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Enhanced Performance of Chalcopyrite Bioleaching in the Presence of Chloride Ion

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ABSTRACT

Chloride leaching is considered as a promising alternative method to recover copper from chalcopyrite and other copper sulfides, because it favors the leaching kinetics and avoids passivation of minerals. However, chloride ions inhibit the growth of acidophilic bacteria used in biomining. Biomining bacteria are unable to survive in highly saline environments and colonize a mineral surface, and would be unsuitable for application in biomining with seawater. This study aimed to establish the effect of sodium chloride on the growth and iron (II) oxidation of some biomining bacteria and evaluate their potential for use in saline bioleaching applications. All tested strains showed reduced cell numbers and a decrease in iron (II) oxidation rates in the presence of NaCl. Meanwhile, it was demonstrated that there was a range of sensitivities between genera of biomining bacteria to chloride, with *Acidithiobacillus ferrooxidans* being the most sensitive. Among the tested genera, *Sulfobacillus* exhibited the highest tolerance to NaCl, with robust growth and high iron (II) oxidation activity, making it suitable for metal bioleaching in saline environments. *Leptospirillum* spp. bacteria showed moderate tolerance, while *Acidithiobacillus* spp. demonstrated the lowest tolerance, with significant reductions in growth and iron oxidizing activity as NaCl concentrations increased. The limited tolerance of these bacteria restricts their use in biomining unless adaptations are explored. The role of chloride ion in the performance of the adapted moderate thermophiles from the genus *Sulfobacillus* in bioleaching of copper sulfide was investigated. It was revealed that *Sulfobacillus* sp. bacteria demonstrated the improved bioleaching of chalcopyrite ($CuFeS_2$) in the presence of high concentration of sodium chloride significantly enhancing the copper leaching process.

Keywords: chalcopyrite, copper bioleaching, chloride ions, *Acidithiobacillus ferrooxidans*

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