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Fouling Characterization of Forward Osmosis Biomimetic Aquaporin Membranes Used for Water Recovery from Municipal Wastewater

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Abstract #A-203 - Seungkwan (SK) Hong, Ph.D., Professor, Korea University (Korea)

Analysis of Pressure Retarded Osmosis Under Varying Draw Pressure by a Novel Method

Osmosis membrane characteristics in terms of intrinsic transport parameter (A and B) and structure parameter (S) can provide a useful approach to estimate membrane performance, including power density, water and reverse solute flux (RSF). In this study, single pressure retarded osmosis (PRO) method to determine A, B, and S value of PRO membrane was proposed to analyze PRO performance more accurately. This method is composed of four consecutive experiments with different concentration of draw solution at certain pressure. The experimental water and reverse solute fluxes calculated from each experiment are used for determination of A, B, and S by performing a nonlinear least squares fitting. Compared to conventional reverse osmosis (RO)/forward osmosis (FO) method, the single PRO method gave good prediction during PRO process whereby pressure was applied on draw sides. A and B values were generally high in conventional RO mode where water and solute move in same direction by hydraulic pressure. In PRO method, solute permeability, B, was found to be increased by applied draw pressure, while water permeability, A, was slightly decreased. Especially, solute permeability showed a strong pressure dependent behavior. Modelded results was best correlated with experimental data when A, B, and S value determined at the corresponding pressure applied. Thus, the results indicated that membrane characteristics should be determined from the PRO method identically simulating its operating condition for predicting the power density accurately in PRO.

Abstract #A-204 - Agata Zarebska, Ph.D., Technical University of Denmark (Denmark)

Fouling Characterization of Forward Osmosis Biomimetic Aquaporin Membranes Used for Water Recovery from Municipal Wastewater

Generally more than 99.93% of municipal wastewater is composed of water, therefore water recovery can alleviate global water stress which currently exists. Traditional ways to extract water from wastewater by the use of membrane bioreactors combined with reverse osmosis (RO), or micro/ultrafiltration coupled with RO and sand filtration, or advanced oxidation process require high energy. Contrary to pressure driven membrane processes, forward osmosis (FO) offers advantages such as no need of high hydraulic pressure, reduced fouling and simple cleaning. Even though fouling of FO membranes is less severe compared to other pressure driven membrane processes, some fouling can occur. This entails that by reducing fouling, increased FO membrane performance can be expected, thus increasing the economic viability of FO processes. Since various types of fouling might occur in membrane systems such as inorganic, organic, and biological fouling, membrane characterization is not a trivial task. The aim of this work is to characterize fouling of FO biomimetic aquaporin membranes during water recovery from municipal wastewater. Membrane fouling was characterized using Scanning Electron Microscopy, X-ray Dispersive Spectrometry, Fourier Transform Infrared Spectrometry, Inductively Coupled Plasma Optical Emission Spectrometry, Ion chromatography, zeta potential, and contact angle measurements. Our preliminary experimental results indicate that FO membrane fouling is dominated by organic fouling caused by adsorption and deposition of organic matter (mainly proteins and carbohydrates) in combination with biofouling and inorganic scaling. This can provide understanding of how fouling can be mitigated by considering various feed pretreatment and cleaning methods.