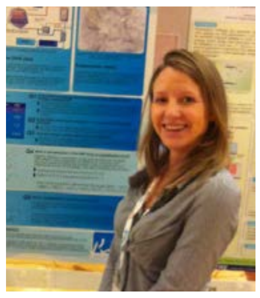
Anion exchange brine treatment toward zero discharge and by-products recovery



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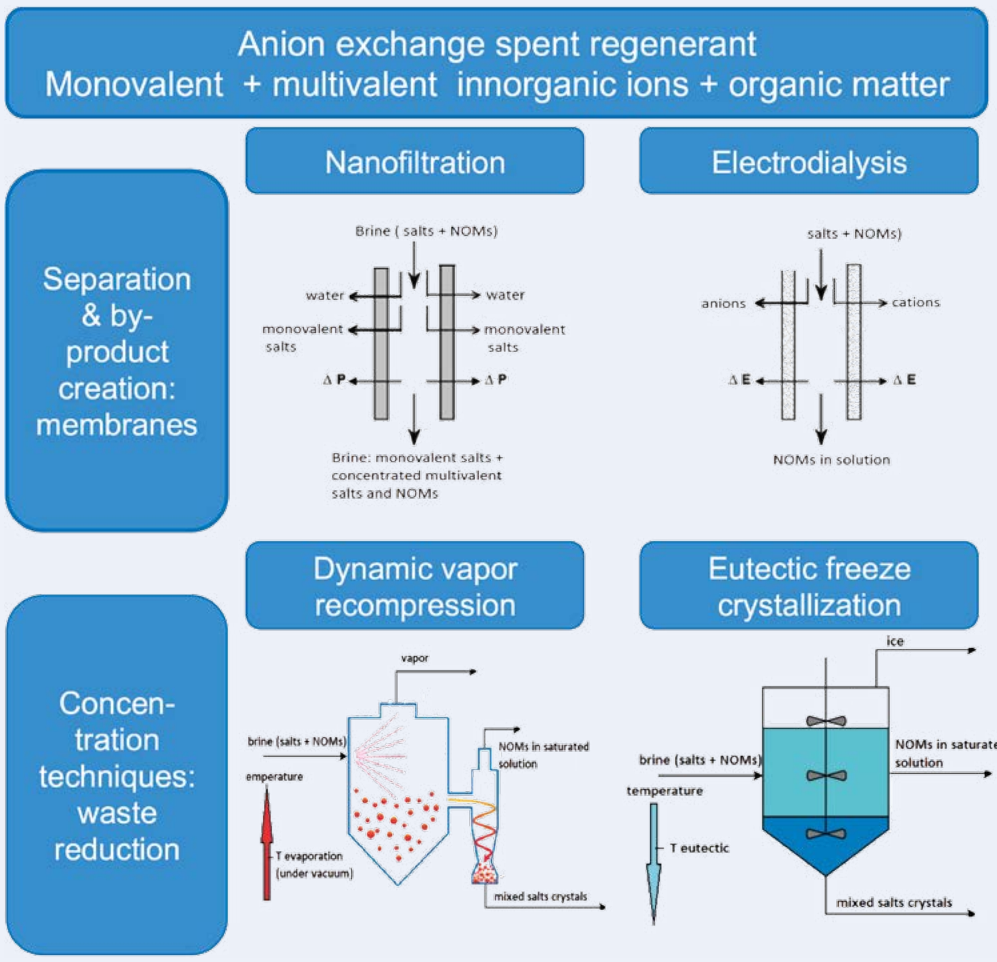
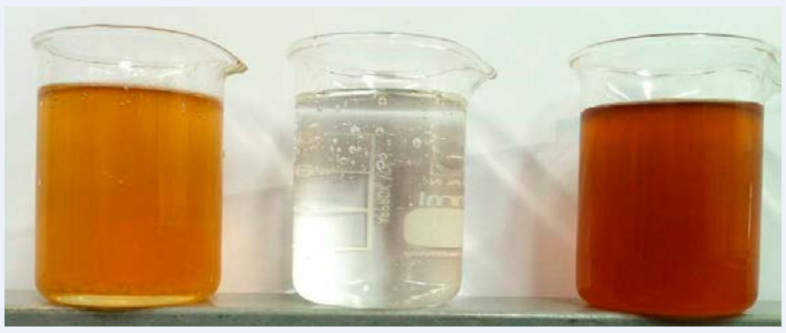
Motivation

In the drinking water sector, anion exchange technologies are increasingly used for color and disinfection by products precursor removal. It targets the low molecular weight natural organic matter and particularly the humic substances (HS) which are the main color impacting compounds in surface or groundwater. After treatment, the resin is being regenerated to 99.9% recovery with NaCl resulting in a saline waste stream – the spent regenerate or generally referred to as brine[1,2].The compounds ending up in it will invariably be the left-over NaCl added during regeneration and desorbed inorganic (SO_4, HCO_3, etc) / organic (HS) anions from raw water. On one hand, disposal of the spent regenerate solution is a problem, especially with regulations becoming increasingly strict: too dark for sea discharge, too corrosive for sewer discharge, too salty for deep ground infiltration, etc. On the other hand, its content can find application if properly separated: NaCl for direct reuse in the regeneration process; and HS as bio-stimulants for crop growth at (the surrounding) farmland or horticultural glasshouses (EU market estimate: 200-400 M€, growing 10% p.a.[3]). This would 1) create circular economy within local businesses; 2) avoid long transport and industrial production of chemicals and fertilizers and 3) offer a durable solution to spent regenerate disposal.



Technological challenge

The challenge lays into separation of inorganic and organic compounds for transformation into crops growth biostimulant material; as well as into separation between divalent and monovalent anions; as the latter are to be recovered into anion exchange resin regeneration process to reduce the overall salt demand and increase its sustainability.



g/L	1- IEX brine	2- NF permeate	3- NF concentrate
Na	15	12.5	18
Cl	14	16	12
SO_4	7	0.4	11
TOC	0.5	0.12	1,3

Fig 1. Example of compound separation: nanofiltration (NF) applied on anion exchange spent regenerate (IEX brine)

Research goals

This project investigates the physical, chemical or biological mechanisms to achieve the separation of organic and inorganics as well as monovalent from divalent ions in a spent regenerate solution. How to apply these mechanisms in processes that would be stable on long terms and economically and environmentally attractive. It includes selection and comparison of technologies leading to an sustainable by-product creation and zero discharge (a step further to zero liquid discharge): a.o. separation technologies such as electrodialysis and nanofiltration, concentration technologies such as eutectic freeze crystallization or dynamic vapor recompression. Finally, it answers the question: can reclamation and sale or reuse of by-products represent a global solution to the brine management issues associated with anion exchange processes in the drinking water industry?

[1] Galjaard G., Martijn B., Koreman E., Bogosh M., Malley J.; Water Practice and Technology 6 (2011), DOI: 10.2166/wpt.2011.0066.
[2] Drikas, M. , Dixon, M., Morran, J. Water Research 45 (2011) 1539-1548.
[3] G.Natale, World Congress on Biostimulants, Strasbourg, 2012.

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