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Tailings Microorganisms as an Alternative for Recycling Strategic Metals: A Green Management Approach

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Abstract

Modern life witnesses a new huge stream of waste called electronic waste, containing various base, valuable, and toxic metals. The entry of this volume of e-waste into the environment can cause many problems for human health and the environment. Therefore, there is a need to establish a green management system for the effective recycling of metals. As regards, this study aimed to investigate the potential of the bacteria isolated from iron ore tailings in the bioleaching of copper and zinc from waste mobile boards. Bioleaching experiments using the isolated consortiums were investigated at 5, 10, and 15 g/L of mobile boards within 15 days of incubation. Metal concentrations were detected by the ICP-MS instrument. Two-way ANOVA was used for statistical analysis. After the bioleaching period, The concentrations of biosolubilized copper and zinc were raised to 4000 mg/L (36%) and 530 mg/L (9.17%) in the solutions respectively. The maximum leached metal concentration was achieved by iron-oxidizing bacteria at the density of 15 g/L. There was a significant difference between the two bacterial groups in terms of bioleaching of the total metals ($P = 0.011$). The results showed that an increase in waste density might lead to a decrease in metal solubilization due to the toxicity of metal in the present study; the toxicity of Zn might be higher. Accordingly, the iron-oxidizing bacteria were found to be a good candidate for the bioleaching of strategic metals. Also, the bacterial consortium of iron mine tailings could be a good option to recover strategic metals such as copper and zinc through biohydrometallurgical technologies in low densities of e-waste (less than 10 g/l).

Keywords: Electronic Waste, Bioleaching, Recovery, Bacteria, Green Technology

1- Introduction

Today, the sustainability of organizations is in three things: paying attention to the environment, attention to society, and economic performance. Therefore, some organizations have undertaken ecological health and safety assessments to improve environmental performance control and developed green management policies. Establishing a green management system in various organizations and bodies is one of the government's priorities (Fayyazi and Afshar 2015). As a result, in an era when society is aware of the importance of the environment, managers should confirm the role of green organizational identity and environmental and organizational legitimacy in their companies and develop a strategy and start green innovation (Chen, Gao, and Zhang 2022).