Refractive Indexes, Viscosities, Densities at 303.15K, 313.15K, 323.15K and \( b_H \) at Differents mole fraction for Ternary System of L-Systeine hydrochloride monohydrate + D- Sorbitol + Water

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Introduction

Studies on the phase equilibria and excess properties of liquid mixtures are of considerable importance for the design of separation processes and theoretical understanding of the nature of molecular interaction [1]. Many investigations have already been carried out for binary mixtures, while that of ternary mixtures are not easily available in the literature. It is therefore interesting to estimate excess properties of ternary mixtures from their subbinary data [2-4].

The experimental excess molar volumes and viscosity deviations were correlated using the Redlich-Kister polynomial equation and the Cibulka equation for the binary and ternary system, respectively.

For the ternary system, the measured excess molar volumes and viscosity deviations were compared with the predicted values using several estimation methods of binary contribution with constituent binary Redlich-Kister fitting parameters.

Experimental Section

Material. D-Sorbitol and L-Cysteine hydrochloride monohydrate were purchase from Merck Co. They are used without further purification.

Apparatus and Procedure. Densities were measured using a digital vibrating glass tube densimeter (DA-500E, China.). Excess molar volumes were calculated with the uncertainty of \( \pm 1 \times 10^{-4} \) cm\(^3\).
Viscosity deviation (Oy) values of the mixture samples were calculated from the viscosities (y) that are experimentally measured. The viscosity (y) of the pure components and mixtures were determined from the kinematic viscosities (u) measured using an Ubbelhode viscometer with automatic measuring unit (SCHOTT, AVS 400, Germany). The uncertainty of the time measurement in the viscosimeter is ±0.01s.

Table 1. Refraction indexes, Densities, Viscosities at 303.15K and bH at eight mole fraction for ternary system of L-Cysteine hydrochlorid monohydrate+D-Sorbitol+Water

<table>
<thead>
<tr>
<th>Mole fraction</th>
<th>0.0121</th>
<th>0.0270</th>
<th>0.0459</th>
<th>0.0574</th>
<th>0.0706</th>
<th>0.0862</th>
<th>0.1264</th>
<th>0.1533</th>
</tr>
</thead>
<tbody>
<tr>
<td>(mPa.s) y</td>
<td>1.1954</td>
<td>1.4963</td>
<td>1.9953</td>
<td>2.4213</td>
<td>2.9027</td>
<td>3.6886</td>
<td>7.6823</td>
<td>10.5878</td>
</tr>
<tr>
<td>(g. cm$^{-3}$ ) q</td>
<td>1.0555</td>
<td>1.0912</td>
<td>1.1311</td>
<td>1.1550</td>
<td>1.1703</td>
<td>1.1939</td>
<td>1.2381</td>
<td>1.2077</td>
</tr>
<tr>
<td>(-----) n</td>
<td>1.3595</td>
<td>1.3780</td>
<td>1.3970</td>
<td>1.4080</td>
<td>1.4180</td>
<td>1.4295</td>
<td>1.4540</td>
<td>1.4640</td>
</tr>
</tbody>
</table>

Results and Discussion

For the ternary system, excess volume and viscosity deviation data were correlated with following Cibulka equation as a modification of the Radojkovic equation (eq 10):

$$M_{123}^E = M_{12}^E + M_{23}^E M_{13}^E + x_1 x_2 x_3 (A_1 + A_2 x_1 + A_3 x_2)$$

Where $M_{kl}^E$, $M_{kl}^E$ and $M_{kl}^E$ represent the excess properties calculated from binary Redlich-Kister parameters and $x_1$, $x_2$ and $x_3$ are mole fractions in the ternary mixture. The Enthalpy (OH) is obtained from slope of curve of Ln y verus T$^{-1}$

$$\text{Ln } y = \text{Ln } A + \text{OH } (RT)^{-1} \quad \text{and } R= 8.314 \text{ J.mole}^{-1}.\text{K}^{-1}$$

$(X=0.0121): Y=1873.6X-6.0131 \quad \&(X=0.0270): Y=1950.4X-6.0363$

$(X=0.0459): Y=2081.9X-6.1806 \quad \&(X=0.0574): Y=2169.8X-6.2799$

$(X=0.0706): Y=2237.8X-6.2218 \quad \&(X=0.0862): Y=2379X-6.5462$
Figure 1. Curve of Ln y versus T⁻¹ at six mole fraction from ternary system of L-Cysteine hydrochloride monohydrate + D-Sorbitol + Water

References

4. Postigo, M.; Mariano, A.; Mussari, L.; Camacho, A.; Urieta, J. Excess molar volume and viscosity study for the ternary system tetrahydrofuran (1) + 1-chlorobutane (2) + 1-butanol (3) at 283.15, 298.15 and 313.15 K. Fluid Phase Equilib. 2003, 207, 193-207.