

Theoretical studies on carbon dioxide removal from a gas stream in hollow fiber membrane contactors

Noureddine Boucif^{a,b*}, Phuc Tien Nguyen^a, Denis Roizard^a, Eric Favre^a

^aLaboratory of Reactions and Engineering Processes (LRGP) (UPR 6811-Nancy Université), ENSIC-BP 451
1, rue Grandville, F-54001 Nancy Cedex, France

Tel. +33 (3) 83 17 53 90; Fax +33 (3) 83 32 29 75; email: Noureddine.Boucif@ensic.inpl-nancy.fr

^bDépartement de Chimie Industrielle et LPQ3M, Faculté des Sciences de l'Ingénieur, Université de Mascara, Mascara 29000, Algeria

Received 24 June 2009; Accepted 15 November 2009

ABSTRACT

This paper presents theoretical studies and modeling investigations on the reactive absorption of carbon dioxide in alkanolamine solutions, specially the monoethanolamine, in a hollow fiber membrane contactor device. The absorption mechanism was built based on mass transport conservation laws in all three regions involved in the process, i.e. the gas phase, the membrane barrier and the liquid region. The gas is flown in the fiber bore in which the velocity is assumed to obey a fully developed laminar flow, and the liquid solution is circulated counter-currently to the gas flow in the shell side where the velocity is characterized by the Happel's free surface model. The rigorous model consisting of a set of highly non-linear partial differential equations is rewritten in dimensionless form and numerically solved. The outlet gas and liquid concentrations are parametrically simulated with the gas and liquid flowrates (Graetz numbers) as well as inlet fresh solvent concentrations.

Keywords: Carbon dioxide removal; Hollow fibre membrane; Reactive absorption; Numerical simulation

* Corresponding author.