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## Combining bioleaching and brine-leaching in metal leaching processes: alternative to conventional

**Tamara Azevedo Schueler** and Daniel Goldmann

Institute of Mineral and Waste Processing, Waste Disposal and Geomechanics, Clausthal University of Technology, Clausthal-Zellerfeld, Germany (tas19@tu-clausthal.de)

The recovery of valuable metals such as copper (Cu), zinc (Zn) and lead (Pb) from mine tailings has gained attention in recent years, mainly for the environmental risk of tailings storage facilities and the demand of such elements in different industrial sectors. Many sulphide tailings deposits are spread worldwide, and some of them belong to active mines, which produce tons of material per year. Leaching is a well-known technology for metal extraction. However, two aspects must be considered: the dissolution of metals involves the use of fresh water and, the tailings contain low metal concentrations and high impurities. As a result, leaching is too expensive due to energy input in water purification and high acid consumption. The use of salt water in mineral extraction processes is becoming more attractive in the mining sectors over the years, especially in regions where fresh water is scarce. The presence of salt water in metal leaching has demonstrated a great capacity to increase metal extraction from ore, for example, by increasing the surface and porosity of copper containing minerals. This phenomenon plays an important role in metal leaching. The formation of a passive layer on the surface of the mineral in oxidizing conditions is a strong barrier in the extraction of the target metal. Conditions that overcome this obstacle are of utmost importance for the mining industry. Furthermore, a combination of conventional leaching systems with biological methods (bioleaching) is shown to be a good strategy in tailings leaching. Bioleaching has been applied to the treatment of poor ores and tailings, since acidophilic bacteria can oxidize  $\text{Fe}^{2+}$  with the regeneration of  $\text{Fe}^{3+}$  ions, together with the reduction of sulphur species to sulfuric acid, leading to the extraction of metals. Moreover, it is considered a more environmentally friendly technology than traditional extraction methods, as it occurs naturally, more economical and results in significantly less pollution. Therefore, some studies have been applying biological leaching as a pre-treatment for chemical leaching of mining tailings. The aim of this work is to present and discuss possibilities to conventional metal extraction processes, combining the two strategies of bioleaching and brine-leaching.