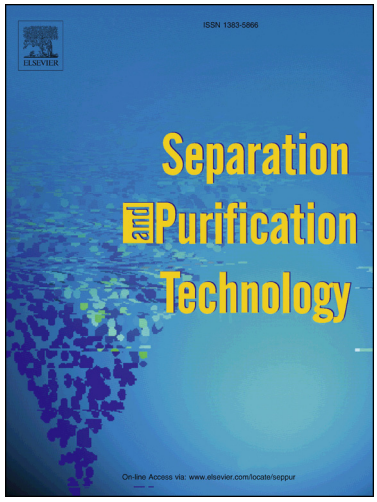

Modeling and simulation of mitigating membrane fouling under a baffle-filled turbulent flow with permeate boundary

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Modeling and simulation of mitigating membrane fouling under a baffle-filled turbulent flow with permeate boundary

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Abstract

Mitigating membrane fouling by using turbulence promoters (TP) is an important issue in the microfiltration field. Considering the particles accumulation on the walls of permeable membrane tubes (one kind of fouling mechanism) with TP, we proposed a three-dimensional numerical model for random decision that decides particle movement on the membrane boundary. We investigated and predicted the permeate flux, fouling layer thickness and optimal TP arrangement modes with different operational parameters with this model. The dynamics process of cake deposition was precisely quantified and visualized. And then the simulated results ignored of pore blockage for the permeation flux were deviated less than 10% compared with the experimental data in literatures. After TP condition being optimized, the mass transfer resistance sharply reduced. Average thickness of the cake layer decreased from 0.318 mm to 0.026 mm, and the permeate flux increased more than 60%.

Keywords crossflow microfiltration; membrane fouling; turbulence promoter; deposition process; computational fluid dynamics

1 Introduction

Particle deposition on microfiltration (MF) membrane surfaces is a type of general membrane fouling that has been a universal obstacle in the continuous service of MF membrane[1-4]. Thus, it is extremely significant to reduce particle deposition in MF process [5, 6]. According to particle deposition mechanism, an increase in fluid disturbance on membrane surface is an effective means