# Application of an experimental design to obtain high purity Mg $(OH)_2$ from native brines.


Camilo J.O. Palacios

**Li + Water proyect - CIDMEJu - Universidad Nacional de Jujuy**

Camilo.palacios1512@gmail.com

www.linkedin.com/in/camilo-palacios-50997011b


## BACKGROUND

One of the by-products that is generated in greater quantity in the production of $Li_2CO_3$ is $Mg(OH)_2$ [1]. With the current implementation method, the evaporitic method (Figure 1), only in Argentina more than 100000 tons of waste is generated per year. A significant portion is magnesium hydroxide, which can be used as a raw material for other industries such as pharmaceuticals, metallurgy, food, among others [2,3]; not to mention the large volumes of water that are released in totally arid environments such as the Puna of Jujuy in northern Argentina[1].

In this work is used the fractional factorial design for obtain a Mg $(OH)_2$ of high purity starting the $Mg(OH)_2$ electrochemical generation. A fractional factorial design allows for a more efficient use of resources as it reduces the sample size of a test. The main use for fractional factorial designs is in screening experiments (tests in which many factors are considered and the objective is to identify those factors that have significant effects) [4].

## METHODS

A three-compartment electrochemical cells was used; anode and middle compartments were separated by an cation exchange membrane (CEM) and the middle and cathode compartments were separated by a anion exchange membrane (AEM). The total volume for each compartment was 200 mL. The anode used was titanium (Ti) mesh electrode coated with an iridium-based mixed metal oxide (IrO2/TiO2; 65/35%), with a centrally at-tached, perpendicular current collector (dimensions: 4.8 × 19.8 cm; 1 mm thickness). The cathode was a stainless steel wire mesh with a stainless steel current collector. The distance between electrodes was 23 mm. Two plastic meshes are placed between the surface of the electrodes and the membranes to avoid direct contact between the electrodes and the membrane. The experiments were run in constant current mode using a DC / DC. Regulated power supply. In Figure 2 the cell used is shown schematically.

For the electrolytic process, native brine was used from the Salar del Hombre Muerto, (located in northwestern Argentina). Brine compositions is shown in Table 1.

The resulting precipitate was treated by a fractional experimental design, with a total of 32 experiences, the factors and levels being those shown in Table 2.

**Table 1**: *Natural brine composition used in this study.*

| Brine | Li | Ca | Mg | B | Na | K | $Cl^-$ | $SO_4^{2-}$ |
|---|---|---|---|---|---|---|---|---|
| mg/L | 1,268 | 685 | 3,090 | 1,619 | 103,239 | 14,209 | 182,850 | 11,155 |

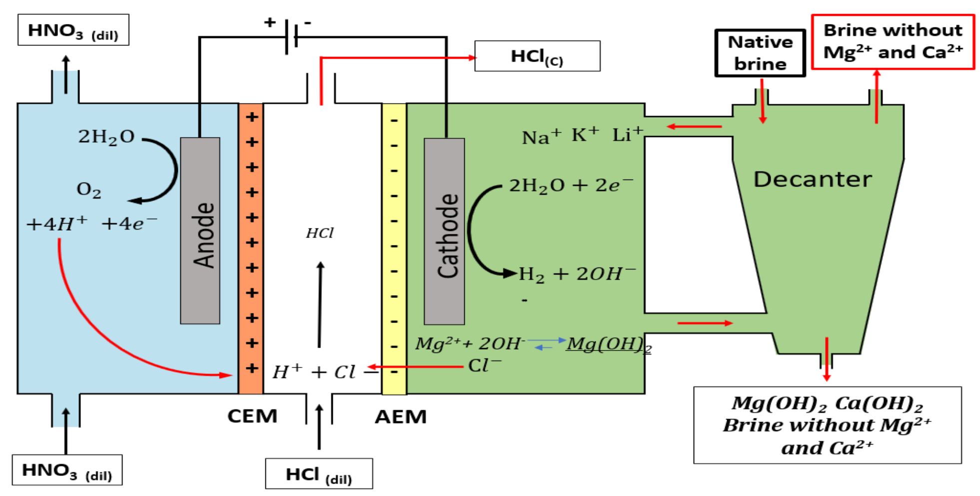


**Figure 2**: *Schematic representation of the electrolytic cell used.*

*The treatment of **solid waste** and the **reduction of water** consumption to obtain $Li_2CO_3$, is essential to achieve **sustainable development** in the Puna.*

The current evaporite method tends to generate a huge amount of solid waste whose fate is uncertain (Seen Figure 1). The idea of this work is to be able to take a solid compound and give it added value through a series of simple unit operations.


**Figure 1**: *Schematic representation of the evaporite method for obtaining $Li_2CO_3$.*

**Table 2**: *Approximate concentrations of native brine used.*

| | Wash water temperature | stirring rate | Stirring time | Water amount | Number of washes | Drying time |
|---|---|---|---|---|---|---|
| **Min** | 25°C | 1000rpm | 1 min | 2 vol | 1 | 4 h |
| **Max** | 60°C | 200rpm | 10 min | 10 vol | 3 | 24 h |

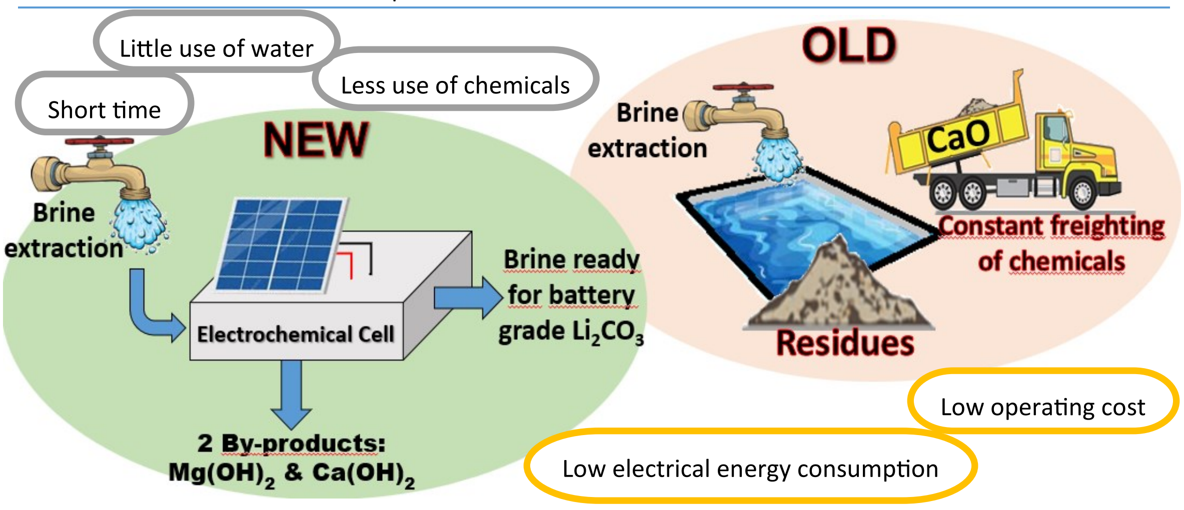


**Figure 3**: Comparison of stage 1 of the electrolytic process with the conventional process.

## RESULTS

- Higher temperatures did not allow obtaining higher purities.
- No significant differences were seen at different stirring speeds.
- At different stirring times, no significant changes were observed in the purity of the Mg $(OH)_2$ obtained either.
- The higher the amount of water, the better the purity values.
- In all cases, increasing the amount of washes was shown to give better purity of $Mg(OH)_2$.
- The drying time did not allow any difference in purity to be appreciated.

## CONCLUSIONS

- Treatment of the precipitate from step 1, properly treated, can result in a solid with a purity greater than 90%.
- In the central compartment it was possible to obtain HCl with good purity and high concentration.

Progress report...

## REFERENCE:


[1] Flexer V., Baspineiro C.F., Galli C.I., Sci. Total Environ. 639 (2018) 1188-1204.
[2] Løvik A. N., Hagelüken C., Wäger P., Sustain. Mater. Technol. 15 (2018) 9–18.
[3] Mordike B. L., Ebert T., Mater. Sci. Eng., A 302 (2001) 37–45.
[4] Montgomery, Douglas C. Design and Analysis of Experiments. 9th ed., John Wiley & Sons, Inc., 2017


**Scan to know our work**


ERA·MIN 2
RESEARCH & INNOVATION PROGRAMME ON RAW MATERIALS TO FOSTER CIRCULAR ECONOMY