Influence of competitive inclusion of CO2 and N2 on sII (CH4 +C3H8) hydrate – flue gas replacement

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Natural gas hydrates (NGHs) have been studied because of tremendous amount of deposits. The CH4-CO2 replacement process has been suggested as a promising technology because global warming gases replace natural gas without direct dissociation of gas hydrates. In this study, the structural transformation and guest exchange behavior in sII (CH4+C3H8) – flue gas replacement was examined. The replacement efficiency of sII hydrate – flue gas replacement was much lower than sI hydrate – flue gas replacement. 13C NMR spectra and PXRD patterns of the replace hydrates indicated that there was no structural transformation through the replacement. The cage-specific guest compositions in the replaced hydrates which were obtained through Rietveld refinement demonstrated that the competitive inclusion between CO2 and N2 and the more preferable inclusion of N2 in the small cages resulted in the increased stability of sII hydrate. The experimental results would be helpful for understanding the accurate replacement mechanism and guest exchange behavior in sII hydrates using flue gas injection.