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Fouling of forward osmosis membranes on municipal waste streams

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ABSTRACT

Water recycling for agricultural and industrial applications offers resource and economic savings. In addition, water recovery can alleviate global water stress which currently exists. Therefore is it of general interest to restore/reclaim water from waste streams. Conventional ways to reclaim water from wastewater such as membrane bioreactors combined with reverse osmosis (RO), or micro/ultrafiltration coupled with RO and sand filtration, or advanced oxidation process are all energy intensive.

In comparison to pressure driven membrane processes, forward osmosis (FO) can operate in the absence of applied hydraulic pressure resulting in a lower fouling propensity and consequently lower need for cleaning. However, FO membranes are not completely resistant to fouling. Therefore it becomes important to identify methods to reduce or if possible eliminate fouling as this will lead to increased FO membrane performance and lifespan thus increasing the economic viability of the FO process. As fouling can occur by a variety of processes including inorganic, organic, and biological processes, fouling characterization becomes a non-trivial task.

The objective of this study is to characterize fouling of FO biomimetic aquaporin membranes used for water recovery from municipal wastewater. Membrane fouling was analyzed using Scanning Electron Microscopy, X-ray Dispersive Spectrometry, Fourier Transform Infrared Spectrometry, Inductively Coupled Plasma Optical Emission Spectrometry, Ion chromatography, contact angle and zeta potential measurements.

Our preliminary experimental results indicate that FO biomimetic aquaporin membranes can tolerate being exposed to municipal waste water and that fouling within the first 20 h operation is not severe. When fouling is observed it appears uneven in character, leading to local surface hydrophilization and overall to more negative surface charge. Taken together our results show that it is feasible to use biomimetic membranes in waste water treatment and the analyses can assist in future optimization of membrane performance.