

Experimental Study of Methane Hydrate Equilibria in [EMIM]-NO₃ Aqueous Solutions

Zhen Long^S, Xuebing Zhou, Deqing Liang^C and Dongliang Li

*Key Laboratory of Gas Hydrate, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences,
Guangzhou, Guangdong, China*

liangdq@ms.giec.ac.cn

Gas hydrates are ice-like crystalline compounds composed of water molecules, connected through hydrogen bonding, forming a three-dimensional lattice that is occupied by another small guest species. Hydrate formation is problematic in the oil and gas industry because the resulting pipelines blockages can lead to a major economic losses as well as flow assurance and ecological risk. To prevent hydrate formation, one common method is the application of thermodynamic and kinetic inhibitors. The former act by changing the hydrate formation conditions such that hydrates will form at much lower temperatures at the same pressures; while the latter have been developed to delay hydrate nucleation and the growth of hydrate crystals. Ionic liquids, as a new class of dual function inhibitors, have attracted much more attention. The present work is to determine the thermodynamic effect of imidazolium-based aqueous ionic liquid solutions containing 1-ethyl-3-methyl-imidazolium nitrate ([EMIM]-NO₃) on methane hydrate at five mass concentrations of (5.5, 10, 20, 30, and 40) wt%. The hydrate phase equilibrium data are obtained in the pressure range of (3 to 16) MPa by using an isochoric pressure search method. The studied ionic liquid is found to behave well as a thermodynamic inhibitor on methane hydrate. The hydrate phase boundary is shifted to the higher pressures/lower temperatures. Moreover, an enhanced increase in inhibition effect is demonstrated with increasing concentrations.