Seawater pre-desalination with electrodialysis

Motivation

Due to rapidly increasing fresh water scarcity, seawater desalination for drinking water production becomes an important option. Seawater reverse osmosis is currently the most used non-thermal technique for seawater desalination. Seawater reverse osmosis has some drawbacks of which the most important are a low water recovery, a relatively high energy consumption and the need for capital and energy intensive pre-treatment. A breakthrough to counter these issues cannot be expected within the development of high-pressure reverse osmosis membranes. Electrodialysis can be further developed to overcome the current limitations in seawater desalination using reverse osmosis, by lowering the osmotic pressure of the seawater.

Technological challenge

Desalination of water with electrodialysis is mainly limited by the low conductivity of the dilute stream. Therefore it is more likely that electrodialysis is considered as a candidate technique for desalination of seawater that has a much higher conductivity.

Thermodynamically the desalination from salt water to brackish water is also more advantageous than desalination of brackish water to fresh water. Another advantage is that electrodialysis needs little pre-treatment. The combination of these features makes further development of electro dialysis attractive as a suitable pre-treatment step for reverse osmosis. The principle of electrodialysis is given in Figure 1. By changing current and or throughput of the system the salinity of diluate and concentrate can be controlled.

The aim of this research project is to investigate and develop a suitable process in which the desalination work could approach the thermodynamic limit at a maximum water recovery. This implies a reduction of energy use of about 50% to 2.0 kWh / m³ and minimizing seawater pre-treatment effort. affordable microbial fuel cell.

Figure 1. Schematic overview of an electrodialysis cell to desalinate sea water to brackish water.