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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.

Gas hydrates are a crucial issue in many fields, from oil & gas industry, to carbon capture and storage, air conditioning, or even planetary science. They also have an enormous potential as an energy resource.

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

- Develop a new approach of experimental and modelling study of mixed gas hydrates under non-equilibrium conditions.
- Determine gas hydrate formation.
- Develop a reliable thermodynamic model based on classical van der Waals and Platteeuw model by implementing Kihara parameters.

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 volume of hydrate and also water conversion in quick crystallization process is larger than slow crystallization rate.
- Moreover, in a hydrocarbon mixture at slow crystallization rate, enclathration of heavier hydrocarbon is more important.
- A new set of Kihara parameters of propane was obtained and it has a good accordance to predict the hydrate equilibrium pressure for a wide range of temperature from literature.