



Exploring the Intricacies A Tale of Binary Mixtures Density, Viscosity, Refractive Index, and Molecular Dynamics Unraveling the Symphony of 2,3 Dichloroaniline & 2 Methoxyethanol From 323.15 K to 293.15 K A Journey Through Molecular Interactions

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ABSTRACT

A new binary mixture system of 2,3 Dichloroaniline (2,3-DCA) and 2-Methoxyethanol (2-ME) including those of pure liquids, over the entire composition range were measured at temperatures from 323.15 K to 293.15 K at atmospheric pressure. The physico-chemical properties of density, viscosity and refractive index for the binary mixtures were determined. The obtained data were compared with those available in literature. The temperature dependences of the viscosities and densities for the system were described. To investigate the internal interactions of the binary mixtures. The trend of energetic and charge distribution of all ions and molecules involved in interactions between the 2,3-DCA and 2-ME.

Keywords : 2,3-DCA and 2-ME, Physico-chemical properties and Molecular Interactions.

I. INTRODUCTION

The physicochemical, thermodynamic and transport properties [1]. of binary liquid mixtures are important in engineering process industry and studied for many reasons, which may provide more information about molecular interactions. Generally speaking, knowledge of basic physicochemical properties on the density, viscosity and refractive index data is an indispensable requirement over a broad range of temperatures 323.15 K to 293.15 K for the absorption and desorption processes of 2,3-DCA. The present work was mainly focused on investigating density, viscosity and refractive index data at T=323.15 K to 293.15 K for the whole composition range that covers the partly industrial applications [2-6]. In addition, the possible intermolecular interaction of

2,3-DCA with 2-ME was investigated using DMA 35 portable vibrating density meter [7] viscosity by LVDL V-pro II Brook field viscometer [7] and Refractive indices for sodium D-line were measured by using Abbe's refractometer [7]. This work is part of the systematic researches on the physicochemical and thermodynamic properties of the binary liquid system containing 2,3-DCA with 2-ME are used in petroleum solvents, fungicides, as an intermediate in the production of agricultural chemicals, azo dyes and pigments and pharmaceuticals [8]. 2-ME is used as a solvent for many different purposes such as varnishes, dyes, and resins [9]. 2-ME is a very interesting class of solvent having hydroxyl -OH group and is noted for its donating and accepting ability. This type of interaction studies (N-H...O-H) plays an important role in biological and drug synthesis applications. The present work is mainly focused on investigating density, viscosity and refractive index data at T=323.15 K to 293.15 K of the system 2,3-DCA+2-ME over the whole composition range. Meanwhile, the work is focused on investigating the possible intermolecular interaction of 2,3-DCA with 2-ME, using density meter, viscometer and refractometer techniques.

I. METHODS AND MATERIAL

2,3-Dichloroaniline (GC Grade) is obtained from Sigma-Aldrich. 2-Methoxyethanol (AR Grade) were obtained from M/S Sd. Fine chemical, Mumbai, India without further purification the two liquids according to their proportions by volume were mixed well and kept 6h in well stoppered bottles to ensure good thermal equilibrium. These liquids used as solute and solvent.

Measurements

All the measurements are carried out at temperatures 323.15 K to 293.15 K by circulating ethylene glycol + water around the liquid cell and temperature is thematically controlled with +0.50°C thermocontrol using Nevitech pvt. Ltd. Mumbai India. The whole of the equipment is standardized with the help of standard materials like methanol and ethyleneglycol+water (40:60). The densities, viscosities, and refractive index of the pure components and their binary mixtures are measured by densities, viscosities and refractive index of the pure components and their binary mixtures were measured by using DMA 35 portable vibrating density meter. Anton paar Autria (Europe) having accuracy of density 0.001 g/cm³, repeatability 0.0005 g/cm³ and resolution 0.0001 g/cm³, viscosity by LVDL V-pro II Brook field viscometer (USA) and Refractive indices for sodium D-line were measured by using Abbe's refractometer having accuracy up to the third place of decimal.

II. RESULTS AND DISCUSSION

This paper reports the density, viscosity and refractive index data of the binary system of 2,3-DCA with 2-ME over the entire binary composition range at T=323.15 K to 293.15 K and atmospheric pressure are reported in table 1. Table 1 show that the density values gradually decrease with increasing temperature at the same concentration the density values increasing with increasing concentration of 2,3-DCA at the all temperature.

Table 1: Mole fraction (X) of 2,3-DCA and 2-ME, Density (ρ), viscosity (η) and refractive index (n) of binary mixture liquid system of 2,3-DCA+2-ME at 20°C, 30°C,40°C and 50°C.

Mole Fraction X	ρ gm/cm ³				η CP				n			
	20°C	30°C	40°C	50°C	20°C	30°C	40°C	50°C	20°C	30°C	40°C	50°C
0.00000	0.9642	0.9566	0.9416	0.9226	2.14	1.34	1.25	1.15	1.4041	1.3962	1.3934	1.3882

0.08697	1.0818	1.0170	1.0060	1.0040	2.87	2.09	1.48	1.30	1.4407	1.4350	1.4302	1.4208
0.18185	1.0943	1.0694	1.0124	1.0098	3.32	2.42	1.74	1.45	1.4553	1.4480	1.4448	1.4323
0.28576	1.1214	1.1210	1.1196	1.0834	4.24	2.98	2.04	1.68	1.4813	1.4741	1.4669	1.4616
0.40006	1.2224	1.2220	1.2171	1.1243	5.21	3.52	2.33	1.90	1.5094	1.5031	1.4969	1.4886
0.52637	1.2456	1.2436	1.2316	1.2200	6.20	4.06	2.63	2.13	1.5342	1.5239	1.5114	1.5060
0.66672	1.3006	1.2750	1.2614	1.2516	7.09	4.55	2.96	2.38	1.5450	1.5430	1.5311	1.5273
0.82356	1.3406	1.3231	1.3141	1.3104	7.88	5.09	3.25	2.62	1.5700	1.5560	1.5480	1.5420
1.00000	1.3711	1.3684	1.3550	1.3345	8.01	5.82	3.74	2.99	1.5990	1.5910	1.5800	1.5630

meanwhile, the density values decreasing with the increase temperature at the same binary concentration. The viscosity values augment with the increasing mole fraction of 2,3-DCA over the whole concentration range, meanwhile, the viscosity values decrease with the increasing temperature at the same composition and this phenomenon is possibly caused by the weak hydrogen bonding interaction [10]. From above table viscosity values decrease gradually with increasing all temperature at the same concentration and they increase slowly increasing mole fraction of 2,3-DCA concentration at the same all temperature. The structural property of liquid and liquid mixtures can be integrated through refractive indices employing mole fractions. In general refraction increases with molecular weight for symmetric and asymmetric molecules. Refractive index depend on molecular weight and nature of liquids. It is observed from table1 that refractive index values decrease with increase of temperature from 323.15 K to 293.15 K.

III. CONCLUSION

The density, viscosity and refractive index of 2,3-DCA with 2-ME. The consequences of adding different amounts of 2,3-DCA and increasing the temperature were investigated. Through density, viscosity and refractive index measurements, it is established that both the increase in temperature and addition of 2,3-DCA lead to decreases in Columbic, hydrogen bonding and van der Waals interactions and hence to structural disorder in the ionic liquid. The results reflect the presence of strong intermolecular interactions in the mixtures under investigation. The stronger interaction in the binary mixture of 2,3-DCA with 2-ME may be due to the hydrogen bonding between $-NH_2$ groups in 2,3-DCA and $-OH$ group in 2-ME and $-NH_2$ group in aniline with the hydroxyl groups at the chain terminals of 2,3-DCA molecules. Dispersive forces are also acting in the 2,3DCA+2-ME mixtures.

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