

ORIGINAL PAPER

Thermodynamic properties of dimethyl phthalate + vinyl acetate, diethyl phthalate + vinyl acetate or bromocyclohexane, and dibutyl phthalate + vinyl acetate or 1,2-dichlorobenzene at $T = 298.15\text{--}308.15\text{ K}$

^aAbbas Mossazadeh Rostamkolahi, ^aAbbas Ali Rostami, ^bFardad Koohyar*, ^cFarhoush Kiani

^aFaculty of Chemistry, University of Mazandaran, 47416-95447, Babolsar, Iran

^bDepartment of Chemistry, Faculty of Science, Babol Branch, Islamic Azad University, 47188-33348, Babol, Iran

^cDepartment of Chemistry, Faculty of Science, Ayatollah Amoli Branch, Islamic Azad University, P.O. Box 678, Amol, Iran

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Thermodynamic properties (densities and viscosities) of binary mixtures of diethyl phthalate (DEP) + bromocyclohexane, dibutyl phthalate (DBP) + 1,2-dichlorobenzene, and vinyl acetate (1) + dimethyl phthalate (DMP) (2), + diethyl phthalate (2), or + dibutyl phthalate (2) were measured over the whole range of mole fractions at atmospheric pressure and different temperatures ($T = 298.15\text{ K}$ to 308.15 K). For these mixtures, their excess molar volumes (V^E) and viscosity deviations ($\Delta\eta$) were calculated from the experimental data. These results were correlated with the Redlich–Kister polynomial equation to derive the coefficients and standard errors.

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Keywords: viscosity, refractive index, density, Redlich–Kister equation, excess molar volumes, viscosities deviation

Introduction

Density (ρ) and viscosity (η) of liquid mixtures are necessary for the design of new processes on industrial scale (Koohyar et al., 2011). Also, these data are needed in most engineering calculations where fluid flow or mixing play an important role. Experimental data of densities and viscosities of a binary liquid system are especially important for the understanding of the liquid theory. Furthermore, knowledge of the dependence of densities and viscosities of liquid systems on their composition is of great interest from a theoretical viewpoint since it may lead to better utilization of the fundamental behavior of liquid mixtures.

Esters are one of the industrially significant classes of organic liquids due to their wide applications in flavoring, perfumery, sophisticated essences, and cosmet-

ics. Also, esters are used in medical and paint industries as solvents and in plastic industry as plasticizers. Experimental data of the densities and viscosities of binary liquid systems containing esters are applicable in pharmaceuticals and specialty chemicals.

Dimethyl phthalate, diethyl phthalate, and dibutyl phthalate are organic solvents applied in various fields of industry (Weast, 1978). Diethyl phthalate is often used to bind cosmetics and fragrances (Api, 2001). Its other industrial uses include plasticizers, detergent bases, and aerosol sprays (Ghorpade et al., 2002). Because of the frequent dermal exposure of humans to the compound, the question of toxicity is crucial. Several studies suggest that DEP can cause damage to the nervous system as well as to the reproductive organs in males and females (Miodovnik et al., 2011; Colón et al., 2000; Swan, 2008). Dimethyl phthalate is an ec-

*Corresponding author, e-mail: FardadKoohyar@yahoo.com