Numerical Analysis of Ion Transport in Stacked Cells of Reverse Electro-dialysis for Generating Electricity

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During the past decade, global warming has been accelerated by the drastic increase in the use of fossil fuels. Energy harvesting technology utilizing salt concentration difference between seawater and fresh water is under development in Europe as a novel source of renewable energy. Reverse Electro-dialysis (RED) method is a direct way to convert salinity-gradient energy to electricity using ion exchange membranes (IEM) that selectively allow only a particular kind of electrolytes to permeate. In this study, RED stack cells with 1~2 watt capacity were constructed, and the characteristics of power generation were examined for various flow conditions of seawater and fresh water. In 3D numerical analysis that simulated ion transport of both convection and diffusion, the corresponding electrical currents were calculated from the total amounts of ion transport through IEM, and the results were compared to experimental results to verify the sanity of numerical simulation. This 3D numerical simulation technique is expected to provide a useful methodology to design efficient RED stack cells for power generation.