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Ultrasonic Study of Methyl Cobalamine Drug At 35 ^{0}c & 45 ^{0}c

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ABSTRACT

In the present study ultrasonic velocity (U), density (ρ) and viscosity (η) have been measured at frequency 1 MHz in the binary mixtures of methyl cobalamine with water in the concentration range (0.1 to 0.0125 %) at 35 ^{0}C & 45 ^{0}C using Multifrequency ultrasonic interferometer. The measured value of density, ultrasonic velocity, and viscosity have been used to estimate the acoustical parameters namely adiabatic compressibility (βa), relaxation time (τ), acoustic impedance (z), free length (Lf), free volume (Vf) and internal pressure (π), Wada's constant to investigate the nature and strength of molecular interaction in the binary mixture of methyl cobalamine with water. The obtained result support the complex formation, molecular association by intermolecular hydrogen bonding in the binary liquid mixtures.

Keywords: free volume, acoustical parameters, ultrasonic velocity.

1. INTRODUCTION

Ultrasonic waves are used in many applications including plastic welding, medicine, jewelry cleaning, pipe inspection and nondestructive test. Within nondestructive test, ultrasonic waves give us the ability to "see through' solid / opaque material and detect surface or internal flaws without affecting the material in an adverse manner. It had been identified about 200 years ago that dogs could hear ultrasonic sound.[1] This canine ability is often used in police departmental work and by dog trainers. These sound waves are used by bats as a kind of navigational radar for night flying.[2] Even blind people unconsciously develop a similar method by which obstacles are sensed by the reflected echoes of their footsteps or the tapping of a cane. In the field of technology, the waves are being used to measure depth of sea, directional signaling in submarine and mechanical cleaning of surface soldering[3] and to detect shoals of fish. Acoustic sonograms have become an important medicinal diagnostic tool which is widely used nowadays.[4-5] Ultrasonic waves are used for both diagnosis and therapy. It includes the detection of wide variety of anomalies, such as tumor, bloodless surgery, proper extraction of broken teeth, cardiology, gynaecology and kidney 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] The unique feature of sound wave property is that it gives direct and precise information of the adiabatic properties of solution. The data of velocity of sound in very few liquids were available up to 1930. The discovery of interferometry and optical diffraction method improved the investigation, both qualitatively and quantitatively. Most of the information extracted from ultrasonic study of fluids is confined to the determination of hydration number and compressibility.[8-9] The successful application 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.[11-12] Thus in the present paper, acoustical studies of have been studied in water at different temperatures over a wide range of methyl cobalamine concentrations. From these experimental values a number of thermodynamic parameters.

2. MATERIALS AND METHODS

Methyl cobalamine used in the present work was of analytical reagent (AR) grade with a minimum assay of 99.9%, Different concentrations of solution were prepared by adding sufficient amount of solvent water to methyl cobalamine. The ultrasonic velocity (U) has been measured in ultrasonic interferometer Mittal Model-F-05 with an accuracy of 0.1%. The viscosities (η) of binary mixtures were determined using Ostwald's viscometer by calibrating with double distilled water with an accuracy of ±0.001 PaSec. The density (ρ) of these binary solutions was measured accurately. using 25 mL specific gravity bottle in an electronic balance precisely and accurately the basic parameter U, η, ρ were measured at various concentration (0.0125 % to 0.1%) and temperature of 35 ^{0}C& 45^{0}C. The various acoustical parameters were calculated from U, η & ρ value using standard formulae. On using ultrasonic velocity, density and viscosity the following acoustical parameters were calculated by applying the known expressions [13].

3. RESULT AND DISCUSSION

The measured values of ultrasonic velocity, density and related thermo acoustical parameters of methyl cobalamine with water at **35 ^{0}C & 45 ^{0}C** temperatures in different concentrations.

The variation of acoustical parameters with concentrations and temperature is shown graphically in fig.1 to 14

Figures: -

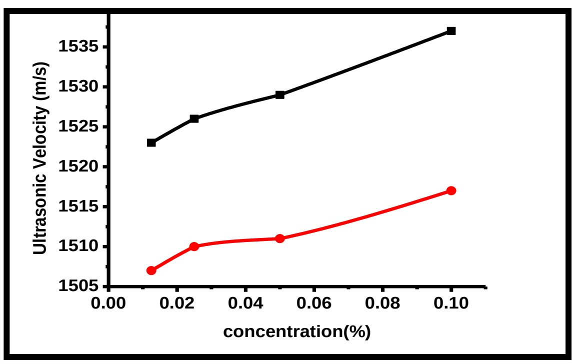

Fig.1:-Variation of Ultrasonic velocity with concentration and temperature

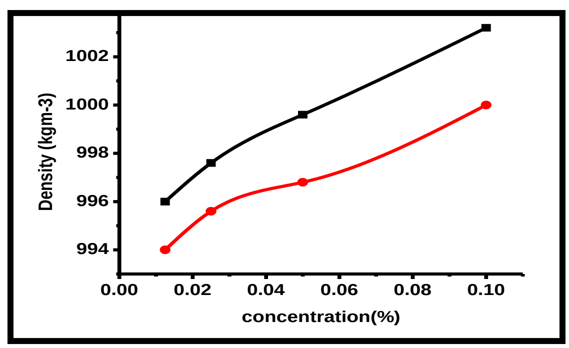

Fig.2:-Variation of Density with concentration and temperature

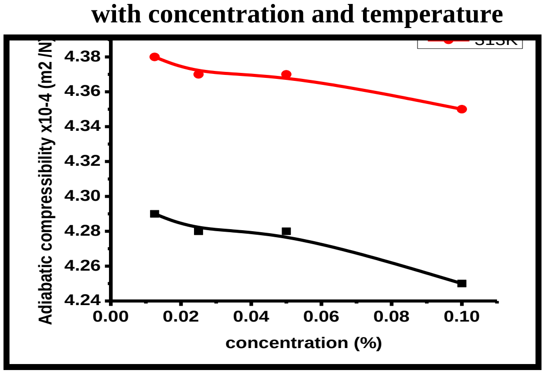

Fig.3:-Variation ofAdiabatic compressibility with concentration and temperature

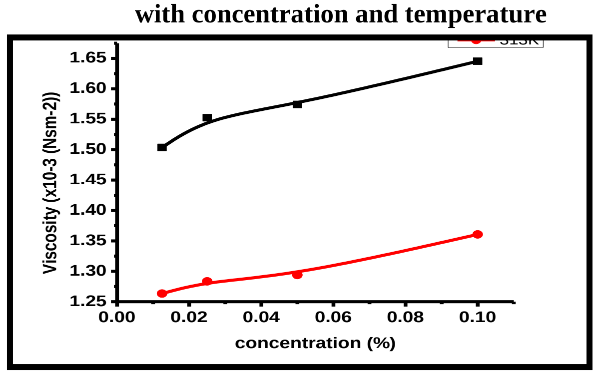

Fig.4:-Variation of Viscosity with concentration and temperature

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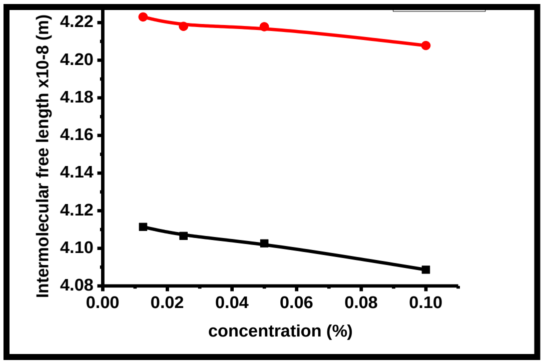


Fig.5:-Variation of Intermolecular free length with concentration and temperature

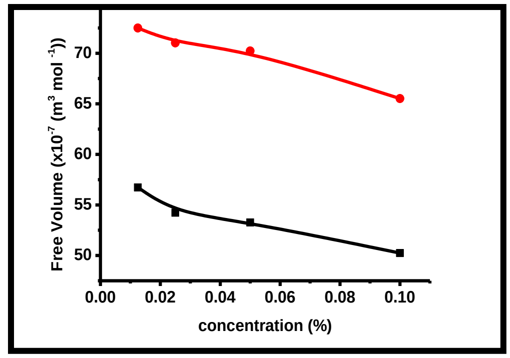
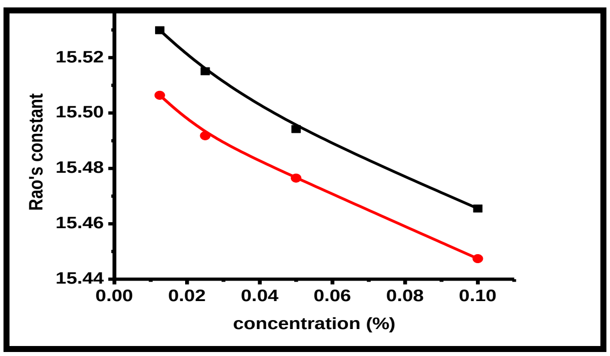


Fig.6:-Variation of free volume with concentration and temperature



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

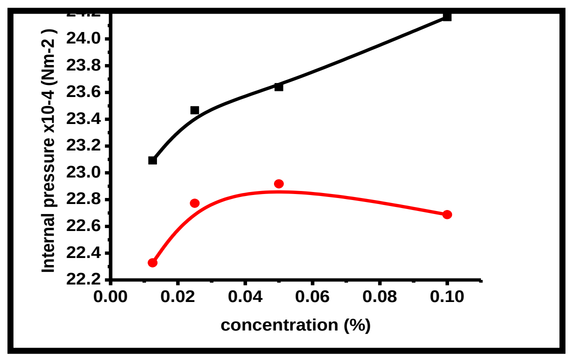


Fig.8:-Variation of Internal pressure with concentration and temperature

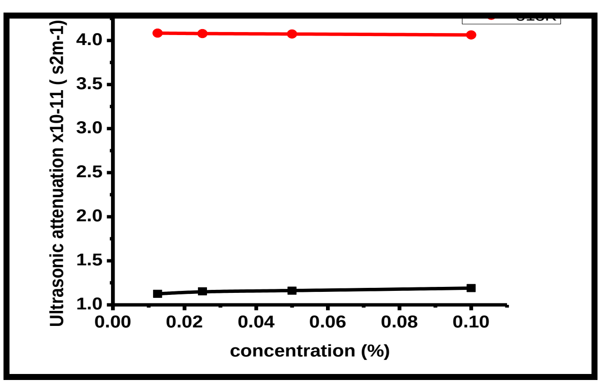


Fig.9:-Variation of Ultrasonic attenuation with concentration and temperature

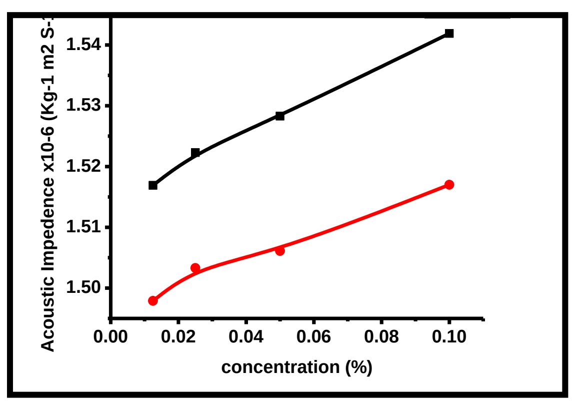


Fig.10:-Variation of Acoustic Impedance with concentration and temperature

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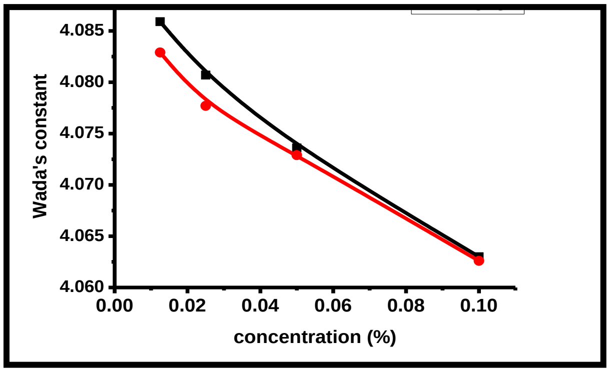

Fig.11:-Variation of Wadas's constant with concentration and temperature

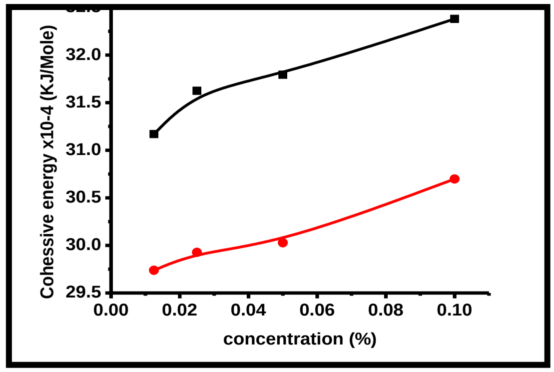

Fig.12:-Variation of Cohesive energy with concentration and temperature

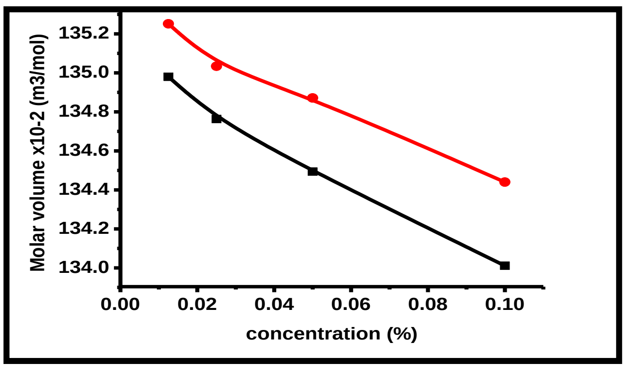

Fig.13:-Variation of Molar volume with concentration and temperature

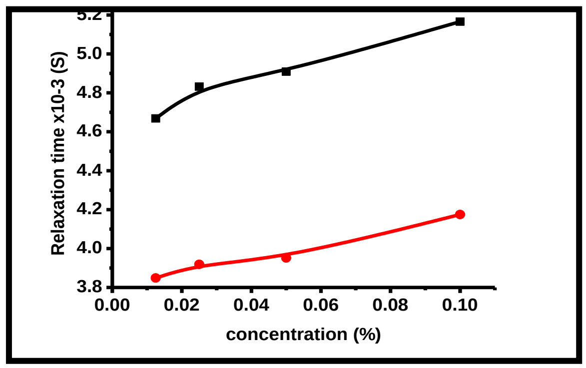

Fig.14:-Variation of Relaxation time with concentration and temperature

Ultrasonic velocity and density of the binary mixtures along with thermodynamic values such as adiabatic compressibility, free length and impedance at different temperature were determined. It is observed that ultrasonic velocity increases with increase in concentration which may be due to solute-solvent interaction. The adiabatic compressibility decreases with increase in concentration shows that there is strong solute-solvent interaction also solution become more and more compressible. Acoustic impedance shows nonlinear increasing variation with increase in molar concentration. This indicates the complex formation and intermolecular weak association which may be due to hydrogen bonding. Thus, complex formation can occur at these molar concentrations between the component molecules. The opposite trend of ultrasonic velocity and adiabatic compressibility indicates the association among interacting methyl cobalamine and water molecules. In the present system of methyl cobalamine, free length varies nonlinearly with increase in molar concentration which suggests the significant interaction between solute and solvent due to which structural arrangement is also affected. Relaxation time decreases with increase in concentration. Nonlinear trend of density with concentration indicates the structure-making and breaking property of solvent due to the formation and weakening of H-bonds. The free volume decreases and internal pressure increases with increases in molar concentration indicate that there is weak interaction between solute and solvent molecules. Rao's constant and Wada's constant decreases with increasing concentration which indicates that there is weak interaction between solute and solvent molecule.

4. CONCLUSION

In the present paper the ultrasonic velocity (ν),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 unlike molecules as the concentration of drugs solution increases and the interaction decreases as temperature increases.

5. ACKNOWLEDGEMENT

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