Measurement and Modeling of the Phase Behaviour of (CO₂ + CO) at Temperatures between (218.15 and 303.15) K and pressures up to 14 MPa

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Abstract

Project comprises two main targets:

- New accurate VLE experimental measurements of binary mixture (CO₂ + CO) are being carried out under conditions representative of the low-temperature separation process.
- Establishment and validation of optimised EOSs using these experimental data.

Introduction

Understanding of (CO₂ + CO) phase behaviour is extremely important in gas processing.

VLE data for the (CO₂ + CO₂) system

<table>
<thead>
<tr>
<th>Reference</th>
<th>Tmax(K)</th>
<th>Tmin(K)</th>
<th>pmax(MPa)</th>
<th>Year</th>
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<tbody>
<tr>
<td>Kaminishi et al.</td>
<td>263</td>
<td>223</td>
<td>14</td>
<td>1991</td>
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<td>Christiansen et al.</td>
<td>223</td>
<td>283</td>
<td>14</td>
<td>1974</td>
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<td>Huamin et al.</td>
<td>223</td>
<td>261</td>
<td>7</td>
<td>1991</td>
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</table>

Thermodynamic Modelling


- Improved GERG-2008 for CO₂-Rich Mixtures
- Mathematical approach of the GERG-2008 equation of state by Kunz and Wagner
- New mixing parameters for mixtures of carbon dioxide, water, nitrogen, oxygen, argon, and carbon monoxide.


- Molecular based equation of state
- Generalized Mie potential to represent segment-segment interactions
- Written in terms of free energy (A) from which all thermodynamic properties can be obtained
- Predictive performance by using g-SAFT (PSE Ltd)

Peng Robinson EoS [4]

- PR EoS combined with the classical one-fluid mixing rule incorporating one temperature-dependent binary parameter

$$p = \frac{RT}{v - b} - \frac{a(T)}{v(v + b) + b(v - b)}$$

$$a = \sum x_i x_j (1 - k_i) \sqrt{a_i a_j}$$

$$b = \sum x_i b_i$$

Summary and Future Work:

- Phase envelope of (CO₂ + CO) system was successfully measured with high accuracy from 218.15 K to 288.15 K up to 15 MPa.
- The results show that all models: optimized PR-EoS, predictive SAFT-VR-Mie, Predictive EoS-CG, can describe the experimental VLE data of (CO₂ + CO) with acceptable accuracy, except in the critical region.
- Assessment of regressing of single temperature-independent binary interaction parameter SAFT-VR-Mie against the present experimental data.
- Further measurements on (CO₂ + CO) system will be carried out in the range on 233.15 K to 303.15 K.
- Select and carry out VLE measurements on relevant binaries and multicomponent systems to low-temperature separation process;

Acknowledgements

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References