Quaternary Ammonium Salt Semiclathrate-Based CO_2 Capture from Flue Gas Mixtures

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In this study, post-combustion CO_2 capture using QAS semiclathrate formation was investigated primarily focusing on thermodynamic stability conditions and spectroscopic analyses of the CO_2 (20%) + N_2 (80%) + QAS semiclathrates. Semiclathrate phase equilibria (H-L_w-V) of TBAB•26.0H2O, TBAC•29.7H_2O, and TBAF•28.6H_2O with flue gas mixtures were measured to determine stability conditions of each QAS semiclathrate. The gas consumption and CO_2 concentration changes in the vapor phases during the semiclathrate formation was analyzed using gas chromatography. The enclathration of CO_2 in the QAS semiclathrates was confirmed by Raman spectroscopy. In addition, dissociation enthalpies of each QAS semiclathrate were obtained using a high pressure micro-differential scanning calorimeter (HP μ-DSC). After completion of semiclathrate formation, the CO_2 concentration in the semiclarhate phase was found to be approximately 60 % for all QAS semiclathrates. However, gas consumption during the semiclathrate formation was in the following order: TBAF < TBAB < TBAC. The overall experimental results obtained in this study are useful information for semiclathrate-based post-combustion CO_2 capture.