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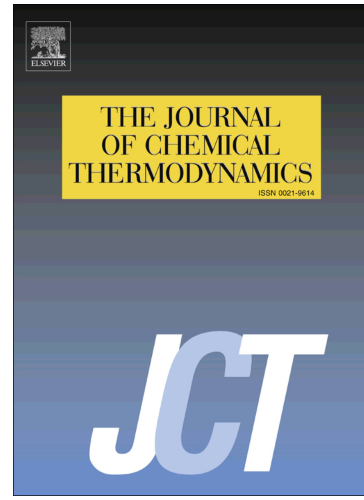

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Modelling hydrate deposition and sloughing in gas-dominant pipelines

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Abstract

We present a model for hydrate deposition and sloughing in gas dominated pipelines which allows for rapid estimations of the pressure and temperature profiles along a horizontal pipeline during normal operation in the hydrate forming region in the presence of monoethylene glycol (MEG). Previous models assume that the hydrate deposit growing at the pipe wall is stable, which may lead to an overestimation of the pressure drop over time. Hydrate growth rates were calculated using a classical hydrate kinetic model combined with a simplified two-phase flow model for pipelines in the annular flow regime with droplet entrainment. Hydrate growth at the pipe wall, deposition of hydrate particles from the gas stream and sloughing due to shear fracture of the deposited film contributed to the evolution of the hydrate deposit. The model parameters included a scaling factor to the kinetic rate of hydrate growth and a particle deposition efficiency factor. The fraction of deposited particles forming a stable hydrate film at the pipe wall through sintering and the shear strength of the deposit were introduced as two additional parameters to enable simulation of sloughing events. The tuned model predicted hydrate formation within 40% and pressure drop within 50% of measurements previously obtained in a gas-dominated flow loop over a wide range of subcoolings, MEG concentrations and high and intermediate gas velocities. The observed decrease of the kinetic factor with decreasing gas velocity indicated larger resistances to hydrate growth