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Bioleaching of copper from flotation tailings in air-nanobubble-rich culture media

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ABSTRACT

The metal assays of ores are continuously decreasing while the low-grade resources such as mine wastes and mineral processing tailings are piling up continuously. Technical and economic concerns limit the application of conventional processing methods on such secondary resources, so finding a low-cost and environmentally friendly method is essential and inevitable. In this study, for the first time, the bioleaching of Cu from the flotation tailings was performed in shaking flasks. Indigenous iron and sulphur-oxidising microorganisms were obtained from local acid mine drainage and then, gradual adaptation of mesophile and thermophile microorganisms to 10% solid-containing pulp was done in 9k and Norris culture media prepared with air-nanobubble-rich water. The average bioleaching recoveries of Cu and Fe after one month were determined as 92.8% and 17.22%, respectively. The effects of air nanobubbles, type of microorganisms, and type of culture medium on bio-dissolution of the ions were investigated. The type of microorganisms was the most influential factor in the Cu dissolution. Thermophilic microorganisms showed better performance in Cu dissolution. Mesophilic microorganisms showed better performance in the Norris culture medium, while thermophilic microorganisms were not sensitive to the culture medium. The addition of nanobubbles to the leaching experiments showed improvements in Cu dissolution.

Les teneurs en métaux des minerais sont en déclin continu, tandis que les ressources à faible teneur, telles que les déchets miniers et les résidus de traitement des minéraux s'accumulent continuellement. Des préoccupations techniques et économiques limitent l'application des méthodes de traitement conventionnelles à ces ressources secondaires, de telle sorte que la découverte d'une méthode peu coûteuse et respectueuse de l'environnement est essentielle et inévitable. Dans cette étude, pour la première fois, on a réalisé la biolixiviation du cuivre à partir des résidus de flottation dans des flacons à agitation. On a obtenu des microorganismes indigènes oxydant le fer et le soufre à partir du drainage minier acide local, puis on a effectué une adaptation graduelle des microorganismes mésophiles et thermophiles à une pulpe contenant 10% de solides, dans des milieux de culture 9k et Norris, préparés avec de l'eau riche en nanobulles d'air. On a déterminé à 92.8% et 17.22%, respectivement, les taux moyens de récupération par biolixiviation du Cu et du Fe après un mois. On a étudié les effets des nanobulles d'air, du type de microorganismes et du type de milieu de culture sur la bio-dissolution des ions. Le type de microorganismes était le facteur le plus influent dans la dissolution du cuivre. Les microorganismes thermophiles ont montré de meilleures performances dans la dissolution du cuivre. Les microorganismes mésophiles ont montré de meilleures performances dans le milieu de culture Norris, tandis que les microorganismes thermophiles n'étaient pas sensibles au milieu de culture. L'ajout de nanobulles aux expériences de lixiviation

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1. Introduction

Continuous extraction of high-grade ores to fulfil everyday increasing demand for metals has limited the availability of associated mineral resources. Therefore, metal extraction/recovery from low-grade or secondary resources has gained strong notice. The implementation of common mineral processing methods or pyrometallurgy is not economically viable due to the low grade of desired metals, which leads to higher energy consumption and environmental impacts once attempts are made to extract valuable metals from such mentioned resources [1–6]. On the other hand, the accumulation and storage of process plant wastes can cause several environmental issues for agricultural lands and surface/underground waters, due to the acid mine drainage (a combination of low pH and high heavy metal concentrations). New methods and concepts can introduce the continuing process tailings as a secondary

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