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Organic Material and Interfaces group
MSc Project
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Permselectivity and electrical resistance of anion exchange membranes: correlation between solution parameters and process performance in presence of phosphate salt.

Introduction

The use of anion exchange membranes (AEMs) for the selective separation and recovery of anions from wastewater is extensively studied for various applications, including electodialysis (ED) and capacitive deionization (CDI). In term of separation performance, a good ion exchange membrane required a low membrane *electrical resistance* [ER] (tendency to resist of the passage ionic current) and a high *permselectivity* [PS] (ability to discriminate between co-ion and counter-ion). Among the various parameters that can affect membrane separation and selectivity performances, there are the nature of the anions and their concentration, the pH of the solution and also the chemical structure of the membrane [1,2].

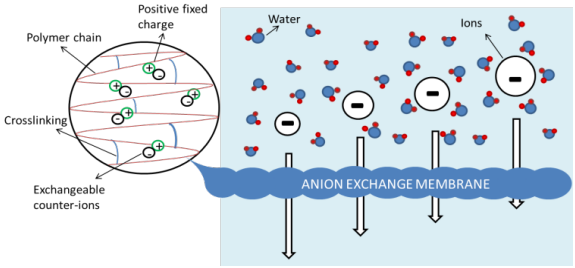

Fig.1 Schematic representation of AEM

All the listed effects reach a higher level of complexity when the salt involved is *phosphate*, and this is mainly due by its ampholyte nature (substance that can enter in protonation-deprotonation reactions in aqueous solution). V. Sarapulova et al. [3] reports that a commercial AEM in the presence of phosphate shows an unusual conductivity trend in function of salt concentration; from our previous studies (see Fig.2) we observed an unexpected decrease of membrane PS when exposed to a high phosphate solutions concentration.

AEM used in combination with electrical field, can effectively removes phosphate ions from stream, but typically the selectivity is quite low. To keep good separation performance and gain in selectivity, AEM are usually modified with deposition of thin coating of polycations and polyanions at membrane surface [4]. A complete understanding of ER and PS performance of modified/not-modified AEM in presence of phosphate is highly important, especially if the membrane is employed for removal and recovery application.

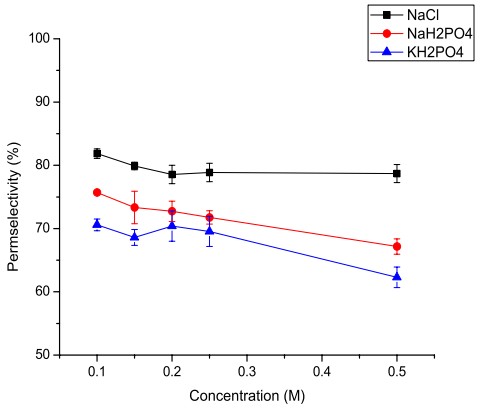

Fig.2 Permselectivity trend of commercial AEM in the presence of NaCl (black), NaH_2PO_4 (red) and KH_2PO_4 (blu). The results were obtained in TuDelft

Aim of the work

In this project we proposed a list of activities that will combine an experimental part and a modeling part (this work has been already started by a previous student).

A) Experimental characterization of modified AEM in term of PS and ER: the modified AEM will be tested by using lab-scale set-up. The permselectivity of the membrane will be investigated with different salt solutions at different concentrations, the same with the electrical resistance. The results will be compared with the commercial AEM tested in a previous project.

B) Modelling electro-driven separation process in AEM in the presence of phosphate solution: theoretical investigation by modelling the effect of ions solution (concentration, type of anions) in PS and ER measurements.

Project Planning

- **Literature research (3 weeks):** anion exchange membrane-phosphate, permselectivity and electrical resistance in presence of different anions.
- **Experimental part (11-12 weeks):** Characterization of membrane with PS and with ER set-up
- **Modelling part (4-5 weeks)**
- **Thesis writing (4-5 weeks)**

References:

[1] G. Geise, *Appl. Mater. Interfaces*, **2013**, 10294-10301.
[2] S. Honk, *J. Membr. Sci.*, **2009**, 2-5.
[3] V. Sarapulova, *J. Membr. Sci.*, **2015**, 28-38.
[4] N. V. White, *Appl. Mater. Interfaces*, **2015**, 6620-6628.