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Adiabatic compressibility, acoustic impedence, free length, relaxation time of *TridaxProcumbens* root extract solution

Shailesh S. Kamble[1], Shashikant R. Aswale[2], Sunanda S. Aswale[3]

[1]*Dept. Chemistry Arts, Commerce and Science College Maregaon, Dist. Yavatmal, India.*

[3]*Department of Chemistry LokmanyaTilakMahavidyalaya, Wani, Dist. Yavatmal,India*.

ABSTRACT:-

Ultrasonic Velocity, density, viscosity have been measured experimentally for the solution of root extract ofTridaxProcumbensin distilled water with various concentrations at 298.15 K, 303.15 K, 308.15 K keeping constant frequency of 4 MH_z.As the acoustical parameters like adiabatic compressibility, intermolecular free length, relaxation time, specific acoustic impedencewould prove to be more useful to predict and confirm the molecular interactions, these have been determined by measuring the Ultrasonic Velocity, density, viscosity of the prepared solution. A variation in these parameters will provide a strong information regarding the molecular interactions taking place in the solution. Ultrasonic velocity together with density and viscosity data will furnish a wealth of information about the interactions between ions, dipoles and hydrogen bonding.

Keywords :Acoustic impedence, adiabatic compressibility, intermolecular length, relaxation timeUltrasonic velocity.

1) INTRODUCTION :

Ultrasonic velocity measurements and other acoustical parameters of liquid mixtures are the powerful technique in understanding the chemical nature and the molecular interactions [1-5]. Many researchers used ultrasonic velocity measurement for studying solute-solvent interaction in number of systems including organic liquid, dilute solutions in organic acid and complexes [6-8].Ultrasonic velocity in liquids and liquid mixtures provide valuable information about their physico-chemical properties and the nature of molecular interactions in them [9-10]. 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. TridaxProcumbensis known for its antifungal nature. The solution of leaf extract of TridaxProcumbens in distilled water solvent 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.

2. MATERIALS AND METHODS:-

The leaf extract used in this study was of analytical range. Distilled water 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 TridaxProcumbenswas Prepared by taking accurate weights on electronic digital balance (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 TridaxProcumbenswas measured with the Multifrequency ultrasonic interferometer (Model M-83, Mittal Enterprizes) at 4 MHz frequency with an accuracy of $\pm$ 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).

2.1. Computation :

By using ultrasonic velocity following ultrasonic parameters are calculated.

2.1.1. Adiabatic compressibility -

$\beta = 1/v_s^2 d$

Where, v - velocity of solution,

d - density of liquid

2.1.2. Intermolecular free length -

$L_f = K\sqrt{\beta_s}$

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

2.1.3. Specific acoustic impedance -

$Z = v \times d_s$

2.1.4. Relaxation time -

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

3. RESULT AND DISCUSSION:

The experimentally determined values are listed in the following table.

Table 1: Density, Viscosity and Velocity (at frequency 4 mhz) of TridaxProcumben root extract solution in dist. water 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	1001.0	1607.1	8.210 E^{-4}
		303.15	999.5	1622.7	7.476 E^{-4}
		308.15	997.8	1678.3	6.709 E^{-4}
2	0.5%	298.15	996.8	1615.1	7.377 E^{-4}
		303.15	995.5	1644.5	7.192 E^{-4}
		308.15	994.4	1685.5	6.590 E^{-4}
3	0.25%	298.15	996.8	1645.5	7.680 E^{-4}
		303.15	996.1	1667.2	7.292 E^{-4}
		308.15	995.5	1695.5	6.709 E^{-4}

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4	0.125%	298.15	995.8	1643.1	7.486 E^{-4}
		303.15	994.3	1677.2	7.000 E^{-4}
		308.15	993.5	1688.3	6.552 E^{-4}

Table 2. Acoustical parameters of *TridaxProcumbens* leaf extract in dist. water solvent at 4 mhz

Sr.No.	Conc. (%)	Temp. (K)	Adiabatic Compressibility	Specific Acoustic Impedence Kg M^{-2} S^{-1}	Intermolecular free length	Relaxation time
1.	1%	298.15	3.867 E^{-10}	1608707	4.044 E^{-11}	4.222 E^{-13}
		303.15	3.799 E^{-10}	1621888	4.045 E^{-11}	3.777 E^{-13}
		308.15	3.558 E^{-10}	1674607	3.950 E^{-11}	3.174 E^{-13}
2.	0.5%	298.15	3.845 E^{-10}	1609931	4.033 E^{-11}	3.772 E^{-13}
		303.15	3.714 E^{-10}	1637099	4.000 E^{-11}	3.552 E^{-13}
		308.15	3.539 E^{-10}	1676061	3.939 E^{-11}	3.101 E^{-13}
3.	0.25 %	298.15	3.705 E^{-10}	1640234	3.959 E^{-11}	3.784 E^{-13}
		303.15	3.611 E^{-10}	1660697	3.944 E^{-11}	3.502 E^{-13}
		308.15	3.494 E^{-10}	1687870	3.914 E^{-11}	3.117 E^{-13}
4.	0.125 %	298.15	3.719 E^{-10}	1636198	3.966 E^{-11}	3.702 E^{-13}
		303.15	3.575 E^{-10}	1667639	3.924 E^{-11}	3.328 E^{-13}
		308.15	3.531 E^{-10}	1677326	3.935 E^{-11}	3.076 E^{-13}

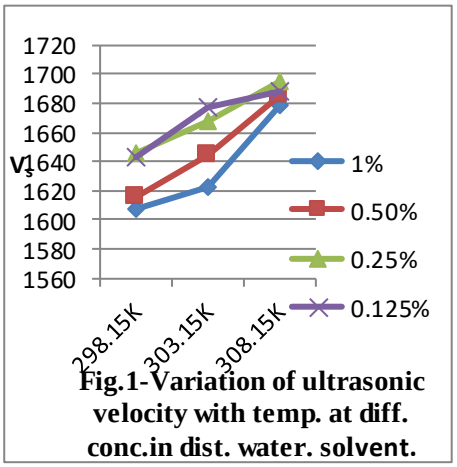

Fig.1-Variation of ultrasonic velocity with temp. at diff. conc.in dist. water. solvent.

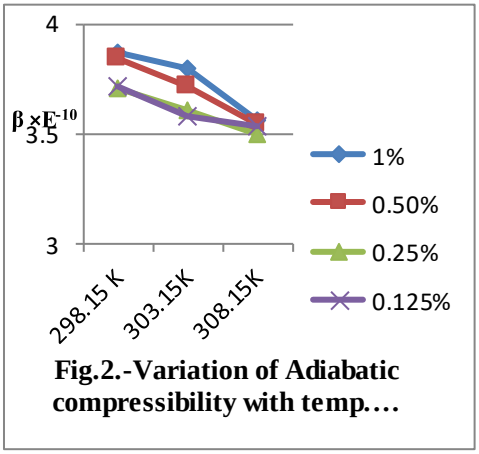

Fig.2.-Variation of Adiabatic compressibility with temp.…

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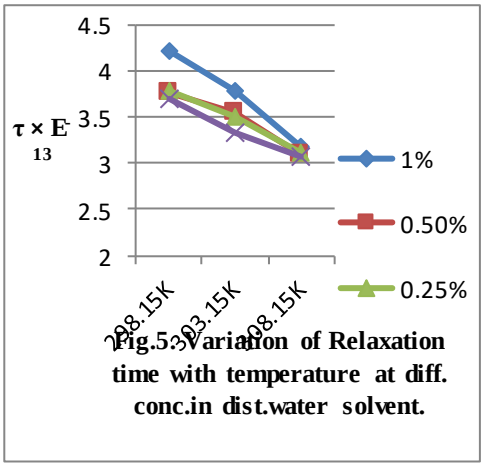

Fig.5. Variation of Relaxation time with temperature at diff. conc.in dist.water solvent.

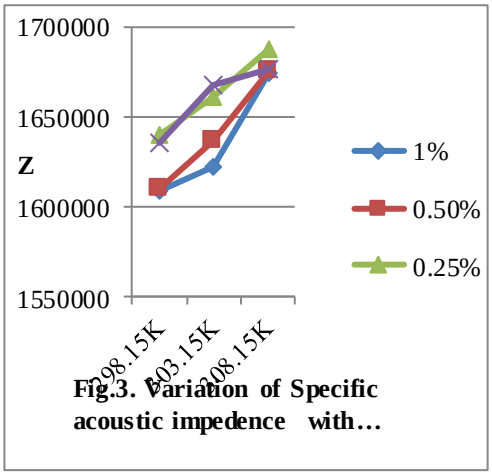

Fig.3. Variation of Specific acoustic impedence with…

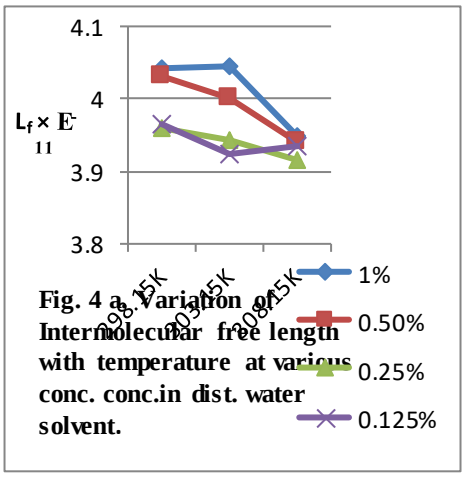

Fig. 4 a. Variation of Intermolecular free length with temperature at various conc. conc.in dist. water solvent.

The ultrasonic velocity of 1%, 0.5%, 0.25%, 0.125% *TridaxProcumbens*root extract was measured at 298.15K, 303.15K, 308.15K at 4 MHz frequency. From Table no.1& fig.no.1, shows that ultrasonic velocity increases with decrease in concentration this behavior is different from the ideal mixture behavior and can be attributed to intermolecular interaction in the system. From table no. 2 and fig.2 it is observed that the adiabatic compressibility increases with increase in concentration this may be due to decrease in number of compressible molecules. From Fig.3 it is seen that the specific acoustic impedence also decreases with increase in concentration, this decrease in acoustic impedence shows decrease in molecular packing in the medium which gives the possibility of molecular interaction due to hydrogen bonding between solute and solvent. "The intermolecular free length is the distance between the surfaces of the neighbouring molecules".Fig.4. shows that intermolecular free length increases with increase in concentration this is due to increase in the number of bulky solute particals and repulsive forces existed between them.

Relaxation time is the "characteristic time in which a system relaxes under certain changes in external conditions". Fig 5.shows that as concentration increases relaxation time increases it is because of the relaxation process showing the presence of strong molecular interactions.

CONCLUSION:-

From the above study we can conclude that for this system ultrasonic velocity increses with decrease in concentration because of intermolecular interaction. Evaluation of adiabatic compressibility, specific acoustic impedence, relaxation time, intermolecular free length clearly shows strong solute – solvent interaction.

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