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A new approach of experimental and modelling study of mixed gas hydrates under non-equilibrium conditions

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Introduction

Gas hydrates are crystalline solids composed of water and gas. The gas molecules (guests) are trapped in water cavities (host) that are composed of hydrogen-bonded water molecules.

Objectives

- Effects of crystallization rate
- Studying the thermodynamics of mixed clathrate hydrates
- Determination of the gas composition in hydrate phase
- Volume of clathrate hydrate and water conversion
- Developing a reliable thermodynamic model based on classical van der Waals and Platteeuw model by implementing Kihara parameters.

Experimental section

Results

Two different gas mixture including propane were studied. For each mixture, we performed two different experiments based on two different crystallization rates at the same initial conditions.

A thermodynamic model, implementing classic van der Waals and Platteeuw model, was used. The Kihara parameters for methane were taken from the previous works of our team and the Kihara parameters for propane have been investigated in this work.

Conclusions

- The equilibrium pressure for a given temperature is slightly different for different crystallization rates.
- The final pressure at final state is slightly different.
- Water conversion and hydrate volume at quick crystallization is more than slow crystallization.
- The composition of heavier hydrocarbon (here propane) at slow crystallization is more than quick crystallization.

<table>
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<th>Parameters from Handa and Tse</th>
<th>Kihara parameters</th>
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<td>Handa and Tse, 2001</td>
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Based on our results of slow crystallization and also some equilibrium data from literature, a new set of Kihara parameters for propane was obtained. The simulation based on the new Kihara parameters was compared with the other Kihara parameters in the open literature.