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Effect of Temperature Gradients in (Reverse) Electrodialysis in the Ohmic Regime

Anne M. Benneker[a], Timon Rijnaarts[b,c], Rob G.H. Lammertink[a,b], Jeffery A. Wood[a,*]

[a] *Soft matter, Fluidics and Interfaces, Faculty of Science and Technology, University of Twente, Enschede, The Netherlands*

[b] *Membrane Science and Technology Group, Faculty of Science and Technology, University of Twente, Enschede, The Netherlands*

[c] *Wetsus, Centre of Excellence for Sustainable Water Technology, Oostergoweg 9, 8911 MA Leeuwarden, The Netherlands*

Abstract

Electrodialysis (ED) and reverse electrodialysis (RED) are processes for the production of desalinated water (ED) and power (RED). Temperature of the feed streams can strongly influence the performance of both processes. In this research, commercial membranes are used for the investigation of temperature and temperature gradients on ED and RED processes. We find that the energy required for ED processes can be reduced by 9% if the temperature of one of the feed streams is increased by 20 °C, while maintaining the charge-selectivity of the membranes. The direction of the temperature gradient did not have a significant influence on the efficiency and selectivity of ED in the Ohmic regime. In RED, we find an increase in obtained gross power density over 25% for the process when one feed stream is heated to 40 °C instead of 20 °C. This work experimentally demonstrates that utilization of low-grade waste heat from industrial processes can yield significant reduction of energy costs in ED processes, or result in higher power densities for RED systems where the increase in temperature of a single feed stream already yields significant efficiency improvements.

Keywords: Waste heat regeneration, (Reverse) Electrodialysis, Temperature gradient, Industrial desalination

Highlights

- Feed temperature gradients enhance performance of ED/RED in the Ohmic regime
- Direction of temperature gradient had no significant influence on performance
- Low grade waste heat can be utilized for enhancing ED/RED performance

*Corresponding author

Email address: j.a.wood@utwente.nl (Jeffery A. Wood)