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Measurements and Predictions of Hydrates of CO_2-rich Gas Mixture in Equilibrium with Multicomponent Salt Solutions

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Abstract : Carbon dioxide (CO_2) is widely used in reservoirs to enhance oil and gas production, mixing with natural gas and other impurities in the process. However, hydrate formation frequently hinders the efficiency of CO_2-based enhanced oil recovery, causing pipeline blockages and pressure build-ups. Current hydrate prediction methods are primarily designed for gas mixtures with low CO_2 content and struggle to accurately predict hydrate formation in CO_2-rich streams in equilibrium with salt solutions. Given that oil and gas reservoirs are saline, experimental data for CO_2-rich streams in equilibrium with salt solutions are essential to improve these predictive models. This study investigates the inhibition of hydrate formation in a CO_2-rich gas mixture (CO_2, CH_4, N_2, H_2 at 84.73/15/0.19/0.08 mol.%) using multicomponent salt solutions at concentrations of 2.4 wt.%, 13.65 wt.%, and 27.3 wt.%. The setup, test fluids, methodology, and results for hydrates formed in equilibrium with varying salt solution concentrations are presented. Measurements were conducted using an isochoric pressure-search method at pressures up to 45 MPa. Experimental data were compared with predictions from a thermodynamic model based on the Cubic-Plus-Association equation of state (EoS), while hydrate-forming conditions were modeled using the van der Waals and Platteeuw solid solution theory. Water activity was evaluated based on hydrate suppression temperature to assess consistency in the inhibited systems. Results indicate that hydrate stability is significantly influenced by inhibitor concentration, offering valuable guidelines for the design and operation of pipeline systems involved in offshore gas transport of CO_2-rich streams.

Keywords : CO_2-rich streams, hydrates, monoethylene glycol, phase equilibria
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