

Influence of feed gas compositions on replacement efficiency and structural transformation in the sH (CH₄ + MCP) – (CO₂ + N₂) replacement

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Natural gas hydrates have been considered as future energy resources due to their huge amount of deposits. Among various production methods, the CH₄-CO₂ replacement has been studied as a promising technology which has a dual function of CH₄ production and CO₂ sequestration. In this study, CO₂+N₂ gas were injected into the CH₄ + methylcyclopentane (MCP) hydrate of structure H (sH) to examine the influence of feed gas compositions on structural transformation and guest exchange behavior in the sH hydrates. Three different gas mixtures (CO₂ 20%, 40%, and 60%) were used. The replacement efficiency was measured using GC and the structural transition was confirmed through ¹³C NMR and PXRD with Rietveld analysis. The experimental results showed that higher CO₂ compositions in the feed gas contributed to the increased structural transition to structure I and also resulted in lower guest exchange due to lower N₂ inclusion. Because of the trade-off between structural transition and N₂ inclusion, the highest replacement efficiency was found at the feed gas composition of CO₂(40%)+N₂(60%).