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ACOUSTICAL STUDIES ONMOLECULAR INTERACTIONS INBINARY LIQUID MIXTURES AT 298K AND 2 MHz FREQUENCY

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ABSTRACT

Measurements of ultrasonic velocity, density and viscosity have been carried out forn- Hexanol in Cyclohexaneat different concentrations at 298 K temperature and 2 MHz frequency. 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 adiabatic compressibility (β_a), intermolecular free length (L_f) and time relaxation time (τ)for n- Hexanol in Cyclohexanewere calculated from ultrasonic velocity and effect of concentration on molecular interaction was predicted.

Keywords: *n- Hexanol, concentration, Cyclohexane, molecular, ultrasonic*

I. INTRODUCTION:

Ultrasonic studies are extensively used to estimate the thermodynamic properties and predict the intermolecular interaction in pure liquid and various binary mixtures. The nature of molecular interaction of the system can be determined by the propagation of ultrasonic wave. The ultrasonic velocity is determined by ultrasonic interferometer. The ultrasonic measurement such as ultrasonic velocity (U), Density(ρ) and the viscosity(η) are widely used in the study of molecular interaction. It also applied in the characterizing the physico-chemical behavior of liquid mixture[1-6].

The Ultrasonic velocity and derived acoustical parameter are of special importance and provides valuable information about the molecular interaction. For this various binary mixture with respect to variation in concentration of liquid has been studied[7-9]. To study different kind of association, molecular motion and various type of interactionand their strength influence by the size of pure component and the mixture, the acoustical parameter are used[10-11].

In present work the accurate thermodynamic and acoustic properties of higher alcohol particularly 1-Hexanol and Cyclohexane have been calculated at 298K. The acoustic parameters are used to explain interaction in these binary mixture.

II. MATERIALS AND METHODS

The ultrasonic velocity (U) in binary liquid mixtures for n- Hexanol in Cyclohexanehave been measured using an ultrasonic interferometer (Mittal type, Model F-81) working at 2 MHz frequency and at

temperature 298K. 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 ±0.1Kgm^{-3}. All the precautions were taken to minimize the possible experimental error.

Adiabatic compressibility (βa), Intermolecular free length (L_f) and Relaxation time (τ)have been calculated from the measured data using the following standard expressions:

$\beta_a = (U^2\rho)^{-1}$ .... (1)

$L_f = K_T\beta a^{1/2}$ .... (2)

$\tau = 4/3\ \eta\ \beta a$ … (3)

Where, K_T is the temperature dependent constant, η be the viscosity.

III. RESULTS AND DISCUSSION

Table-I shows that, Ultrasonic velocity and density increases with concentration of n- Hexanol in Cyclohexane at temperature 298K. The viscosity increases in the system, suggesting thereby more association between solute and solvent molecules.

From the Table-I, the adiabatic compressibility (β_a) and free length(L_f) decreases with increase of mole fraction of the n- Hexanol. This may lead to the presence of specific molecular interaction between the molecules of the liquid mixture. The adiabatic compressibility and free length are the deciding factors of the ultrasonic velocity in liquid systems. Decrease in intermolecular free length in the system leads to deviation in compressibility. This indicates that the molecules are nearer in the system.

The free lengthdecreases with increasing mole fraction of the solute in this system. The decrease in free length show that the strength of interaction increases gradually with the increase in n- Hexanol concentration. Relaxation time (τ)increases with increasing mole fraction of the solute in this system. It represents that there is molecular interaction between the n- Hexanol and Cyclohexane[12-15].

Table 1: Measured values of Ultrasonicvelocity (U), density (ρ) and viscosity (η) and calculated values of Adiabatic compressibility (β_a), free length (L_f) and Relaxation time (τ) of n- Hexanol in Cyclohexane at 298K and 2 MHz Frequency.

Mole fraction of n- Hexanol in Cyclohexane	U (m/s)	ρ (kg/m^3)	$\eta*10^{-3}$ (CP)	β_a*10^{-10} (Pa^{-1})	L_f*10^{-10} (m)	$\tau*10^{-12}$ (s)
0	1198.120	780.05	0.9935	8.9305	0.6151	1.1830
0.1	1207.714	783.90	1.0376	8.7460	0.6087	1.2099
0.2	1219.712	788.80	1.0967	8.5215	0.6008	1.2460
0.3	1222.130	791.30	1.2008	8.4610	0.5987	1.3546
0.4	1225.120	794.90	1.3012	8.3816	0.5959	1.4541

0.5	1227.400	798.20	1.5962	8.3160	0.5935	1.7698
0.6	1235.120	800.70	1.8032	8.1867	0.5889	1.9683
0.7	1243.140	805.90	1.9324	8.0293	0.5832	2.0687
0.8	1274.000	810.50	2.6036	7.6016	0.5675	2.6388
0.9	1276.800	815.70	3.1202	7.5201	0.5644	3.1285
1.0	1282.000	818.90	3.5541	7.4300	0.5610	3.5209

IV. CONCLUSION

The ultrasonic velocity, density, viscosity and other related parameters were calculated. The existence of molecular interaction in solute-solvent is favored in the system, confirmed from the U, ρ, η, βa, L_f and τ data. The variation in ultrasonic velocity (U), density (ρ) and viscosity (η) and other related thermodynamic parameters such as βa, L_f and τ at various concentrations and at 298K temperature in the n- Hexanol in Cyclohexaneshows the variation -linear. Strong intermolecular interactions are confirmed in the systems investigated. This provides useful information about solute solvent interactions in the mixture as existing in the liquid system.

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