STUDY OF PHYSICAL PROPERTIES OF NITROMETHANE +N-BUTANOL

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ABSTRACT

Physical properties like Densities and viscosities of the binary mixtures of NM (NITROMETHANE) with N- Butanol at 303. 15 K are measured. This data is used to calculate excess density, excess viscosity. The variation in magnitude of these quantities has been used to discuss the type and nature of binary interactions.

***Keywords**: Density, Viscosity, Binary Interaction, Excess parameters.*

1. INTRODUCTION

The physical properties like Density (ρ), viscosity (η) measurements finds many application in characterizing the physico-chemical behavior of liquid mixtures and in the study of molecular interaction. Such studies as a function of concentration are useful in gaining an insight into the structure and bonding of associated molecular complexes and other molecular processes. Further, they play an important role in many chemical reactions due to their ability to undergo self-association with manifold internal structures. [1-5]

The process of studying the molecular interaction from the variation of thermodynamic parameters and their properties such as Density, Viscosity and Excess values with composition of pure liquids and their binary liquid mixtures are very useful to understand the thermodynamic and transport properties associated with heat and fluid flow [7-12] that gives an insight into the molecular process. [6] This characterized behavior of the binary liquid mixtures have attracted the considerable attention because of their importance for both practical and theoretical point of view, since they are used in many application, such as liquid chromatography (HPLC), calorimetric, titration, pharmaceuticals etc.

The liquid Alcohols serve as simple example of biological and industrially important amphiphilic materials that exists in the liquid state, which is, be due to hydrogen bonding of their O-H group. (NITROMETHANE) is a furan ring without double bonds between abysses of the carbon atoms. It is the building block of the sugars ribose, deoxyribose, and fructose. NITROMETHANE is a five-membered cyclic ether. Its satirically unhindered oxygen atom carries two unshared pairs of electrons—one structure favors the formation of coordination complexes, and the other favors the solvation of cations. Both properties influence the rate, and therefore the selectivity of chemical reactions. As a reaction solvent, NITROMETHANE can be used in Grignard Reagent formation processes, pharmaceuticals, steroids, preparation of organometallic reagents.

This is the reason to select the NITROMETHANE as a solute and N- Butanol as a solvent. N- Butanol and general anesthetics are widely used drugs, but the mechanism of action of these compounds has remained uncertain despite intensive study. Biochemical and electrophysiological experiments have shown that these compounds alter the function of a large variety of receptors, ion channels, transporters and second messenger systems at physiological concentrations.

2. EXPERIMENTAL DETAILS

2.1 Chemicals- In the present system of NITROMETHANE + N- Butanol binary mixture, NITROMETHANE is being used of Analytical Reagent grade and is obtained from MERCK (99.99) and N- Butanol is of AR grade and is obtained from Changshu Yangyuan Chemical China (99.9). Both the liquids are used without further purification. The liquid mixtures of different composition were prepared by measuring appropriate volumes of each composition

2.2 Mixture Preparation- The liquid mixtures of different composition were prepared in air tight stopper bottles by measuring appropriate volumes of each component at atmospheric pressure.

2.3 Density Measurement- The Density measurements were carried out by portable Digital Density meter (DMA-35, Anton Paar) for pure liquids and binary mixture. This Digital Density meter uses the vibrating U-tube principle to calculate the Density of the sample. The required quantity of sample is approximately 2ml. (the temperature of the sample is controlled by environmental temperature around U-tube/sample cell). The measured values of pure liquids are found to be in good agreement with standard values. Accuracy of the instrument used is =0.0001 g/cm3. The instrument is calibrated by various pure liquids and found to be in good agreement with literature/standard values.

2.4 Viscosity Measurement- Viscosity of the sample in the present study were measured by using Brookfield Viscometer (Brookfield Viscometer, Model: LV DV-II+ Pro, Cone-plate Model with CPE-40 spindle).The required sample is very low in quantity (0.5ml). The device is calibrated using the doubly distilled water and other pure liquids of known viscosity at 250C/room temperature and found to be in good agreement with standard value from literature. The accuracy of the instrument is =0.01cP. The sample cell of the instrument is double walled, and electronically operated programmable constant temperature water bath is used to circulate water through the double walled measuring cell made up of steel containing the experimental liquid at the desired temperature.

The general formula for calculating the excess parameters is as given below

$$A^E = A_m - (x_1 M_1 + (1 - x_1) M_2)$$

Where, A^E is the excess parameter such as excess density x_1 mole fraction.

And the excess parameters are fitted by the Redlich-Kister polynomial equation [8] of third order and this equation is given by

$$A^E = x_1 x_2 \sum_{i=0}^{n} A_i (1 - 2x_2)^i$$

Where x_i is the mole fraction of pure component 1 and 2.

RESULT AND DISCUSSION

The Table 1 gives us details about Values of density, viscosity, velocity of NITROMETHANE +N-BUTANOL binary mixture at303.15 K

Table -1

Volume fraction of NM	Viscosity (cP)	Density (gm/cm3)
0.0	2.40	0.8023
0.10	1.43	0.8492
0.20	1.10	0.8783
0.30	1.06	0.8973
0.40	0.94	0.9220
0.50	0.69	0.9576
0.60	0.70	0.9978
0.70	0.67	1.0218
0.80	0.64	1.0421
0.90	0.62	1.0753
1.0	0.59	1.1229

As shown in table 1 as the concentration of NITROMETHANE increases viscosity decreases. As concentration of NITROMETHANE increases density increases It indicates the presence of intermolecular interactions in the system.

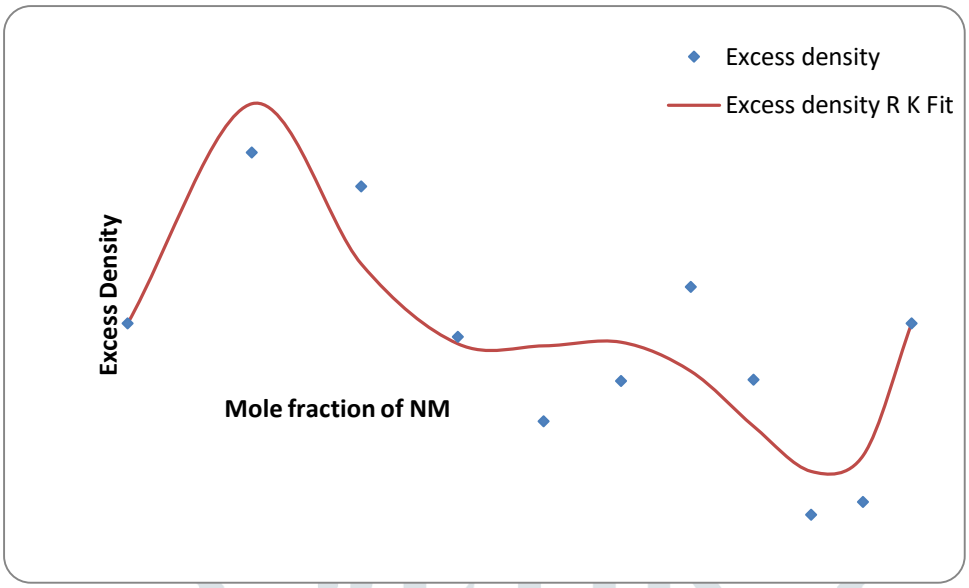

Fig 1 - Excess density of NM + butanol

Fig 1 shows positive deviation in excess density up to $X_{NM} = 0.4$ as concentration of NM increases excess density shows negative values. It indicates the presence of strong dispersive interactions in the system. It can be concluded that strong molecular interactions are found for all concentration in the system after mixing. Negative contribution arise from break up of interaction between molecules, rupture of hydrogen bonded chains and loosening of dipolar interactions

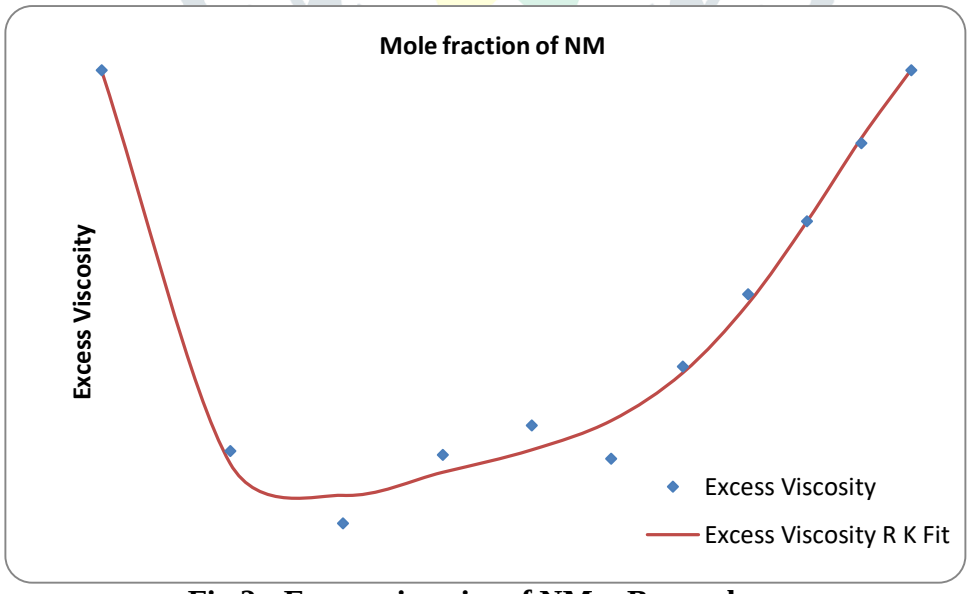

Fig 2 - Excess viscosity of NM + Butanol

Fig 2 shows negative values of excess viscosity Negative values of excess viscosity for mixture may be attributed to presence of weak dipole –dipole interaction due to predominance rupture of dipolar association. Dispersive forces and dipolar interaction are operating in negative deviation of viscosity. Negative values of viscosity suggest the existence of weak intermolecular interaction upon mixing.

CONSLUSION

In this study, the measurement of density, viscosity, of NITROMETHANE in n- Butanol solution was studied in different concentrations at 303.15K. The experimental data and contain valuable information regarding the solute-solvent interactions in the measurements, it can be concluded that the concentration of the NITROMETHANE affects the dipole interaction. In conclusion, the concentration, nature of the solvent, nature of the solute and its potion play an important role in determining the interactions occurring in the solutions.

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