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In-situ assessment of biofilm formation in submerged membrane system using optical coherence tomography and computational fluid dynamics

Luca Fortunato, Adnan Qamar, Yiran Wang, Sanghyun Jeong, TorOve Leiknes*

Water Desalination and Reuse Center (WDRC), Biological and Environmental Science & Engineering (BESE), King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Kingdom of Saudi Arabia

*Corresponding author. Tel.: +966 12 808 2193. Email: Torove.Leiknes@kaust.edu.sa

Abstract

This paper introduces a novel approach to study the biofouling development on gravity driven submerged membrane bioreactor (SMBR). The on-line monitoring of biofilm formation on a flat sheet membrane was conducted non-destructively using optical coherence tomography (OCT), allowing the *in-situ* investigation of the biofilm structure for 43 d. The OCT enabled to obtain a time-lapse of biofilm development on the membrane under the continuous operation. Acquired real-time information on the biofilm structure related to the change in the flux profile confirming the successful monitoring of the dynamic evolution of the biofouling layer. Four different phases were observed linking the permeate flux with the change of biofilm morphology. In particular, a stable flux of 2.1±0.1 L/m^2h was achieved with the achievement of steady biofilm morphology after 30 d of operation. Biofilm descriptors, such as thickness, biofilm area, macro-porosity and roughness (absolute and relative), were calculated for each OCT acquired scans. Interestingly, relative roughness was correlated with the flux decrease. Furthermore, the precise biofilm morphology obtained from the OCT scans was used in computational