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Simulation of an ion exchange membrane electrodialysis process for continuous saline water desalination

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ABSTRACT

A computer program is developed and a continuous ion exchange membrane process is simulated applying a constant voltage between electrodes. Inputting membrane characteristics, electrodialyzer specifi cations and electrodialysic conditions into the program, the performance of an electrodialyzer is predicted. Salt concentration in a desalted solution, current efficiency, desalting ratio, water recovery, energy consumption, current density distribution, current density non-uniformity coefficient, limiting current density are evaluated. Influence of cell voltage and salt concentration in a feeding solution on (1) the transport of ions (migration and diffusion) and solutions (electro-osmosis and hydro-osmosis) across a membrane pair, (2) ohmic and membrane voltage in a membrane pair and (3) electric resistance of membranes, desalting cells and concentrating cells in a stack are discussed at the inlets and outlets of desalting cells. Electroosmosis, ohmic voltage and electric resistance of membranes are increased with the increase of cell voltage and salt concentration of a feeding solution. Hydroosmosis and membrane voltage are remarkable at lower cell voltage and lower feeding solution concentration and this phenomenon contributes to energy-saving in brackish water desalination. However, in this circumstance, electric resistance of desalting cells is relatively high.

Keywords: Ion exchange membrane; Electrodialyzer; Continuous electrodialysis; Saline water desalination; Limiting current density