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# Experimental Study of Carbon Dioxide Absorption into Aqueous Ammonia with a Hollow Fiber Membrane Contactor

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## Abstract

The aqueous ammonia process is a promising $CO_2$ capture technology for post-combustion flue gas treatment. The most attractive advantage of this technology is a relative low cost of solvent regeneration compared to traditional amine solutions. In this work, the absorption of $CO_2$ into aqueous ammonia was experimentally studied in a gas/liquid contactor fitted with hollow fiber PTFE membranes at ambient temperature. The absorption performance was evaluated in terms of $K_G a_v$. Experimental results indicated aqueous ammonia can absorb $CO_2$ in a hollow fiber membrane contactor over a wide range of experimental conditions. The value of $K_G$ ranged from $1.06\times10^{-4}$ to $2.89\times10^{-4}$ m/s. The impacts of operating parameters including $CO_2$ partial pressure, liquid flow rate, ammonia concentration and inlet $CO_2$ solution loading were evaluated. The parametric impacts are similar to those of traditional amine-based absorption processes. Although the reactivity of aqueous ammonia is moderately lower than MEA, the $K_G a_v$ value of aqueous ammonia is the same order of magnitude as that of MEA under the same operating conditions. As the liquid flow rate increases aqueous ammonia can achieve a performance comparable to MEA solvent. Long-term stability tests showed the absorption performance of aqueous ammonia remained constant in the first hour and then gradually decreased over time. Precipitation of ammonium salts was observed on the membrane surface of the shell side, which caused membrane fouling and may facilitate membrane wetting.

Keywords: Aqueous ammonia; Membrane contactor; $CO_2$ absorption; Polytetrafluoroethylene; Long-term stability

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## Nomenclature

| | |
|---|---|
| $A$ | membrane module lumen area ($m^2$) |
| $C_{HCl}$ | concentration of hydrochloric acid (mol/L) |
| $C_{MEA}$ | concentration of MEA solution ($mol/m^3$) |
| $C_{NH_3}$ | concentration of aqueous ammonia solution (mol/L) |
| $d_i$ | inner diameter of membranes (m) |
| $D_{G,eff}$ | effective diffusion coefficient ($m^2/s$) |

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