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EXPERIMENTAL AND NUMERICAL INVESTIGATION ON THERMOPHYSICAL PROPERTIES OF HYDROCARBON LIQUID MIXTURES USING KRISHNAN-LADDHA AND JOUYBAN-ACREE MODELS AT VARIOUS TEMPERATURES

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ABSTRACT
The thermophysical properties such as density and viscosity of binary liquid mixtures were determined experimentally over the entire composition range at 303.15K, 308.15K and 313.15K. The experimentally determined thermophysical properties of the binary liquid mixtures were used to calculate the excess molar volume V^E and viscosity deviations $\Delta\eta$ with two hydrocarbons bromobenzene and ethylbenzene. The excess thermophysical properties of liquid mixtures provide additional information regarding molecular interactions. The calculated excess volumes, V^E and deviations in viscosities, $\Delta\eta$ exhibited positive and negative values respectively over the whole range of composition in both binary systems. The Krishnan-Laddha and Jouyban-Acree Models were used to correlate deviations in viscosities, $\Delta\eta$, to derive the binary coefficients and standard deviations of these systems. The fitted outcomes and the calculated data clearly indicated that weak interactions present in two mixtures. It is mainly because of the number and position of methyl groups existing in these aromatic hydrocarbons. It can be concluded that the data found with the values fitted by the corresponding Krishnan-Laddha and Jouyban-Acree models gives high degree of precision.

Keywords: Krishnan-Laddha Model • Jouyban-Acree Model • Viscosity measurement •

INTRODUCTION
The quantitative viscosity and density data of liquid mixtures are required to solve many engineering problems, involve in chemical separations, heat transfer, mass transfer, and fluid flow. They are important from practical and theoretical points of view, especially for understanding liquid theory. The low polarity of 1,4 Dioxane is interesting to be studied with hydrocarbon mixtures, for the type of interaction between the components of binary systems. 1,4 Dioxane commonly known as excellent aprotic solvent, has a zero dipole movement and cyclic ether that has an electron donor ability towards aromatic rings, it act like weak electron acceptors. 1, 4Dioxane is used as a stabilizer in aluminium containers and solvent in inks and adhesives. There are few reports on density and viscosity data of 1, 4 Dioxane with hydrocarbon mixtures (Martin, 2001 and Ramesh et al., 2014). In our earlier paper, we had studied thermo physical properties of binary systems (Ramesh et al., 2014) . In the present paper, it has been reported density (ρ) and viscosity (η) of pure 1, 4 Dioxane, Bromobenzene and Ethylbenzene for the binary system constituted by these two chemicals at entire range of composition and temperature 303.15K to 313.15K. With this data, the excess molar volume and deviation in viscosity have been computed. These results have been fitted to the Krishnan-Laddha and Jouyban-Acree models and polynomial equations. The Krishnan-Laddha and Jouyban-Acree models were used to correlate the viscosity and deviations in viscosities, $\Delta\eta$. This analysis technique was used to derive the binary coefficients and estimate the standard deviation (σ) between the experimental and calculated data (Redlich, 1948) . The variation of these parameters with the composition and temperature of the mixtures has been discussed in terms of the molecular interactions in these mixtures. The effect of the number and position of the methyl groups in these aromatic hydrocarbons on molecular interactions in these mixtures has also been discussed. A literature search showed that no measurements have been previously reported by using Krishnan-Laddha and Jouyban-Acree models for the mixtures studied in this paper.

EXPERIMENTAL SECTION

Materials
Bromobenzene and Ethylbenzene were supplied by M/s E.Merck Ltd, with the stated purities better than 99 %, were stored over molecular sieves (0.3 nm). 1, 4 Dioxane with purity of 99 % was provided by Sigma-Aldrich chemicals and it 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 densities and viscosities of pure substances and experimental values comparison with literature values are listed in Table 1 (Martin, 2001, Ramesh et al., 2014, Jouyban, 2005 and Redlich, 1948)