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CO_2 capture from the phases of spodumene's lithium extraction

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CO_2 emissions have been a big environmental issue since the Industrial Revolution, with irreversible consequences[1], which have motivated most of COPs (Conference of the Parties) outcomes – as COP15 and the Paris Agreement – to work on reducing the greenhouse gas emissions and, consequently, reducing the global temperature[2]. With that, countries have worked on changing the energy infrastructure and getting to net-zero carbon emissions. One step for it is increasing the use of electric cars[3] which are commonly built with lithium batteries. The demand for lithium has then exponentially grown, causing an increase in its market price[4]. This project proposes an alternative for both problems mentioned, optimizing carbon dioxide capture from lithium phases obtained through its extraction from an alternative lithium source – spodumene – for the synthesis of lithium carbonate. The extractions were performed through the alkaline hydrothermal reaction of spodumene (whether in its alpha or beta crystalline phases) with a hydroxide source (NaOH or $Mg(OH)_2$). The syntheses were tested in different alkaline concentrations (for NaOH: 15M or 20M; and for $Mg(OH)_2$: 4M, 7M or 11M), reaction times (3, 5 or 7 hours) and temperatures (100, 200 or 300°C), optimizing it for the best capture yields. Two different phases were obtained: a lithium-rich solution - characterized through atomic absorption spectrometry - and a solid with remaining lithium – characterized through X-ray diffraction and thermogravimetry analysis. The solids were tested for carbon capture potential through a CO_2 physisorption analysis equipment and the solutions, through the percentual weight gain of fractioned precipitation of lithium carbonate. The XRD diffractograms have shown that the solids obtained were sodium or magnesium silicates, or simple zeolites, such as Faujasite and Cancrinite. The atomic absorption spectrometry results have shown that $Mg(OH)_2$ was more efficient for lithium extraction, extracting up to 87% of it, with NaOH extracting up to 12%, though the latter has shown up to 12% of CO_2 capture in preliminary tests, through the use of thermogravimetry curves. To conclude, the synthesis conditions and its carbon capture experiments are still being optimized, but have been showing promising results.

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