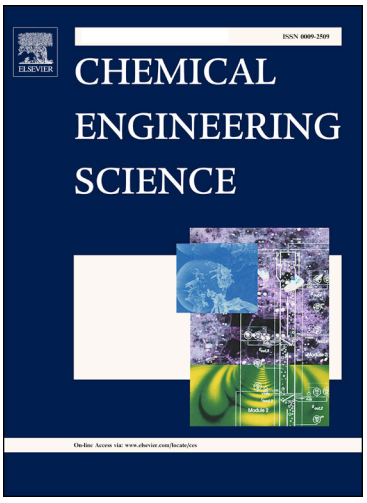

Modeling and simulation of CO_2 capture in aqueous ammonia with hollow fiber composite membrane contactors using a selective dense layer

Villeneuve Kévin, Albarracin Zaidiza David, Roizard Denis, Rode Sabine

PII: S0009-2509(18)30378-6
DOI: https://doi.org/10.1016/j.ces.2018.06.016
Reference: CES 14290

To appear in: *Chemical Engineering Science*

Received Date: 16 January 2018
Revised Date: 23 May 2018
Accepted Date: 4 June 2018

Please cite this article as: V. Kévin, A. Zaidiza David, R. Denis, R. Sabine, Modeling and simulation of CO_2 capture in aqueous ammonia with hollow fiber composite membrane contactors using a selective dense layer, *Chemical Engineering Science* (2018), doi: https://doi.org/10.1016/j.ces.2018.06.016

Modeling and simulation of CO_2 capture in aqueous ammonia with hollow fiber composite membrane contactors using a selective dense layer

VILLENEUVE Kévin, ALBARRACIN ZAIDIZA David, ROIZARD Denis, RODE Sabine*

*Laboratoire Réactions et Génie des Procédés (LRGP) (UMR 7274), Université de Lorraine, ENSIC, 1, rue Grandville – BP 20451, 54001 Nancy Cedex, France - *sabine.rode@univ-lorraine.fr*

Abstract:

Aqueous ammonia is a promising chemical absorbent for CO_2 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_2 transfer over NH_3. 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_2 specific absorption capacity was of 2.7 mol/m^3/s, which is roughly twenty times higher than values for our simulations in packed columns. The corresponding NH_3 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_2 absorption capacity, highlighting an important trade-off between two performance parameters.

Keyword:

Selective membrane contactor; composite membrane; CO_2 capture; aqueous ammonia; modeling