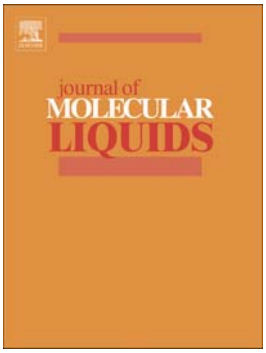

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A STUDY OF VISCOMETRIC, OPTICAL AND INTERFACIAL PROPERTIES OF BINARY AND TERNARY LIQUID MIXTURES

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Abstract

Transport, optical and interfacial (surface tension) properties , have been evaluated for ternary system(2-propanol + tetrahydropyran + 2,2,4 trimethylpentane) and its constituent binaries at 4 different temperatures ranging between 293.15 and 323.15 K. Viscosity, an important transport property, has been computed by employing 15 approaches. Refractive index, an optical and transport property of due significance has also been evaluated using 10 approaches. Surface Tension, an interfacial property, has also been computed by five different models. . A new approach has been put to test for predicting refractive index and surface tension ,for the first time, for binary systems and has been extended for ternary system under investigation. The obtained results have been compared with the predictive and correlative approaches by taking absolute average percentage deviation (AAPD) as the criterion. Further, excess Gibbs free energy of activation of viscous flow(ΔG^{*E}) and excess coefficient of thermal expansion (α^{E}) have also been elucidated to predict the nature of interactions for all the four systems to get a better understanding of the various intermolecular interactions taking place thereof. The present investigation attempts to develop a universal equation for evaluation of thermophysical properties.

Keywords: viscosity, refractive index, surface tension, ternary, excess**.**

1. INTRODUCTION

Analysis and study of thermophysical properties encompassing transport, optical and interfacial properties in terms of interpretive, predictive or correlative models constitute a comprehensive and constructive pathway to interpret the nature and extent of molecular interaction in the binary and higher order liquid mixtures through correlation between the molecular structure and macroscopic properties of liquid state mixtures. Literature survey indicates numerous investigations related to determination of the viscometric, refractive index and surface tension properties on an individual basis [1-4], however very few studies [5] are seen to provide a comprehensive data pertaining to all the above mentioned parameter.

The present investigation attempts to evaluate all the aforementioned properties employing wide variety of empirical, semi-empirical, predictive and correlative approaches. The efficacy and capability of some of the standard and commonly used, few uncommon and some scarcely used models have been tested, to predict the behaviour and extent of interactions in liquid mixtures. The present work is also an attempt to develop a global equation for evaluating various transport (viscosity, thermal conductivity etc.) optical (refractive index), interfacial (surface tension) and allied properties.

Viscosity of pure liquids and liquid mixtures constitutes an important property for hydraulic calculations, pipeline systems etc. in chemical and petroleum industries [6]. There are numerous models for prediction of viscosity in literature ranging from empirical to purely theoretical[7-22]. For the present investigation, fifteen models for evaluating viscosity, comprising of empirical, semi-empirical, correlative and predictive approaches have been put to test. Some of the predictive models employed are Bingham, Frenkel, Kendall-Munroe, Hind-Ubbelhode, Eyring, Additive and Sutherland–Wassiljewa [7-12] relations. Six correlative methods have also been employed viz., Hind [9, 13-14], Grunberg-Nissan [15], Katti-Chaudhri, Tamura-Kurata [16-18], McAllister 3 body [19] and 4 body [20-21] approach. Furthermore, a modified McAllister relation pioneered by Nhaesi- Asfour [22] has also been tested. This model employs a method for calculating values of the binary