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STUDY OF DIFFERENT PARAMETERS FOR BINARY LIQUID MIXTURE OF ETHYL AMINE AND CYCLOHEXANOL AT 308.15 K

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ABSTRACT:

Ultrasonic investigation of acoustic parameters in binary liquid mixture of ethyl amine with cyclohexanol at 308.15 K have been measured. Acoustic parameters like isentropic compressibility, intermolecular free length, available volume, molar volume, Nissan's parameter and their excess function have been calculated for this binary liquid mixture at 308.15K. The corresponding excess functions are a better measure of the extent of interactions present between the component molecules of the system. It is used in so many fields of scientific researches in physics , chemistry, biology, medicines and industry. These properties also provide important information about molecular packing, molecular motion and the chemical nature of the component molecules.

KEYWORDS: Binary mixture, ethyl amine , cyclohexanol , Density, Viscosity, Ultrasonic interferometer.

INTRODUCTION: In the recent years, a considerable progress has been made in theoretical understanding of liquid-liquid binary mixture. The ultrasonic studies find extensive applications as sound speed intrinsically related with many parameters which characterized the physico chemical behavior of the liquids and liquid systems. Intermolecular interaction in various binary liquid mixtures at different temperatures have been studied by several authors [1-4]. Besides the theoretical importance, the knowledge of physico chemical properties of binary mixtures is indispensable for many chemical process industries, examples are the petroleum, petrochemical etc. are commonly used in industries where physico chemical processes are involved to handle the mixture of hydrocarbons, alcohols, aldehydes, ketones etc. Importantly for accurate designing equipment, it is necessary to know the interaction between the components of mixtures. A considerable progress has been made theoretical understanding of liquid-liquid mixture [5-8]. The thermodynamic studies of binary solutions have attracted much attention of scientists and experimental data on a number of systems are available for review and publications [9-22].

In the frame work of a research work, which aims to study the ultrasonic study, density, viscosity measurements and the properties derived. These are excellent tools to detect solute-solute and solute-solvent interactions. It is used in so many fields of scientific researches in physics, chemistry, biology, medicines and industry. The present paper deals with the measurement of density, viscosity, speed of sound, molar volume, available volume, isentropic compressibility, intermolecular free length, Nissan's parameter and their excess values of binary liquid mixture ethyl amine with cyclohexanol at 308.15K. This technique using ultrasonic instrument is in the tremendous

use in measuring the rate of flow of blood through the human body and getting images of vital organs of the body like kidney , liver, blood vessel, foetus etc.

MATERIALS AND METHODS:

Both ethylamine and cyclohexanol were obtained from E-Merck. They were purified by the recommended method . The weighing was done on an electronic balance with precision ±0.1mg. The density of pure liquid and mixtures were measured using precalibrated bicapillary pyknometer with an accuracy 0.053%. The viscosities of binary liquid mixture were measured by Ostwald viscometer designed properly to minimize the loss of liquid components through vaporization. Ultrasonic velocity was measured by multi frequency ultrasonic interferometer model (M-84) at 2 M Hz frequency and data were accurate up to ± 0.04 %. All measurement were made in a thermostatically controlled water bath with temperature accuracy of ± 0.1°c . The purity of components was ascertained by comparing the boiling points and density of pure components with those reported in literature [23, 24] .

The volume of mixing of binary mixture is given by

$$Vm = V - X_1V_1 - X_2V_2 \quad \text{----------} \quad (1)$$

Where V is molar volume, V_1 and V_2 are molar volume of pure components and X_1 and X_2 are mole fractions of the components 1 and 2.

Excess volume (V^E) of binary liquid mixture of varying composition was calculated using relations

$$V^E = V^{obs} - V^{id} \quad \text{----------} \quad (2)$$

Where V^{obs} is the experimental value of volume of binary liquid mixture

$$V^{obs} = M_1X_1 + M_2X_2 / \rho \quad \text{----------} \quad (3)$$

'ρ' is the measured density of binary liquid mixture of given composition. V^{id} refers to the value for ideal binary mixture.

$$V^{id} = X_1V_1+X_2V_2 = X_1M_1 / \rho_1 + X_2M_2 / \rho_2 \text{ -------} \quad (4)$$

Where M_1 and M_2 are molar masses and ρ_1 and ρ_2 are densities of component liquid in pure state X_1 and X_2 are mole fractions of first and second component. Thermodynamic properties like isentropic compressibility (βs) and inter molecular free length (Lf) are calculated using following relations

$$\beta s = 1/u^2\rho \quad \text{----------} \quad (5)$$

$$Lf = K / u\,\rho^{1/2} \quad \text{----------} \quad (6)$$

Where 'K' is temperature constant, 'u' is speed of sound and ρ is the density of liquid.

Nissan's parameter (d) $= L n\eta^E / X_1X_2$ ----------(7)

'η^E' is the excess value of viscosity, X_1 and X_2 are the mole fractions of the liquid 1and 2.

RESULTS AND DISCUSSION:

The various experimental results of acoustic parameters are shown in table [1-4] . Deviation in the properties demonstrated that their exist a molecular interaction between unlike molecule of the liquid mixture . These may be attributed to the change in the adhesive and cohesive forces, the experimental values of ultrasonic speeds, densities, molar volumes and their excess values for the system of ethylamine and cyclohexanol at 308.15K [Table -1]. Table -

2 shows isentropic compressibility intermolecular free length and their excess value for the system at 308.15 K. Table -3 presents available volume and their excess values for the system at 308.15 K. Table -4 shows the viscosity and their excess values , Ln η^E (Logarthem of excess value of viscosity) and Nissan's parameter (d) for the system at 308.15 K .

TABLE-1

ULTRASONIC VELOCITIES, DENSITIES, MOLAR VOLUMES AND THEIR EXCESS VALUE FOR THE SYSTEM ETHYLAMINE + CYCLOHEXANOL AT 308.15K

Mole fraction of ethylamine (X_1)	Ultrasonic Velocity m/sec	Density g/ml	Molar Volume (exp) ml/mole	Molar Volume (add) ml/mole	Excess molar Volume ml/mole
0.0000	1436	0.9404	106.50	106.50	0.00
0.1000	1430	0.9322	101.35	101.22	+ 0.13
0.2019	1425	0.9227	96.49	96.16	+ 0.33
0.3017	1421	0.9126	9160	91.10	+ 0.50
0.4023	1417	0.9016	86.51	85.89	+ 0.62
0.5004	1410	0.8901	81.56	80.87	+ 0.69
0.6008	1404	0.8774	76.43	75.72	+ 0.71
0.7007	1401	0.8643	71.23	70.60	+ 0.63
0.8003	1400	0.8508	65.91	65.50	+ 0.41
0. 8992	140	0.8355	60.72	60.54	+ 0.18
1.0000	1434	0.8156	55.27	55.27	0.00

TABLE 2

ISENTROPIC COMPRESSIBILITIES, INTER MOLECULAR FREE LENGTHS AND THEIR EXCESS VALUES FOR THE SYSTEM ETHYLAMINE + CYCLOHEXANOL AT 308.15K

Mole fraction of ethylamine X_1	**Isentropic compressibility(exp) cm^2/dyne $X10^{12}$**	**Isentropic compressibility (add)cm^2/dyne$X10^{12}$**	**Excess isentropic compressibilitycm^2/dyne$X10^{12}$**	**Inter molecular Free length (exp) A^0**	**Inter molecular Free length (add) A^0**	**Excess inter molecular Free Length A^0**
0.0000	51.56	51.56	0.00	0.4570	0.4570	0.0000
0.1032	52.45	52.40	+ 0.05	0.4609	0.4604	+ 0.0005
0.2019	53.37	53.19	+ 0.18	0.4649	0.4639	+ 0.0010
0.3007	54.26	53.99	+ 0.27	0.4688	0.4672	+ 0.0016
0.4023	55.23	54.81	+ 0.42	0.4730	0.4707	+ 0.0023
0.5004	56.50	55.60	+ 0.90	0.4784	0.4743	+ 0.0041
0.6008	57.81	56.41	+ 1.40	0.4839	0.4778	+ 0.0061
0.7007	58.94	57.22	+ 1.72	0.4886	0.4810	+ 0.0076
0.8003	59.96	58.02	+ 1.94	0.4928	0.4844	+ 0.0084
0.8992	60.54	58.81	+ 1.73	0.5952	0.4883	+ 0.0069
1.0000	59.62	59.62	0.00	0.4914	0.4914	0.0000

TABLE - 3
AVAILABLE VOLUMES AND THEIR EXCESS VALUES FOR THE SYSTEM ETHYLAMINE + CYCLOHEXANOL AT 308.15K

Mole fraction of ethylamine X_1	Available volume (exp) ml /mole	Available volume (add) ml / mole	Excess available volume ml /mole
0.0000	109.16	109.16	0.00
0.1032	107.68	103.80	+ 3.88
0.2019	105.53	98.69	+ 6.84
0.3007	102.47	93.46	+ 9.01
0.4023	8.94	88.30	+ 10.64
0.5004	96.85	83.22	+ 13.60
0.6008	93.62	78.01	+ 15.61
0.7007	88.59	72.84	+ 15.75
0.8003	82.38	67,67	+ 14.71
0.8992	73.62	62.67	+ 10.95
1.0000	57.34	57.34	0.00

TABLE -4
VISCOSITIES AND THEIR EXCESS VALUES, $Ln\eta^E$ AND NISSAN'S PARAMETER (d) FOR THE SYSTEM ETHYLAMINE + CYCLOHEXANOL AT 308.15K

Mole fraction of ethylamine X_1	Viscosity (exp) Cp	Viscosity (add) Cp	Excess Viscosity Cp	$Ln\eta^E$	'd'
0.0000	12.986	12.986	0.000	0.000	0.000
0.1032	8.816	11.731	– 2.915	–0.102	–1.102
0.2019	6.682	10.530	– 3.848	–0.107	– 0.664
0.3007	4.665	9.328	– 4.663	– 0.190	– 0.904
0.4023	3.392	8.092	– 4.700	– 0.233	– 0.968
0.5004	2.623	6.899	– 4.276	– 0.219	– 0.876
0.6008	2.118	5.678	– 3.560	– 0.156	– 0.650
0.7007	1.534	4.462	– 2.928	– 0.203	– 0.967
0.8003	1.220	3.251	– 2.031	– 0.157	– 0.982
0.8992	0.955	2.061	– 1.106	– 0.131	– 1.431
1.0000	0.822	0.822	0.000	0.0	0.000

In the system of ethylamine + cyclohexanol mixture, the ultrasonic velocity and molar volumes increase with the increase in mole fractions of ethylamine [Table-1]. However, the density, available volume, isentropic compressibility, intermolecular free length and viscosity decrease under similar condition (shown Table 2- 4). Excess molar volume, Excess isentropic compressibility, Exces available volume and excess intermolecular free length are all positive

under all condition of composition and temperature which shows weak interactions between the molecule of ethylamine and cyclohexanol , thus the positive values predict weak interaction involving dispersion forces. Excess value of viscosity and Nissan;s parameter 'd' were found to be negative which also shows the weak interactions between the molecule of ethylamine and cyclohexanol at 308.15K.

4 CONCLUSION:

The positive value of excess molar volume, excess available volume, excess isentropic compressibility and intermolecular free length shows the presence of weak molecular interactions between the unlike molecules of the binary liquid mixture (ethylamine + cyclohexanol) at the temperature 308 .15K. Where the negative value of logarithm value of excess viscosity and Nissan's parameter (d) also shows the weak interactions between the unlike molecules of the binary liquid mixture (ethylamine + cyclohexanol) at the temperature 308.15K.

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