

Post-combustion CO₂ Capture Using Clathrate Formation: Effects of Thermodynamic Promoters

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Clathrate-based CO₂ capture from flue gas was investigated in the presence of tetrahydrofuran (THF) as a water-soluble sII hydrate former, tetra-butyl ammonium chloride (TBAC) as a semiclathrate former, and cyclopentane (CP) as a water-insoluble sII hydrate former. The clathrate stabilities of the CO₂ (20%) + N₂ (80%) + promoters (THF (1.0 and 5.6mol%), TBAC (1.0 and 3.3mol%), and CP (1.0 and 5.6mol%)) systems were measured using an isochoric method. The clathrate equilibrium pressures at a specified temperature were significantly reduced in the presence of these thermodynamic promoters. Gas uptake and CO₂ composition analysis in both vapor and clathrate phases were conducted using gas chromatography. The 5.6 mol% THF solution showed the largest gas uptake during the clathrate formation, but it demonstrated the lowest CO₂ concentration (35 %) in the clathrate phase after the completion of clathrate formation. TBAC solutions exhibited approximately 60% CO₂ concentrations in the clathrate phases regardless of TBAC concentration. The inclusion of CO₂ in the clathrate phase was also confirmed via Raman spectroscopy. The overall experimental results are useful for the clathrate-based CO₂ capture process from flue gas.