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Reverse electrodialysis process: Analysis of optimal conditions for process scale-up

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Reverse electrodialysis (SGP-RE or RED) process has been widely accepted as a viable and promising technology to produce electric energy from salinity difference (e.g. using river water/seawater, or seawater and concentrated brines). Recent R&D efforts demonstrated how an appropriate design of the SGP-RE unit and a suitable selection of process conditions may crucially enhance the process performance. With this regard, a process simulator was developed and validated with experimental data collected on a lab-scale unit, providing a new modelling tool for process optimisation.

In this work, the process simulator previously proposed by the authors has been adopted for a wide sensitivity analysis of the SGP-RE process. The aim of this analysis is to investigate the influence of the most relevant variables (i.e. solution properties, stack geometry) on the overall process performance. In particular, the use of different salt concentration for feed streams, as well as flow rates and membrane size have been taken into account as optimisation variables. Different stack sizes were investigated, starting from a 10x10 cm^2 lab-stack, up to a 44x100 cm^2 large prototype unit.

Finally, different scenarios are proposed for a prototype-scale plant, providing useful indications for the technology scale-up towards 1 kW of power production. These model predictions will be eventually used to address the economic feasibility of the SGP-RE technology for large scale applications.

Keywords: Salinity gradient power; RED; Seawater; Brine; Process simulator; Model

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Insights into desalination plant operation through advanced modeling and simulation of spiral wound membrane element performance

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Optimization of performance characteristics of spiral wound membrane (SWM) elements essentially determine the overall efficiency and economics of desalination plants. Therefore, it is imperative to be able to predict with high degree of reliability this performance as a function of the main SWM design variables and system operating parameters. The compact SWM element design does not permit detailed local measurements that are needed to map the flow field and the related