ACOUSTIC PARAMETERS OF STREPTOMYCIN SOLUTION AT DIFFERENT CONCENTRATION

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ABSTRACT

Experimental measurements of ultrasonic velocity, density have been carried out on aqueous solution of Streptomycin at different concentrations at 303 K temperature and 2 MHz frequency. For velocity measurements, Ultrasonic Interferometer (Model No. F-81, Mittal, New Delhi) working at fixed frequency 2 MHz was used. Ultrasonic studies may throw more light on the molecular interaction to know the behavior of solute and solvent molecules in liquid mixtures and solutions. Acoustical parameters as acoustic impedance, relative association for aqueous solution of streptomycin solution were calculated from ultrasonic velocity and effect of concentration on molecular interaction was predicted .

Keywords: Concentration, Impedance Molecular, Streptomycin, Ultrasonic,

I INTRODUCTION

In liquids ultrasonic study is of immense important in understanding the nature and strength of molecular interactions. The biological activity of drug molecules and the activation energy of the metabolic process basically depend on the type and strength of the intermolecular interactions[1]. Literature survey shows the ultrasonic velocity, density, viscosity and allied thermodynamic parameters plays a key role to study the nature of intermolecular forces in liquid solutions and the behavior of biomolecules and physico-chemical behavior of liquid mixture can also be studied with ultrasonic study[2-7]. Antibiotics, also called antibacterial, are a type of antimicrobial drug used in the treatment and prevention of bacterial infections. Streptomycin is an antibiotic used to treat a number of bacterial infections.

In this work, an attempt has been made to study some thermo acoustical properties such as acoustic impedance, relative association, Rao's constant and Wada's constant of aqueous solution of streptomycin. The effect of concentration on molecular interaction was predicted from acoustical parameters. The structure of streptomycin is as below

II EXPERIMENTAL

The ultrasonic velocity (U) in liquid mixtures which prepared by taking purified AR grade samples, have been measured using an ultrasonic interferometer (Mittal type, Model F-81) working at 2MHz frequency and at temperature 303K. The accuracy of sound velocity was ±0.1 ms-1. An electronically digital operated constant

temperature water bath has been used to circulate water through the double walled measuring cell made up of steel containing the experimental solution at the desire temperature. The density of pure liquids and liquid mixtures was determined using pycknometer by relative measurement method with an accuracy of $\pm 0.1 Kgm-3$.

III RESULT AND DISCUSSION

From the observed values specific acoustic impedance, relative association, Rao's constant, Wada's constant were calculated.

Specific acoustic impedance is determined from equations,

$$Z = vs.ds \qquad\qquad ………(1)$$

Relative association is a function of ultrasonic velocity and is calculated by the equation,

$$RA = \frac{ds}{d0}\left(vs\frac{v0}{}\right)^{1/3} \qquad …….. (2)$$

Where, v0 and vs are ultrasonic velocities in solvent and solution respectively.

Rao's constant and Wada's constant is also a measure of interaction existing in the solution.

Rao's constant is calculated by using following equation.

$$R = [Meff/ds]\ v^{1/3} \qquad ……(3)$$

Wada's constant is calculated by following equation.

$$W = [Meff/ds]\ \beta^{-1/7} \qquad ………..(4)$$

The experimentally determine values are listed in table -1.

Table 1: The experimentally measured values of Ultrasonic velocity (U), Density (ρ), Specific acoustic impedance Relative association Rao's constant Wada's Constant of aqueous solution of Streptomycin at different concentrations at temperatures 303 K at 2MHz frequency

Concentration (M)	Velocity (m/s)	Density (kg/ m^3)	Specific acoustic impedance $Z x 104$ (kg m^{-2}sec^{-1})	Relative association RA	Rao's constant R (m^3/mole)(m/s)$^{1/3}$	Wada's Constant W (m^3/mole) (N/m^2)$^{1/7}$
0.00625	1612.8	1235.60	19.92	1.248	0.1736	0.3376
0.0125	1602.48	1238.00	19.83	1.254	0.1728	0.3365
0.025	1590.96	1240.00	19.72	1.259	0.1722	0.3353
0.05	1570.36	1242.10	19.50	1.266	0.1711	0.3336

When ultrasonic waves are present in the solution, the molecules get perturbed. Due to some elasticity of the medium, perturbed molecules regain their equilibrium positions. When a solute is added to a solvent, its molecules attract certain solvent molecules towards them. The phenomenon is known as compression and also as limiting compressibility. The aggregation of solvent molecules around solute molecules supports powerful solvent-solute interactions. Because of solvent-solute interactions, the structure of the solute is modified to the considerable extent[8]. It is evident from the values of that ultrasonic velocity decreases and density increases with increase in

concentration suggesting increase in solvation with increase in concentration. It may be due to electrostriction in that solution. This electrostriction decreases the volume and hence increases the density as a number of solute molecules increase the electrostriction and density increases. Acoustic impedance decreases with increase in concentration. Relative association increases with increases in concentration .It can be explained by two factors [9]: 1) the breaking up of solvent molecules on addition of solute to it and 2)solvation of the solute molecule. The former leads to decrease and the latter to the increase of relative association. In our study the values of RA increases with increase in the solute concentration due to solvation of the solute molecule. Decreasing values of Rao's constant and Wada's constant shows weak interaction in the solution.

IV CONCLUSION

The ultrasonic velocity, density, viscosity and other related parameters were calculated. The existence of weak molecular interaction in solute-solvent is observed in the solution. All the experimental determinations of acoustic parameters are strongly correlated with each other. This provides useful information about inter and intra molecular interactions of the mixture as existing in the liquid system.

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