

## Phase equilibrium for seawater/wastewater treatment and carbon capture with clathrate hydrates

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### Abstract

New hydrate-based processes combining different applications are now a topical subject in the hydrate community. This effort focusses on carbon capture as well as desalination or water treatment. Here, carbon dioxide can be considered as a guest that will be captured as well as the hydrate promoter that will separate water from brine. In addition, cyclopentane is an interesting co-former since it presents a very low solubility in water, and promotes significantly the hydrate formation.

Efforts have been made in order to furnish thermodynamic data and models for mixed cyclopentane/carbon dioxide hydrates in presence of salts (NaCl+KCl, MgCl<sub>2</sub>, CaCl<sub>2</sub>). Results have been obtained in a pressurized batch reactor within a pressure range of 10-25 bars and salinity up to 10% mass (fig. 1). Final dissociation points and as well as intermediate metastable points were obtained. The dissociation enthalpies and compressibility factors have been calculated and compared to literature data. Furthermore, the thermodynamic consistency of our results and literature data were performed to discuss their reliability.

Finally, results have been modelled and compared according to van der Waals and Platteeuw model (vdW-P), Hu-Lee-Sum (HLS) correlation, and ice melting point method derived from HLS proposition. Simulations furnishes temperature data within 0.9 K difference (fig. 1).

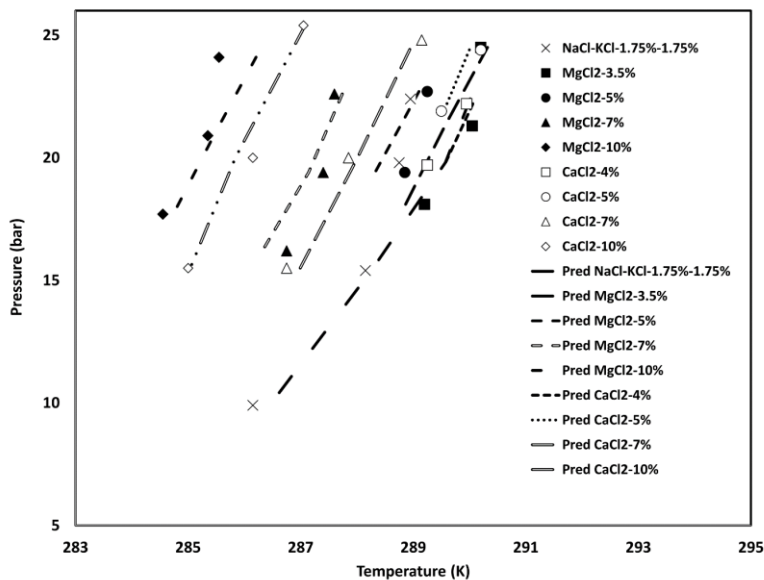


Fig. 1. Measured and predicted (vdW-P approach) equilibrium data of binary CP/CO<sub>2</sub> hydrate in pure water and brine.

**Keywords:** Desalination, cyclopentane hydrates, CO<sub>2</sub> hydrates, thermodynamics, modelling.