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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

REQUIMTE/CQFB, Chemistry Department

Sustainable Energy via Water Salinity Gradients

BPEG / Requimte
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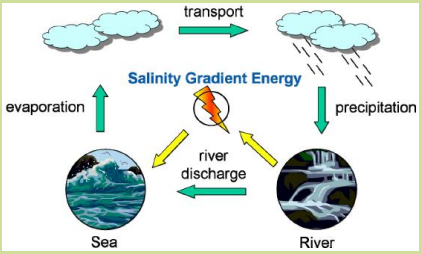
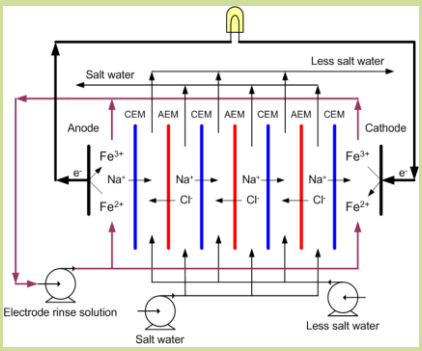
Objectives

A potentially sustainable source of energy is the **chemical energy associated with solvation of salts**. When two streams of different concentrations are brought in contact, they mix spontaneously and release energy (Gibbs free energy). **Extraction of such energy, using membrane processes, is the main goal of the project.**

Reverse electrodialysis (RED) is an emerging technology for power generation from salinity gradients, in which a number of alternating cation- and anion-exchange membranes are stacked between two electrodes. The compartments between the membranes are alternately fed with concentrated (e.g. sea water) and dilute (e.g. river water) saline solution, which leads to an electric potential difference between the electrodes, where a redox couple converts the chemical into electrical energy.

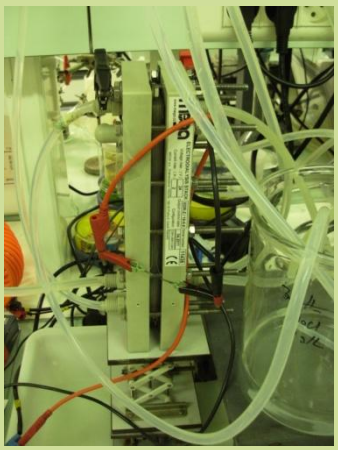




Methodology

An EDR-Z-Mini unit (MEGA a.s.) constituted by 10 cell pairs of membranes (10 AMH-PES and 11 CMH-PES of the Ralex type) has been used. Titan electrodes with a platinum layer are applied. The measurements are performed in an OCV (open circuit voltage) mode or are carried out at an AUTOLAB potentiostat / galvanostat coupled with 10 A current booster. The methodology applied involves the following issues:

Evaluation of the impact of the type of red-ox couple used;
Evaluation of the effect of ionic composition and concentration of the two salt solutions on the process performance;
Evaluation of the impact of the fluid dynamics in the unit channels;
Exploring the potential of using Atlantic ocean water, or brines, as the high-salinity stream.



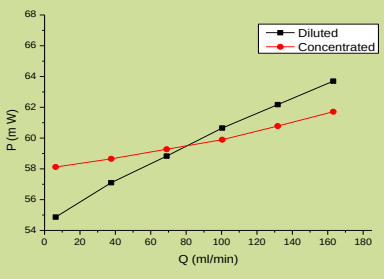
Expected Results

A better insight into the impact of using different homogeneous redox systems, which do not cause net chemical reactions and, therefore, the power losses are expected to be low.

Elucidating the effect of the presence of multi-valent ions ion on the stack resistance, The first results obtained are rather promising, as shown by successful utilization of Atlantic Ocean water (generated specific power: 0,55 W/m^2).

In plate-and-frame RED stacks, the main resistance is located in the dilute stream compartments. Reformulation of the diluted stream channels design and/or operation will be therefore essential for further optimization of the RED process.

Max. P_d (W/m^2) = 0,63
(For 30 g/L NaCl vs. 1 g/L NaCl at OCV)



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