Forward osmosis biomimetic membranes in industrial and environmental applications

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Forward osmosis biomimetic membranes in industrial and environmental applications

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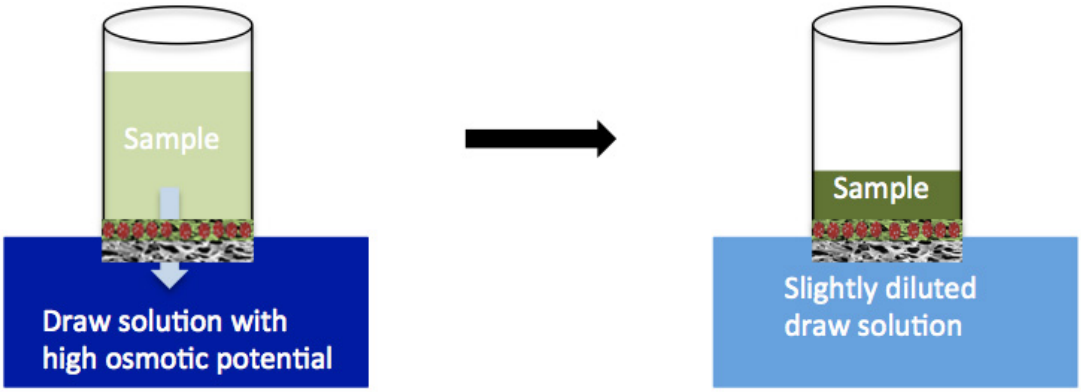
Membrane processes have in recent years found increasing uses in several sectors where separation of one or more components from a solvent, typically water, is required. The most widespread types of membranes are polymeric and pressure driven, but the high pressures that are required results in increasing costs and fouling/scaling problems. In an attempt to overcome these problems, attention has recently turned to the use of forward osmosis, where a solution with a high osmotic pressure is used to draw water from the solution that is to be filtered. This technology promises to reduce the energy consumption and lead to much more stable operations, but is currently limited by the availability of suitable membranes. However, by introducing aquaporin protein channels into a polymeric membrane to make a biomimetic membrane, the vision of both high flux and separation efficiency may be achieved. In this work we have investigated two potential uses of this technology: Peptide up-concentration and pesticide removal.

We have developed a new method for up-concentration of small molecular compounds based on gentle water removal from the sample by forward osmosis. The technology is based on two units; 1) a single use filtration module containing a sample reservoir and a biomimetic aquaporin based forward osmosis membrane. 2) a multi-use desktop forward osmosis system containing draw solution mixing, and monitoring devices. The sample is placed in the single use module and the module is then mounted in the forward osmosis system. Here the up-concentration can be carried out by forward osmosis with a suitable draw solution while controlling volume, concentration, etc., allowing the up-concentration to be terminated at a given value for the monitored parameters. Our technology differentiates itself by being a simple unit operation based on osmotic extraction of water from dilute peptide samples with no – or very little loss of sample material.

A big challenge in modern water treatment is the handling of micropollutants. One example of these is the pollution of ground-/drinking water with pesticides, which in Denmark have affected close to half of the groundwater resource. In this part of the work we have studied the rejection of three key pesticides: Atrazine, BAM and DEIA at different operating conditions. These are some of the most widespread groundwater pollutants, and also some of the most challenging to remove with membranes due to their small size. They may therefore be considered as a suitable benchmark test for general micropollutant removal with biomimetic membranes.



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