Peter Andreas Nötzli

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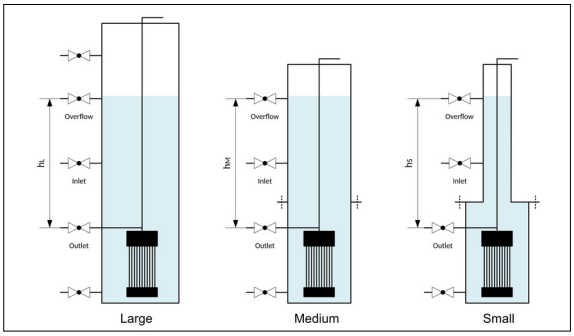
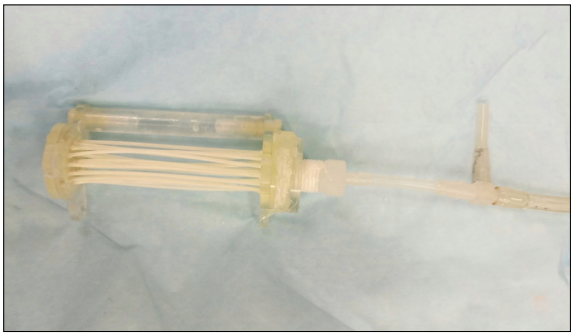
Subject Area	Water treatment

Gravity-driven membrane reactor for seawater pretreatment

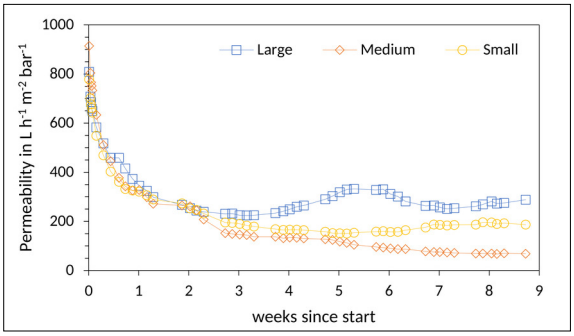
Effect of hydraulic retention time



Schematic representation of the reactor setup



Hollow fibre membrane module (unused) with tubing



Permeability of the reactors during the operation time

Introduction: To produce drinking water from the sea water, desalination plants operating with reverse osmosis (RO) are needed. Desalination plants require high capital and operating costs due to installation, maintenance, and energy usage. To improve efficiency and save energy it is necessary to create a well-designed pretreatment step for the desalination process. At present, filtration is the dominating process for pretreatment. However, in the last ten years ultrafiltration membrane (UF) pretreatment has been emerging as an attractive alternative to common filtration.

Objective: This bachelor thesis aims to develop an ultra-low energy membrane pretreatment process for seawater desalination. It demonstrates the flux stabilisation during dead-end ultra-low-pressure membrane filtration (gravitiy driven UF; GDM) of seawater at different hydraulic retention times (HRT) and shows their influence. Initially, five hollow fibre membrane modules were prepared and installed in three different reactors afterwards. Those different in their volumes were filled with seawater, which was newly procured weekly. The water level in the reactor was kept constant. Various measurements were performed. The flow rate was measured daily, the pH value and dissolved oxygen (DO) concentration three times a week. Samples from feed water, reactor water and permeate were analysed with EEM and LC-OCD weekly. In the same samples the amount of trans exopolymer particles (TEP) was determined. During the operation time, the AOC measurements were conducted four times.

Solution:

- A longer HRT leads to a higher flux.
- A longer HRT favours a smaller irreversible fouling of membranes.
- A shorter HRT results in a slightly better water quality, but this is insignificant.

In the future, the influence of different HRTs on the GDM performance should be studied. It is therefore recommended to carry out the same experiment with a larger amount of reactors. If correlations can be found, maybe there also can be found an optimal HRT for GDM pretreatment with desalination.