PHASE EQUILIBRIA, MOLECULAR COMPOSITION, AND SPECTROSCOPIC IDENTIFICATION OF TERARY CH₄ CLATHRATE HYDRATE

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ABSTRACT

Landfill gas is a mixture of methane, carbon dioxide, and trace components (hydrogen sulphide, ammonia, and mercaptan etc.) generated by the bacterial decomposition of organics, and this landfill gas has an adverse effect on the natural and living environment in the surrounding region. Recently a number of studies have been performed to develop the landfill gas as an alternative energy source. The purpose of this study is to investigate the effect of trace components on the hydrate formation and structure for energification of landfill gas. The hydrate phase behaviour of “CH₄+CO₂+H₂S+water” and “CH₄+CO₂+mercaptan+water” was investigated using both a high-pressure equilibrium viewing cell and a kinetic pressure-temperature measurement system at a constant volume conditions. The hydrate phase equilibrium in pores were measured and CH₄, CO₂, H₂S, and mercaptan concentrations in vapour and hydrate phase were determined under the two phase region (hydrate–vapour) at a constant temperature of 275.15K. The inhibition effect appeared due to H₂S and mercaptan, and the corresponding equilibrium dissociation pressure became higher than those of “CH₄+CO₂+water” hydrates at a specific temperature. The Raman spectroscopy was measured to support the phase equilibrium results and to investigate the cage occupation of CH₄, CO₂, and H₂S molecules in the small and large cages of the hydrate framework.

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