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Physics

# PHYSICOCHEMICAL INVESTIGATION OF ACOUSTICAL PARAMETERS OF α-TOCOPHEROL ACETATE AND DIETHYL ETHER AT 293 K

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**ABSTRACT** In this paper, density (ρ), ultrasonic velocity (u) and viscosity (η of binary liquid mixture of α-Tocopherol and Diethyl ether have been measured using 2 MHz ultrasonic interferometer at 293 K. These experimental parameters can be used to calculate acoustical parameters i.e adiabatic compressibility, free length, free volume and internal pressure. The finding of results assists the structural changes and association of molecules in the binary liquid mixture of α-Tocopherol and Diethyl ether.

**KEYWORDS :** Ultrasonic velocity, binary liquid mixture, Association.

## INTRODUCTION

Ultrasonic technique is an effective tool for investigating the physicochemical properties and molecular interactions in both pure liquids and liquid mixtures[1-3]. Researchers identified associations, molecular motions, interaction types, and their strengths based on the physicochemical properties of various liquid mixtures, which were influenced by the sizes of pure components and mixtures[4-7]. A survey of literature shows that scanty work has been done on binary mixture of α-Tocopherol acetate and Diethyl ether. Therefore, the binary system of this mixture is taken into consideration to investigate physicochemical characteristics of acoustical parameters.

This paper reports the ultrasonic velocity, density and viscosity of α-Tocopherol acetate with Diethyl ether at 293K at various molar concentrations The acoustical properties, including adiabatic compressibility, free length, free volume and internal pressure of mixtures at 293K have been studied. The variation of these parameters have been attributed to structural changes and association of molecules in the binary liquid mixture.

## MATERIAL AND METHODS

The chemicals α-Tocopherol acetate and Diethyl ether are used in the present investigation is of Merck grade. The mixture of these chemicals has initially been prepared with different molar concentrations. Ultrasonic interferometer at a fixed frequency of 2 MHz can be used for accurately measured an ultrasonic velocity. The thermostat maintains the steady temperature of experimental solution by circulating water around the liquid cell of interferometer. The Viscosity of the experimental liquid can be measured by Ostwald's Viscometer to an accuracy of ± 0.2%. The electronic stopwatch with a precision of 0.01 s is used to measure flow time of experimental liquid. The pycnometer method is used to measure density of experimental liquid with an accuracy of ± 0.5%. The digital balance of precision ± 0.1 mg measures the mass of liquid mixtures.

## RESULTS AND DISCUSSION

The ultrasonic velocity, density and derived acoustical parameters such as adiabatic compressibility($\beta_a$), free volume ($V_f$), free length ($L_f$), and internal pressure($\pi_{in}$) of α-Tocopherol acetate and Diethyl ether solution at 293K were shown in Fig-1 to 6.

The variation of ultrasonic velocity with increase in molar concentration of α-Tocopherol acetate is shown in Fig.1.

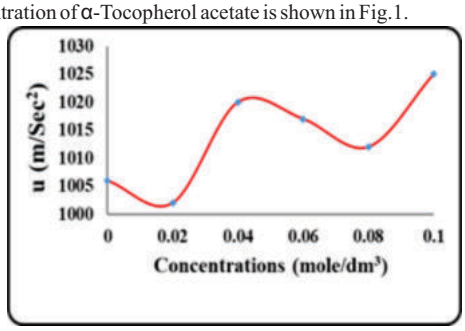


**Fig. 1 Variation of Ultrasonic Velocity with Molar Concentrations.**

The nonlinear increasing variation of ultrasonic velocity suggests the formation of complexes and weak association may be due to hydrogen bond formation between the interacting molecules[8]. This behavior causes the structural changes that take place in the liquid mixture of α-Tocopherol acetate and diethyl Ether. The peak at molar concentration 0.04 indicates the strong hydrogen bond and therefore maximum association of molecules may be possible at this molar concentration, whereas dip at 0.02 and 0.08 molar concentrations indicates weakening of hydrogen bond and hence maximum dissociation of molecules takes place at these molar concentrations.

The nonlinear variation of density with increase in molar concentration of α-Tocopherol acetate is shown in Fig.2.

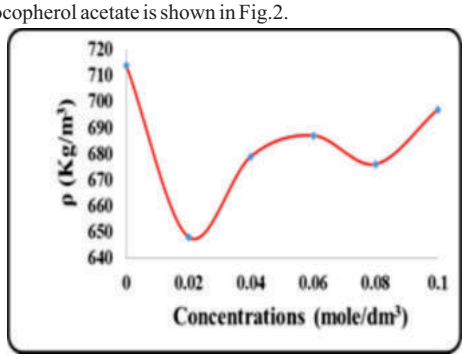


**Fig.2 Variation of Density with Molar Concentrations.**

The nonlinear variation of density, suggests the structure making (Hydrophilic) and breaking (hydrophobic) property of diethyl ether due to the formation and weakening of Hydrogen- bonds[9].

The variation of adiabatic compressibility with molar concentrations is shown in Fig.3.

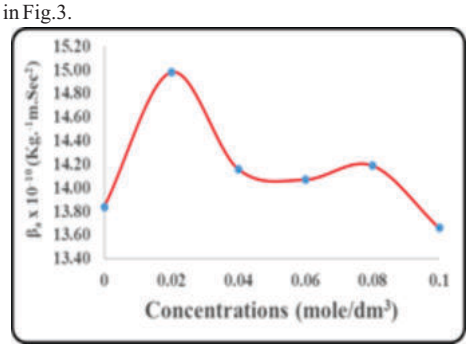


**Fig. 3 Variation of Adiabatic Compressibility with Molar Concentrations.**

The variation of adiabatic compressibility with molar concentration exhibits nonlinear variation with increase in molar concentration of α-Tocopherol acetate. The converse relationship that exists between ultrasonic velocity and adiabatic compressibility clearly indicates association between the α-Tocopherol acetate and Diethyl ether molecules[10].

The variation of free length with molar concentration is shown in Fig.-4.

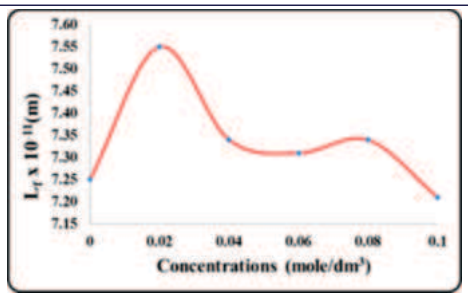


**Fig. 4 Variation of Free Length with Molar Concentrations.**

It has been observed that, free length ($L_f$) shows nonlinear variation with peak at 0.02M. Free length behaves similarly to adiabatic compressibility but is inversely reflected by ultrasonic velocity, supporting the molecular association of the interacting molecules[11].

The free volume measures the binding forces[12] and internal pressure measures the attractive and repulsive forces[13] in between the solute and solvent molecules. Fig. 5 and 6 shows the variation of free volume and internal pressure with increase in molar concentration of α-Tocopherol acetate respectively. The inverse variation in these parameters clearly indicates an association in between α-Tocopherol acetate and diethyl ether molecules through hydrogen bonding[14].

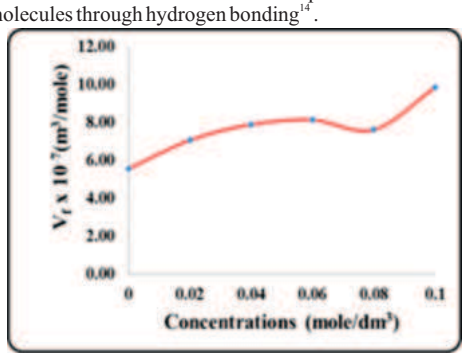


**Fig. 5 Variation of Free Volume with Molar Concentrations.**

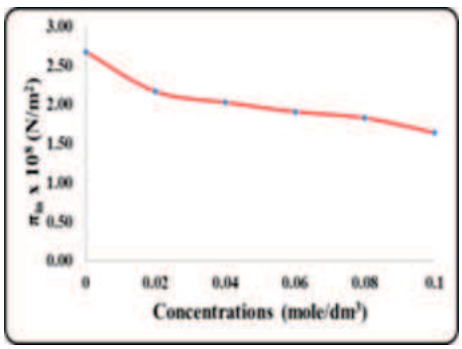


**Fig. 6 Variation of Internal Pressure with Molar Concentrations.**

## CONCLUSIONS

The variation of acoustical parameter with molar concentration of α-Tocopherol acetate shows the presence of molecular interaction in the binary liquid mixture of α-Tocopherol acetate and Diethyl ether. The hydrogen bonding existing between the molecules of interacting components causes their association and complex formation in the mixture.

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