Electrodialysis-based desalination of polymer-flooding produced water: reverse vs pulsed operation

Motivation

Every year, millions of cubic meters of polymer-flooding produced water (PFPW) are produced in the world, and the figure is likely to keep increasing. Just in the Daqing field in China, the amount is 6 x10^7 m^3 of PFPW/year[1], equivalent to the volume in 24,000 Olympic pools. This water results from applying enhanced oil recovery (EOR) techniques, and in general contains a viscosifying polymer, varying amounts of salts, solids, and some emulsified oil, a combination that makes its treatment for reuse or disposal very challenging. Even after removing the oil and solids, the high salt content makes the mixture difficult to reuse. This is because the salts' ions interact with the polymer reducing its swelling degree, consequently lowering the viscosity of the solution.

Electrodialysis, a salt selective technology that relies on ion-exchange membranes to desalinate streams, is being employed in this project to reduce the salinity of the PFPW stream and, consequently, restore the expanded state of the polymer molecules. This will increase the viscosity of the solution and lead to a reduction in the consumption of fresh water and polymer.

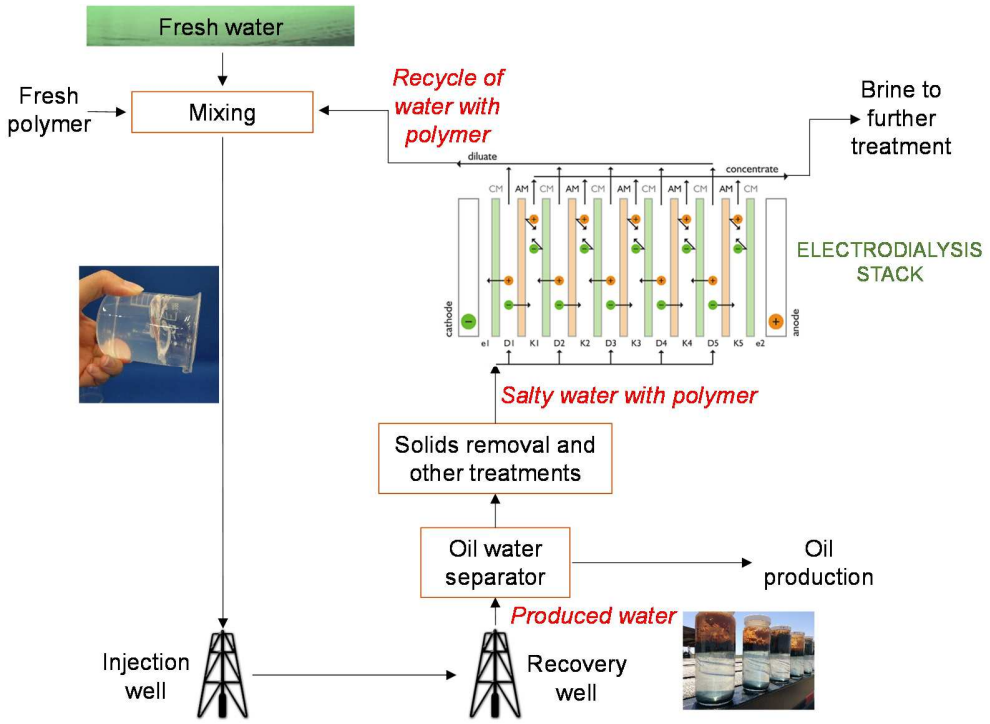

Figure 1. Scheme of the use of electrodialysis for the recovery of polymeric solutions from EOR

[1] Guolin et al. (2010) *Desalination*, *264*(3), 214–219.

Project summary

Electrodialysis is usually operated in the reversal mode, also known as EDR, meaning that the direction of the electric current is continuously switched. These continuous changes delay the formation of fouling and extend the life of the membranes. However, it is also possible to operate electrodialysis in a pulsed mode, in which the current is intermittently switched on and off. The goal of the project is to find the optimal parameters to desalinate PFPW with each of the operation modes, compare them, and eventually evaluate their combined use.

Activities

The project would involve two main lines: 1) the creation of simple models to predict process performance, and 2) execution of experimental work. You will be running the electrodialysis experiments, with the correspondent preparation and post-analysis required. This involves the preparation of the solutions, assembling the electrodialysis stack, setting the run parameters, monitoring, and sampling during the experiments. It is a good opportunity for you to get insight in the application of desalination technologies, polymeric membranes and membrane processes, transport phenomena and analytical methods.

Your profile

- You have a chemical engineering, process engineering, or similar background.
- You can work in an independent manner, have good analytical skills and are highly motivated to learn new things.
- You like paying attention to details and working in an ordered manner.
- You are fluent in English (speaking and writing) and are willing to work in an international environment.

Further remarks

- The duration of your internship/thesis will be at least 6 months, starting in February 2019 or later, at the water technology institute Wetsus in Leeuwarden, Netherlands.
- Salary for HBO/WO (Bachelor and Master students): 350 € per month.

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