

Experimental Verification of the Iso-structural CH₄ - Flue Gas Replacement Occurring in sH Hydrates

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In this study, flue gas, consist of CO₂ (10%) + N₂ (90%) and CO₂ (20%) + N₂ (80%), was injected into initial sH hydrate, formed with 2,2-dimethylbutane (Neohexane, NH) and CH₄ (99.95%) gas for CH₄ recovery and CO₂ sequestration. The four- phase (H-L_w-L_{NH}-V) equilibrium line shift after the replacement verified that flue gas was successfully replaced with the CH₄ in the sH hydrates. The ¹³C NMR confirmed that the CH₄-flue gas replacement reaction proceeded without structural transition and the CO₂ molecules also occupied the cages of sH hydrates. Stability conditions and heat of dissociation values after the replacement were measured using a high pressure micro-differential scanning calorimeter (HP μ -DSC) to confirm the extent of the replacement. During the CH₄ - flue gas replacement in sH hydrates, there was no significant heat flow change associated with the dissociation and formation of hydrates. This study revealed that the CH₄ - flue gas replacement in sH hydrate could successfully proceed without structural transition and noticeable hydrate lattice destruction.