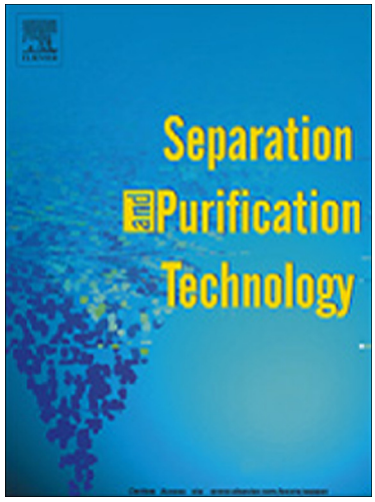

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Sylwin Pawlowski, Claudia F. Galinha, João G. Crespo, Svetlozar Velizarov

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Prediction of reverse electrodialysis performance by inclusion of 2D fluorescence spectroscopy data into multivariate statistical models

Sylwin Pawlowski, Claudia F. Galinha*, João G. Crespo and Svetlozar Velizarov

LAQV, REQUIMTE, Departamento de Química, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

*Corresponding author: Tel: (+351) 212948300, E-mail: cf.galinha@fct.unl.pt

Abstract

The power density obtainable by a reverse electrodialysis (RED) stack decreases along its operating period due to fouling; however this effect is not accounted for by the so far proposed mechanistic models. Recently, it has been demonstrated that 2D fluorescence spectroscopy can capture the time evolvement of ion-exchange membrane fouling. In this work multivariate statistical modeling was performed, by using the projection to latent structure (PLS) approach, to predict relevant RED stack performance parameters: pressure drop, stack electric resistance and net power density. Several PLS models, with and without 2D fluorescence data as models inputs, were developed. It was found that inclusion of fluorescence data considerably improved the models fitting, because the otherwise missing information about the dynamic state of ion-exchange membranes was added. Additionally, the coefficients of the optimized models revealed important contributions of some of the input parameters to the predicted outputs and allowed to mathematically confirm the qualitative observations that fouling of anion-exchange membranes facing river water is the main factor affecting the RED stack performance. This work confirms the applicability of 2D fluorescence spectroscopy for monitoring of fouling in RED stacks and demonstrates the ability of simple, statistically based models to follow RED performance.

Keywords

Reverse electrodialysis (RED), Ion-exchange membranes, 2D fluorescence spectroscopy, Fouling Monitoring, PLS modeling