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Densities and Viscosities for Binary and Ternary Mixtures of Benzene + Cyclohexane and + N,N-Dimethyl acetamide at Temperature of 298.15 K

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ABSTRACT

Densities, viscosities and derived properties for binary and ternary mixtures consist of Benzene, Cyclohexane and N,N-Dimethyl acetamide were measured at temperatures of 298.15 K in the whole range of mole fractions. The measured data and calculated values of all systems are in good agreement with literature and Redlich-Kister and the Cibulka equations.

Keywords: Density; Viscosity; Excess molar volume; N,N-Dimethyl acetamide

1. Introduction

Thermodynamic and transport properties are essential in process design and operation. Density and viscosity of the multicomponent mixtures are required in many chemical engineering calculations involving fluid flow, heat, and mass transfer [1]. The experimental data of excess thermodynamic properties of the liquid mixtures provide useful information about molecular interactions. Excess molar volumes (VE), deviations in the viscosity (Δη) for the mixtures were derived from the experimental data. Theexperimental

results are considered to talk about the strength of intermolecular interactions between the components of the systems.

2. Experimental

Chemicals are supplied by Merck with purity higher than 99% .The mixtures were prepared by weighing pure liquids into stoppered bottles to prevent evaporation and reducing possible errors in mole fraction calculation. The densities were measured with digital densitometer and viscosities were measured with an Ubbelohde viscometer. The apparatus was frequently calibrated by known pure liquid viscosity and density. The uncertainty in the mole fraction is estimated to be lower than $\pm 10^{-4}$.

3. Results and discussion

Dynamic viscosities and viscosity deviations were calculated from the following equation:

$$\eta = \eta_{water} \frac{\rho \times t}{\rho_{water} \times t_{water}} \Delta\eta = \eta - \sum_{i=1}^{N} X_i \eta_i$$

Where η_{water}, ρ_{water} and t_{water} refers to viscosity, density and efflux time of pure water respectively.

The excess molar volumes (V^E) were calculated from density data by:

$$V^E = \sum_{i=1}^{N} X_i M_i \left(\frac{1}{\rho} - \frac{1}{\rho_i}\right)$$

.The mixing functions V^E, $\Delta\eta$were represented mathematically by the Redlich-Kister [2] equation for correlating the experimental data:

$$\Delta Q_{ij} = X_i X_j \sum_{i=1}^{N} A_k \left(X_j - X_i\right)^k$$

.Derived data (V^E, $\Delta\eta$) for the ternary system were correlated, respectively, using the

equation:

$$.\Delta Q_{123} = \Delta Q_{bin} + X_1 X_2 X_3 \Delta_{123}$$

$$\Delta Q_{bin} = \sum_{i=1}^{3} \sum_{j>1}^{3} \Delta Q_{ij}$$

Where ΔQ_{123} refers to V^E, $\Delta\eta$ for the ternary mixtures. The ternary contribution term Δ_{123} was correlated using the expression suggested by Cibulka [3]:

$$.\Delta_{123} = B_0 + B_1 X_1 + B_2 X_2$$

Where the ternary parameters B_0, B_1, and B_2 were determined with an optimization algorithm similar to that for the binary parameters.

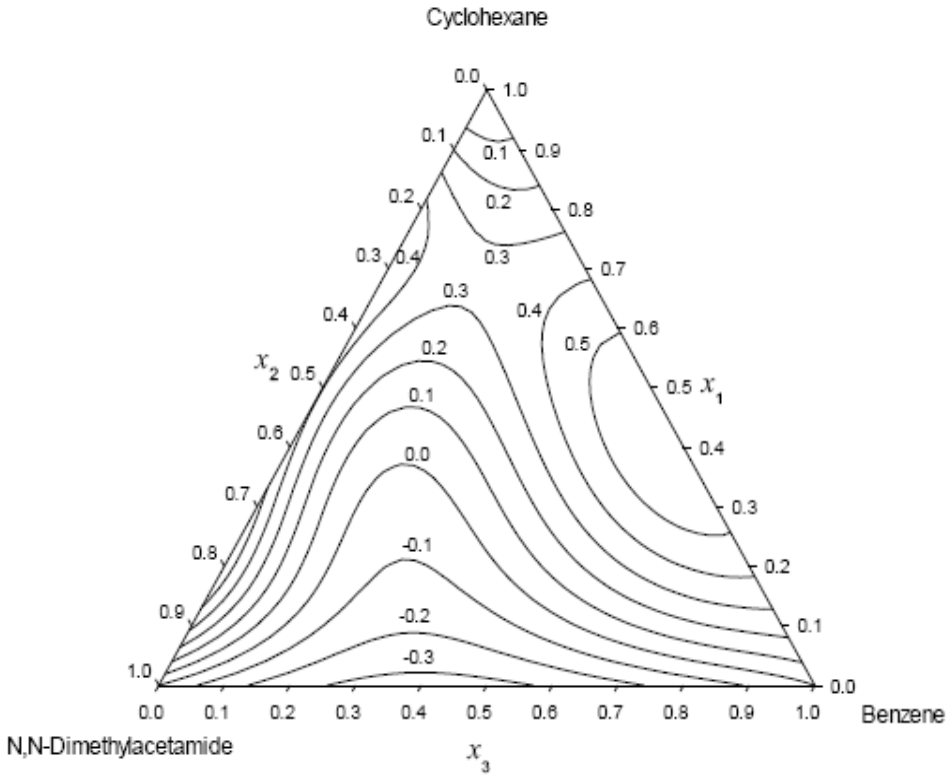

Fig. 1: Curves of $V^E/cm^3.mol^{-1}$ for the ternary system Benzene(1) + Cyclohexane (2) + N,N-Dimethylacetamide (3) at 298.18

4. Conclusions

Densities, viscosities and derived properties for binary and ternary mixtures consist of Benzene, Cyclohexane and N,N-Dimethyl acetamide were measured at temperatures of 298.15 K in the whole range of mole fractions. The measured data and calculated values of all systems are in good agreement with literature and Redlich-Kister and the Cibulka equations.

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