Simulation and mechanisms of aeration impacts on the permeate flux in submerged membrane systems

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ABSTRACT

This study was designed to investigate the impacts and mechanisms of aeration of the liquid crossflow along membrane surface, and the air bubble contact with membrane surface on the permeate flux in a submerged membrane system. The results indicate that the decline of the permeate flux over filtration time and filtered volume could be characterized by an initial short period of fast permeate flux decline, followed by a longer period of slower permeate flux decline, according to an exponential equation. Aeration had a great impact on enhancing the permeate flux. The maximum pseudo-steady state permeate flux and the minimum pseudo-steady-state permeate flux decline coefficient were achieved when the membrane system was operated with aeration. Aeration had a significant impact on the pseudo-steady-state permeate flux and the pseudo-steady-state permeate flux decline coefficient. As the intensity of aeration increased, the pseudo-steady-state permeate flux increased, and the pseudo-steady-state permeate flux decline coefficient decreased. However, there were no significant meanings in pseudo-steady-state permeate flux and pseudo-steady-state permeate flux decline coefficient if the aeration intensity is operated too high. Throughout this study, a better knowledge of aeration impacts and mechanisms are gained, and the submerged membrane systems could be designed and operated so as to maximize the permeate flux.

Keywords: Submerged membrane system; Aeration; Permeate flux; Impacts; Simulation; Mechanisms

1. Introduction

Since the development of synthetic asymmetric membranes in 1960, membrane processes for water and wastewater treatment have grown steadily. Moreover, the hollow-fiber microfiltration (MF) and ultrafiltration (UF) membrane processes have had the most profound impact on the use, acceptance, and regulation of all types of membrane processes for drinking water treatment [1]. The use of submerged membrane processes has increased rapidly for drinking water treatment applications. However, the operating costs for submerged membrane systems are still relatively high, when compared with conventional treatment technologies, such as sand filtration. The capital and operating costs associated with membrane systems are typically proportional to the membrane permeate flux that can be achieved. Thus, the permeate flux, which can be achieved, and the factors that affect the permeate flux are central considerations in determining membrane performance and cost. Moreover, the permeate flux that can be achieved is largely governed by the extent of fouling that occurs on the membrane surface.