

# An Electrochemical Alternative to Reduce the Environmental Impact of Evaporitic Lithium Extraction from Brines. Stage I: Removal of Calcium and Magnesium

Noelia A. Palacios<sup>a</sup>, César H. Díaz Nieto<sup>a</sup>, Korneel Rabaey<sup>b</sup>, Victoria Flexer<sup>a</sup>

<sup>a</sup> Centro de Investigación y Desarrollo en Materiales Avanzados y Almacenamiento de Energía de Jujuy (CONICET- Universidad Nacional de Jujuy)

Av. Martijena S/N, Palpalá, 4612, Argentina

<sup>b</sup> Center for Microbial Ecology and Technology (CMET), Faculty of Bioscience Engineering, Ghent University

Coupure Links 653, Ghent, 9000, Belgium

npalacios@cidmeju.unju.edu.ar

In a context in which it is urgent to change the energy matrix dependent on fossil fuels for a more sustainable one, the reference to energy accumulation, electromobility and lithium is undeniable. 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 [1]. Current practice is highly water and chemical intensive, and delivers besides lithium only waste to be landfilled [2,3]. Concerns about processing practices are growing, particularly with the local native population. As an alternative to the current extraction process, it is proposed an integrated membrane electrolysis process with three stages, each based on a water electrolyser with a side crystallizer. 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. In the stage I of this approach, hydroxyl groups are generated in situ in a two chamber electrochemical cell with a side crystallizer, 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 of a 2-chamber electrolyzer (AEM) like the one show in the figure. As the pH increases,  $\text{Mg}(\text{OH})_2$  and  $\text{Ca}(\text{OH})_2$  will quantitatively precipitate. The objective is to obtain these two salts with commercial value, avoiding that they remain as waste in the salar and minimize the amount of brine adsorbed on solids. 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  $223 \text{ A m}^{-2}$ . It is necessary to remark that the  $\text{Li}^+$  concentration in the brine is not affected. The first stage of this alternative process to the evaporitic method, not only performs the necessary removal of the divalent cations from the brine, but also allows obtaining magnesium and calcium compounds simultaneously, minimizing the production of waste.

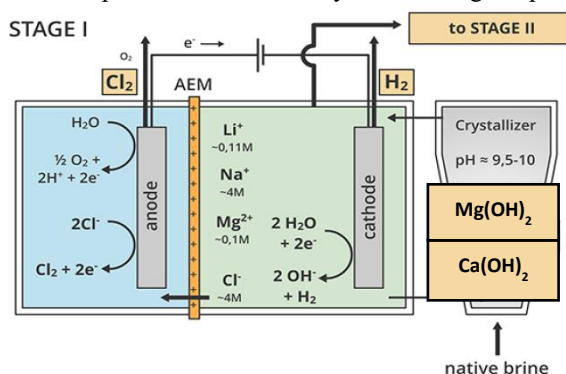


Figure: Scheme of the electrochemical cell of Stage I

## REFERENCES

1. Border, S. and L. Sawyer, Evaporites and brines – geological, hydrological and chemical aspects of resource estimation. Transactions of the Institutions of Mining and Metallurgy, Section B: Applied Earth Science, 2014. 123(2): p. 95-106.
2. Garrett, D.E., Part 1 - Lithium, in Handbook of Lithium and Natural Calcium Chloride, D.E. Garrett, Editor. 2004, Academic Press: Oxford. p. 1-235.
3. Flexer, V. et al, Lithium recovery from brines: A vital raw material for green energies with a potential environmental impact in its mining and processing. Sci Total Environ, 2018. 639: p. 1188-1204.