Refractrometric study of binary liquid mixtures of triethyl amine with alcohols at 303.15K

Dhirendra Kr. Sharma, Akas Shukla

I. INTRODUCTION

One of the physical properties, which is applied now- a -days, is the refractive index of pure liquid and their mixtures for the study of interactions between the components. Refractive index is an optical property of a dielectric substance. Pandey *et. al (1-2)* have made refractive index measurements in liquid mixtures and have suggested that such studies are very much helpful for understanding of the molecular interaction in the components of the mixture. Owing to this, refractive index measurements are carried out in the present investigation. In the following section some theoretical aspects (3-4) of the refractive index have been discussed. Refractive index (or index of refraction) is a measure of the amount of refraction. It is the ratio of the wave length or phase velocity of an electromagnetic wave in a vacuum to that in the substance. It is also called as absolute index of refraction or absolute refractive index. It can be a function of wave length, temperature and pressure. If the substance is non-absorbing and non-magnetic at any wave length, then square of the index of refraction is equal to the dielectric constant at that wave length (5). When a light wave posses from one medium having refractive index, n_1 to another with n_2, the angle of incidence (i), and the angle of refraction (r), both measured with respect to the normal to the interface, are related by

$$\frac{Sin\ i}{Sin\ r} = \frac{n_1}{n_2} = Constant$$

which becomes, for a non-absorbing medium, the ratio of the indices of refraction. In the particular case that medium 2 is vacuum, (6) this ratio is the index of refraction of medium 1. This is the famous Snell's law. Sometimes, it is also defined as the ratio of the absolute indices of refraction of the two media.

II. WORKING OF ABBE REFRACTOMETER

A small amount of liquid is placed on the centre of the face of the measuring prism and the illuminating prism is slowly closed and tightened with the locking knob. Proper adjustments are made for optimum illumination of the field of view. The boundary between bright and dark, patches which can be seen through the eye piece is approximately focused by turning the large control knob. The boundary between bright and dark patches is made colourless and sharp by turning the upper compensator knob. The boundary line is next set with the large control knob exactly on the intersection of the cross wires and the scale reading for refractive index is taken.

III. EXPERIMENT

The binary system studied Triethylamine + Propanol, Triethylamine + Butanol. All the solvent were of CDH India Limited A. R. grade. All the chemicals were purified before use by fractional distillation over one meter long column collecting the middle fractions only. The purities of the chemicals were checked by densities measurement.

The sample were prepared in a rubber seal glass vials and the liquid were added with the help of syringe in order to avoid losses due to evaporation during sample preparation. The weighing was done using electrical single pan analytical balance with an accuracy of ±1.0 x 10^{-8}kg.

Refractive indicies of pure liquids and liquid mixtures measured by an Abbe Refractometer model R-8 (M/s Mittar Enterprises, New Delhi). The Refractive index was measured directly up to three decimal places & the four decimal places were estimated with the accuracy of ±0.0002. Temperature of the sample was kept constant at 303.15 K (± 0.03 K) by circulating water from a thermostat with the help of pump through the prism boxes of the refractometer. Observation of refractive indices of liquid were made after attainment of constant temperature. An average of four measurement for each sample was taken.

Table-1 : Mole fraction (x_1), density (ρ), Refractive index (n_{exp}) and Excess Refractive index (n^E) of the binary system Tetraethylamine and propanol at 303.15K.

S. No.	X_1	Density (ρ)	Refractive index (n_{exp})	Excess Refractive index (n^E)
1.	0.0000	0.9070	1.3818	-
2.	0.1098	0.757	1.3830	-0.42
3.	0.2173	0.753	1.3879	-0.46
4.	0.3225	0.749	1.3901	-0.52
5.	0.4255	0.745	1.3956	-0.58
6.	0.5264	0.743	1.3987	-0.62
7.	0.6250	0.740	1.3996	-0.78
8.	0.7216	0.737	1.4001	-0.86
9.	0.8164	0.732	1.4003	-0.89
10.	0.9091	0.729	1.4007	-0.92
11.	1.0000	0.719	1.4010	-

Manuscript received March 01, 2016
Dhirendra Kr. Sharma, Department of Chemistry, Bundelkhand University, Jhansi (U.P.)
Akas Shukla, Department of Chemistry, Bundelkhand University, Jhansi (U.P.)

Table-2: Mole fraction (x_1), density (ρ), Refractive index (n_{exp}) and Excess Refractive index (n^E) of the binary system Tetraethylamine and butanol at 303.15K.

S. No.	X_1	Density (ρ)	Refractive index (n_{exp})	Excess Refractive index (n^E)
1.	0.0000	0.8025	1.3950	-
2.	0.1240	0.7964	1.3963	-0.98
3.	0.2184	0.7856	1.3971	-1.26
4.	0.3239	0.7724	1.3980	-1.38
5.	0.4269	0.767	1.3995	-1.58
6.	0.5279	0.758	1.4002	-1.78
7.	0.6265	0.749	1.4003	-2.21
8.	0.7231	0.742	1.4006	-2.35
9.	0.8174	0.737	1.4007	-2.40
10.	0.9102	0.728	1.4008	-2.36
11.	1.0000	0.719	1.4010	-

IV. RESULT AND DISCUSSION

The experimental values of refractive indices (n_{12}) at 303.15 K with mole fraction of triethylamine + Propanol and triethylamine + Butanol are reported in table 1 and 2 respectively.

Perusual of table 1 & 2 (triethylamine +Propanol and triethylamine + Butanol) shows that the experimental refractive indices increase with increase in mole fraction of triethylamine with the binary mixture of primary alcohol.

Table 1 & 2 shows that the experimental refractive indices increase with the increase in mole fraction of triethylamine with the binary mixtures of propanol and butanol. Perusal tables 1 & 2 shows that the experimental refractive indices increase with increase mole fraction of triethylamine with the binary mixture of propanol and butanol.

Values of excess refractive indices (n^E) for all the system studied are evaluated using experimental values of refractive indices for pure liquids and liquids mixtures employing following equation.

$$n^E = n_{12} - (n_1x_1 + n_2x_2)$$

Where n_{12} and $n_1x_1 + n_2x_2$ are refractive indices for actual binary mixtures and ideal binary mixtures respectively. Some workers (7-9) have defined n_{ideal} on a volume fraction basis. However, many have to define (10) on mole fractions basis given below as in the present work.

$$n_{ideal} = n_1x_1 + n_2x_2$$

Where x_1, x_2 and n_1, n_2 are the mole fraction and refractive indices of the component 1 and 2 respectively. Values of excess refractive indices n^E with mole fraction of binary mixture of triethylamine + Propanol and triethylamine + butanol studied at experimental temperature are also recorded in table 1 & 2 respectively.

The values of excess refractive indices for binary mixture of triethylamine + Propanol and triethylamine + butanol are negative shows in table 1 & 2 reported that strong intermolecular interactions between them

The binary mixture of triethylamine + Propanol and triethylamine+ butanol have negative values of excess refractive indices shown in table 1 & 2 reported strong intermolecular interactions between them.

Moreover it's negative value (11) has increased with increase in mole fraction of first named component. These values are indications of stronger molecular interaction in the system I as compared to the system II.The negative deviations of high magnitude lead to the unstable complex formation between the hetromolecules of the mixtures. In the present study the negative excess refractive indices indicate the breaking the hydrogen bond of alcohol polymer, as alcohol is diluted with triethylamine and association between unlike molecules causing concentration with increasing concentration of triethylamine.

On the basis of the above it may be inferred that excess refractive indecies for the binary system studied in the present investigation is governed by the unlike interaction between the components. It may also be concluded that there is graded interaction between the components of binary mixtures as one either from propanol to butanol.

REFERENCES

[1] Pandey J.D and Gupta U, Z physik chernie (Leipzig) 268 (1987) 477.

[2] Pandey, J.D., Shukla, A.K., Shukla, R.K. and Rai, R.D., Indian J. Chem., **27 A** (1908) J36.

[3] A Pineiro, P. Brocos, A. Amigo, M. Pintos and Bravo, R., J. Chem. Thermodyn., **31** (1999) 931.

[4] Segade,L. deLlano, J.J., Dominguez-Perez, M., Cabeza,O. Cabanas, M., and Jimenez, E. J. Chem. Eng. Data, **48 (5)** (2003) 1251.

[5] Rodriguez, A., Canoa, J. and Tojo, J., J. Chem. Eng. Data, **46 (6)** (2001) 1476.

[6] J. M. Resa, C. Gonzaleg, S. O. Landaluce and J. Lanz, J. Chem. Eng. Data, **47 (3)** (2002) 435.

[7] R·. Francesconi, A. Bigi and F. Comelli, J. Chern. Eng. Data, **50 (4)** (2005) 1404.

[8] J. Acosta, A. Arce, E. Rodil and A. Soto, J. Chern. Eng. Data, **46 (5)** (2001) l176.

[9] R. Peilam and J K. Galt, J. Chern. Phys., **14** (1946) 608.

[10] F. Comelli, S. Ottani R. Francesconi and C. Castellari, J. Chern. Eng. Data, **47 (1)** (2002) 93.

[11] U. Bharadwaj, K. C. Singh and S. Maken, Indian J. Chem., **36 A** (1997) 1046.