Water Recovery from Sewage Using Forward Osmosis


BACKGROUND

The amount of fresh water per person is decreasing. Therefore interest into alternate, low cost solutions i.e. water recovery from wastewater, is growing.

Forward Osmosis (FO) has the potential to produce high quality water which can be used as

• industrial process water
• (indirect) source of potable water etc.

SEWER MINING CONCEPT

Figure 1 summarises the different processes involved in the Sewer Mining Concept. This poster focuses primarily on the FO unit, which extracts water from sewage by means of osmosis.

AIM

• Investigate the influence of settled sewage on FO performance vs deionised water (DI)
• Investigate the fouling propensity of the FO membrane by inducing fouling.

RESULTS

The short-term experiments, which lasted 6 hours were all performed in a U-tube, lab-scale setup (Figure 2). Figure 3 illustrates the influence of the different feed types. The feeds used were settled sewage and DI water, and the draw solution 0.5 M NaCl. Stable FO water fluxes were obtained. Produced values (> 4.3 LMH) with settled sewage as feed were approximately 20% lower than with DI water as feed (5.2 LMH) using 0.5 M NaCl.

Figure 4 demonstrates the results from the fouling test. The test attempted to induce fouling by increasing the draw solution concentration. Fouling is evident when comparing water flux values of a fresh membrane (virgin) with a membrane used for the full series.

Results from the Scanning Electron Microscopy (SEM) of the fouled membrane, show cracks in the support layer due to possible drying-out of the membrane (Figure 5A), while Figure 5B confirms the thin fouling layer on the membrane. This layer could be simply rinsed off showing that fouling was, in this case, reversible.

FO membranes can be used in the recovery of water from settled sewage resulting in low fouling propensities.

FOUling of the membrane was found to be reversible during short-term experiments.

CONCLUSION

Figure 1: Schematic overview of the Sewer Mining concept. FO is coupled to (i) a reconcentration system to produce high-quality water and to (ii) an anaerobic digester to convert the subsequent concentrated sewage into renewable energy.

Figure 2: Experimental U-tube setup.

Figure 3: Water flux over time with feed solutions (i) DI water [grey] and (ii) settled sewage [black], 0.5 mol/L NaCl as draw solution (temperature normalised to 20°C, membrane orientation: active layer facing feed side).

Figure 4: SEM micrographs of the FO membrane surface: (A) Image of the fabricated mesh within the membrane (magnification ×100, accelerating voltage: 6 kV). Cracks in the surface can be observed, possibly caused by drying out of the membrane. (B) Image of the fouled, dull layer of the membrane (magnification ×100).

Figure 5: SEM micrographs of the FO membrane surface: (A) Image of the fabricated mesh within the membrane (magnification ×100, accelerating voltage: 6 kV). Cracks in the surface can be observed, possibly caused by drying out of the membrane. (B) Image of the fouled, dull layer of the membrane (magnification ×100).