Fouling reduction in MBR-RO processes: the effect of MBR F/M ratio

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Received 31 August 2012; Accepted 18 January 2013

ABSTRACT

This work investigated fouling propensities of microfiltration membranes and reverse osmosis (RO) membranes and analyzed the characteristics of deposited foulants on the membranes in two parallel Membrane bioreactor (MBR)-RO systems, with MBRs operated at different food to micro-organism (F/M) ratios. The results show that a high F/M ratio (0.50 g/g MLSS day) in the MBR caused greater membrane fouling rates of the MBR and RO membranes than a low F/M ratio (0.17 g/g MLSS day). In the MBRs, deposited microbial flocs were major foulants at low flux (10 L/m² h), whereas soluble substances in the cake foulants predominantly induced membrane fouling at high fluxes (20 and 30 L/m² h). In order to investigate the contributions of the protein, polysaccharides, and transparent exopolymer in the soluble substances to membrane fouling, bovine serum albumin, sodium alginate, and gum xanthan were used as model compounds, respectively, in experiments with the activated sludge samples from the MBR. The results imply that soluble polysaccharides (SP) and soluble transparent exopolymer particles (sTEP) were associated with fouling propagation. On the RO membranes, SP and sTEP were identified as major contributors to RO fouling rather than microbial cells and soluble protein. Our findings emphasize that the important role of the nature of soluble substances in membrane fouling and highlight that optimization of MBR operation is crucial to alleviate RO membrane fouling.

Keywords: Integrated membrane systems; Membrane fouling; Soluble polysaccharides; Transparent exopolymer particles; Extracellular polymeric substances; F/M ratio

1. Introduction

Membrane bioreactor (MBR)-reverse osmosis (RO) processes have been applied to reclaim municipal wastewater. An MBR process can remove above 95% of organic carbon and completely remove suspended solids from wastewaters by biodegradation and membrane retention with less production of waste sludge.

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Presented at the Conference on Membranes in Drinking and Industrial Water Production.
Leeuwarden, The Netherlands, 10–12 September 2012.
Organized by the European Desalination Society and Wetsus Centre for Sustainable Water Technology

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