Optimization of Oceanic Lithium Mining: A Quantification of Extraction Methods

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The shift towards a fossil-free society has exponentially increased the demand for Li-- the most critical material used in electric vehicles and Li+ batteries. However, mineral demand for Li is expected to increase over 40 times by 2040, necessitating the exploration of extraction methods. Consequently, the objective of this research is to determine the most effective technique by utilizing instrumentation, including a spectrometer and pH probe, to quantify values. In this investigation, LiCl served as the primary reactant and was manipulated through the following procedures. First, brine evaporation was simulated with the addition of Na2CO3 to form a precipitate, Li2CO3. Such an experiment was compared to a separate electrolysis method of LiCl with KCl. Wavelength values derived from the spectrometer were compiled into an absorbance spectrum. This was then compared to the control spectrum of the respective compounds, concluding that electrolysis extracted a higher product purity than brine evaporation. Taking advantage of the low-cost, high-purity method of LiCl electrolysis, adjustments to voltage, properties of anode and cathodes, and enclosure characteristics were made for further optimization. The results lead to a notable energy reduction, decreasing the temperature necessary for electrolysis from 612°C (LiCl) and 745°C (KCl) to 352°C. Additionally, it was found that there was a statistical significance between the cathode and anode length and geometry of an electrolytic cell. The concluding combination can be an aiding framework for lithium mining technologies at a larger scale, thereby advancing sustainable resource extraction practices.