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Reverse osmosis modeling with the orthogonal collocation on finite element method

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ABSTRACT

A mathematical model was used to predict the performance of hollow fiber reverse osmosis membrane. The model is based on the solution-diffusion mass transfer model and takes into account the effect of the flow pattern of the permeate in the membrane. According to the flow direction inside the membrane, two types of flow can be distinguished: the co-current and counter-current flow pattern. Several studies underlined the effectiveness of the countercurrent flow pattern [1]. However, no study was carried out to demonstrate this assumption. This work aims to answer clearly the question of the choice of the flow type. The parameters used in this work are the overall recovery, the average concentration of the obtained product and the final concentration of the feed rate in the closed loop processes. The resolution of the mathematical model developed for the counter-current flow pattern is subjected to the split boundary value problem. To solve this problem, a robust and efficient procedure based on orthogonal collocation on finite element method was used. Experimental data were used to verify the proposed mathematical model and accomplish the comparative study between the two flow types. The results obtained show clearly the better efficiency of the counter-current flow pattern especially in the concentrating process.

Keywords: Reverse osmosis; Co-current; Counter-current; Orthogonal collocation; Finite elements

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