Microcalorimetric Measurement of a Physical-Chemical Absorbent for CO_2 Capture

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The traditional CO_2 capture material, aqueous monoethanolamine (MEA), have a good CO_2 solubility and a high absorption rate, but is expensive to regenerate in terms of energy cost and solvent loss. Instead of water, an aprotic polar solvent, diglyme, was used to dissolve MEA to form a physical-chemical absorbent MEA+diglyme in this work. To evaluate the performance of proposed absorbent, an experimental apparatus was designed and built up, which combined the microcalorimetry and the isothermal synthesis method. The apparatus was able to measure the CO_2 solubility and absorption heat simultaneously. The calorimeter BT2.15, produced by SETARAM Instrumentation (Caluire, France), was used to measure the heat of CO_2 absorbed by MEA+diglyme pre-stored in the vessel of calorimeter. The isothermal synthesis method has been used to measure solubilities of many vapor-liquid systems including CO_2 in organic solvents, polymers, and ionic liquids. In this work, the isothermal synthesis method was used to measure the load of CO_2 in absorbent corresponding to the absorption heat detected by the calorimeter. The CO_2 solubility and heat of absorption in aqueous MEA were measured to validate the apparatus. Deviations between experimental data and data in literature were calculated, and the calculation indicated a good reliability of the apparatus. Then the CO_2 solubility and heat of absorption in MEA+diglyme were measured. The obtained data were compared with that of aqueous MEA. Results indicated that both CO_2 solubility and absorption heat in MEA+diglyme were less than those in aqueous MEA under CO_2 pressures below ~1200 kPa and MEA concentration of 30 % (mass fraction).