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Towards implementation of reverse electrodialysis for power generation from salinity gradients

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ABSTRACT

Reverse electrodialysis is a conversion technique to obtain electricity from salinity gradients. Over the past few years, the performance of reverse electrodialysis on laboratory scale has improved considerably. In this paper, we discuss the challenges we are still facing concerning the economic and technological feasibility and the developing path of reverse electrodialysis. We focus on the following issues: (i) the development of low-cost membranes, (ii) pre-treatment in relation to stack design and operation, and (iii) the economics of reverse electrodialysis. For membranes, the challenge is to increase availability (>km^2/y) at reduced cost (<2 €/m^2). The membranes should be manufactured at high speed to meet this challenge. For pre-treatment, a capital-extensive microscreen filter with 50 μm pores was selected and tested. Such a straightforward pre-treatment is only sufficient given the fact that the reverse electrodialysis stack was redesigned towards a more robust spacer-free system. For the economic feasibility, a 200 kW repetitive unit was designed. The cost price is estimated to be less than 0.08 €/kWh (excluding any subsidy or compensation), comparable with that of wind energy. The feasibility of the technology should be proved with a scaled-up system under practical conditions. The intended pilot facility at the Afsluitdijk (The Netherlands) will be an essential step towards implementation of reverse electrodialysis for power generation.

Keywords: Salinity-gradient energy; Reverse electrodialysis; Blue energy; Renewable energy; Fouling; Biofouling; Ion-exchange membranes

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