

Experimental Verification of Cyclopentane Hydrates with Guest Molecules for Potential Applications to Desalination and Gas Storage

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Cyclopentane (CP) forms gas hydrate with water under atmospheric pressure. CP can function as a thermodynamic promoter for gas hydrates, which can reduce hydrate equilibrium pressure at a given temperature. Accordingly, CP hydrate can be used for various potential applications of desalination and gas storage. However, the thermodynamic stability and guest inclusion behavior of CP + guest gas systems were not clearly revealed. In this study, four-phase (hydrate-liquid water-liquid CP-vapor) equilibria of the CP + guest gas (CH₄, CO₂, and N₂) + water mixtures were measured to determine the stability conditions of the mixed gas hydrate systems. The quintuple point was also investigated for the CP + CO₂ hydrate in the high pressure region. The accurate structure and guest distributions of CP hydrates with guest molecules were analyzed through ¹³C NMR and Raman spectroscopy. The hydration number and dissociation enthalpy of CP hydrate were measured using DSC (differential scanning calorimetry). It was found from the experimental results that the CP + guest gas hydrates form sII hydrates and CP molecules occupy large 5¹²6⁴ cages of sII hydrate.