ISOBARIC VAPOUR LIQUID EQUILIBRIUM
OF DI (iso) PROPYL ETHER–n. HEPTANE SYSTEM

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ABSTRACT

Vapour liquid equilibrium data for the system di (iso) propyl ether–n. heptane are reported. The system is found to be an ideal one.

Vapour liquid equilibrium data for the system di (iso) propyl ether–n. heptane are not available in the literature. Hence the system has been studied under isobaric conditions at 684 ± 2.5 mm of Hg.

EXPERIMENTAL

The equilibrium still used has been described earlier and is a modified Ellis and Garbett still. Since the system is a miscible one, the still is operated without stirrers for three hours to attain equilibrium and samples are drawn for analysis.

Di (iso) propyl ether of BDH laboratory reagent quality and n-heptane of Merck laboratory reagent grade are used. The density and refractive index of reagents used and also the literature values are given in table I. Samples are analysed by the determination of refractive index using Abbe's refractometer at a temperature of 25 ± 0.1°C.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Density Exptl.</th>
<th>Density Lit.⁰⁰</th>
<th>Refractive Index Exptl.</th>
<th>Refractive Index Lit.⁰⁰</th>
</tr>
</thead>
<tbody>
<tr>
<td>Di (iso) propyl ether</td>
<td>0.7250₂⁰°C</td>
<td>0.7258₂⁰°C</td>
<td>1.3672₂³⁰°C</td>
<td>1.3678₂³⁰°C</td>
</tr>
<tr>
<td>n.Heptane</td>
<td>0.6838₂⁰°C</td>
<td>0.68376₂⁰°C</td>
<td>1.3880₂³⁰°C</td>
<td>1.3876₂³⁰°C</td>
</tr>
</tbody>
</table>

THERMODYNAMIC CONSISTENCY

The experimental vapour liquid equilibrium data are presented in table II. Liquid phase activity coefficients are calculated from the equation,

\[ \gamma_i = \frac{y_i \pi}{x_i P_i} \]
### Table II

Vapour-liquid equilibrium data (Pressure: 684 ± 2.5 mm.)

<table>
<thead>
<tr>
<th>No.</th>
<th>Temp.°C</th>
<th>Mole % of di (iso) propyl ether in liquid</th>
<th>Mole % of di (iso) propyl ether in vapour</th>
<th>γ₁</th>
<th>γ₂</th>
<th>γ₁calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91.4</td>
<td>7.1</td>
<td>16.0</td>
<td>1.0076</td>
<td>1.0053</td>
<td>15.88</td>
</tr>
<tr>
<td>2</td>
<td>89.6</td>
<td>11.0</td>
<td>24.0</td>
<td>1.0260</td>
<td>1.0037</td>
<td>23.39</td>
</tr>
<tr>
<td>3</td>
<td>85.9</td>
<td>20.3</td>
<td>39.0</td>
<td>1.0038</td>
<td>1.0127</td>
<td>38.85</td>
</tr>
<tr>
<td>4</td>
<td>83.2</td>
<td>27.8</td>
<td>49.5</td>
<td>1.0010</td>
<td>1.0068</td>
<td>49.35</td>
</tr>
<tr>
<td>5</td>
<td>80.0</td>
<td>37.9</td>
<td>60.0</td>
<td>0.9765</td>
<td>1.0302</td>
<td>61.38</td>
</tr>
<tr>
<td>6</td>
<td>78.3</td>
<td>43.5</td>
<td>66.0</td>
<td>0.9836</td>
<td>1.0173</td>
<td>67.09</td>
</tr>
<tr>
<td>7</td>
<td>76.2</td>
<td>50.1</td>
<td>71.9</td>
<td>0.9929</td>
<td>1.0244</td>
<td>72.42</td>
</tr>
<tr>
<td>8</td>
<td>74.0</td>
<td>58.5</td>
<td>78.5</td>
<td>0.9903</td>
<td>1.0160</td>
<td>79.19</td>
</tr>
<tr>
<td>9</td>
<td>72.6</td>
<td>63.9</td>
<td>82.2</td>
<td>0.9890</td>
<td>1.0127</td>
<td>83.12</td>
</tr>
<tr>
<td>10</td>
<td>70.0</td>
<td>75.4</td>
<td>88.7</td>
<td>0.9801</td>
<td>1.0352</td>
<td>90.41</td>
</tr>
<tr>
<td>11</td>
<td>67.4</td>
<td>86.2</td>
<td>94.2</td>
<td>0.9859</td>
<td>1.0367</td>
<td>95.55</td>
</tr>
<tr>
<td>12</td>
<td>66.0</td>
<td>92.4</td>
<td>96.9</td>
<td>0.9882</td>
<td>1.0585</td>
<td>98.06</td>
</tr>
</tbody>
</table>

The vapour pressures at various temperatures for n-heptane are calculated using the following equation:\(^3\):

$$\log_{10} P (mm) = 6.90319 - \frac{1268.586}{216.954 + t}$$

Since equation of Antoine type for calculating vapour pressure at different temperatures for di (iso) propyl ether is not available, the following equation has been formulated with the data available\(^3\):

$$\log_{10} P (mm) = -\frac{1581.0}{T} + 7.5218$$

The system does not form an azeotrope. The values of γ₁ and γ₂ are found to be nearly one, which indicates that it is an ideal system. The small deviations that are observed may be attributed to the experimental inaccuracies and do not show any definite trend. The calculated values of γ₁ using Raoult’s law (γ = xP/π) are given in table II. The root-mean-square deviation of (γexperimental - γcalculated) is found to be 1.161. So, for all practical purposes, the system can be considered as an ideal one.
Isobaric vapour liquid equilibrium

FIG. I
Di (iso) Propyl Ether—n-Heptane
\( x-y \)
FIG. II
Di(iso) Propyl Ether—n-Heptane
\( t - x - y \)
**Isobaric vapour liquid equilibrium**

**FIG. III**

Di (iso) Propyl Ether—n-Heptane
logarithm of activity coefficient vs. composition

**NOMENCLATURE**

\( P \) = Vapour pressure of pure component  
\( x \) = Mole fraction in liquid phase  
\( y \) = Mole fraction in vapour phase  
\( \gamma \) = Activity coefficient  
\( \pi \) = Total pressure, \( ^\circ \)C  

**Subscripts**

1 = Di (iso) propyl ether  
2 = n.Heptane
LITERATURE CITED

