

# Electrochemical method to remove calcium and magnesium from native brines

## What challenges have been presented?

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### BACKGROUND

#### What do we need lithium for?

To accumulate energy and promote electromobility, becoming independent from fossil fuels.

#### Where does the lithium come from and how is it extracted?

Continental brines as present in a small region in South America (the Lithium Triangle), are the most abundant and the easiest to exploit with an evaporitic method. Current practice is highly water and chemical intensive, with wasted by-products. Lithium is present in diluted concentrations together with different ions, and it is imperative to fully remove both magnesium and calcium before lithium carbonate can be precipitated.

### OUR APPROACH

It is proposed an integrated membrane electrolysis process with three stages, each based on a water electrolyser. In stage I, hydroxyl groups are generated in situ in a two chamber electrochemical cell separated for by anion exchange membrane (AEM), omitting the need for chemical addition and not leading to substantial loss of lithium rich brine. The native brine is introduced into the cathodic compartment (Fig. 1) Batch electrolysis experiments were performed and showed that for a native south american brine, containing  $3090 \text{ mg L}^{-1}$  of  $\text{Mg}^{2+}$  and  $685 \text{ mg L}^{-1}$  of  $\text{Ca}^{2+}$ ,  $62 \text{ kWh m}^{-3}$  are needed for the full removal of both cations when a current density of  $223 \text{ A m}^{-2}$ .

The proof of concept has been successful, we are working to scale the process.

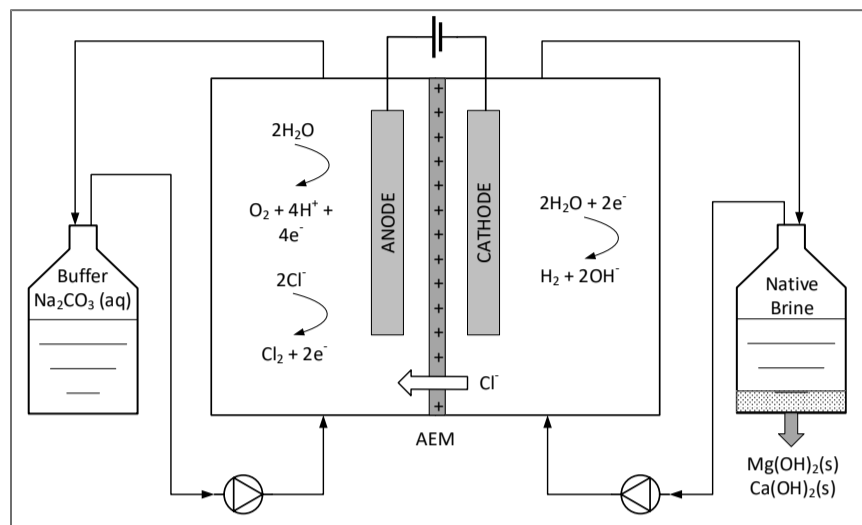


Fig.1: Electrochemical removal of calcium and magnesium cations from native brine

### CHALLENGES AND PROPOSED SOLUTIONS

I) Magnesium hydroxide precipitates inside the reactor, causing scaling of the membrane and obstruction of flow. We tested brine precipitation out of the reactor by mixing high pH electrolyzed brine with fresh brine (Fig. 2).

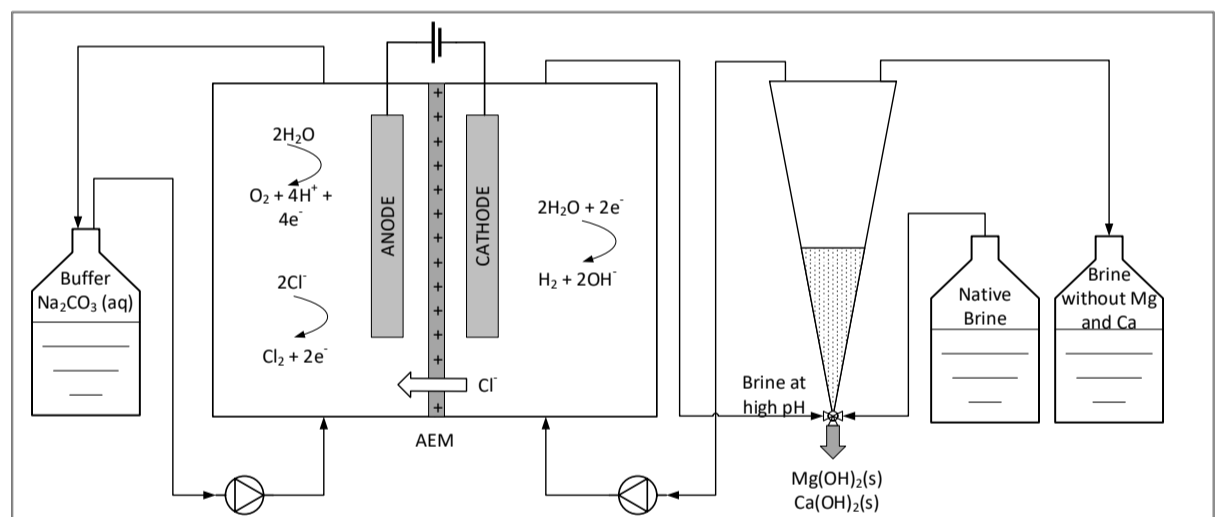


Fig. 2: Electrochemical removal of calcium and magnesium ions from native brine with lateral precipitation

II) We discovered that by removing the boron before electrolysis with an ion exchange resin (Fig. 4), we can obtain a precipitate of magnesium hydroxide that traps less brine and therefore reduces the loss of lithium (Fig. 3).

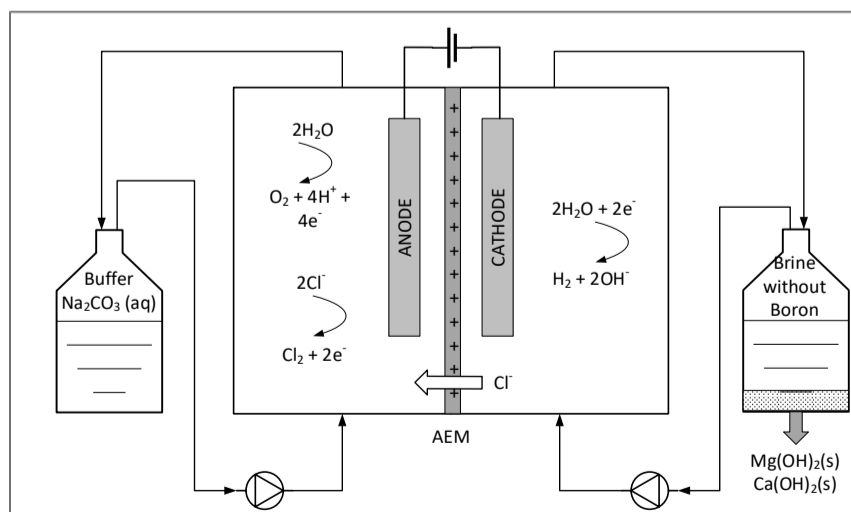


Fig. 3: Electrochemical removal of calcium and magnesium ions from native brine without boron.

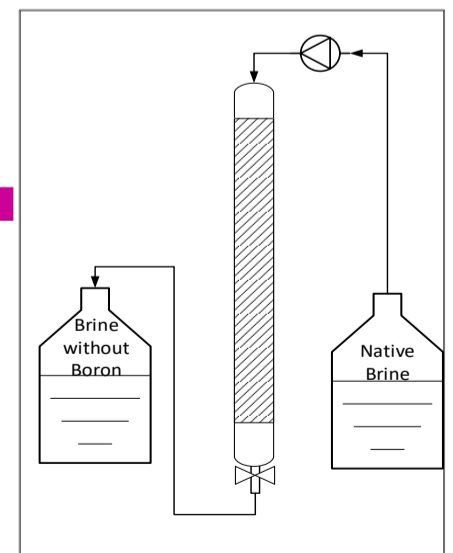


Fig. 4: Previous stage of boron removal with an ion exchange resin