

Molecular Interaction Study of β - Benzoyl Propionic Acid in Ethanol at 298K Using Acoustic Parameters

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Abstract— The density, viscosity and ultrasonic velocity of β - benzoyl propionic acid has been determined for 2 MHz in different concentration of ethanol at 298K. Using values of density, ultrasonic velocity and viscosity the various acoustic parameters for example , adiabatic compressibility (β_A), acoustic impedance (Z_s), intermolecular free length (L_F) have been evaluated. The structure of synthesized molecules of β -Benzoyl propionic acid was confirmed by spectral analysis. All these parameters have been used to study the molecular interactions between solute and solvent molecules.

Keywords: Density, viscosity, ultrasonic velocity interferometer, β -Benzoyl propionic acid.

I INTRODUCTION

The density, viscosity and ultrasonic velocity and acoustic parameters are used to study physiochemical and thermodynamic parameters of liquid [1]. The measurement such as ultrasonic and acoustic parameters are found and it is used to understand the nature of interaction in liquid mixtures [2]. The degree of molecular interactions and nature in different concentration of solution depends on the structure of solute molecules and nature of solvent molecules [3].

Friedel craft acylation reaction are among most flexible technique utilized for combination of aromatic substituted molecule[4]. Friedel craft acylation is an essentially vital transformation for industry as it is utilized to get ready compounds feedstocks, and fine chemicals[5].

The synthesized organic molecule β -Benzoyl propionic acid has been reported [6-7]. In the present work, we studied density, viscosity and ultrasonic velocity of synthesized molecule β -benzoyl propionic acid in ethanol at 298 K. From experimental data of density ,viscosity and ultrasonic velocity various acoustic parameters such as adiabatic compressibility, acoustic impedance ,intermolecular free length were determined.

II METHOD AND MATERIALS

All chemicals and reagent are AR and LR Grade and obtained from Loba chemie, Mumbai. IR spectra recorded with the help of FT- IR spectrophotometer. Melting points were determined with the help of Electro thermal melting points apparatus.

The density of solution has been measured by using Pycnometer. The viscosity of solution has been measured by using Ostwald's viscometer. Ultrasonic velocity in liquid mixture were measured by using Ultrasonic Interferometer (Model No-F81S.Mittal Enterprise, New Delhi) at frequency 2 MHz. From measured experimental data of density ,viscosity and ultrasonic velocity various acoustic parameters such as adiabatic compressibility, acoustic impedance ,intermolecular free length were determined by using following standard relation.

$$\beta_A = 1/U^2 * \rho \dots\dots\dots 1$$

$$Z_s = \rho * U \dots\dots\dots 2$$

$$L_F = K * (\beta_A)^{1/2} \dots\dots\dots 3$$

Where,

β_A is adiabatic compressibility.

Z_s is acoustic impedance.

L_F is intermolecular free length.

K is a Jacobson constant .

Table 1

Concentration (M)	Density (ρ) (Kg/m ³)	Viscosity (η)x 10 ⁻³ (Pa s)	Ultrasonic velocity (U) (m sec ⁻¹)	Adiabatic compressibility (β_A)x 10 ⁻¹⁰ (m ² N ⁻¹)	Acoustic impedance (Z_s)x 10 ⁶ (kg m ⁻² sec ⁻¹)	Intermolecular free length (L_F)x 10 ⁻¹⁰ (m)
0.01	780.2	0.8571	1538.6	5.41430	1.2004	0.4753
0.02	781.9	0.8849	1583.0	5.10372	1.2377	0.4736
0.03	783.2	0.8864	1600.0	4.98755	1.2531	0.4681
0.04	784.8	0.9149	1631.3	4.78821	1.2802	0.4587
0.05	786.3	0.9158	1644.1	4.70495	1.2927	0.4547

From measured experimental values of density, viscosity, ultrasonic velocity and acoustic parameters such as adiabatic compressibility, acoustic impedance, intermolecular free length, with respect to different concentration of β - benzoyl propionic acid in ethanol at 298K.

III RESULT

From measured values of density, viscosity, ultrasonic velocity and various acoustic parameters such as adiabatic compressibility, acoustic impedance, intermolecular free length, with respect to different concentration of β - benzoyl propionic acid in ethanol at 298K are given in table above. The graphical representation in figure 1,2,3,4,5 and 6.

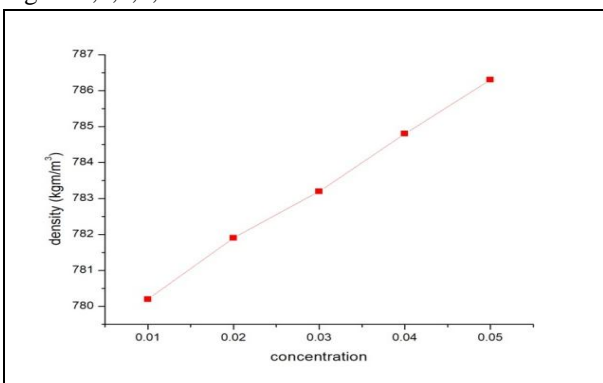


Figure 1. variation Density (ρ) with concentration (C)

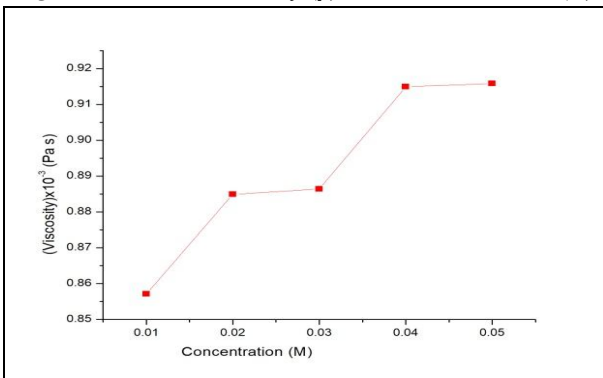


Figure 2. Variations Viscosity (η) with concentration (C)

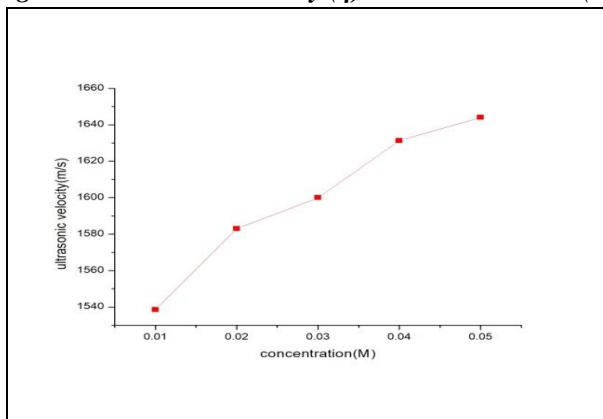


Figure 3. Variation Ultrasonic velocity (U) with Concentration(C)

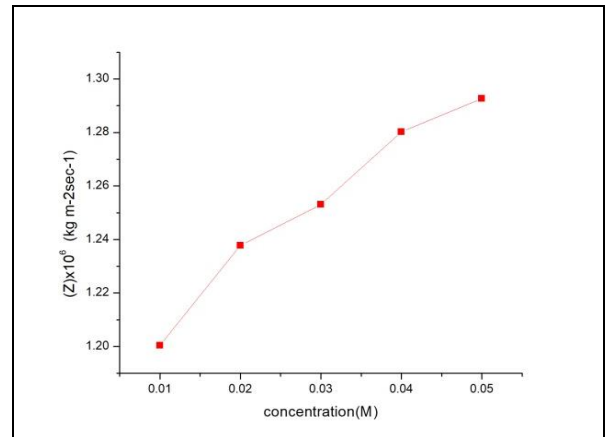


Figure 4. variation acoustic impedance (Z_s) with concentration (C)

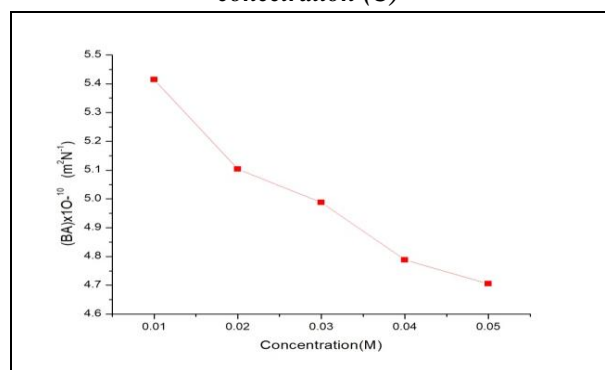


Figure 5. Variation adiabatic compressibility (β_A) with concentration (C)

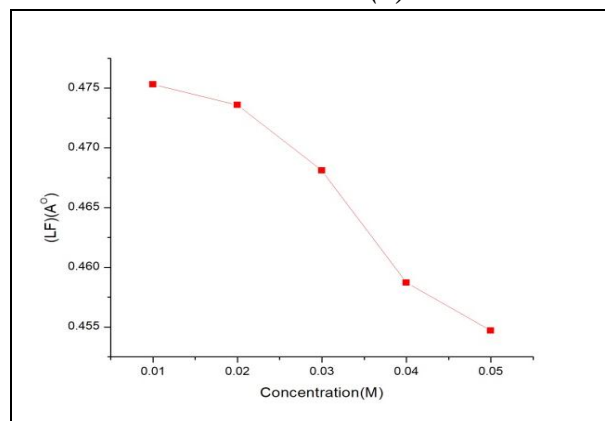


Figure 6. Variation intermolecular free length (L_F) with concentration (C)

Fig 1 shows the variation of density with different concentration of β - benzoyl propionic acid and it is observed that density increases with increase in different concentration of β - benzoyl propionic acid at 298K.

Fig.2 shows the variation of viscosity with different concentration of β - benzoyl propionic acid. In this case viscosity of solution increases with increase in different concentration of synthesized molecules. It indicates that there is presence of interaction between β - benzoyl propionic acid and the solvent molecule Similar increase of viscosity has been reported by U.

D. Chapke et al. in hybridized drugs molecules in 70% DMF- Water at 300.15K [8].

Fig.3 shows the variation of ultrasonic velocity with different concentration. It shows that Ultrasonic velocity increases with the increase in different concentration of β - benzoyl propionic acid. It is due to strong solute solvent interactions. Similar increase in ultrasonic velocity has been reported by N.Santhi et al [9].

Fig.4 shows the variation of acoustic impedance with different concentration .It is found that acoustic impedance increases with increased concentration of β - benzoyl propionic acid. It is due to continuous increase of density and viscosity with concentration [10].

Fig.5 shows the variation of adiabatic compressibility and free length with different concentration. It observed that there is continuous decrease of adiabatic compressibility with increase of different concentration of synthesized molecules. There is strong interaction between β - benzoyl propionic acid and solvent [11].

Fig. 6 shows the variation of the intermolecular free length with different concentration of β - benzoyl propionic acid. It is found that the intermolecular free length decreases with increase in the concentration of β - benzoyl propionic acid. It is due to strong close packing molecule inside the shield [12].

IV CONCLUSION

Density, viscosity and ultrasonic velocity have been measured for different concentration of β - benzoyl propionic acid at 298K and 2 MHz frequency. Ultrasonic velocity of synthesized molecule of different concentration depends on the intermolecular free length. It is also observed that continuous decrease of adiabatic compressibility and free length is due to strong specific molecular interaction between β - benzoyl propionic acid and solvent molecules.

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