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Research Article

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Thermo Excess Acoustical Parameters in Binary Liquid Mixtures of Ethylene Glycol with Ethanol at Five Different Temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15) K

Ibrahim SM* and Sreehari Sastry S

Department of Physics, Acharya Nagarjuna University, Guntur, India

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ABSTRACT

Thermo Excess acoustical parameters such as excess internal Pressure(π^E), excess enthalpy (H^E) and excess viscosity (η^E) have been measured from experimentally measured values of densities(ρ), ultrasonic velocities(u) and viscosities(η) in binary liquid mixtures containing Ethylene Glycol with Ethanol at temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15) K. These results are fitted to the Redlich-Kister polynomial equation. These results have been explained on the basis of intermolecular interactions in liquid mixtures.

Keywords: Excess internal pressure; Excess enthalpy; Excess viscosity; Ethylene Glycol; Ethanol

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INTRODUCTION

Study of excess acoustical parameters is very much important in explaining the nature of molecular interactions in binary liquid mixtures [1-3]. These interactions influence the structural arrangement and shape of the molecules. Study ultrasonic velocity and their derived excess parameters investigations in liquid mixtures find eminent applications in explaining physico-chemical behavior and non-ideal behavior [4-6]. In the present research work [7] the authors reported the variations of excess acoustical parameters such as excess internal Pressure (π^E), excess enthalpy (H^E) and excess viscosity (η^E) in binary liquid mixtures of Ethylene Glycol with ethanol at temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15) K over the entire mole fraction range of Ethylene Glycol. The deviations of these excess acoustical parameters indicate the presence of interactions between the component molecules of the liquid mixtures.

EXPERIMENTAL SECTION

The chemicals used in the present investigation are of AR grade and they are purified by standard procedure. The different concentrations of the liquid mixture are prepared by varying mole fractions with respect to Job's method of continuous variation. Stoppard conical flasks are used for preserving the prepared mixtures and the flasks are left undisturbed to attain thermal equilibrium. Ultrasonic pulse echo interferometer (Mittal enterprises, India) is used for ultrasonic velocities measurements and all these measurements are done at a fixed frequency. The temperature of the pure liquids or liquid mixtures is done by using temperature controlled water bath by circulating water around the liquid cell which is present in interferometer. Specific gravity bottle is used for the measurement of densities of pure liquids and liquid mixtures. An electronic weighing balance (Shimadzu AUY220, Japan), with a precision of + or - 0.1 mg is used for the measurements of mass of pure liquids or liquid mixtures.

THEORY

Thermo excess acoustical parameters are evaluated by using the following equations,

$$\pi^E=\pi_{exp} - (x_1\pi_1 + x_2\pi_2)\ m^2N^{-1} \quad (1)$$

$$H^E=H_{(exp)} - (x_1H_1 + x_2H_2)\ \text{Å} \quad (2)$$

$$\eta^E=\eta_{exp} - (x_1\eta_1 + x_2\eta_2)\ m^3 \quad (3)$$

Here x is the mole fraction and 1, 2 represent 1st and 2nd component respectively. These excess parameters are fitted to the following Redlich-Kister equation as given by Kumar *et al* [8].

$$A^E = x_1(1-x_1) - \sum_{i=1}^{N} A_i(2x_2-1)^i \quad (4)$$

RESULTS AND DISCUSSION

The alues of ultrasonic velocities (u), densities (ρ) and viscosities (η) over entire mole fraction range of Ethylene Glycol at different temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15)K are given in the Table 1.

Table 1. The values of ultrasonic velocities(u), densitites(ρ) and viscosities (η) over entire molefraction range of Ethylene Glycol at temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15)K

Molefraction (X1)	Ultrasonic velocity(u)/(m.s^{-1})				
	T=298.15 K	T=303.15 K	T=308.15 K	T=313.15 K	T=318.15 K
0	1174.76	1140.24	1108.28	1072.69	1043.3
0.1039	1213.74	1179.22	1147.26	1111.67	1082.28
0.2069	1251.65	1217.13	1185.17	1149.58	1120.19
0.3091	1288.56	1254.04	1222.08	1186.49	1157.1
0.4103	1328.54	1294.02	1262.06	1226.47	1197.08
0.5107	1371.53	1337.01	1305.05	1269.46	1240.07
0.6102	1430.51	1395.99	1364.03	1328.44	1299.05
0.7089	1493.27	1458.75	1426.79	1391.2	1361.81
0.8068	1542.25	1507.73	1475.77	1440.18	1410.79
0.9038	1601.23	1566.71	1534.75	1499.16	1469.77
1	1664.98	1642.25	1632.88	1612.75	1604.17
Density(r)/(Kg.m^{-3})					
0	789.46	783.34	775.02	767.88	761.47
0.1039	813.33	807.21	798.89	791.75	785.34

0.2069	832.58	826.46	818.14	811	804.59
0.3091	852.33	846.21	837.89	830.75	824.34
0.4103	873.67	867.55	859.23	852.09	845.68
0.5107	899.18	893.06	884.74	877.6	871.19
0.6102	929.69	923.57	915.25	908.11	901.7
0.7089	965.72	959.6	951.28	944.14	937.73
0.8068	1005.78	999.66	991.34	984.2	977.79
0.9038	1067.58	1061.46	1053.14	1046	1039.59
1	1110.02	1105.73	1102.89	1098.42	1095.61
viscosity (η)/(Ns.m^{-2})					
0	1.1198	1.0999	1.078	1.0489	1.0275
0.1039	1.0225	1.0026	0.9807	0.9516	0.9302
0.2069	0.9253	0.9054	0.8835	0.8544	0.833
0.3091	0.8281	0.8082	0.7863	0.7572	0.7358
0.4103	0.7309	0.711	0.6891	0.66	0.6386
0.5107	0.6337	0.6138	0.5919	0.5628	0.5414
0.6102	0.5365	0.5166	0.4947	0.4656	0.4442
0.7089	0.4393	0.4194	0.3975	0.3684	0.347
0.8068	0.3394	0.3195	0.2976	0.2685	0.2471
0.9038	0.2499	0.2221	0.1981	0.1721	0.1562
1	0.1882	0.1603	0.137	0.115	0.1002

Thermo-excess acoustical parameters play an important role in studying the nature of molecular interactions in liquid mixtures [9]. The variations of the above excess acoustical parameters such as excess internal pressure (π^E), excess enthalpy (H^E) and excess viscosity (η^E) with the mole fraction of Ethylene Glycol at different temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15)K are represented in Figures 1-3 respectively.

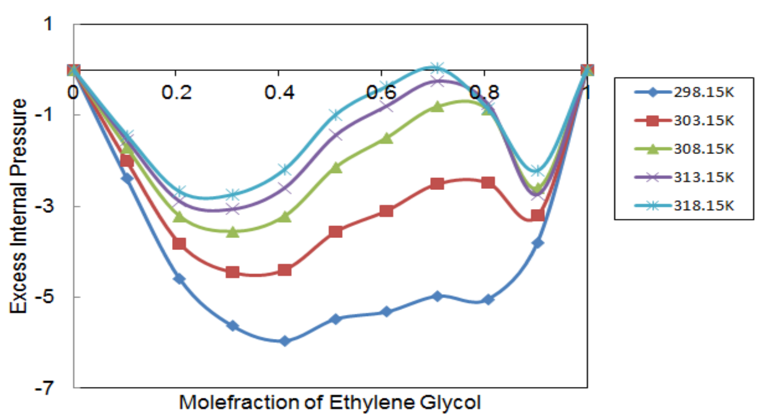

Figure 1. The variations of excess internal pressure (π^E) in binary liquid mixtures of (Propylene + Ethanol) with the molefraction of Ethylene Glycol at different temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15)K

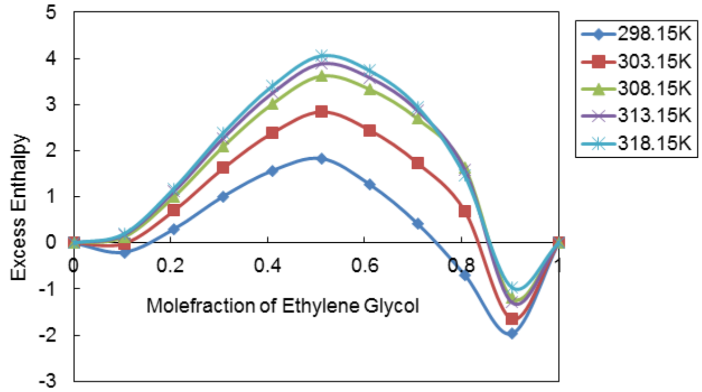

Figure 2. The variations of excess enthalpy (H^E) in binary liquid mixtures of (Propylene + Ethanol) with the molefraction of Ethylene Glycol at different temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15)K.

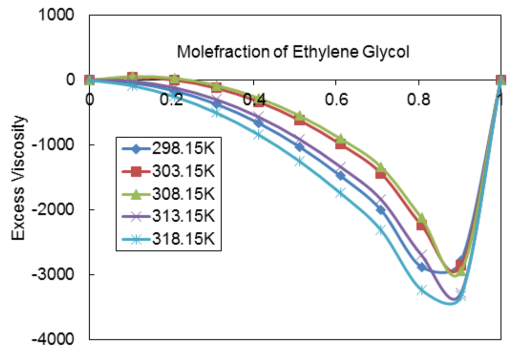

Figure 3. The variations of excess viscosity (η^E) in binary liquid mixtures of (Propylene + Ethanol) with the mole fraction of Ethylene Glycol at different temperatures T=(298.15, 303.15, 308.15, 313.15 and 318.15)K.

The variations of excess internal pressure (π^E) with the mole fraction of Ethylene Glycol ranging from 0 to 1 at different temperatures in the present binary liquid mixtures are as shown in Figure 1. It is observed from Figure 1 is that the excess internal pressure values are negative for entire mole fraction range. The negative values of excess internal pressure suggest that there exist strong interactions between the components of liquid mixture[10].

Figure 2 represents the variations of excess enthalpy (H^E). From Figure 2, it is observed that excess enthalpy values are showing mixed trend with positive and negative variations. The positive variations at lower mole fraction of ethylene glycol and negative variations at higher mole fraction of ethylene glycol which indicate that there exist a special nature of interactions with less magnitude in present the binary liquid mixtures [11].

Figure 3 represents the variations of excess viscosity (η^E) with the mole fractions of Ethylene Glycol. It is observed from Figure 3 is that, excess viscosity values are positive over the entire mole fraction range of Ethylene Glycol. This suggests that there exists specific interactions between unlike molecules are operative in the system [12,13].

CONCLUSIONS

By using the excess values of Ethylene Glycol, an analysis of these results suggests the presence of a special nature of interactions with less magnitude in the present binary liquid mixtures**.**

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