



## Removal of potentially toxic elements contained in abandoned tailings by froth flotation

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In northern part of Chile several sites containing mine waste were abandoned without any environmental concern. The mine waste contain tailings, which were produced from former metallurgical processing of copper sulfide minerals. These sites needs to be remediated to protect the health of population and ecosystems. Moreover, the tailings may contain elements to concentrations that can be economically recovered and could render them suitable for recycling. Thus, the present research aims at removing potentially toxic elements (PTEs) such as Cu, Pb, Zn, and As through reprocessing of tailings by using froth flotation.

The sampling consisted of taking 50 soil and tailing samples at different depth ranges in a 24 ha site. The samples were dried, sieved at 2 mm, stored in plastic bags, transported to the lab and kept to 4 °C prior to the analytical determination of their physical and chemical characteristics. Cu, Pb, Zn, and As were chosen for this study owing to their abundance in the mine waste. The samples were analysed for total Cu, Pb, Zn, and As concentrations, pH, redox potential, and conductivity. In order to remove the content of these PTEs, the tailings were floated by using froth flotation. Several laboratory-scale flotation test on an Magotteaux flotation unit were conducted in triplicate. The influence of pulp pH, air flow rate, pulp density, and process time on PTEs removal efficiency was studied. The Cu, Pb, Zn, and As recoveries were calculated after 0, 2.5, 5.0, 7.5, and 15 min of flotation time.

The geochemical analysis of waste samples highlighted high concentrations of Cu, Pb, Zn, and As. The median concentration of Cu was the highest followed by, Zn, Pb, and As. A large coefficient of variation was observed for the concentrations of Cu Zn, Pb, and As, reflecting the non-homogeneous distribution of these PTEs, which is in accordance with chemical properties of mine waste. The pH, and conductivity of soils were 6.86-8.01, and 0.10 - 43.2 mScm<sup>-1</sup>, respectively. PTEs concentration ranged from 516 to 1,620 mg Cu kg<sup>-1</sup>, 38.6 to 1,394 mg Zn kg<sup>-1</sup>, 5.83 to 1,510 mg Pb kg<sup>-1</sup>, and 7.88 to 493 mg As kg<sup>-1</sup>. The results confirm that froth flotation was effective to reduce PTEs contents of tailings. Recovery percentages of Cu, Pb, Zn, and As varied from 55-78, 54-60, 55-61, and 53-63% respectively, after 15 minutes of flotation and decreased when pH increased from 9 to 12. Based on the data presented in this study, satisfactory results in recovery of total Cu, Pb, Zn, and As were achieved when the operational parameters were set to the air flow rate 20 L/min, impeller speed 500 rpm and pulp density 10%. It can be concluded that the use of froth flotation appears to be a useful technique for treating of tailing. However, more test should be conducted in order to increase the efficiency of PTEs removal.