Phase equilibrium of CP-CO_2 hydrate in the presence of salts: Experimental measurements and modeling.

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The shortage of freshwater is one of the grand challenges that humans are facing. That requires the advent of seawater desalination and water treatment technology. As a promising novel method, hydrate-based desalination has been developed and achieved considerable milestones in the past few years. However, the experimental data are still limited in the open literature. Therefore, in this study, thermodynamic equilibrium data of mixed CO_2-Cyclopentane (CP) hydrates in the presence of salts were investigated. In particular, $MgCl_2$ and $CaCl_2$, which are dominant cations in water caused hard water. Experiments have been conducted in two batch reactors with the same characteristics in a pressure range of 8-20 bars, specially developed to study the phase equilibria and kinetics of gas hydrates. The inhibition (Figure 1) of salt on the formation of the clathrate hydrate was exposed. Additionally, the increase of initial salt concentration leads to the increase of hydrate inhibition of salts. The equilibrium points could be also investigated by the P-T evolution of CP-CO_2 binary clathrate hydrate. Finally, the van der Waals and Platteeuw model was applied to describe equilibrium conditions. By using an optimal set of Kihara parameters from previous work, the experimental data were reproduced. It is shown that the modeling method agrees tolerably with measured data with regards to the Absolute Average Deviation (AAD) less than 0.5 K. The correlation method also was used to compare the efficiency of the modeling method using Kihara parameters. That gives more accuracy to the modeling method at a smaller concentration (≤ 10wt%).

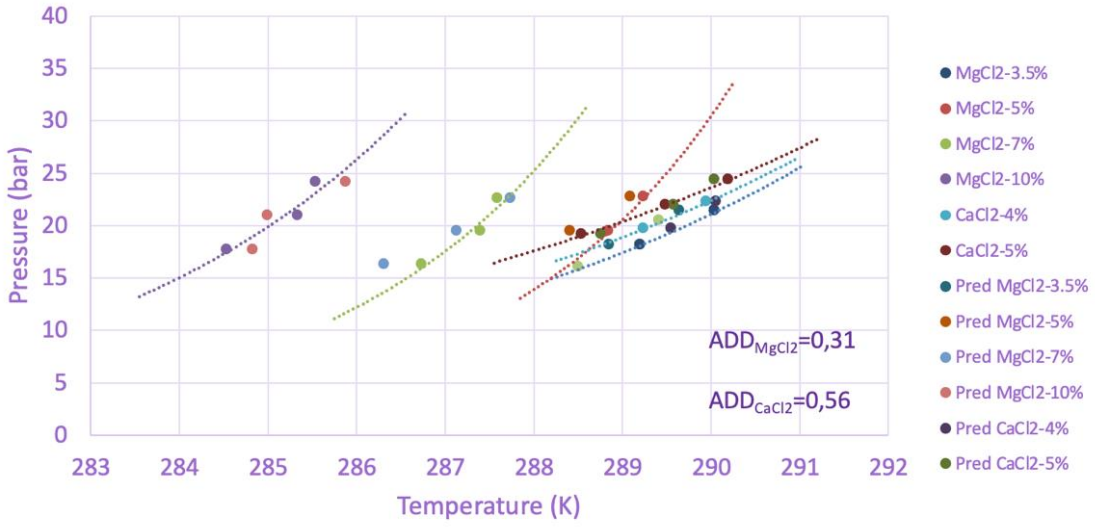

Figure 1. Comparison of the experimental data and modeling results

References

Ngo-Van H., Bouillot, B., Herri, J-M. Phase equilibrium of cyclopentane hydrate in the presence of CO2 and salts: Experimental determinations and computational method.