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ADIABATIC COMPRESSIBILITY,FREE LENGTH, RELATIVE ASSOCIATION, ACOUSTIC IMPEDENCE OF *TRIDAXPROCUMBENS* LEAF EXTRACT SOLUTION IN ALCOHOLIC SOLVENT

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ABSTRACT:
Various parameters such as Ultrasonic Velocity, density, viscosity have been measured experimentally for the solution of leaf extract of *TridaxProcumbens* in 50% ethanol with various concentrations at 298.15 K, 303.15 K, 308.15 K keeping constant frequency of 4 MHz.The intermolecular free length decreases with decrease of temperature and hence the close packing of molecules which in effect decreases the sound velocity. From these experimental data the acoustical parameters such as adiabatic compressibility, intermolecular free length, acoustic impedance, relative association have been computed.The acoustical parameters like adiabatic compressibility, intermolecular free length, relative association, relaxation time, specific acoustic impedence prove to be more useful to predict and confirm the molecular interactions. These parameters are useful to predict the magnitude of molecular interactions taking place in the solution.

Keywords :- Ultrasonic velocity, Adiabatic compressibility, Relative association, Intermolecular free length,Specific acoustic impedence.

INTRODUCTION :

Ultrasonic wave is a non-distructive and mechanical wave, which behaves like a powerful probe to investigate various properties of liquids[1]. It plays an important role in understanding the physico-chemical behavior of liquids[2-5]. Density and ultrasonic velocity are the physic-chemical properties used to determine composition of pure components and their mixtures in terms of intermolecular interactions[6-9].Ultrasonic velocity measurements and other acoustical parameters of liquid mixtures are the powerful technique in the understanding of chemical nature and the molecular interactions[10]. Many researchers used ultrasonic velocity measurement for studying solute solvent interaction in a number of system including organic liquid, dilute solutions [11].Our country is very well known for Ayurveda, in the Ayurveda medicines are largely made up from plants, herbs. One of such plants is which is also known as *Tridaxprocumbens*. *Tridaxprocumbens* is known for its antifungal nature. The solution of leaf extract of *Tridaxprocumbens* in 50% ethyl alcohol is studied at 4 MHz for the concentration of 1%, 0 .5%, 0.25%, 0.125% at 298.15K, 303.15K, 308.15K. Here the effect of concentration at different temperature on molecular interaction will be predicted which may be helpful for predicting the reactivity of the extract.

METHODOLOGY :

The leaf extract used in this study was of analytical range. 50% ethyl alcohol was used for the preparation of solution. A special thermostatic water bath arrangement was made to maintain constant temperature. 1%, 0.5%, 0.25%, 0.125% solutions of leaf extracts of *Tridaxprocumbens* was Prepared by taking accurate weights on electronic digital balance (

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Model CB/CA/CT-Series, Contech having accuracy ± 0.0001 g.) The ultrasonic velocity of the 1%, 0.5%, 0.25%, 0.125% solutions of leaf extracts of *Tridaxprocumbens* was measured with the Multifrequency ultrasonic interferometer (Model M-83, Mittal Enterprizes) at 4 MHz frequency with an accuracy of ±2 m/s. All the readings were taken at 298.15 K, 303.15K, 308.15K. The viscosity was measured by using Ostwald's viscometer and the density of the solution was measured by using Digital densitometer (DMA-35, Anton paar)

Computation :

By using ultrasonic velocity following ultrasonic parameters are calculated.

Adiabatic compressibility -

$$\beta = 1/v_s^2 d$$

Where, v - velocity of solution,

d - density of liquid

Intermolecular free length -

$$L_f = K\sqrt{\beta_s}$$

Where, K - temperature dependent known as Jacobson's constant

Specific acoustic impedance -

$$Z = v \times d_s$$

Relative association -

$$R_A = d_s / d_0 [v_0 / v_s]^{1/3}$$

Where, v_0 - ultrasonic velocity of solvent

v_s - ultrasonic velocity of solution

Relaxation time -

$$\tau = 4/3\ \beta_s \times \eta$$

From table no.1and fig.no.1, it is observed that at different concentrations the ultrasonic velocity increases with increase in concentration. The ultrasonic velocity increases here with increase in concentration this is due to the salvation process of solute by solvent.

From table no.2 and fig.2, it is observed that adiabatic compressibility decreases with increase in concentration. This can be explained as the solvent molecules strongly associate through hydrogen bonding with leaf extract molecules. Therefore bonds between solute-solvent strengthen the intermolecular forces resulting in decrease in adiabatic compressibility with increase in concentration.

From table 2 and figure 3, it is observed that there is increase in acoustic impedence with concentration shows the increase in molecular packing in the medium which gives the possibility of molecular interaction due to hydrogen bonding between solute- solvent.

"The intermolecular free length is the distance between the surfaces of the neighbouring molecules". Here the intermolecular free length decreases with increase in concentration it indicates that as the concentration of the system increases (table 2, fig.4.) at particular temperature, solute molecule and solvent molecules arrange themselves resulting into a closed packed structure. Due to these closed packed structure, distance between these molecules decreases and intermolecular free length decreases.

Relative association is a measure of extent of association of components in the medium. It is a property of understanding the molecular interaction in liquid mixtures and solutions. As discussed relative association depends on either of breaking of solvent molecules on addition of solute to it or the salvation of ions that are present. From table 2 and fig.5, it is observed that relative association decreases with increase in concentration this is due to breaking up of associated solvent molecules on addition of solute.

From table 2 and fig.6, it is observed the variation in the relaxation time is due to the changes in viscosity of the solution due to both concentration and temperature. Decrease in values of acoustical relaxation time with increase in concentration may be due to presence solvent molecule around solute molecule.

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CONCLUSION :

From above discussion, it is observed that at different concentrations the ultrasonic velocity increases with increase in concentration this is due to the salvation process of solute by solvent. It is observed that molecular association between *Tridaxprocumbens* leaf extract and solvent may arise from intermolecular hydrogen bonding which supports the molecular association occurring in the solution. Various acoustical parameters suggested the existence of molecular interactions in the solutions. Also it shows that there are both solute-solute and solute-solvent interactions in the system.

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Table 1: Density, Viscosity and Velocity (at frequency 4 mhz) of TridaxProcumbensleaf extract solution in 50% ethanol solvent.

Sr. No.	Conc. (%)	Temp. (K)	Density (d_s) (Kg m^{-3})	Velocity (v_s) (m/s)	Viscosity (η) (Kg $m^{-1}s^{-2}$)
1	1%	298.15	934.6	1633.2	10.47 E^{-4}
		303.15	931.4	1596.2	08.67 E^{-4}
		308.15	929.2	1588.1	08.01 E^{-4}
2	0.5%	298.15	934.8	1621.8	8.85 E^{-4}
		303.15	932.5	1584.2	7.258 E^{-4}
		308.15	929.4	1564.2	6.625 E^{-4}
3	0.25%	298.15	932.8	1605.3	9.272 E^{-4}
		303.15	929.8	1587.7	8.086 E^{-4}
		308.15	927.2	1555.8	8.3 E^{-4}
4	0.125%	298.15	933.2	1601.2	8.988 E^{-4}
		303.15	931.1	1581.7	8.103 E^{-4}
		308.15	931.4	1545.1	8.327 E^{-4}

Table 2. Acoustical parameters of *Tridaxprocumbens* leaf extract in 50% ethanol solvent at 4mhz

Sr. No.	Conc. (%)	Temp. (K)	Adiabatic Compressibiliy	Specific Acoustic Impedence Kg M^{-2} S^{-1}	Intermolecular free length	Relative Association	Relaxation time
1.	1%	298.15	4.011 E^{-10}	1526388	4.119 E^{-11}	3.357 E^{-1}	5.585 E^{-13}
		303.15	4.213 E^{-10}	1486514	4.260 E^{-11}	3.372 E^{-1}	4.861 E^{-13}
		308.15	4.267 E^{-10}	1475662	4.326 E^{-11}	3.353 E^{-1}	4.546 E^{-13}
2.	0.5%	298.15	4.067 E^{-10}	1516058	4.147 E^{-11}	3.381 E^{-1}	4.787 E^{-13}
		303.15	4.272 E^{-10}	1477266	4.290 E^{-11}	3.401 E^{-1}	4.123 E^{-13}
		308.15	4.397 E^{-10}	1453767	4.391 E^{-11}	3.404 E^{-1}	3.874 E^{-13}
3.	0.25%	298.15	4.160 E^{-10}	1497423	4.195 E^{-11}	3.409 E^{-1}	5.130 E^{-13}
		303.15	4.266 E^{-10}	1476243	4.287 E^{-11}	3.384 E^{-1}	4.587 E^{-13}
		308.15	4.455 E^{-10}	1442537	4.420 E^{-11}	3.412 E^{-1}	4.917 E^{-13}
4.	0.125 %	298.15	4.179 E^{-10}	1494239	4.204 E^{-11}	3.418 E^{-1}	4.995 E^{-13}
		303.15	4.292 E^{-10}	1472720	4.300 E^{-11}	3.400 E^{-1}	4.625 E^{-13}
		308.15	4.502 E^{-10}	1437561	4.443 E^{-11}	3.453 E^{-1}	4.986 E^{-13}

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Fig.1-Variation of ultrasonic velocity with temp. at diff. conc.in 50% ethanol solvent

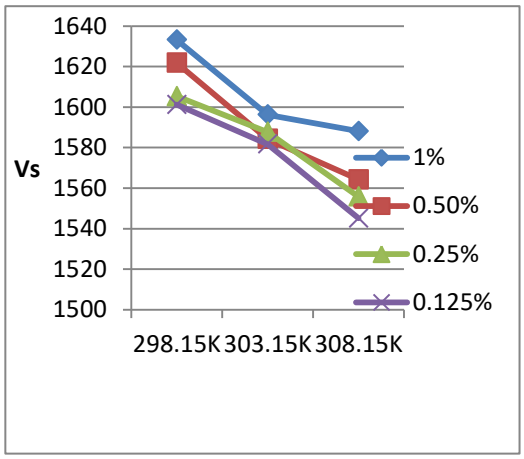


Fig.2.-Variation of Adiabatic compressibility with temp. at different conc.in 50% ethanol solvent

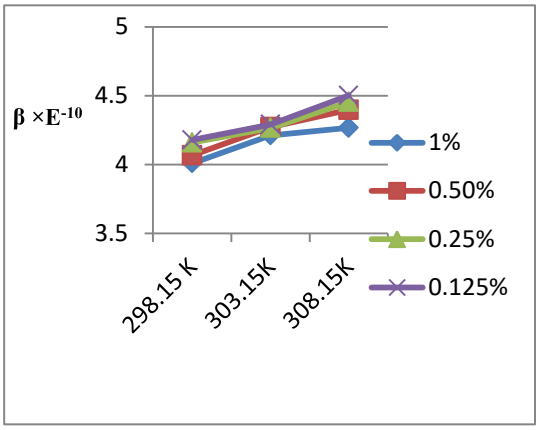


Fig.3. Variation of Specific acoustic impedence with temperature at diff. conc.in 50% ethanol solvent

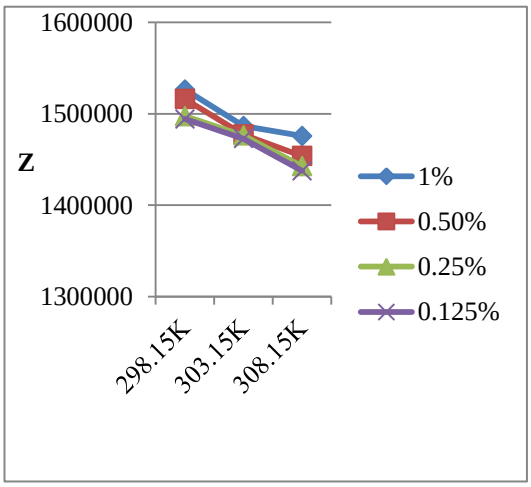


Fig. 4. Variation of Intermolecular free length with temperature at various conc. in 50% ethanol solvent

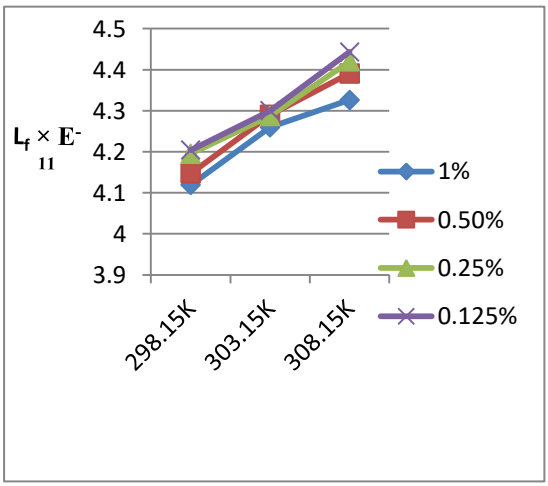


Fig.5. Variation of Relative with temperature at diff. conc in 50% ethanol solvent

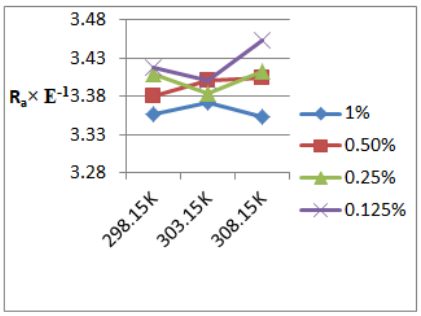
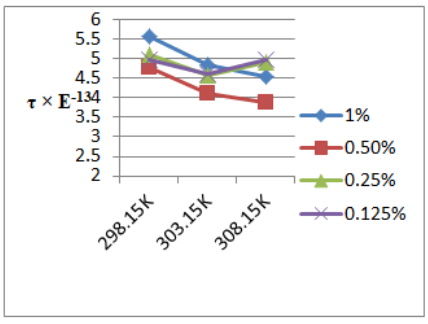


Fig.6. Variation of Relaxation time with temperature at diff. conc in 50% ethanol solvent



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