Evaluation of energy and water recovery in forward osmosis–bioelectrochemical hybrid system with cellulose triacetate and polyamide asymmetric membrane in different orientations

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\textbf{ABSTRACT}

Recent forward osmosis–bioelectrochemical hybrid systems (FO-BESs) have been designed to simultaneously produce bio-energy and clean water from wastewater. Asymmetric forward osmosis (FO) membranes are a crucial component for determining FO-BES performance, but only cellulose triacetate (CTA NW) membranes in the same orientation have been applied to FO-BESs. In this work, both CTA NW and polyamide (PA) membranes were tested in two membrane orientations (active layer facing feed solution or anolyte and support layer facing feed solution). For an in-depth understanding of the FO membranes, properties were investigated using scanning electron microscopy, contact angle, impedance spectroscopy, and proton transport analyses. The electricity generation and water extraction in FO-BESs having these two FO membranes in different orientations were then evaluated. Based on membrane characterization, PA seemed to be a proper membrane for the FO-BES because of higher hydrophilicity, lower membrane thickness, lower mass transfer resistance, and better proton transfer ability. However, there was no significant current output difference between the FO-BESs having CTA NW and PA. Rather, in terms of water flux, the FO-BESs having CTA NW in the support layer facing feed solution orientation showed better performance.

\textit{Keywords:} Bioelectrochemical systems; Cellulose triacetate; Desalination; Forward osmosis; Membrane orientation; Polyamide

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