Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2020.25265

191 (2020) 29–39
July

Effect of design and operating parameters on power generation in reverse electrodialysis (RED): experimental analysis and modeling

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Received 23 August 2019; Accepted 29 November 2019

ABSTRACT

This paper investigated the effect of key parameters such as the number of cell pairs, flow rate, temperature, and salt concentration on the power output characteristics of a reverse electrodialysis (RED) system. Experiments were carried out to measure the open-circuit voltage (OCV) and maximum power (P_{max}) in a bench-scale RED system. The Nernst–Plank flux equations, together with the Donnan equilibrium relations and the electrical neutrality condition, were used to interpret experiments values. Results showed that the OCV and P_{max} increased with an increase in the number of cell pairs and temperature. Using 20 cell pairs, the OCV and P_{max} were 2.75 V and 1.4 W/m^2, respectively. The flow rate affected the OCV and P_{max} but also led to an increase in the pressure drop in the RED stack. Thus, the flow rate was suggested to be 60 mL/min with the use of 20 cell pairs in our system. The OCV and P_{max} were higher at a higher salinity difference between the high salinity and low salinity solutions. Nevertheless, the OCV and P_{max} were smaller at a higher salt concentration even if the salinity gradient between the high and low salinity solutions were the same.

Keywords: Salinity gradient power (SGP); Reverse electrodialysis (RED); Open circuit voltage (OCV); Power density; Model validation

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Presented at the 12th International Desalination Workshop (IDW2019), 28–30 August 2019, Jeju, Korea