Prediction of Induction Time for Methane and Carbon Dioxide Hydrates

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A correlation for prediction of induction time of methane and carbon dioxide hydrates was suggested based on experimental data carried out in this study. Induction time is theoretically considered to be the time which hydrate particles need to reach a critical radius thereafter they grow continuously. This critical radius was calculated through derivation of Gibbs free energy function during the growth process. An empirical relation was presented to predict the induction time of gas hydrate formation by correlating measured induction times to the calculated critical radii at different pressures and temperatures for CO₂ and methane hydrates. Average absolute deviations between experimental data and predictions for CO₂, methane and propane were 7, 12, and 17%, respectively. In order to check the validity of the correlation beyond the range of tuning, sets of data from this study and from literature were testified. Additionally, the effect of CO₂ on thermodynamic and kinetic behavior of methane hydrate was investigated. Results showed that in a pressure range both in labile zone of CO₂ and metastable zone of methane, formation of methane hydrate was promoted by heterogeneous nucleation of CO₂ and induction time reduced dramatically. For instance, CO₂ at a concentration of 20% by volume and a temperature of 275 K decreased the induction time of methane hydrate to one third of its pure case.