

ENHANCING NICKEL LATERITE PROCESSING: UTILIZING ELECTROCHEMICAL SEPARATION TO EXTRACT SULFURIC ACID FROM MAGNESIUM SULFATE SOLUTIONS

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ABSTRACT

Nickel holds a broad spectrum of applications, with its production expanding to meet the surging demand, particularly in energy storage applications. Extracting nickel from laterite ores via hydrometallurgical methods demands a substantial volume of sulfuric acid, mainly due to acid-consuming minerals like magnesium silicates. This reaction yields magnesium sulfate waste solution, posing environmental concerns. To address this, electrochemical separation offers a solution, producing acid from these waste solutions for on-site reuse, enhancing nickel recovery. Additionally, the resulting magnesium hydroxide can serve for carbon capture or as a precipitant in the nickel process.

In our study, a single membrane electrolyser was employed to convert magnesium sulfate solutions into sulfuric acid and magnesium hydroxide precipitate. We evaluated the electrolyser's performance in terms of faradaic efficiency, acid production energy intensity, current density, and sulfate recovery extent. We varied the electrolyser potential and the initial concentrations of catholyte and anolyte for evaluation. Results indicated that maintaining 90% faradaic efficiency is feasible with a starting MgSO_4 concentration of 1M or lower and a 4V electrolyser potential, up to an anolyte concentration of 0.16M H_2SO_4 . However, higher voltages, concentrations, and conductivities across the anolyte and catholyte negatively impact faradaic efficiency due to water splitting. While a high electrolyser potential enhances sulfate transport, it also leads to excessive $\text{Mg}(\text{OH})_2$ precipitation, scaling the cathode, posing operational challenges.

Keywords: Wastewater; Waste recycling; Tailings; Sulfuric acid; Membrane electrolysis