Volume: 2, Issue: 5, 412-413
May 2015
www.allsubjectjournal.com
e-ISSN: 2349-4182
p-ISSN: 2349-5979
Impact Factor: 3.762

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Surface tension and refractive index of binary mixture of 1-propanol + ethanol at various volume compositions at 313.15k

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Abstract
The studies of, refractive indices and surface tension are being increasingly used as tools for investigation of the properties of pure components and the nature of intermolecular interactions between the liquid mixture constituents. Refractive indices (n_D and surface tension (σ) have been measured for the ternary liquid mixture of 1-propanol + ethanol over the entire composition range at 313.15 K. Both refractive index and surface tension increased linearly with increase in 1-propanol added to ethanol.

Keywords: Refractive index, Surface tension, Binary mixtures, Alcohols

Introduction
Measurements of physico-chemical properties such as density, vtscosity, surface tension, refractive index and ultrasonic velocity of pure components and their mixtures are being increasingly used as tools for investigations of the properties of pure components and the nature of intermolecular interactions between the components of liquid mixtures (Maurya et al, 2013). Liquid mixtures due to their unusual behavior have attracted considerable attention.Data on some of the properties associated with the liquids and liquid mixtures like refractive index, ultrasonic velocities and surface tension find extensive application in chemical engineering process simulation, solution theory and molecular dynamics (Baskaran and Kubendran, 2008).
Alcohols are polar liquids strongly self-associated by hydrogen bonding to the extent of polymerization that may differ depending on temperature, chain length and position of the OH group and dilution by other substances. As hexane is a nonpolar chain molecule, the alcohol molecules associate with hexane medium and form clusters, (Vasantharani et al, 2009). These properties are important from practical and theoretical point of view to understand liquid theory. The review of literature on thermophysical studies of solutions reveals that these measurements are used to estimate the different elastic properties of the molecule from which the type of molecular interactions can be very well be understood.
In this study a report of refractive index and surface tension of pure 1-propanol and ethanol and as well as for the ternary system constituted by these two alcohols at temperatures of 313.15K is presented

2. Materials and Method
The 1-propanol and ethanol used were of analytical grade and obtained from Yola laboratories. All the components were dried over anhydrous potassium carbonate and fractionally distilled. Different volumes of 1-propanol were added to a fixed volume of ethanol and each experimented. A thermostatically controlled well-stirred water bath whose temperature was controlled to ±0.01 K accuracy was used for all the measurements. All the measurements were done by using electronic balance accurate to 0.02 g. The possible uncertainty in the volume fraction was estimated to be less than ±0.0001.
Refractive indices were measured using thermostatically controlled Abbe refractometer with an accuracy less than 0.0001units.Water was circulated in to the prism of the refractometer by a circulation pump connected to an external thermostatic water bath. Calibration was performed by measuring the refractive indices of doubly distilled water and propyl alcohol at defined temperatures (Baskaran and Kubendran, 2008).
Surface tension of pure liquids and binary mixtures over the whole composition range was determined using Interfacial tensiometer (ASTM D.971) with 1No. 4cm platinum ring as

per IS 6104.. It was calibrated with distilled water. The accuracy of the surface tension measurement was estimated to be 0.03mNm$^{-1.}$ (Baskaran and Kubendran, 2008).

3. Results and Discussion

The measured, refractive indices (n_D), and surface tension (σ) for the binary liquid mixture of 1-propanol and ethanol over the entire volume composition range at 313.15 K have been presented in Table 1.

Table: 1 Refractive Index (n_D) and Surface Tension (σ) Nm^{-1} of 1-propanol + ethanol at various volume compositions

(v/v) x 100	n_D	σ (Nm^{-1})
10	1.5456	17.02
20	1.5567	25.36
30	1.5678	33.48
40	1.5779	41.28
50	1.5886	49.56
60	1.5978	57.48
70	1.6085	65.62
80	1.6185	73.34
90	1.6274	80.16
100	1.6366	88.19

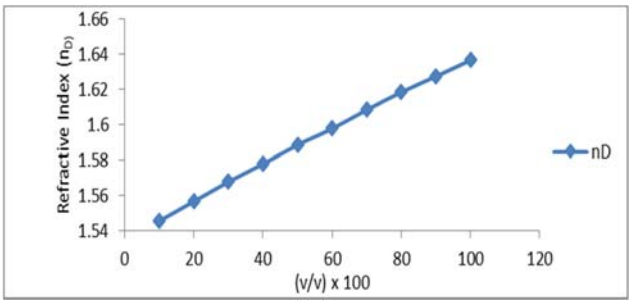

Fig: 1 Variation of refractive index, **(n_D)** with volume composition, (v_1 /v_2) x 100

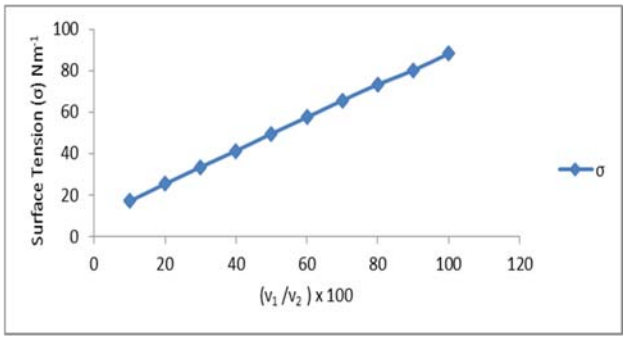

Fig: 2 Variation of surface tension **(σ)** with volume composition, (v_1 /v_2) x 100

From Table 1 or Figures 1 & 2, the refractive index, and surface tension values
increase linearly with the volume composition of 1-propanol and ethanol. This means that interaction in the mixture is not strong and hence increases.

4. Conclusion

Experimental data of the refractive index and surface tension of 1-propanol and ethanol mixture have been measured at 313.15 K. The study showed that both refractive and surface tension of the binary mixture increased with increase in volume of 1-propanol added to ethanol.

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