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LESS MAY BE MORE – IMPROVING CHALCOPYRITE BIOLEACHING KINETICS VIA SEQUENTIAL INOCULATION OF ACIDOPHILIC MODEL SPECIES

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Abstract

Biohydrometallurgy, or bioleaching, describes a more environmentally friendly technology to extract metals such as copper via the microbially promoted oxidation of insoluble sulfide minerals to water soluble salts at low pH. As high grade metal ores start to become depleted globally, in recent decades this technology has steadily gained interest. To date, up to 20 % of the world wide copper production can be attributed to biological leaching from chalcopyrite (CuFeS2) in heap operations. However, a major drawback to overcome during the operation of such bioleaching heaps is the long lag phase typically occurring after constructing the bioheap, lasting up to three years until the release of dissolved metals. The objective of this study is to find ways to shorten this period and thus, accelerate the release of copper from chalcopyrite. In experiments with three acidophilic model species, namely Acidithiobacillus caldus, Sulfobacillus thermosulfidooxidans, and Leptospirillum ferriphilum, the rate of initial copper release has been observed to strongly correlate with the oxidation/reduction potential of the leach liquor. To influence this parameter in a way that would likewise be feasible in large scale, laboratory bioleaching experiments have been inoculated with the model species in different orders and combinations and the effect on lag phase and metal release was recorded. Preliminary results show that inoculation of L. ferriphilum, an obligate iron oxidizer, raises the redox potential to levels detrimental for copper leaching rates. In contrast, S. thermosulfidooxidans oxidizes iron at a lower rate, seemingly allowing for more selective dissolution of copper containing crystals. A. caldus appears to play a supporting role in the beginning phase of mineral dissolution. To understand the mechanisms and principles underlying these results further work is planned, including sequencing of RNA transcripts and proteins from these bioleaching environments.

Keywords

Biohydrometallurgy; Bioleaching; Chalcopyrite; Acidophiles; Copper; Sequential inoculation strategy