Applications of Nonlinear Models to Measure and Predict Thermo Physical Properties of Binary Liquid Mixture1, 4 Dioxane with Bromo benzene at Various Temperatures

R.Ramesh[1], M. Y. M. Yunus[2], K.Ramesh[†1]

Abstract—The study conducted in this research are Viscosities, η, and Densities ρ, of 1, 4-dioxane with Bromo benzene at different mole fractions and various temperatures in the atmospheric pressure condition. From experimentations excess volumes, V^E, and deviations in viscosities, %η, of mixtures at infinite dilutions have been obtained. The measured systems exhibited positive values of VmE and negative values of %η. The binary mixture 1, 4 dioxane + Bromobenzene show positive V^E and negative %η with increasing temperatures. The outcomes clearly indicate that weak interactions present in mixture. It is mainly because of number and position of methyl groups exist in these aromatic hydrocarbons. These measured data tailored to the nonlinear models to derive the binary coefficients. Standard deviations have been considered between the fitted outcomes and the calculated data is helpful deliberate mixing behavior of the binary mixtures. It can conclude that in our cases, the data found with the values correlated by the corresponding models very well. The molecular interactions existing between the components and comparison of liquid mixtures were also discussed.

Keywords— 1,4dioxane, Bromobenzene, Density, Excess molar volume, Viscosity, Viscosity deviation, Oswald viscometer and Oswald-Sprengel Pyknometer

I. Introduction

THIS Measurements and predictions in chemical design and effective chemical process optimization, the molecular interactions existing in process fluids and thermo physical properties like Densities and viscosities playing key role. These two are essential for engineering designs involving chemical separations, heat transfer, mass transfer, and fluid flow and important from practical and theoretical points of view for understanding liquid theory.1 1, 4-dioxane commonly known as excellent aprotic solvent, has a dipole movement is zero. In polymerization and other chemical reactions it was used commercially like cleaning of polymer surfaces and electronic materials. The aromatic hydrocarbon molecules possess a large quadruple moment, which causes an orientational order in these liquids. The orientational order is thought of as a partial alignment of neighboring segments or possibly of whole molecules. Also, binary mixtures containing aromatic hydrocarbons are interesting because they have applications in the study of polymer phase diagrams and the preferential interaction of polymers in mixed solvents. 1, 4-dioxane is cyclic ether that has electron-donor ability toward the aromatic rings that act like weak electron acceptors. Therefore, the 1, 4-dioxane+aromatic hydrocarbon mixtures will be interesting because they involve charge-transfer interactions that may be influenced by the presence of alkyl groups on the ring. Other uses of 1,4-dioxane include the manufacture of adhesives, cements, deodorant fumigants, cosmetics, drugs, cleaning preparations, magnetic tape, plastic, rubber, insecticides, and herbicides, and as a chemical intermediate. As a polymerization catalyst, in the purification of drugs, and 1,4dioxane has low toxicity to aquatic organisms, toxicity values are greater than 100 mg/L. 1, 4-dioxane is not likely to be acutely toxic. The entire range of composition was studied at T = (303.15 to 313.15) K. With this data, the excess molar volume and deviation in viscosity have been computed. These results have been fitted to the Redlich-Kister, K-Laddha, Jouyban - Acree model and Grunberg Nissan polynomial equations. McAllister's three-body model is used to correlate the kinematic viscosities of these binary mixtures.[2] this analysis technique to derive the binary coefficients and to estimate the standard deviation (σ) between experimental and calculated data.

R. Ramesh, M. Y. M. Yunus and K.Ramesh are with the Process Systems Engineering group (PSEG, Faculty of Chemical Engineering & Natural Resources Engineering, Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia. ([†]Corresponding author to provide Phone : +609549 2855, Fax: +609549 2889; e-mail: ramesh@ump.edu.my)

II. Experimental Section

A. Materials:

1,4dioxane, Bromobenzene this were all supplied by M/s E.Merck Ltd. With stated purities of better than 99 % were stored over molecular sieves (0.3 nm). 1, 4 Dioxane with a purity of 99 % was provided by Sigma-Aldrich Chemicals and was used without further purification. To minimize the contact of these reagents with moist air, the products were kept in sealed bottles in a desiccator. The purity of the substances was determined by GLC. Densities and viscosities of pure substances and their comparison with literature values are listed in Table 1.[1–4]