Forward Osmosis: Membrane and Module development and process applications (FOMM)

Forward osmosis (FO) is an osmotically driven membrane process where water diffuses through a semi-permeable membrane from a low osmotic process stream to a high osmotic draw solution. Forward Osmosis has the potential to generate clean water while simultaneously enhancing the reuse of valuable components present in waste streams (figure 1). FO can treat highly fouling or viscous feed streams, due to its low fouling potential. These streams are omnipresent in multiple industrial processes at companies ranging from chemical companies (e.g. oil brine) to food, dairy and animal industries (e.g. juice, cheese, whey, manure). For such streams, the efficiency of RO and other pressure driven membrane technological processes is too low due to huge fouling issues and limited concentration factors.

FO is a very energy efficient process. Since the transport is based on the osmotic difference between two solutions the only energy required is the pumping energy to circulate the process stream and the draw solution through the membrane module.

Ideal characteristics of forward osmosis membranes are a high-water transport and high salt rejection. A low reversed salt flux prevents the fall in value of the concentrated product stream by salt intrusion. To promote a high water transport the selective layer of the membrane is best as thin as possible, the needed mechanical strength can be provided by an open support layer. The main issue with present forward osmosis membranes is the decreased water flux due to dilution of the draw solution in the membrane support, the so called dilutive internal concentration polarization (dilutive ICP). A more open support promotes mixing of the draw solution present in the support layer and the bulk solution thereby maintaining a high osmotic gradient over the selective layer of the membrane.

The goal of this research is to develop supports of forward osmosis membranes that reduce the impact of dilutive ICP and that can be commercially produced. Therefor a technique named electrospinning will be used for the support development. Electrospinning is a solution or melt spinning process whereby the fibre is formed under influence of an electrical force.

By electrospinning very open structures from randomly oriented nanofibers can be created with a high porosity, high strength and tailorable properties. Various types of polymers can be used to optimise the support properties. After production of the porous support a dense selective layer will be applied to complete the FO membrane.

Contact details

Name: Sjoukje Lubach  
Country of origin: The Netherlands  
Room: STO 0.49  
E-mail: s.lubach@tue.nl  
TU/e phone: +31 40 247 3546