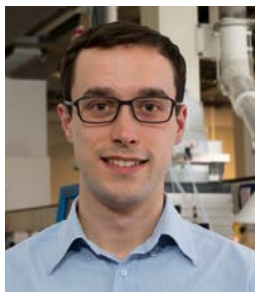
wetsus
european centre of **excellence**
for sustainable **water technology**

Material Design for Fouling Control in Reverse Electrodialysis



Diego Pintossi
diego.pintossi@wetsus.nl

Motivation

Renewable energy sources are crucial to meet the growing world energy demand in a sustainable way. In recent years, salinity gradient energy has shown an increased potential as a viable source of renewable energy. This energy is based on the generation of electricity from the mixing of aqueous solutions with different salinity, such as river and seawater. Reverse electrodialysis (RED) is used to harvest the salinity gradient energy by using ion exchange membranes (Fig. 1).

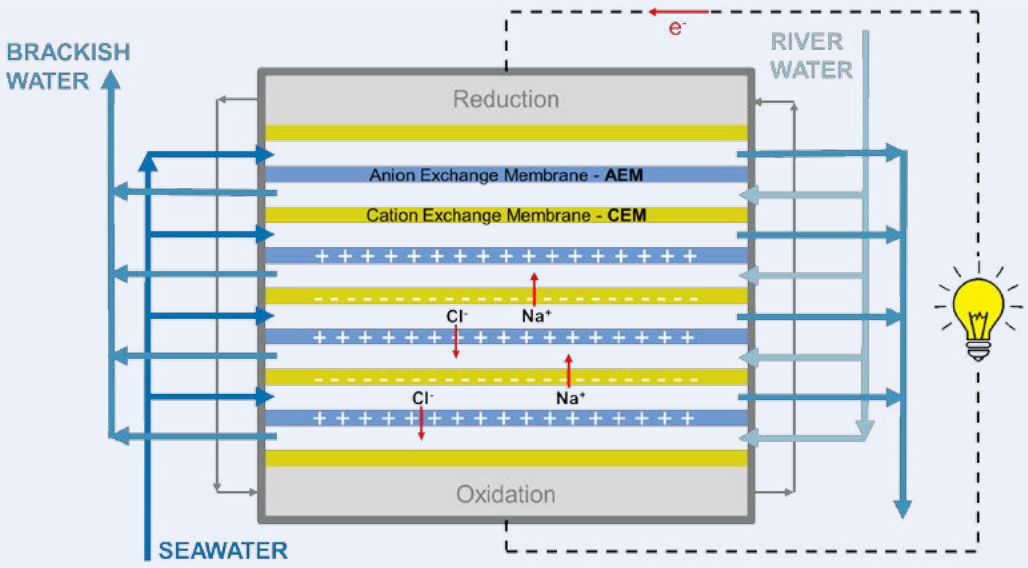


Fig.1 Schematic illustration of the working principle of RED. River water and seawater flow alternately in channels separated by anion and cation exchange membranes (AEM and CEM, respectively), which enable the selective transport of anions and cations. The ion current flowing inside the stack is converted in an electrical current by a redox couple at the electrodes.

Wetsus has extensively investigated RED at laboratory and pilot plant scale in the past decade. Testing with real feedwaters at the Afsluitdijk research facility (Fig. 2) opens up new opportunities to study and to overcome issues related to membrane fouling.

Fig.2 Full scale 50 kW RED research facility at the Afsluitdijk in the North of The Netherlands [1].

Technological challenge

Natural feedwater streams contain several foulant species like e.g. multivalent ions, micro-organisms, silicates and humic acids. These species interact with the membrane surface in the RED stack, reducing the power output up to 60% in the first few days of operation (Fig. 3) [2]. To run the RED stack at a stable and high performance level, fouling control needs to be developed based upon modification of the chemistry of the membranes.

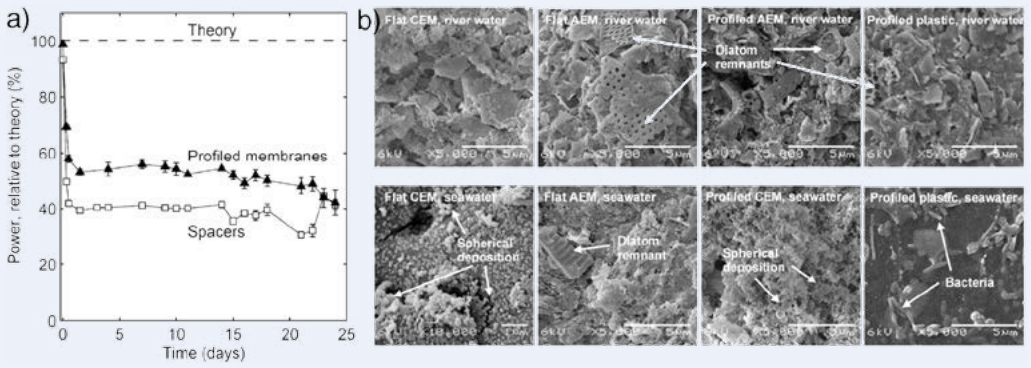


Fig.3 (a) Loss of normalized power output over time for RED stacks in natural feedwater streams for stacks with spacers and with profiled membranes (less fouling) (b) SEM images of foulants on the membrane surface like diatomic species and bacteria [2].

Research objectives

The aim of this PhD project is to investigate the influence of the chemistry of RED membrane materials on fouling in natural conditions. In particular, a study of the interactions taking place at the membrane-feed interface will be followed by the development of suitable membrane to control them. Newly designed membrane materials and surface modifications will be implemented to develop membranes capable of optimal RED performance with natural feedwaters (Fig. 4).

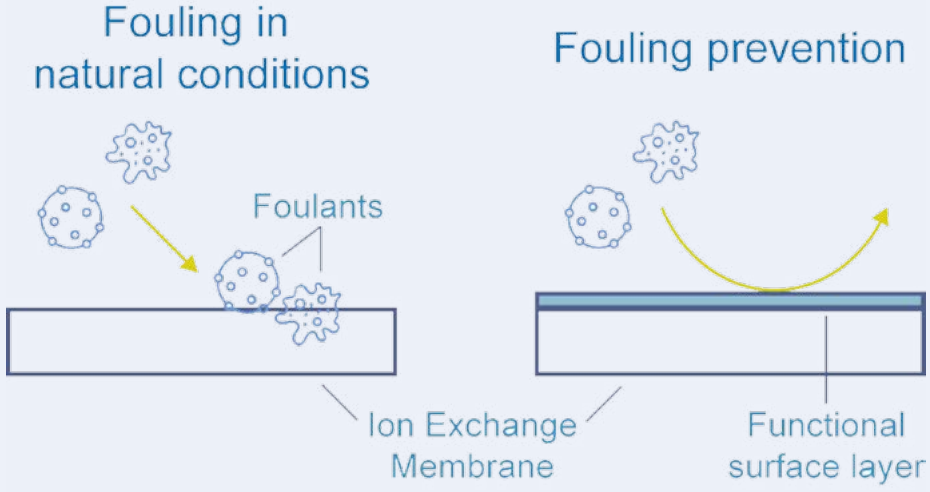


Fig.4 Surface modification of RED membranes is one of the possible approaches to prevent fouling.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 665874

References:
[1] www.redstack.nl
[2] Vermaas et al., Water Research 47 (3) (2013), 1289-1298.