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Research Paper Physics

Acoustic Properties of Ternary Liquid Mixture Using Ultrasonic Interferometer Technique

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ABSTRACT *Density, viscosity and ultrasonic velocity have been measured for ternary liquid mixtures containing aqueous ascorbic acid with NaOH at room temperature. Adiabatic compressibility, free length, acoustic impedance and relaxation time have been calculated from experimental data. These parameters were used to discuss the molecular interactions between the component molecules. They are found to be sensitive to the nature and extend of the interactions taking place in the ternary liquid mixtures.*

KEYWORDS: Ultrasonic velocity, binary mixture, molecular interaction, hydrogen bonding

INTRODUCTION

Ultrasonic technique has powerful tool for studying the molecular behavior of liquid mixtures[1-6]. The ultrasonic study of liquid and liquid mixtures has gained much importance in assessing the nature and relative strength of molecular interactions and investigating the Physiochemical behavior of such system[7-9]. In recent years ultrasonic investigations find large number of applications in characterizing of thermodynamic and physiochemical aspect of ternary liquid mixtures[10]. The acoustical and thermodynamic parameter have been used to study different kinds of associations, molecular motion and various types of interaction and their strengths influenced by the size of pure component and the mixtures.[11-12]

The ultrasonic velocity, density and viscosity for ternary liquid mixtures have been measured by many researchers .However no effort have been made to collect the ultrasonic velocity, density, and viscosity of ternary liquid mixtures of aqueous ascorbic acid with NaOH up to now.

In the present Paper, we report the ultrasonic velocity, density, viscosity of aqueous ascorbic acid with NaOH at room temperature over entire range of molar concentrations .From these experimental value a number of thermodynamic parameters namely adiabatic compressibility, free length, acoustic impedance and relaxation time have been calculated. The variation of these parameters with molar concentration was found to be useful in understanding the nature of interactions between the components.

MATERIALS AND METHODS

Ascorbic acid used in the present work was of Analytical Reagent (AR) grades with a minimum assay of 99.9%, they are used without purification. Double distilled water was used for preparation of solution. The various concentration of solution was prepared by adding sufficient amount of solvent NaOH to aqueous ascorbic acid.

The ultrasonic velocity(u) have been measured in ultrasonic interferometer(Model-F-05) supplied by mittal enterprises, New Delhi operating at a frequency of 2 MHz with an accuracy of 0.1%.The viscosities (η) of ternary mixtures were determined using Ostwald's viscometer by calibrating with double distilled water. The density (ρ) of these ternary solution were measured accurately using 25 ml specific gravity bottle in an electronic balance precisely and accurately using weighting is 0.1mg.These basic parameter u, η and ρ were measured at room temperature and at various concentration (0.00 M to 0.1M) .The acoustical parameters were calculated from U, η and ρ value using standard formulae.

RESULTS & DISCUSSION

The calculated acoustical parameters of aqueous ascorbic acid with NaOH at room temperature were shown graphically in fig.1 to 4.

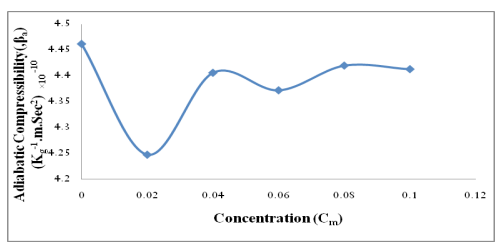

Fig.1 Variation of adiabatic compressibility with C_m

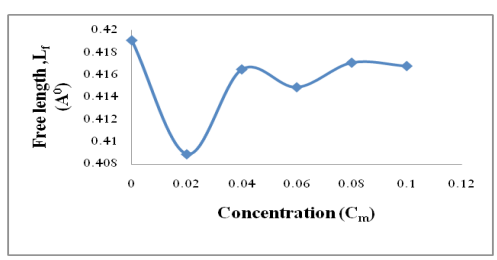

Fig. 2 Variation of free length Vs C_m

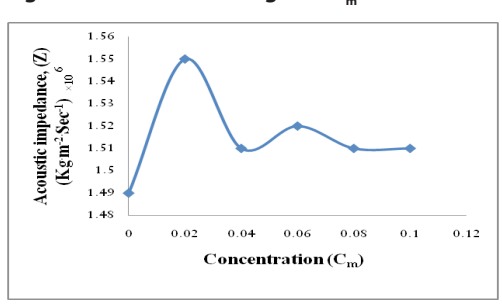

Fig. 3 Variation of acoustic impedance Vs C_m

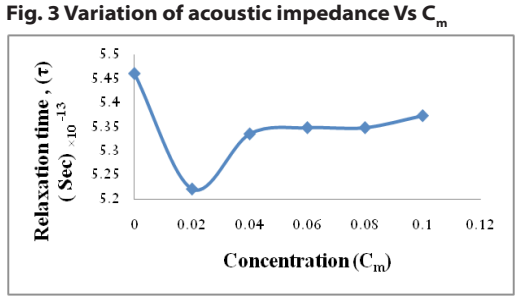

Fig. 4 Variation of relaxation time with C_m

In ternary liquid system of aqueous ascorbic acid with NaOH, adiabatic compressibility and free length shows nonlinear variation with increase in molar concentration. This indicates molecular association and complex formation may be due to possibility of hydrogen bond formation between the interacting molecules[13].

The acoustic impedance shows nonlinear behaviour with increase in molar concentration. This nonlinear behaviour indicates the increase or decrease in solute-solvent interaction .The increase in acoustic impedance shows hydrophilic nature whereas decrease in acoustic impedance shows hydrophobic nature of interacting components[14].

Nonlinear variation of relaxation time with increase in molar concentration is due to the existence of significant molecular interaction between the solute and solvent molecules[15].

The adiabatic compressibility, free length and acoustic impedance show dip at 0.02M whereas the relaxation time shows peak at corresponding concentration. This indicates the formation of strong hydrogen bond at this molar concentration.

CONCLUSIONS

The nonlinear variation of acoustical parameters with molar concentration shows that, there exist intermolecular forces in the ternary liquid mixture. The complex formation and molecular association in these mixtures may be due to formation of hydrogen bonding in the molecules and the tendency of solute-solvent interaction. The complex formations are responsible for heter-molecular interaction in the liquid mixture.

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