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# Abstract title

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**ABSTRACT**

*The management of mining wastes and tailings from the iron ore sector poses significant environmental challenges, necessitating innovative chemical engineering solutions to recover valuable resources sustainably. This study presents a novel process utilizing a biochar-derived lixiviant, composed of acetic acid and phenolic compounds, to leach metals such as iron, calcium, and magnesium from mining wastes. Biochar, a carbon-rich byproduct of biomass pyrolysis, provides a sustainable source for the lixiviant, reducing reliance on conventional acids. The leached metals are subsequently carbonated using captured CO2 to form stable carbonate minerals, which have potential applications in construction, agriculture, and environmental remediation. This integrated approach leverages waste-derived materials and CO2 to transform mining tailings into valuable products, aligning with circular economy principles and advancing sustainable process engineering.*

*Experimental investigations demonstrate the efficacy of the biochar-derived lixiviant under controlled conditions, with variations in pH, temperature, and ionic strength optimizing leaching efficiency. The carbonation process effectively sequesters CO2, contributing to greenhouse gas mitigation while producing marketable mineral products. Compared to traditional inorganic acids, the biochar-derived lixiviant offers environmental benefits, including biodegradability and reduced contamination risks, making it a promising alternative for hydrometallurgical applications. This research not only addresses the technical challenges of metal recovery from complex waste matrices but also integrates waste management with carbon capture and utilization, offering a scalable solution for the mining industry. By harnessing chemical engineering principles to valorize waste and mitigate emissions, this work contributes to the development of green technologies, supporting the transition to sustainable industrial processes and providing a framework for future innovations in resource recovery and environmental stewardship.*

**KEY WORDS**

*Mineral Carbonation, Biochar, Sustainability, CCUS*

## BIOGRAPHY

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