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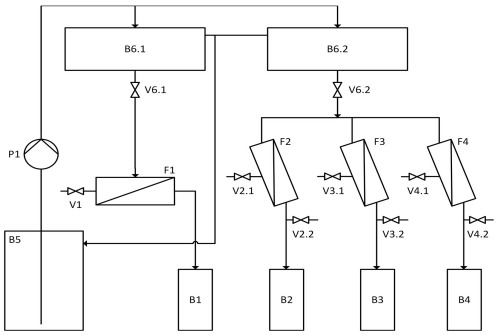
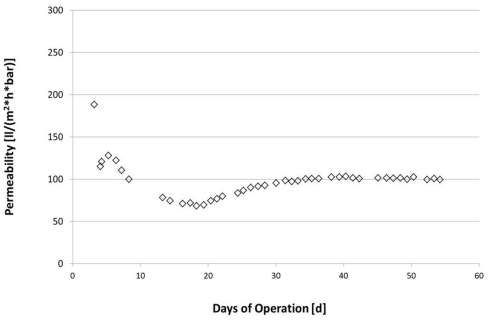
Ultra Low Energy Membrane Pretreatment for Seawater Reverse Osmosis (SWRO)

Conception and Design of a GDMUF Pilot Plant and Membrane Experiments



Setup of the membrane experiments. Membranes F1-F4 were fed with seawater at a constant transmembrane pressure of 40 mbar.



Detail of permeability of the UF membrane. After an initial drop (hidden), permeability recovered and stabilized at 100 l/(m^2*h*bar).

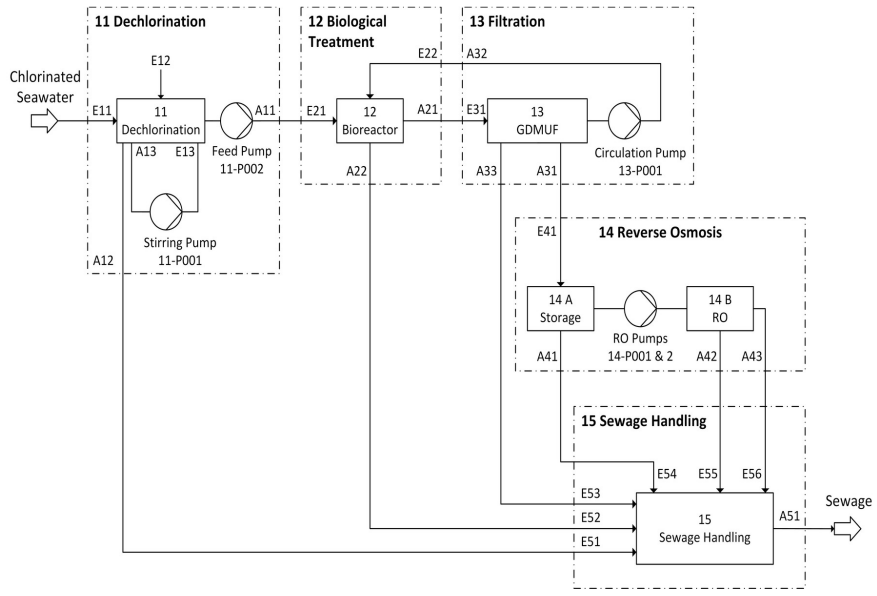
Ausgangslage: Gravity driven membrane ultrafiltration (GDM) seems to be a promising ultralow energy pretreatment for seawater reverse osmosis. Until recently permeate of GDM from seawater preatrement tests has shown an increased AOC content followed by biofouling on reverse osmosis membranes. Latest studies show that AOC content can be lowered if a bioreactor is installed before the GDM step.

Firstly, a dechlorination step, bioreactor and GDM section run as a energy-saving pilot plant was designed. The plant consists of:

- a dechlorination section providing 3000 l dechlorinated seawater per day
- a bioreactor with 580 sqm active biofilm area for AOC removal
- a GDM section providing 53 l/h pretreated seawater

Conservatively calculated, the energy demand of the pilot plant for pretreatment will be about 0.3 kWh/m^3 of pretreated seawater which is congruent with the energy demand of conventional pretreatment.

Secondly, the influence of pore size and wettability of a UF and three different MF on long-term permeability was investigated. Long-term permeability seemed to be dependent on the initial wettability of the membrane: the higher the wettability, the higher was the long-term permeability. Hence, the membrane with a contact angle of 34° had the highest permeability (190 l/(m^2*h*bar)) whereas permeability of the one with the biggest contact angle of 76° membrane was at 90 l/(m^2*h*bar).



Block diagram of the pilot plant. Seawater is pretreated in three sections (11, 12, 13), passes the RO section (14) and is collected in (15).