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**Modeling and simulation of CO<sub>2</sub> capture in aqueous ammonia with hollow fiber composite  
membrane contactors using a selective dense layer**

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**Abstract:**

Aqueous ammonia is a promising chemical absorbent for CO<sub>2</sub> capture but its high volatility leads to important solvent leakage necessitating expensive solvent recovery strategies. This study investigates the potential of using hollow fiber membrane contactors with composite membranes instead of packed columns to reduce solvent leakage. In this study, we used a composite membrane with a thin, dense selective layer (non-porous) coated on a microporous support to favor CO<sub>2</sub> transfer over NH<sub>3</sub>. We developed one-dimensional adiabatic multi-component transfer models to simulate the capture process using both hollow fiber membrane contactors and packed columns. These models were validated with laboratory-scale and pilot-scale data. Simulations under industrial relevant operation conditions were conducted to investigate process performance as a function of membrane characteristics, i.e. membrane dense layer thickness, selectivity and the micro-porous support mass-transfer coefficient. For contactors using homemade selective membranes, the CO<sub>2</sub> specific absorption capacity was of 2.7 mol/m<sup>3</sup>/s, which is roughly twenty times higher than values for our simulations in packed columns. The corresponding NH<sub>3</sub> slip reduction was of 4.3 %. A parametric study revealed that thick dense membrane layers led to greater reductions of ammonia slip but that this corresponded to lower specific CO<sub>2</sub> absorption capacity, highlighting an important trade-off between two performance parameters.

**Keyword:**

Selective membrane contactor; composite membrane; CO<sub>2</sub> capture; aqueous ammonia; modeling

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