# *An Ion Exchange Membrane Crystallisation reactor for Magnesium recovery from brines*

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## Abstract

Magnesium hydroxide is valuable chemical that can be precipitated from concentrated brines by mixing them with an alkaline reactant. Even if common bases are suitable for the process, several limitations arise from direct reactive precipitation: by-products formation and dilution phenomena could prevent to reach a proper purity or a complete magnesium recovery.

A novel crystallizer based on ion exchange membranes (CrIEM) was developed to overcome process limitation. An anionic exchange membrane segregates the alkaline solution from the brine, allowing $Cl^-$ and $OH^-$ to be exchanged between the two solutions under a self-generating electrochemical potential gradient. As the brine pH arises above 9, the supersaturation is quickly reached and $Mg(OH)_2$ precipitates. The performance of a CrIEM prototype was tested with three different membranes and two reactants, by measuring the average $OH^-$ flux (Figure 1 and Figure 2 ). Finally, the proof of concept was successfully demonstrated in lab-scale experiments.

CrIEM technology is a novel ion exchange application that allows reactive crystallization for separation of valuable species (e.g. Mg from brines) with a large flexibility in the choice of reactants. The use of IEM prevents undesired species to induce low product purity. Nevertheless, some bottlenecks have been identified: (i) channel plugging phenomena and (ii) high area requirement in a possible up-scale application arise respectively from the suspension formation and low fluxes recorded. For this reason, the core of future R&D activities will be focused on fluid dynamics analysis, on novel prototype geometries (i.e. tubular) and on new IEMS able to guarantee high fluxes, high selectivity and low cost.

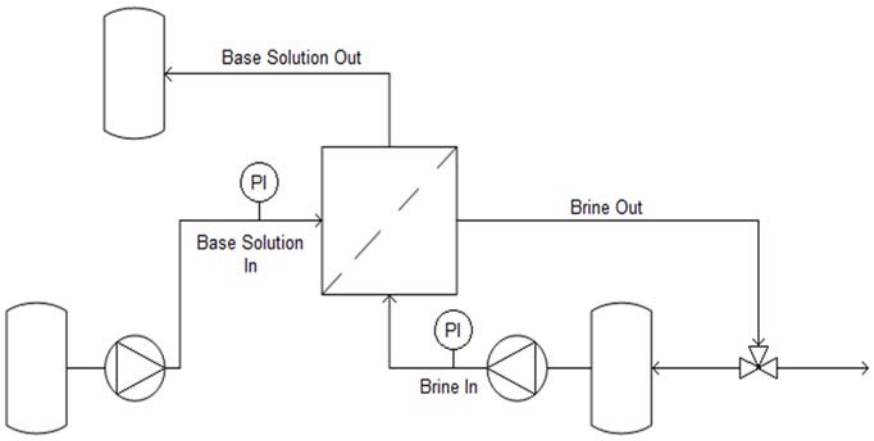


**Figure 1: Scheme of CrIem and auxiliary equipments, as used in experiments.**

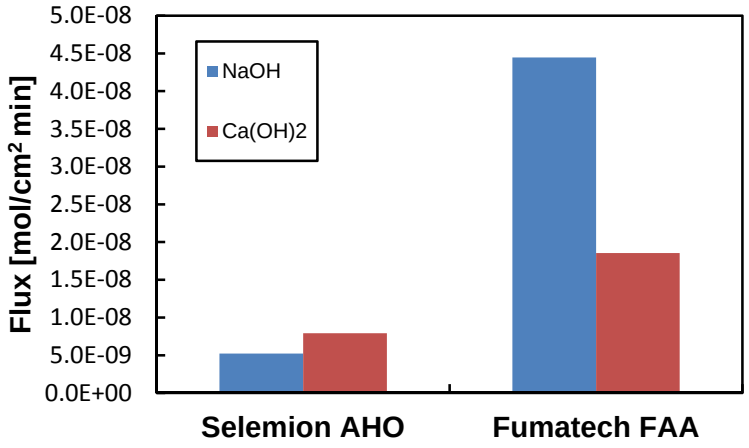


**Figure 2: Experimental Flux, as function of membrane and reactant nature.**

**Keywords:** membrane reactor, crystallisation, magnesium, ion exchange membrane