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Solute-Solvent Interactions in Water Solutions of Doxycycline Drug At 303 And 313 K On Ultrasonic and Viscometrical Data

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ABSTRACT

We looked at how velocity, density and viscosity of Doxycyline mix with water. We did this at a frequency of 1 MHz. The Doxycyline and water mixtures had concentrations from 0.1 to 0.0125 percent. We did the measurements at two temperatures, 303 K and 313 K. We used a tool called a multifrequency ultrasonic interferometer. We found the density, ultrasonic velocity and viscosity of Doxycyline in water at concentrations and temperatures. We measured these values for Doxycyline in water, at 303 K and 313 K. This data is used to calculate thermodynamic parameters such as adiabatic compressibility (κ), relaxation time (τ), acoustic impedance (z), free length (Lf), free volume (Vf), and internal pressure (Πi),Wada's constant(W), The obtained results support the complex formation, molecular association by intermolecular hydrogen bonding in the binary liquid mixtures.

Keywords:- Doxycycline, free volume, acoustical parameters, ultrasonic velocity.

1. INTRODUCTION

Ultrasonic waves are used for both diagnosis and therapy. It includes the detection of wide variety of anomalies, such as tumor, bloodless surgery, and proper extraction of broken teeth, cardiology, and stone fragmentation [6]. Ultrasound is more sensitive than X-rays in distinguishing various kinds of tissues. It is believed to be less hazardous than X-rays, although possible hazards of ultrasound have not yet been thoroughly explored [7].. Most of the information extracted from ultrasonic study of fluids is confined to the determination of hydration number and compressibility [8-9]. The successful applications of acoustic methods to physicochemical investigations of solution become possible after the development of adequate theoretical approaches and methods for precise ultrasound velocity measurements in small volumes of liquids [10-12]. In the present paper, acoustical studies have been studied in water at different temperatures over a wide range of Doxycycline concentrations. From the experimental values a number of thermodynamic parameters namely ultrasonic velocity, adiabatic compressibility, acoustic impedance, relaxation time, free length, free volume, internal pressure, Rao's constant, ultrasonic attenuation, cohesive energy, and molar volume, Wada's constant has been calculated. The variation of these parameters with concentration was found to be useful in understanding the nature of interactions between the components [13-16].

2. MATERIALS AND METHODS

We bought chemicals from stores that sell these kinds of things and they are good enough for a laboratory. The Doxycycline we used for this project is really pure it is a reagent grade, which means it is, at least 99.9% pure. We made solutions with amounts of Doxycycline in them by using water to dissolve the Doxycycline. The speed of waves has been measured using an ultrasonic interferometer called Mittal Model-F-05. This machine is very accurate. Can measure the speed of ultrasonic waves with an error of only 0.1%.

The main things we measured were the speed of waves the thickness of the liquid and the density of the liquid. We did this at concentrations of the liquid ranging from 0.1 to 0.0125 percent and at two different temperatures 303 Kelvin and 313 Kelvin.

We then used these values to calculate important things, about sound waves like how they travel through the liquid using standard formulas for ultrasonic velocity, thickness and density. When we use velocity and things like density and viscosity we can figure out some important acoustical parameters. These parameters include compressibility, which is also known as kappa (κ) [17]. Intermolecular free length or Lf, for short [18]. We also have relaxation time, which is represented by the symbol Ƭ [19] and free volume, which is Vf [20].

Then there is pressure, which is sometimes called Πi [21] and acoustic impedance, which is Z [22]. We also have something called Wada's constant which's W [23]. Lastly there is attenuation, which is often shown as alpha over f squared or α/f2 for short [24]. Rao's constant [25] (R), molar volume (Vm), and cohesive energy (CE) were calculated by applying the following expressions.

3. RESULT AND DISCUSSION

The measured values of ultrasonic velocity, density and related thermo-acoustical parameters like adiabatic compressibility (κ), intermolecular free length (Lf), relaxation time (Ƭ), free volume (Vf), internal pressure (Πi), acoustic impedance (Z), Wada's constant (W), ultrasonic attenuation (α/f2), Rao's constant (R), molar volume (Vm),cohesive energy (CE) of Primaquine with water at 303 K, 313 K in different concentrations are shown in figure 1 to 14 .Figure: The following figures shows the variation of various acoustical parameters with concentration and temperature

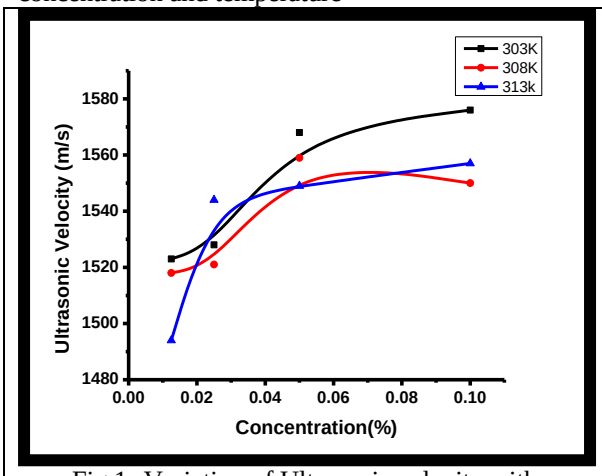

Fig.1:-Variation of Ultrasonic velocity with concentration and temperature

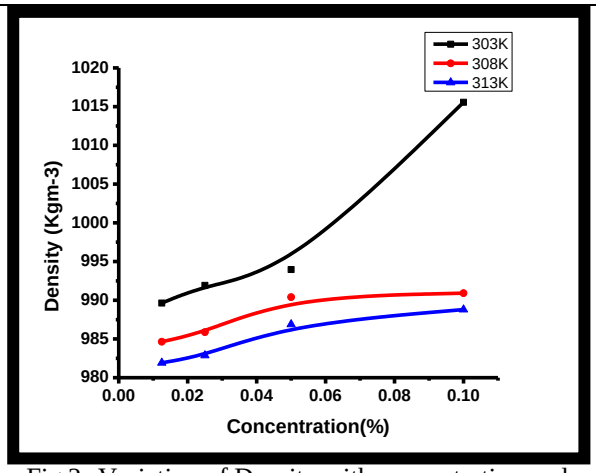

Fig.2:-Variation of Density with concentration and temperature.

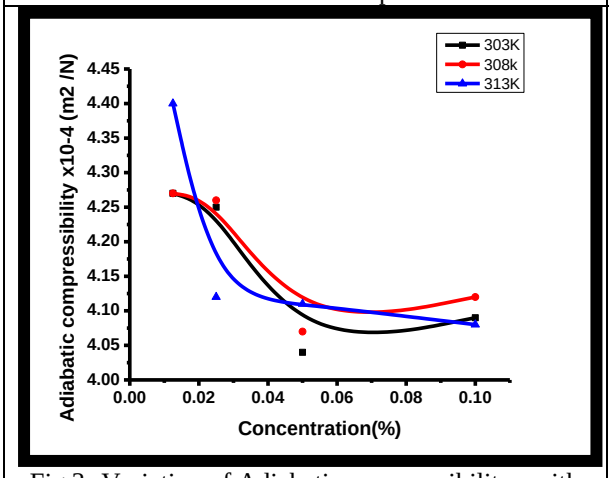

Fig.3:-Variation of Adiabatic compressibility with concentration and temperature

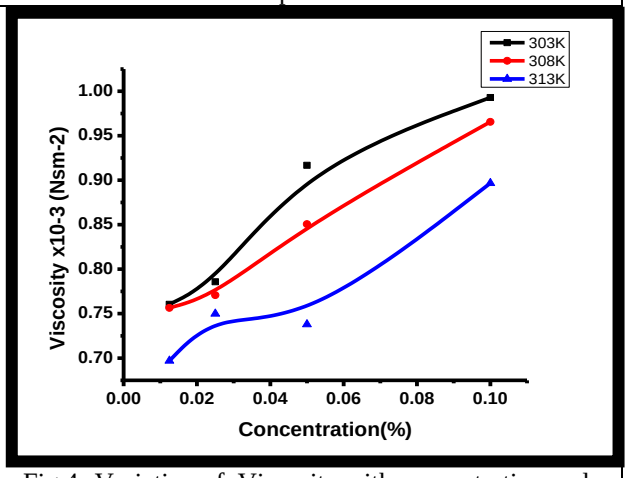

Fig.4:-Variation of Viscosity with concentration and temperature

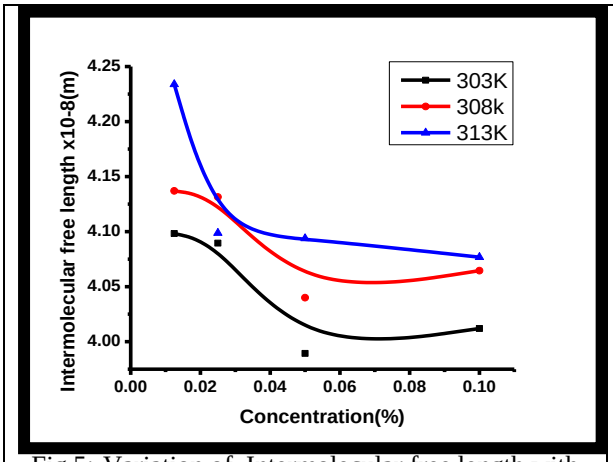

Fig.5:-Variation of Intermolecular free length with concentration and temperature

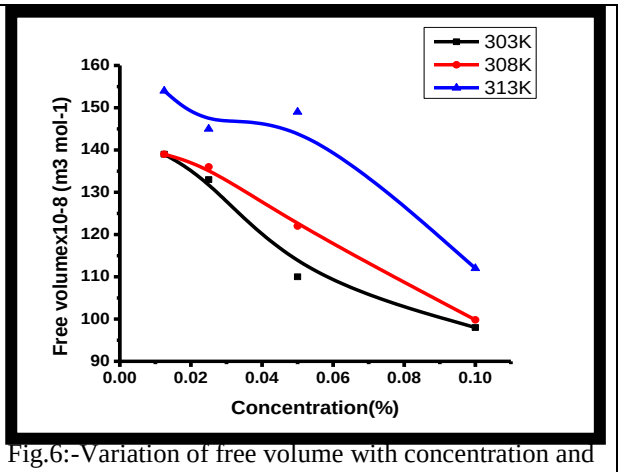

Fig.6:-Variation of free volume with concentration and temperature

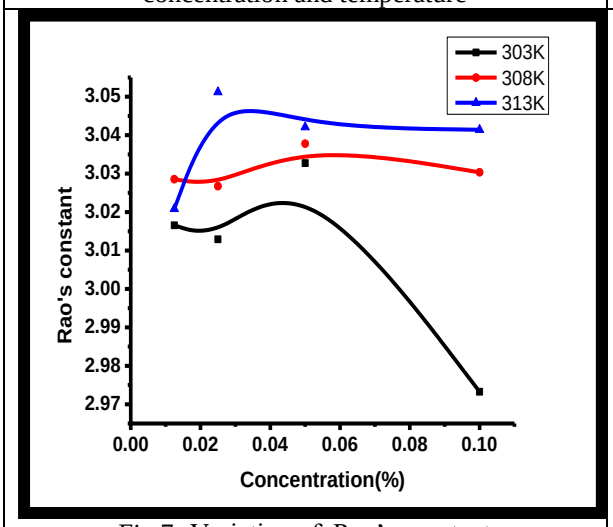

Fig.7:-Variation of Rao's constant with concentration and temperature

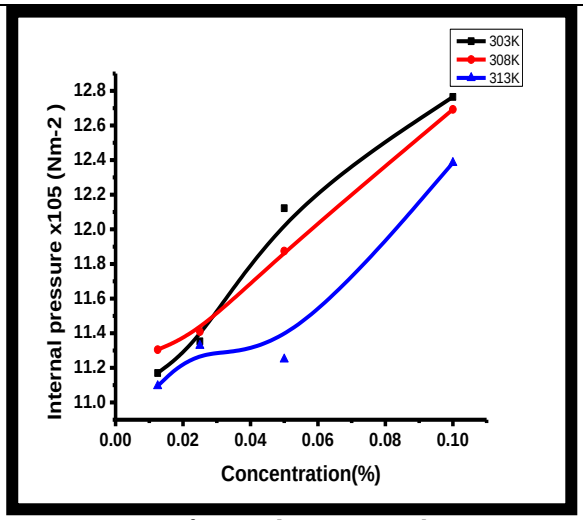

Fig.8:-Variation of Internal Pressure with concentration and temperature

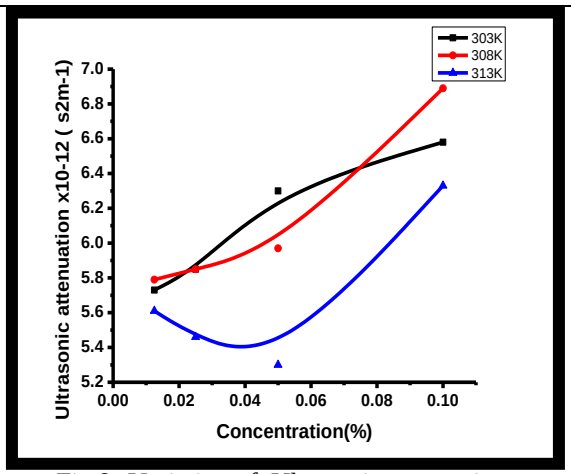

Fig.9:-Variation of Ultrasonic attenuation with concentration and temperature

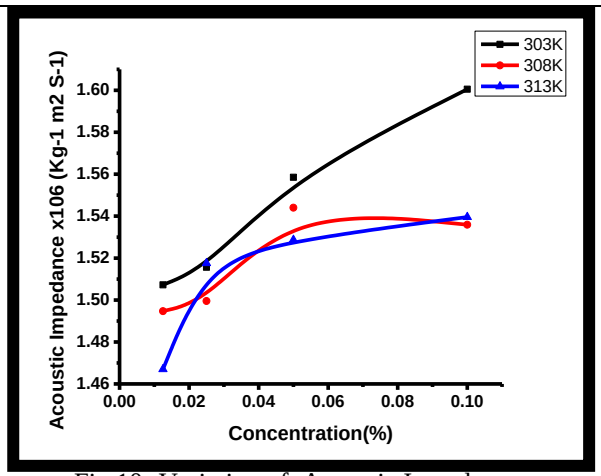

Fig.10:-Variation of Acoustic Impedance with concentration and temperature

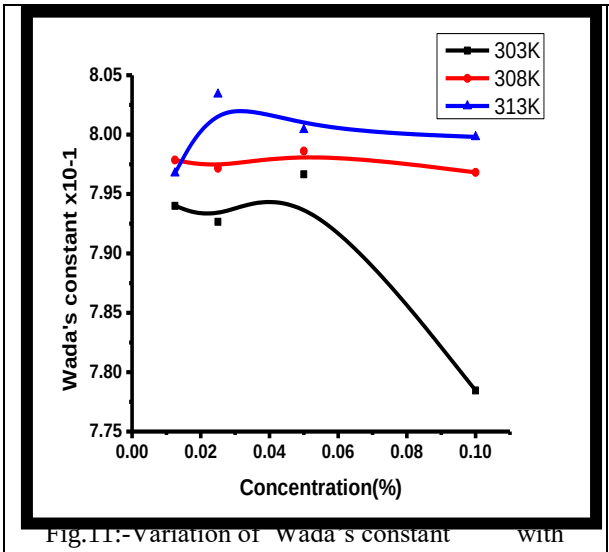

Fig.11:-Variation of Wada's constant with concentration and temperature

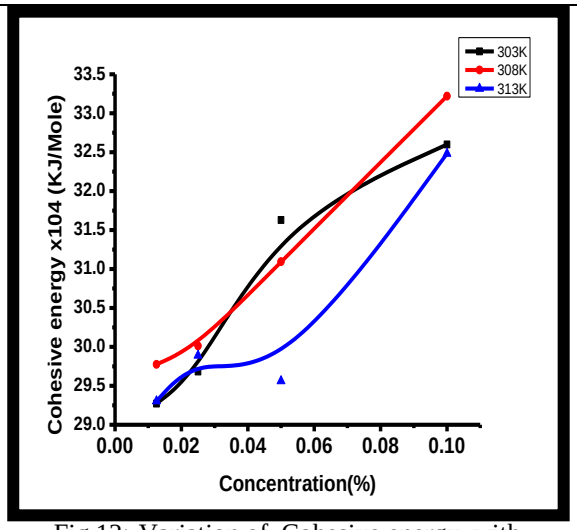

Fig.12:-Variation of Cohesive energy with concentration and temperature

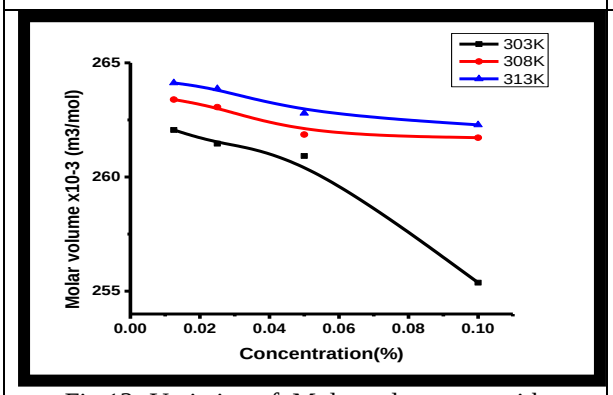

Fig.13:-Variation of Molar volume with concentration and temperature

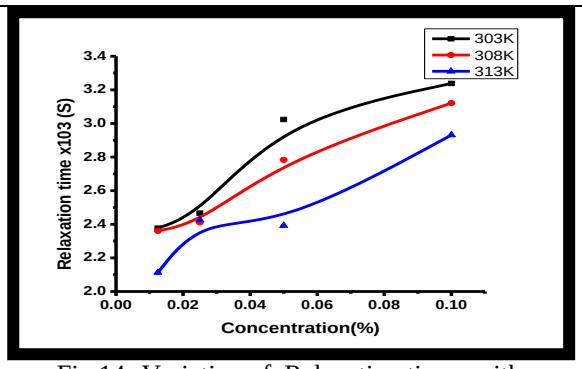

Fig.14:-Variation of Relaxation time with concentration and temperature

4. CONCLUSION

In the present paper the ultrasonic velocity(υ), density, viscosity and acoustical parameters, viz. adiabatic compressibility, intermolecular free length, relaxation time, acoustic impedance, attenuation, Rao's constant, molar volume, cohesive energy, Wada's constant have been measured at different concentrations. The parameters indicate that there is a strong molecular interaction between present in the solution of doxycycline at303 K and 313 K.

5. ACKNOWLEDGEMENT

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