A NOVEL APPROACH TO SEAWATER DESALINATION USING POLYMERIC HYDROGELS

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Polymeric Hydrogels exhibit a large swelling capacity in water (up to 10^3 times of their own weight), especially when they contain charged groups as for example in poly acrylate. By adding a low molecular salt to the system, the swelling capacity will be drastically lowered as the gel's osmotic potential is influenced by these ions.

In contact with a salt solution such gels will take up preferably water depleted in the mobile ions. This is a result of the shielding by the polymer bound charges.[1] In this respect the gel surface is a pseudo 3-D membrane being partly impermeable to the low molecular ions.[2] The effect opens a field of possible ion enrichment or depletion processes which make use of the concentration difference between the gel and solution phase.

One example is a method to reduce the content of sodium chloride in part of a solution presented by us recently.[3] This method can be seen as a model process for seawater desalination. Particles of crosslinked poly(Acrylic acid) are allowed to swell freely in an excess of NaCl-solution. Afterwards the supernatant phase enriched in salt is removed and discarded. The gel is deswollen by means of mechanical force in a homemade filter setup (**Figure 1**). Thereby the depleted solution is regained separately from the polymer. In the eluent the salt concentration is monitored online, finding at first a salt content similar to the supernatant phase which is then significantly reduced with volume flux (**Figure 2**). During the experiment the pressure necessary to maintain the flux is steadily increased.

Here we present a new setup with improved sensors and optimized geometry which gives better insight to the process of deswelling the gel. All parameters are obtained online with high time resolution. In addition several parameters suitable to optimize the desalination capacity in terms of pressure profile, salt content and gel composition like the degree of crosslinking and particle size are investigated.

[1] F. L. Buchholz, A. T. Graham, *Modern Superabsorbent Polymer Technology*, 1st Ed., Wiley-VCH, New York, **1998**, S. 181.

[2] G. Maurer, J.M. Prausnitz, *Fluid Phase Equilibria* **1996**, *115*, 113.

[3] J. Höpfner, C. Klein, M. Wilhelm, *Macromol. Rapid Commun.* **2010**, *31*, 1337.

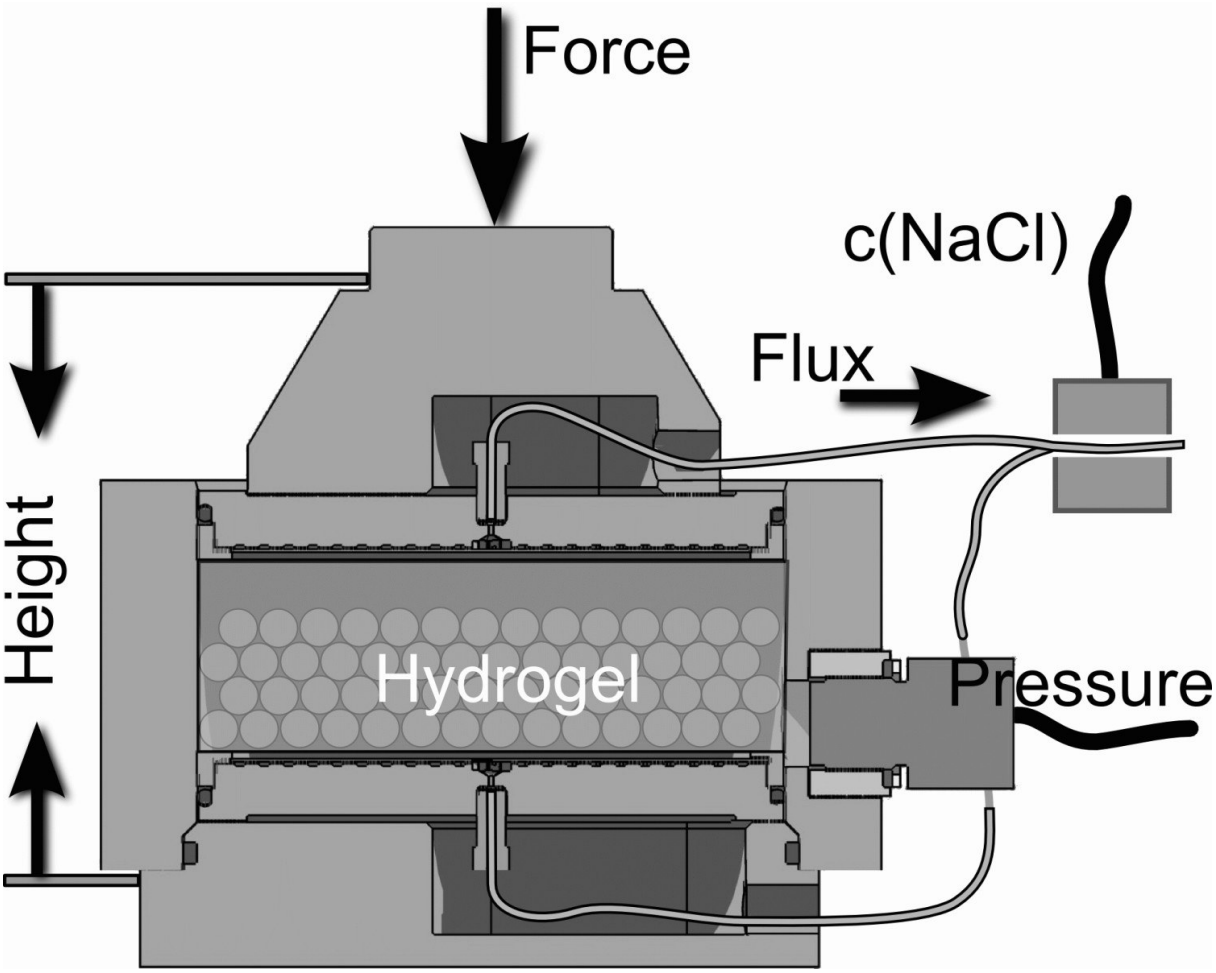

Figure 1*:* Schematic cross-section of the filter setup used in the desalination experiments. The hydrogel is compressed by force between two sieve elements. The resulting eluent is monitored for its salt content by a conductivity flow cell. All important parameters as pressure, flux and salt concentration are permanently monitored.

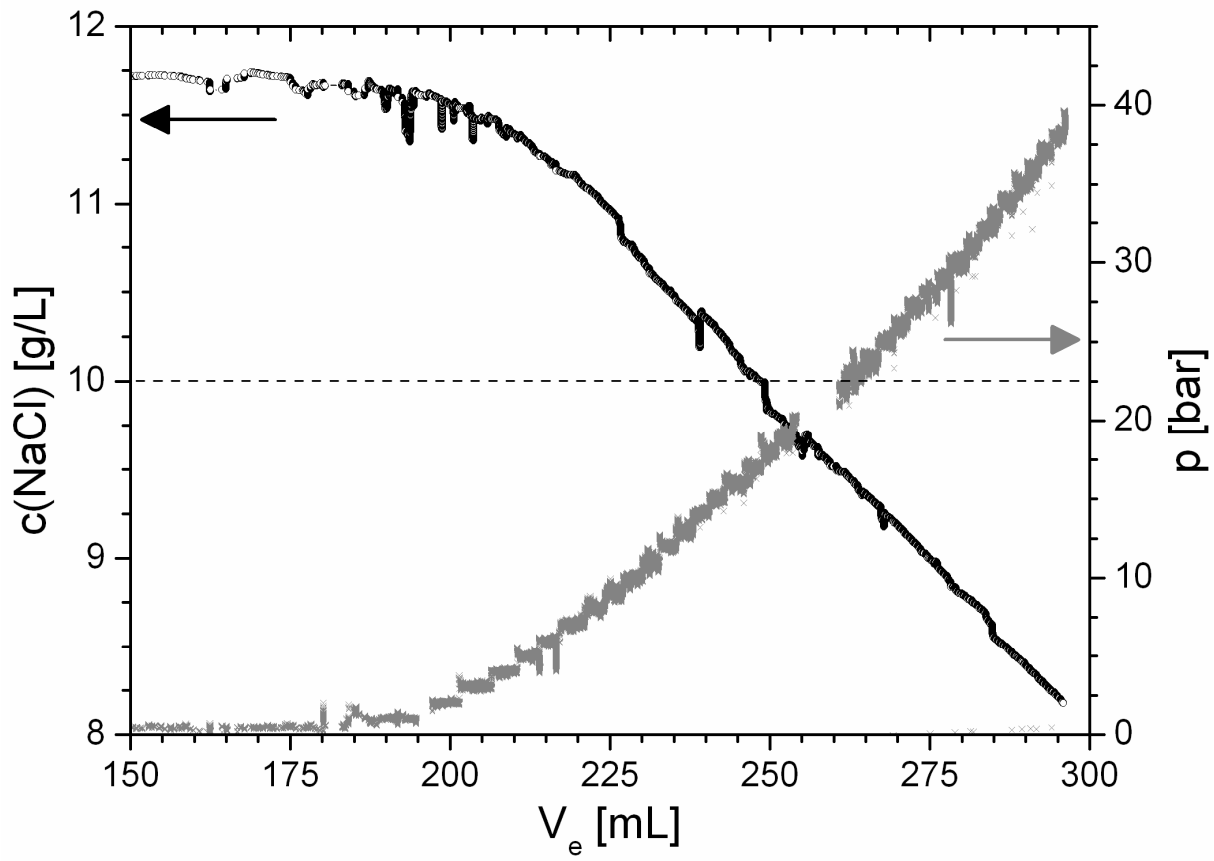

Figure 2: Typical result of a desalination experiment. With the eluent flux the salt concentration is reduced under the value of the initial salt concentration (10 g/L, dotted line) to achieve actual desalination. The pressure p is raised by 6 bar/h to maintain the flux.