Experimental measurement and modeling of the rate of absorption of carbon dioxide by aqueous ammonia

In this work, the rate of absorption of carbon dioxide by aqueous ammonia solvent has been studied by applying a newly built wetted wall column. The absorption rate in aqueous ammonia was measured at temperatures from 279 to 304K for 1 to 10wt% aqueous ammonia with loadings varying from 0 to 0.8molCO2/molNH3. The absorption rate in 30wt% aqueous mono-ethanolamine (MEA) was measured at 294 and 314K with loadings varying from 0 to 0.4 as comparison. It was found that at 304K, the rate of absorption of carbon dioxide by 10wt% NH3 solvent was comparable to the rates for 30wt% MEA at 294 and 314K (a typical absorption temperature for this process). The absorption rate using ammonia was however significantly lower at temperatures of 294K and lower as applied in the Chilled Ammonia Process. However, at these low temperatures, the rate of absorption in ammonia has only a small temperature dependency. The rate of absorption decreases strongly with decreasing ammonia concentrations and increasing CO2 loadings. The rate of absorption of carbon dioxide by aqueous ammonia solvent was modeled using the measurements of the unloaded solutions and the zwitter-ion mechanism. The model could successfully predict the experimental measurements of the absorption rate of CO2 in loaded ammonia solutions.

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