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Ultrasonic Studies and Molecular Interactions of Binary Liquid Mixture of Ethylamine and Benzyl Alcohol at 313.15^{0}K

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Abstract

The experimental values of the parameters like - ultrasonic velocity (u), isentropic compressibility (β_s), intermolecular free length (L_f) and viscosity (η) of ethylamine and benzyl alcohol in the pure state as well as mixture over the whole composition range at 313.15^{0}K. The excess values of available volume (V_a) ,molar volume (V_m) and Nissan,s parameter(d) have been calculated. It is used in so many fields of scientific researches in physics, chemistry, biology, medicines and industry. About molecular packing , molecular motion and various types of interactions and their strength, influenced by the size ,shape and the chemical nature of component molecules are also provided by these parameters.

Keywords: Binary mixture, ethylamine, benzyl alcohol and ultrasonic interferometer.

Introduction

A considerable progress has been made in theoretical understanding of liquid-liquid mixture[1]. The thermodynamic study of binary mixture have attracted much attention of scientist and experimental data on a number systems are available from review and publication[2-8]. Many investigations[9-18] have been engaged in the task of collecting more and more data and explaining in terms of the properties of pure liquid. Viscosity, density measurements and the derived properties from these are excellent tools to detect solute- solute and solute-solvent interactions. The present paper deals with the measurement of density, viscosity (η) and excess thermodynamic properties i.e. Molar volume (V_m), isentropic compressibility (β_s), intermolecular free length (L_f) and Nissan parameter (d) have been calculated. 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, fetus etc.

Material and Methods

Ethylamine and Benzyl alcohol were obtained from E-Merck and BDH. They were purified by the recommended methods. The volume of mixing binary liquid mixtures is given by

$V_m = V - (X_1V_1 - X_2V_2)$

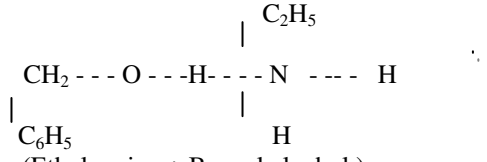
Where V_m is molar volume. V_1 and V_2 are molar volume of pure components and X_1 and X_2 are mole fractions of the components (1) one and (2) two. In the present study density, ultrasonic, velocity, molar volume, isentropic compressibility, intermolecular free length, Nissan's parameter and their excess values have been reported.

Results and Discussion

The results are shown in tables 1 to 4. Deviations in the properties computed demonstrated that their exist a molecular interaction between the liquid mixture of unlike molecules. These may be attributed to the change the adhesive and cohesive forces. The experimental values of ultrasonic velocities, densities, molar volumes and their excess values for the system of ethylamine and benzyl alcohol are shown in table - 1 at 313.15^{0}K.

The table–2 shows isentropic compressibility, intermolecular free length and their excess values for the system (ethylamine +benzyl alcohol) at 313.15^{0}K. Table–3 shows available volume and their excess values for the system (ethylamine +benzyl alcohol) at 313.15^{0}K. Table – 4 shows the viscosity and their excess values, $L_n \eta^E$ (Logarithm of excess value of viscosity) and Nissan's parameter (d) have been calculated for the system (ethylamine +benzyl alcohol) at 313.15^{0}K.

Thus the mixture of ethyl amine and benzyl alcohol is a polar – polar system. In case of ethylamine + benzyl alcohol at 313.15^{0}K, the excess isentropic compressibility (β_S^E) and the intermolecular free length (L_f) are negative shown in (table-2) but the value of Nissan's parameter (d) shown in (table–4) is positive. Thus the π electrons of benzene ring is also supposed to be involved in the specific interaction as shown below



(Ethyl amine + Benzyl alcohol)

The negative values of excess molar volume(Vm^E), excess available volume (Va^E) (table 1 and 3) and excess viscosity (η^E) (table – 4) may be different molecular size attributed to the presence of dispersive forces between the mixing components and suggest the presence of specific intermolecular interactions of the binary mixture, while the positive values Vm^E, Va^E and η^E may be due the presence of strong and specific molecular interactions between the unlike molecules of the binary mixture.

Table- 1
Ultrasonic velocities, Densities, Molar volumes and their excess values for the system Ethaylamine + Benzyl alcohol at 313.15 ^{O}K

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	1482	1.0295	105.04	105.04	0.00
0.1025	1481	1.0210	99.57	99.95	-0.38
0.2008	1480	1.0072	94.78	95.08	-0.30
0.2992	1479	0.9917	90.00	90.21	-0.21
0.4006	1474	0.9740	85.07	85.19	-0.12
0.4986	1467	0.9552	80.29	80.33	-0.04
0.5991	1457	0.9319	75.49	75.36	+0.15
0.6992	1450	0.9050	70.75	70.40	+0.35
0.7992	1443	0.8750	65.97	65.45	+0.52
0. 8986	1434	0.8409	61.19	60.53	+0.66
1.0000	1417	0.8121	55.51	55.51	0.00

Table - 2
Isentropic compressibilities, intermolecular free length and their excess values for the system Ethylamine + Benzyl acohol at 313.15^{0}K

Mole fraction of ethylamine X_1	Isentropic compressibility (exp) cm^2/dyne $X10^{12}$	Isentropic compressibiliy (add) cm^2/dyne$X10^{12}$	Excess isentropic compressibilitycm^2/dyne$X1^{12}$	Inter molecular Free length (exp) A^0	Inter molecular Free length (add) A^0	Excess inter molecular Free Length A^0
0.0000	44.22	44.22	0.00	0 .4269	0.4269	0.0000
0.1025	44.65	45.96	- 1.31	0.4289	0.4347	- 0.0058
0.2008	45.32	47.65	- 2.33	0.4321	0.4420	- 0.0099
0.2992	46.09	49.32	- 3.23	0.4358	0.4495	- 0.0137
0.4006	47.25	51.12	- 3.87	0.4413	0.4571	- 0.0158
0.4986	48.64	52.74	- 4.10	0.4477	0.4646	- 0.0169
0.5991	50.54	54.45	- 3.91	0.4564	0.4722	- 0.0158
0.6992	52.55	56.17	- 3.62	0.4653	0.4798	- 0.0145
0.7992	54.88	57.88	- 3.00	0.4656	0.4874	- 0.0118
0.8986	57.83	59.58	- 1.75	0.4882	0.4949	- 0.0067
1.0000	61.32	61.32	0.00	0.5027	0.537	0.0000

Table-3
Available volumes and their excess values for the system Ethylamine + Benzyl alcohol at 313.15^{0}K

Mole fraction of ethyl amine X_1	Available volume (exp) ml /mole	Available volume (add) ml / mole	Excess available volume ml /mole
0.0000	7.74	7.74	0.00
0.1025	7.40	7.59	- 0.19
0.2008	7.10	7.45	- 0.35
0.2992	6.80	7.31	- 0.51

0.4006	6.69	7.16	- 0.47
0.4986	6.67	7.04	- 0.37
0.5991	6.65	6.90	- 0.25
0.6992	6.63	6.75	- 0.12
0.7992	6.47	6.61	- 0.14
0.8986	6.34	6.47	- 0.13
1.0000	6.34	6.34	0.00

Table-4
Viscosity and their excess values, $Ln\eta^E$ and Nissan's parameter (d) for the system Ethylamine + Benzyl alcohol at 313.15^0K

Mole fraction of ethylamine X_1	Viscosity (exp) Cp	Viscosity (add) Cp	Excess Viscosity Cp	$Ln\eta^E$	'd'
0.0000	2.017	2.017	0.000	0.000	0.000
0.1025	1.935	1.875	+ 0.060	+ .077	+ 0.837
0.2008	1.786	1.738	+ 0.048	+ 0.110	+ 0.685
0.2992	1.632	1.603	+ 0.019	+ 0.134	+ 0.639
0.4006	1.451	1.464	- 0.009	+ 0.135	+ 0.562
0.4986	1.267	1.328	- 0.061	+ 0.099	+ 0.396
0.5991	1.073	1.190	- 0.117	+ 0.059	+ 0.245
0.6992	0.920	1.051	- 0.131	+ 0.022	+ 0.104
0.7992	0.793	0.914	- 0.121	- 0.011	- 0.069
0.8986	0.694	0.776	- 0.082	- 0.031	- 0.340
1.0000	0.637	0.637	0.000	0.000	0.000

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