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A Zero-Waste Framework for Iron Removal and Product Generation from Pregnant Leach Liquors Sourced from Bioleaching

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The demand for critical minerals is at an all-time high due to increased global usage resulting from a push towards sustainable and advanced technologies. Unfortunately, production may not be able to match demand for critical minerals as the frequency of discovery and overall grade of new ores are diminishing. Thus, to meet the demand for, as well as create critical mineral security, reprocessing of low-grade tailings and process reject materials is being rigorously explored [1]. Within the scope of reprocessing tailings, sulfide tailings are one of the most common materials due to their abundance and often significant contents of critical elements such as Ni, Co, Cu, REEs, and PGMs. To date much of the research has focused on how to economically and sustainably extract these valuable components from waste using bioleaching while less attention has been given to how to economically recover Fe and S, which occur in leach liquors at concentrations several orders of magnitude higher than the critical elements.

In this work we highlight a zero-waste framework for stripping and benefaction of Fe and S focusing on ease of use and flexibility in pregnant leach liquor processing obtained from bioleaching of tailings. Through high-precision manipulation of biogeochemical mechanisms using stirred tank reactors [2] >90% of Co, Cu, and Ni can be extracted from legacy pyrrhotite tailings while generating a high quality soluble Fe feed compatible with end product generation such as green-steel, magnetic nano-particles, and ferrofluids. Additionally, within the zero-waste framework, S can be recovered as agricultural grade fertilizer. Our work shows the scalability of the processes and potential of Fe and S benefaction to underwrite critical metals recovery while operating using circular compartments and waste streams native to the mining industry.

References

1. Sarker, S.K., Pownceby, M.I., Bruckard, W., Haque, N., Bhuiyan, M. and Pramanik, B.K., (2023), *Chemosphere* 328, 138582.
2. Ngoma, E., Pakostova, E., Wiesner, J.A., Clark, T., Laamanen, C. and Mykytczuk, N., (2025), *Journal of Sustainable Metallurgy* 11, 3806–3822.