Experimental and Numerical Analysis for Improving CO2 Mass Transfer Performance in Hollow Fiber Membrane Contactors

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Abstract

In this study, the COMSOL Multiphysics simulation software was used to simulate the CO2 mass transfer process in laminar flow and turbulent flow in a hollow fiber membrane contactor. The established simulation model was verified by comparing the simulated value of CO2 absorption flux in a DEEA/MAPA mixed solution with the actual process value. It was found that the laminar flow model with 5% membrane wettability is in good agreement with the experimental value, with an average relative error of only 2.64%. In addition, the effects of operating parameters and membrane process optimization on the velocity field, concentration field and mass transfer process in the membrane contactor were studied taking into consideration both the diffusion effect and the convection effect. From the analysis of the simulation results, increasing the degree of fluid turbulence and the series connection of multi-stage membrane modules are both good methods to promote mass transfer.

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