High Pressure Micromechanical Properties of Gas Hydrate Particles in the Presence of a Liquid Hydrocarbon Phase and Salts

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The formation of solid gas hydrate particles can lead to plugging and pressure build up in oil and gas flowlines. The agglomeration of gas hydrate particles and hydrate particle deposition/adhesion on the pipe wall are key phenomena that can lead to hydrate plugging. To advance the fundamental understanding of hydrate particle agglomeration and adhesion processes in a liquid hydrocarbon phase, a high-pressure micromechanical force (MMF) apparatus was applied to directly measure gas hydrate adhesive/cohesive forces under low temperature and high-pressure conditions. In this study, cohesive force measurements of a gas hydrate particle-particle system were performed in the presence of a model liquid hydrocarbon with the presence of salt (salt will be added into aqueous phase before hydrate formation). The effect of salt concentrations (1 – 5 wt. %) was investigated and compared to the baseline test results. Annealing time and contact time were both kept the same through the entire study. Calculations were performed using the liquid bridge theory compared with experimental data. In addition, interfacial tension (IFT) and contact angle (CA) measurements were performed to improve understanding of the effect of salts on these parameters, as well as their influence on inter-particle interactions based on the liquid bridge theory for different conditions. It was found that IFT increased and CA decreased with increasing salt concentrations at ambient pressure and temperature. These test results provide insight into the influence of salts on the inter-particle / interfacial interactions, and can also help to improve the corresponding models used in these systems.

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