact ultrasonic characterization on different systems such as : 1) Amino acetic acid +Distilled Water , 2) Amino acetic acid +Distilled Water + Sodium Chloride and 3) Amino acetic acid +Distilled Water +Potassium Chloride , under distinct temperature and concentration were studied. The various Volumetric and sound parameter is calculated by using literature formulae. Trends of the different properties provide the information about the ilk and geometry of the system. Measurement of apparent molal volume for all the three system, Showed that dependency of concentration and temperature, with negative trends. Decreasing the apparent molal volume upon aggregation can result from the contribution of three different processes: (i) liberation of structured water. (ii) the electrostatics attraction between the ions of solute and solvent. And (iii) the release of water molecule from the counter, ions upon binding to component of solute and solvents. The difference for the systems investigated follows the order: Amino Acetic Acid+Distilled Water+Potassium Chloride>Amino Acetic Acid +Distilled Water+Sodium Chloride >Amino Acetic Acid+Distilled Water.

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INTRODUCTION

Ultrasonic analysis having small amplitude which gives important information about structure and ionic interaction in the solute-solvent mixture. (1) Ultrasonic approach in aqueous solution of electrolytes with amino acids gives better understanding about behavior of fluent, because intra-molecular and intermolecular associations, complex formation and associated structural changes affect the compressibility of the system.(2) Amino acids are basic unit of protein amino acid contain an amino group (NH_2) and a carboxylic group amino acid chemical formula COOH. These are called natural amino acids are available as intermediate of the natural amino acids. Humen body connect synthesize them therefore they must be supplied through food in amino acid this mixture is use to find the various chemical intermediates are widely used in pesticide, medicine, food, feed and other field.(3) Since amino acid are the building block of proteins, and are member of an important family of biomolecules, the study of these substance is a helpful technique. Also amino acids are ionizable in aqueous solution and can act as acids or bases, it is important known their acid-base properties to understand the different characteristics associated with proteins.(4)

Amino acids are used by the human body to make proteins, which help carry out many other bodily process there are three different types of amino acid essential non-essential, and conditional amino acid are produced by the human body there are not produced from food foods essential amino acids cannot be produced by the body therefore they must be obtained from food.(5) Although there are 22 different types of amino acids only 9 of them are considered essential (6). Previous researcher has done a lot of researchers on drug like amino acetic acid with aluminum Nitride on the structure, curing processes, and properties of Epoxy Nanocomposites. (Amirbek Bekeshev,21 November.2023) (7). Synthesis and performance of flame-retardant additives based on cyclodiphosphi(V)azane and amino acetic acid.(8)Corrosion Control by Amino Acetic Acid (glycine) an Overview (9).Effect of foliar application of amino acid, acetic acid on growth and yield traits of wheat.Now we study the interaction between Amino Acetic Acid and salt solution impact by contrast in solute concentration and temperature there are many categories of drugs, between then we will study only Amino Acetic Acid (10). However up to this date, threre are no exhaustive (like Ultrasonic, volumetric and viscometric etc.)

Studies that examine the influence of electrolytes on the acoustic and volumetric behavior of Amino Acetic acid and aqueous sodium/potassium chloride solution.In this attempt to obtain further evidences about the salting impact caused due to the addition of amino acetic acid (AAA) to aqueous salt solution and analyzing the effect of different anions and captions on the aggregation behavior AAA in aqueous medium. The present work is thus mainly focused on the study of impact of electrolytes its different concentration NaCl and KCl as well as temperature on the acoustic and volumetric parameters.

MATERIALS

Amino Acetic Acid (AAA), Sodium chloride and potassium chloride having CAS number as: 55-40-6, 7647-14-5,7447-40-7, and molecular weight of 75.07g/mol,58.44g/mol,74.55g/mol, used in research work were purchased from HimediaLab.Pvt.Ltd. Mumbai. The aqueous stock solution of NaCl and KCl were prepared at molal concentration. Further various molal made by using man fraction method. Doubly distilled water was used for solution preparation.

METHODS

An ultrasonic digital velocity interferometer was used for velocity analyzer at 2MHz frequency purchased from Chennai. For the determination of density of all the system, a 10 ml specific gravity density of bottle was used along with digital electronic weighing machine with four decimal accuracies for the weighing purpose. The temperature was maintained constant by water circulated from a high precision water temperature controller both of ±1k supplied by Lab Hosp.Pvt. Ltd Nagpur.

DEFINING RELATIONS

Acoustic Impedance (Z): An acoustic impedance is useful in discussing the relation between density and velocity and it is derived from given equation.

$Z = U\rho$ ------- $(Kg\text{-}\ m^2s^{-1})$

Relative Association: The relative association is derived from the given equation.

(R_A): $\{\frac{\rho}{\rho_0}\}\{\frac{U_0}{U}\}^{1/3}$

Apparent Molal Volume (φ_V): It is a ratio of volume of solution to the mole of solute.

$$V\varphi = \frac{1000}{m\rho_0}(\rho_0 - \rho) + \frac{M}{\rho_0} \quad \text{------ } (m^3mole^{-1})$$

Where, ρ = Density of solution.

ρ_0 = Density of solvent.
M = Molality of the solution.
m = Molecular weight of

Rao's Constant (R): Rao's constant is determined by molar volume and velocity hence is also called as molar sound velocity.

$R = (V_mU^{1/3})$ -------$(m^3mole^{-1})(ms^{-1})^{1/3}$

Wada's Constant: Wada's constant also known as molar compressibility is dependent on adiabatic compressibility and density is given by,

$W = Vm\beta^{-1/7}$

Relaxation strength (r): Relaxation strength is straightly connected with adiabatic compressibility the relation as follows.

$(r)= 1- (\frac{U}{U_\infty})^2$

Available Volume (V_a): Available volume is used to calculate the compactness and strength of molecular attraction among solute and solvent.

$$V_a=\left\{V_m\left[1-\frac{U}{U_\infty}\right]\right\}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(m^3mol^{-1})$$

Specific Heat Ratio: The specific heat ratio is the specified relation between isothermal compressibility and adiabatic compressibility.

$\frac{17.1}{T^{\frac{4}{9}}\times\rho^{1/3}}$ …… $\{K^{4/9}\}^{-1}\{Kg^{1/3}/m\}^{-}$

Free Length (L_f): The spacing between two neighboring molecules of the solution is known as intermolecular free length.

$L_f= K\,(\beta a)^{1/2}$

Isothermal Compressibility (KT_1): The isothermal compressibility value has been evaluated it has been evaluated from McGowan's equation and this is dependent on velocity and density.

$(K_T) = \frac{1.33\times10^{-8}}{(6.4\times10^{-4}U^{3/2}\rho)^{3/2}}\ldots\ldots\{m^2/N\}$

RESULT AND DISCUSSION

In this section various thermo-acoustic parameters calculated and explained along the density and ultrasonic velocity for the systems:

- Amino Acetic Acid + Water (distilled)
- Amino Acetic Acid + Water (distilled) + Sodium Chloride.
- Amino Acetic Acid +Water (distilled) + Potassium Chloride.

The trends of ultrasonic velocity in all the three systems at different temperature (283,288,293,288K) Shows the existence of intermolecular interaction between solute-solvent where increasing trend in ultrasonic velocity confirms strong

association in molecules this association is due to hydrogen bonding between solute-solvent molecules Rises in the values of ultrasonic velocity (as shown in Fig.1) Also exhibits that cohesion. Brought by the ionic hydration it predicts the interaction between the solute-solvent. The information about then interaction among solute-solvent, ion–solvent and solvent-solvent can be well predicted by the density.(11) A concentration increases, the shrinkage in the volume occurred and hence the corresponding values of density exhitrits increasing nature. It results in increase in density is interpreted to the structure makes of the solvent. Further more the decrease in the density due to increase in temperature indicates the decrease in solute-solvent and solvent-solvent interactions which results structure–breaking of the solvent. Thus, the size of the resultant molecules increases with increase in concentration and these will be decrease in density(12).

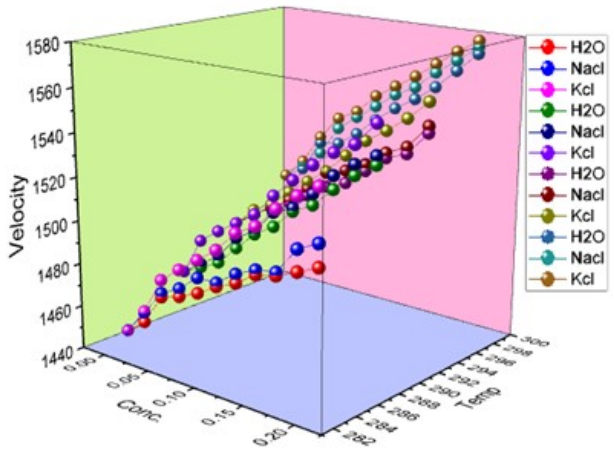

Fig.1. Ultrasonic Velocity

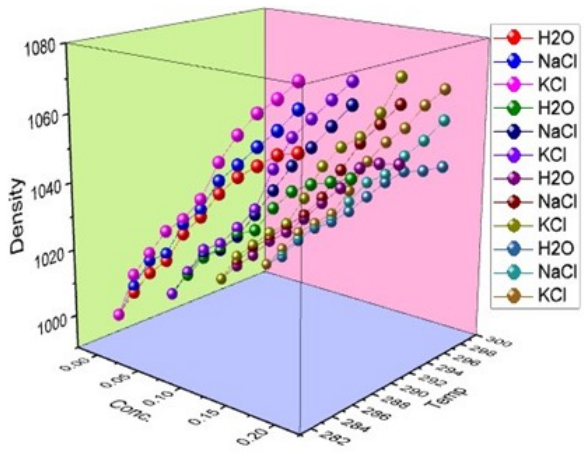

Fig. 2. Density

The variation of acoustic impedance with weight fraction at different temperature evident from Fig. 3, indicates increasing trends in all the three system. Hence it can be concluded that there is a significant interaction present due to which structural rearrangement is above affected. This it is clear from this; there is a strong association between the solute and solvent molecules due to hydrophilic nature.(13) The acoustic impedance escalates from system I to III with the concentration and temperature suggestry fragments of water molecules are less attracted as compared to sodium and potassium.

The relative association shows that close association of component of molecules (Solute-Solvent) depicted in Fig. 4, due to increase in salvation of ions of solute and there exist interaction. With respect to temperature, R_A shows decreasing trends indicating the present of interaction (14,15).

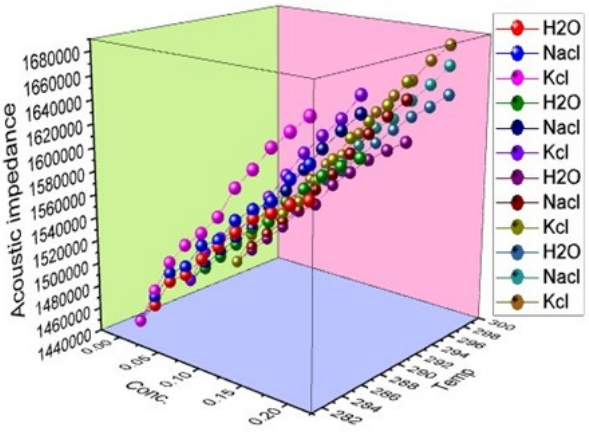

Fig. 3. Acoustic impedance

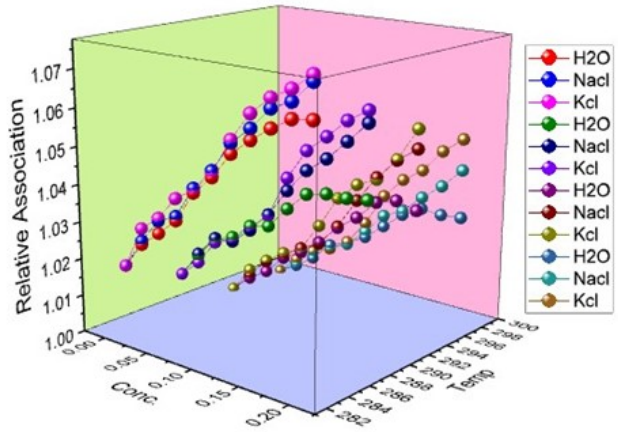

Fig. 4. Relative Association

Apparent molal volumes were calculated from the measured densities. And plotted against molality of AAA in NaCl and KCl at different temperature shown in Fig. 5 at gives the idea about the molecular size of the hydrated solute molecules in the solution which moles a passage. Hydrogen bonding is present in the water molecules and it surrounds the solute molecules by creative a compact. Around them which decrease the apparent molar volume. As the amount of AAA increases in the solution mode by NaCl and KCl, increases the solute-solvent interactions replaced by the solute-solute interactions. Temperatures also impacts slight effect on the Apparant molal volume. And negatively decreases the values (16). Generally, the following interactions in the binary systems of AAA occurred. KCl>NaCl>H_2O.

Rao's constant is known as an adaptive property or molar sound velocity. Whereas Wada's constant is dependent on adiabatic compressibility and density hence it is also termed as molar adiabatic compressibility. The values of Wada's constant and Rao's constant are presented in Fig.6 and 7 From the experimental values, it has been found that as concentration increases the values of 'R' increase. The increasing treandof Rao's constant risein concentration as well the temperature rise suggests that in the present system more components are available in a given volume of the medium and the presence of the solute-

solventinteractions.(17)Variation in the values of Wada's constant follows the same trend as observed for molar sound velocity. It increases with an increase in concentration at a constant temperature indicating the compact packing and greater molecular association present in the medium.(18) As temperature increases, Wada's constant also increases. Relaxation strength is directly proportional to adiabatic compressibility when we added solute to a solvent, the value of relaxation strength decreases it is an indication solute-solvent interaction in the system. The relaxation strength of amino acetic acid+H_2O+NaCl+KCl solution with increase in the concentrations and temperature. It indicates the highest molecular relation between solute and solvent molecules and depicted in Fig. 8.

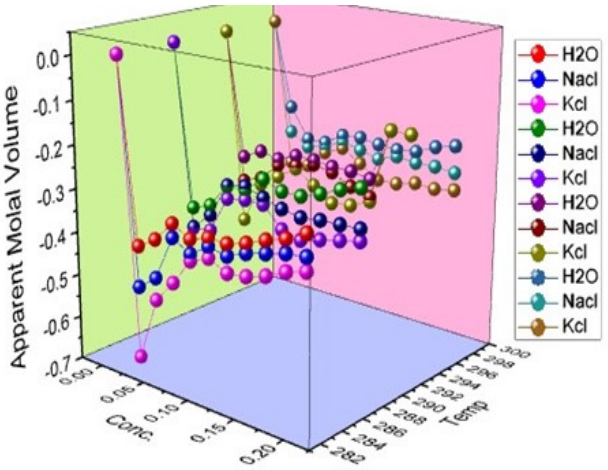

Fig. 5. Apparent Molal Volume

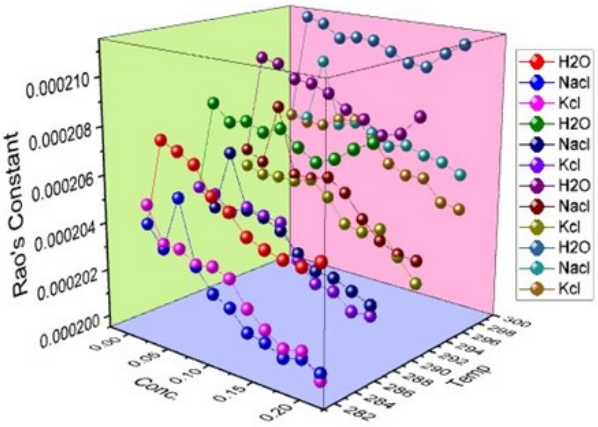

Fig. 6. Rao's Constant

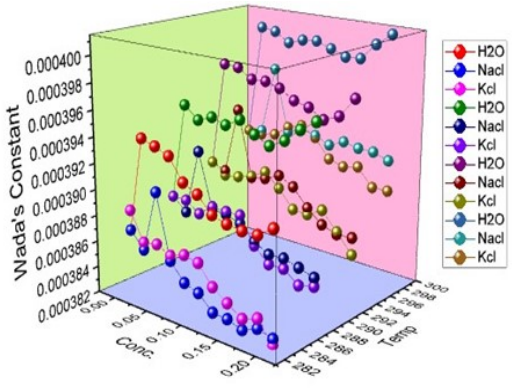

Fig.7 Wada's Constant

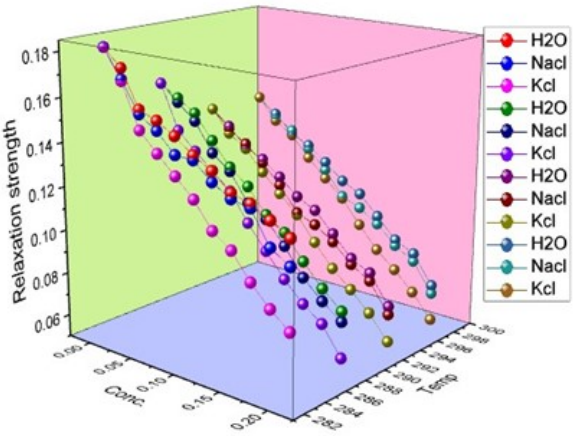

Fig.8. Relaxation Strength

The available volume is used to study the intermolecular interaction present in the liquid solution. (19) It is observed that as the concentration of the solute increases, the value of 'Va' exhibits a decreasing trend as shown in fig.9 the decrease in available volume is due to the net packing of molecules inside the shell, which may be formed by complexion between unlike molecules inside the shell. Which may be formed by complexion between unlike.Fig.10 shows that the specific heat ratio values rise with rising concentration and falling with rise in temperature. The temperature of the specific heat ratio in the container decreases which is visible in the intermolecular interaction. It shows that there is a nearer packing of the molecule in the solution because of hydrogen attraction between them (20).

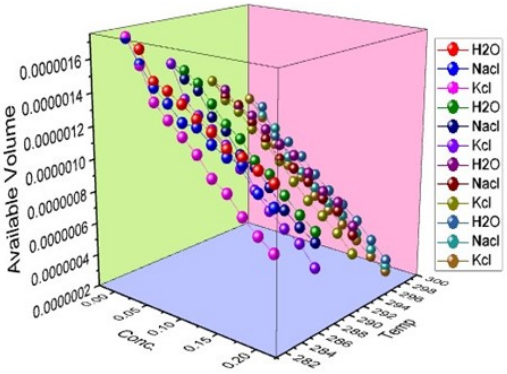

Fig. 9. Available Volume

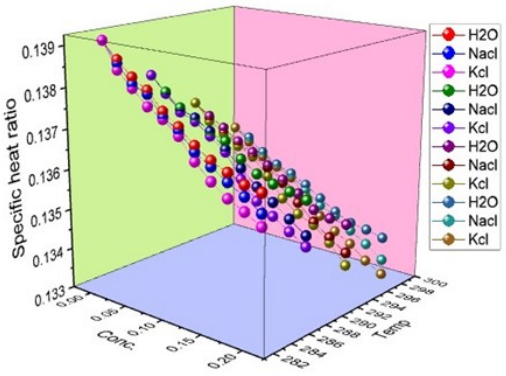

Fig.10. Specific Heat Ratio

The free length is the spacing between the middle of the surface of the near molecules. The value of intermolecular free length rises with rising concentration and temperature as shown in Fig.11. From this fig is observed that presence of intermolecular forces in the solution.

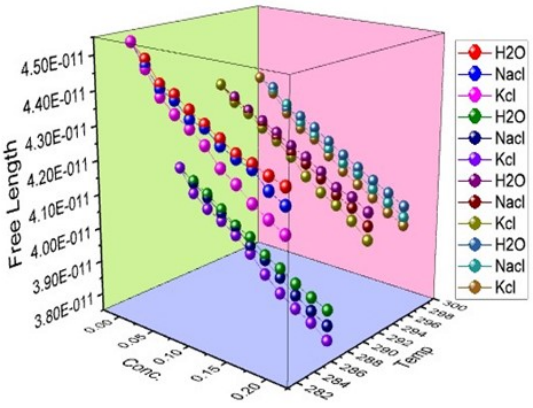

Fig.11. Free Length

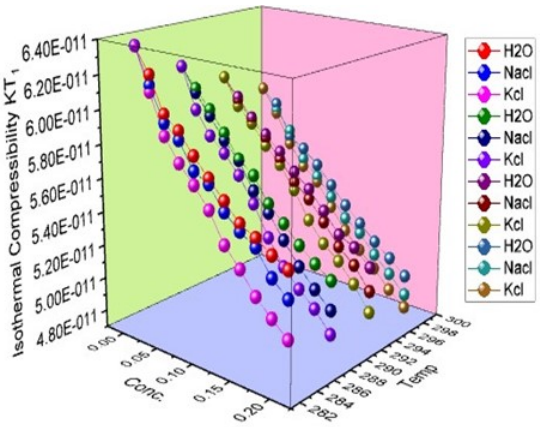

Fig. 12. Isothermal Compressibility K_T

The decreasing nature of free length show that compactness of the structure is increasing and it is less compressible (21). We can explore the thermodynamic responses functions of these mixtures by varying the composition and the temperature isothermal compressibility is one of the thermodynamic response functions which can give information about the structure features of binary and ternary mixtures. The overall trends observed the isothermal compressibility (K_T) at all four temperatures are as shown in Fig. 12 and it has been found that the calculated values of isothermal compressibility's by using both the relations to be decreasing with an increase in concentration. The outcomes of 'K_T'values with an increase in the concentration of potassium sulphate in all three solvents seem to be the result of the corresponding decrease in free volume and average kinetic energy of the constituent's solute-solvent molecules in the saline salt solution molecules in the saline salts solution. (22)

CONCLUSION

The interactions of AAA with H_2O/ NaCl /KCl have been an intense field of research as it finds number of applications in industries, medicine, pharmacology, biosynthesis and so on. The over all evaluation of the results of experimental and calculative data of different thermodynamics, volumetric and acoustical properties.conclude that the interaction occurs between solute and solvent.

Herein this work, AAA interacts well with the components of KCl as compared to H_2O and NaCl. Furthermore, the results indicate that there exists hydrophilic–ionic group type interaction which increases with increase in concentration of AAA. All over the observed interaction trend is found to be: AAA+H_2O+ KCl>AAA+ H_2O+NaCl>AAA+H_2O.

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