Influence of Emulsion Stability and Cohesion Force on Hydrate Formation and Transportability

Yan Wang [S,1], Carolyn Koh[1] and Luis E. Zerpa [C,1,2]

[1]*Center for Hydrate Research, Department of Chemical and Biological Engineering, Colorado School of Mines, Golden, CO, U.S.A.*

[2]*Department of Petroleum Engineering, Colorado School of Mines, Golden, CO, U.S.A.*

lzerpa@mines.edu

Hydrate formation and plugging in deep water subsea tiebacks can prematurely terminate the production of offshore wells, and is one of the most challenging problems in flow assurance. In the Center for Hydrate Research at the Colorado School of Mines, there has been a continuous effort to develop a comprehensive hydrate formation prediction model (CSMHyK), which requires a good understanding of hydrate interfacial properties related to emulsion properties and hydrate-hydrate interactions. The emulsion stability may largely affect the hydrate growth rate during transient operations such as shut-in/restart, as well as the effective viscosity of the fluid. The hydrate-hydrate cohesion will influence the hydrate agglomeration and thus the effective hydrate volume fraction and viscosity of the system. In CSMHyK, the hydrate cohesion is modeled with a capillary bridge theory, and the cohesion force increase with longer hydrate contact time (sintering) is captured by a dynamic cohesion force model. Applying the capillary bridge theory into CSMHyK, the effects of different interfacial tensions and hydrate contact angles on cohesion force and thus the hydrate agglomeration and transportability are investigated. Using the geometry, fluid properties, and production data from an offshore well, CSMHyK is applied to assess the hydrate plugging risk of different scenarios at both steady state and shut-in restart operations. Some of these scenarios will include the injection of chemical inhibitors that will inhibit hydrate agglomerations (anti-agglomerants). In the simulation, the influence of emulsion stability as well as cohesion force on hydrate formation and transportability is studied in detail.