Microbial Desalination Cell for low energy drinking water production

Author
Dr. Abdulsalam Alhadidi
Fujifilm Manufacturing Europe B.V. P.O. Box 90156, 5000 LJ Tilburg, The Netherlands
Abdulsalam_alhadidi@Fujifilm.eu, +31 (0)13 579 1911

Introduction

One of the major challenges facing the humanity on earth, is the availability of fresh water over the world. Water desalination can fill the gap by producing a fresh water from the brackish water or even the seawater for drinking or industrial applications. Current state-of-the-art shows that the conventional **R**evers **O**smosis (RO) has a challenging limit of minimum energy consumption ~ 2-3 kWh/m^3. A lot of work has been done in optimising the pump's design and operation for the RO systems. On the other hand, "hybrid systems" by combining the RO with other innovative desalination concepts show an optimistic solutions to overcome the thermodynamical limitations of the RO.

The **M**icrobial **D**esalination **C**ell (MDC) shows a good ability to treat wastewater and at the same time, generate energy to be used to desalinate the saline water using an electrodialysis concept incorporated within the MDC as a pre-softening step for the RO system as shown in figure 1.

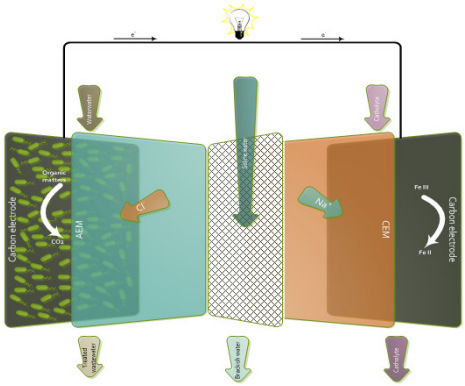

Figure 1. Microbial desalination cell MDC concept

Pilots around the world

In this project, an automated and well controlled system will be developed and used as a smart energy management tool. Besides that, a simulation modelling tool will be used for optimizing the MDC process performance.

Figure 3. Three MIDES pilot plants around the world

The integration of the whole MIDES concept including MDC and RO, will be first validated at a pre-pilot scale. The effectiveness of this innovative solution will be demonstrated at representative demo-sites at three international locations (Spain, Tunisia and Chile). The pilot-plants will be operated for 12 months with challenging target of desalination capacity of 150 l/h of fresh water at low energy consumption combined with **W**aste**W**ater **T**reatment (WWT) of 1-3 m^3/day.

MIDES concept

The main goal of MIDES project is to develop the world's largest demonstrator of an innovative and low-energy technology for water production using the MDC as a pre-treatment step for RO. Therefore, MIDES will focus on developing a new dedicated Ion-exchange membrane for MDC, new nanostructured electrodes, selection of specialized salt tolerant bioelectrogenic cultures and Self-cleaning novel nano-coated ceramic membranes.

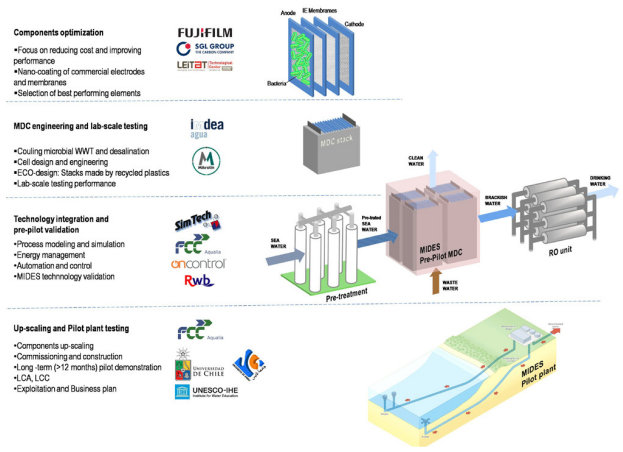

Figure 2. MIDES concept

Expected impacts

MIDES aims at:

- High performance, low manufacturing cost and optimized MDC process
- High **C**hemical **O**xygen **C**hemical (COD) reduction
- Low energy consumption for Seawater desalination
- Less cleaning and extended life of the ion-exchange membrane

It is expected that MIDES will help to increase the water resources and reduce pollution in areas where less effective WWTs are used at present. MIDES will promote desalination to increase public acceptance of purified water through the desalination process.

Besides that, MIDES aims to achieve positive environmental impacts:

- Decrease of 1.42 kg of CO_2 per emission m^3 of water, 20% less comparing to a conventional RO system
- Additional reduction in **G**reen**H**ouse **G**as GHG emission from less energy used for WWT
- No aeration is needed and no sludge handling due to the use of Geobacter in an anaerobic condition

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