Studies of acoustic, thermodynamic and additive properties of Eperisone in 10% ethyl alcohol.

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ABSTRACT:-

Acoustical and additive properties have been studied for Eperisone in 10% ethyl alcohol at different temperature. The measurement have been perform to determine acoustical parameter such as adiabatic compressibility (βs), Partial molal volume (ϕ_v), intermolecular free length (L_f), apparent molal compressibility (ϕ_κ), specific acoustic impedance (Z), relative association (R_A), salvation number (Sn) and also studied the molar polarization, polarisability constant and thermodynamic properties like free energy change, enthalpy change, entropy change of system.

KEYWORD: - Ultrasonic velocity, intermolecular free length, relative association, Molar polarization, polarizability constant,

INTRODUCTION:-

Eperisone is used as reduction of myotonia, improvement of circulation, and suppression of the pain reflex. The drug inhibits the vicious circle of myotonia by decreasing pain, ischaemia, and hypertonia in skeletal muscles, thus alleviating stiffness and spasticity, and facilitating muscle movement[1-2].

The thermodynamic properties of solution are important in chemistry and biology. Studies of the viscosities of such solutions were among the earliest in the field of solution chemistry. The activation Gibb's free energy, entropy and enthalpy change by measuring the viscosity of aqueous solution of tetra methyl, tetraethyl, tetra n-propyl, tetran-butyl and tetran-pentyl ammonium cyclohexa sulfamate in the temperature range 293.15 to 323.15 K[3].

Numbers of researcher measurements of the Ultrasonic velocity are helpful to interpreted solute-solvent, ion-solvent interaction in aqueous and non aqueous medium [4-5]. The acoustical properties of four different drugs in methanol and he drawn conclusion from adiabatic compressibility. The four different drugs compress the solvent methanol to the same extent but it shows different solute-solvent interaction due to their different size, shape and structure [6]. The different acoustical properties of some substituted Pyrazolines in binary mixture acetone-water and observed variation of ultrasonic velocity with concentration[7]. The measurement of ultrasonic velocity and density of amino acid in aqueous magnesium acetate at constant temperature [8]. The ion-dipole interaction mainly depends on ion size and polarity of solvent. The strength of ion-dipole attraction is directly proportional to the size of the ions, magnitude of dipole. But inversely proportional to the distance between ion and molecules. The structural properties of solution of lanthanide salt by measuring ultrasonic velocity [9].The ultrasonic velocity of PEG-8000, PEG- study of acoustical properties of substituted heterocyclic compounds under suitable condition[10]. An acoustical and thermodynamic properties of citric acid in water at different temperature[11]. Ultrasonic velocity and density in non aqueous solution of metal complex and evaluate acoustic properties of metal complex [12]. An acoustic properties for the mixture of amines with amide in benzene at 303K-313K .They also determined thermodynamic parameters [13]. The different acoustical parameters of binary mixture of 1-propanol and water [14].

The refractive index is an important additive property for molecular structure of liquid. The extent of refraction depends on –i) the relative concentration of atom or molecule ii) The structure of atom or molecule. So refractive index gives idea about geometry and structure of molecule. Refraction of light is additive property, but also depends on the structural arrangement of atom in molecule. This can some time be used to determine the structure of an unknown compound whose molecular formula is known.

Density and refractive index of binary liquid mixture Eucalyptol with Hydrocarbon at different temperature. Refractivity properties of some homologous series such as n-ethanoate, methyl alkanoates, ethyl alkanoates etc. were measured in the temperature range from 298.15 to 333.15^{0}K [16].

After review of literature survey the detail study of Eperisone under identical set of experimental condition is still lacking. It was thought of interest to study the acoustical and thermodynamic properties of substituted heterocyclic drug under suitable condition.

EXPERIMENTAL:-

The viscometer put in double wall glass cell. For viscosity measurement Ostwald viscometer (10 ml) was used. The constant temperature was maintained by circulating water through the double wall measuring cell, made up of glass. The flow time was also measured by using digital clock (0.01 Sec).The substituted heterocyclic drug (Eperisone) is used in the present study. The density was determined by using specific gravity bottle by relative measurement method with accuracy ± $1x10^{-5}$ gm/cm^3. The ultrasonic velocity was measure by using ultrasonic interferometer having frequency 3MHz (Mittal Enterprises, Model No F-82) .The constant temperature is mentioned by circulating water through the double wall measuring cell made up of steel.

In the present investigation different parameters such as adiabatic compressibility (βs), apparent molal volume (ϕ_v), intermolecular free length (L_f), apparent molal compressibility (ϕ_κ), specific acoustic impedance (Z), relative association (R_A), Solvation number (S_n) were studied.

$$Adiabetic\ comprressibility(\beta o) = \frac{1}{Uo^2 do}$$

$$Adiabetic\ comprressibility(\beta s) = \frac{1}{Us^2 ds}$$

$$Apparent\ molal\ volume(\phi_v) = \left(\frac{M}{ds}\right) x\ \frac{(d_o - d_s)x10^3}{m\ x\ d_s\ x\ d_o}$$

$$Apparent\ molal\ compressibility(\phi_k) = 1000x\ \frac{(\beta_s d_o - \beta_o d_s)x10^3}{m\ x\ d_s\ x\ d_o} + \frac{\beta_s M}{d_o}$$

$$\text{Specific acoustic impedance } (Z) = U_s d_s$$

$$\text{Intermolecular free length } (L_f) = K\sqrt{\square} ds$$

$$\text{Relative association } (R_A) = x\ 1\left(\frac{d_s}{d_o}\right)^{1/3}$$

$$Solvation\ number(Sn) = \frac{\phi_k}{\beta_o\left(\frac{M}{d_o}\right)}$$

$$\eta_r = A.e^{-\Delta G/RT}$$

$$\log\left[\frac{\eta r_2}{\eta r_1}\right] = \frac{\Delta H}{2.303R}[T_2 - T_1]/[T_1 T_2]$$

$$(\Delta G - \Delta H)/T = \Delta S$$

$$\text{Molar polarisation}(Rm) = \frac{(n^2-1)}{(n^2+2)} x \frac{M}{d} = \frac{4\pi N\alpha}{3}$$

RESULTS AND DISCUSSION:-

In the present investigation , different thermodynamic parameters , such as adiabatic compressibility (βs), Partial molal volume (ϕ_v), intermolecular free length (L_f), apparent molal compressibility (ϕ_κ), specific acoustic impedance (Z), relative association (R_A), salvation number(Sn).

From table-1, these found that ultrasonic velocity increases with increase in temperature. Such an increase in ultrasonic velocity clearly shows that molecular association is being takes place in these mixtures. Variation of ultrasonic velocity in solution depends upon the increase or decrease of molecular free length after mixing the component, based on a model for sound propagation proposed by Eyring and Kincaid [17]. It was found that, intermolecular free length decreases linearly on increasing the temperature of solution. The intermolecular free length decrease due to less force of interaction between solute and solvent by forming hydrogen bonding. This was happened because there is less significant interaction between ions and solvent molecules suggesting a structure promoting behavior of the added electrolyte .This may also indicates that increase in number of free ions showing the occurrence of ionic association due to stronger ion-ion interaction. The value of specific acoustic impedance (Z) increases with increase in temperature. The increase of adiabatic compressibility is decrease with increase in temperature may be due to loss of solvent molecule around ions, this supporting stronger ion-solvent interaction. This indicates that there is not significant solute-solvent interaction.

The decrease in adiabatic compressibility following a increase in ultrasonic velocity showing there by stronger intermolecular interaction.

From table-2, it is observed that apparent molal volume increases with increase in temperature indicates the existence of weak ion-solvent interaction. The values of apparent molal volume are all negative values indicate the presence of solute solvent interaction [18] .The value of apparent molal compressibility is decrease with increase in temperature. It shows weak electrostatic attractive force in the vicinity of ions. It can be concluded that weak molecular association is found in solution. The value of relative association increases with increase in temperature of system. It is found that there is strong interaction between solute and solvent.

The Solvation number decrease with increase in temperature due to strong solute-solvent interaction. There is regular decrease in solvation number with increase temperature indicates the decrease in size of secondary layer of Solvation. The Solvation number in all system decreases with increase in temperature indicates the solvent molecule forms weak coordination bond in primary layer.

The rise of the temperature is accompanied by a decrease of the viscosity of the solution. The rise of the temperature is accompanied by a decrease of the density of the solution. The table 1 shows values of viscosity and density at different temperature. The thermodynamic functions of viscous flow were estimated from the dynamic Viscosity values. Flow process is governed by the ability of molecule to move into the prepared hole and the readiness with which the holes are prepared in the liquid.

The values of Gibb's free energy were calculated from the slope of graph by plotting logη Vs 1/T (Fig. 1). The values of Gibb's free energy were determine and are given in table 2. The values of Gibb's free energy are positive. The values of enthalpy change in reaction were determined and are also negative in all systems. From the values of ΔG and ΔH, the reaction is non spontaneous and exothermic in nature. The values of entropy change were determined from equation. The negative value of entropy change indicates the reaction must be non spontaneous process of flipping of molecule over each other. ΔS were positive due the destruction of hydrogen bond in compounds.

Table-1: Ultrasonic velocity, density, adiabatic compressibility (β_S), Specific acoustic impedance (Z) Intermolecular free length (L_f) at different temperature.

Temperature (K)	Density (ds) Kg m^{-3}	Ultrasonic velocity (Us) m s^{-1}	Adiabatic compressibiliy (β_S) $x10^{-10}m^2N^{-1}$	Intermolecular free length (L_f) $x10^{-11}$m	Specific acoustic impedance ($Zx10^6$)kg m^{-2} s^{-1}
Eperisone + 10% Ethyl alcohol					
298.15	995.96	1050.22	9.1033	6.06815	1.04598
303.15	995.6	1056.66	8.9959	6.03225	1.052010
308.15	994.73	1060.15	8.9446	6.01502	1.05456
313.15	994.33	1065.70	8.8552	5.6849	1.05966
318.15	993.55	1069.36	8.8016	5.9668	1.62462

Table-2: Relative association (R_A), apparent molal compressibility (ϕ_κ), Apparent molal volume (ϕ_v), Solvation number (S_n) -

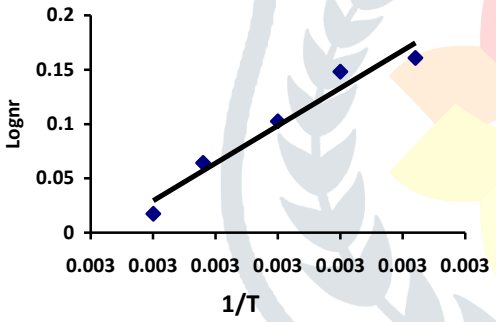
Temperature(K)	Apparent molal volume ($-\phi_v$) m^3mole^{-1}	Apparent molal compressibility (ϕ_κ)$x0^{-10}$ m^2 N^{-1}	Relative association (R_A)	Solvation number (S_n)
Eperisone + 10% Ethyl alcohol				
298.15	0.24009	2.37734	1.15530	1.2274
303.15	0.24011	2.34847	1.16226	1.1584
308.15	0.24029	2.33609	1.16463	1.1198
313.15	0.24036	2.31245	1.16675	1.0766
318.15	0.24048	2.29871	1.17554	1.0256

Table-3: Viscosity measurement and thermodynamic parameters at different temperature

Temp.(K)	1/T	Density (Kg/M^3)	Time (Sec)	η_r	log η_r	ΔG ($JM^{-1}K^{-1}$)	$-\Delta H$ ($JM^{-1}K^{-1}$)	$-\Delta S$ (JK^{-1})
Eperisone + 10% Ethyl alcohol								
298.15	0.00336	995.96	204	1..4477	0.16069	939.61	--	--
303.15	0.00330	995.60	176	1.4067	0.14820		10568.7	37.9624
308.15	0.00325	994.73	148	1.2662	0.10251		11868.6	41.5643
313.15	0.00319	994.33	126	1.1594	0.06420		16687.6	56.2899
318.15	0.00315	993.55	97	0.9607	0.01741		12170.5	41.2013

Table-4: The values of molar refraction and polarizability constant at different temperature

Temp.(K)	Density (Kg/M^3)	R.I. (η)	$Rmx10^{-6}$	$\alpha \times 10^{-29}$
298.15	995.96	1.3584	5.72	2.27
303.15	995.6	1.3563	5.70	2.26
308.15	994.73	1.3551	5.68	2.26
313.15	994.33	1.3430	5.51	2.19
318.15	993.55	1.3490	5.59	2.22



CONCLUSION:-

The experimental data for ultrasonic velocity, density at different temperature for eperisone in 10% ethyl alcohol. From experimental data calculated acoustical parameters and studied to explanation solute-solvent interaction and ion-ion / solute-solute interaction are existing between drug and solvent mixture. From experimental data it can be conclude that weak solute-solvent interaction in all systems. The viscous flow of this substituted heterocyclic drug in ethyl alcohol is thermodynamically spontaneous and exothermic process. Because ΔG and ΔH are negative and ΔS is positive which is indicate the spontaneity of reaction according to thermodynamics.

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