

Mobilization of arsenic and heavy metals from polluted soils by humic acid

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The existence of soils contaminated with harmful elements by mining activities is a global environmental concern. The northern part of Chile has several heavy metal contaminated sites due to former copper and gold artisanal mining activities. Therefore, a complete characterization of abandoned sites and the implementation of remediation technologies are of interest for regulators, the industry, and the population. The objective of the study was to test the use of humic acid as a washing treatment to reduce the heavy metal concentration of soil samples impacted by mine waste material.

A stratified random sampling was conducted on the target site to determine the physical and chemical composition of mine waste and soil material. The sampling consisted of taking 37 samples at 0–20 cm depths in a 10,000 square-meter area. The samples were dried and sieved at 2 mm. The batch washing experiments were conducted in triplicate at pH 7.0. A 1:10 solid to liquid ratio and three humic acid dose (0, 50, and 100 mg/l) were used. After shaking (24 h, room temperature) and subsequently filtration (0.22 μm), the supernatants were analyzed for heavy metals, redox potential and pH. The heavy metals mobility was assessed using extraction methods before and after treatments.

The soils had alkaline pH values, conductivity ranged between 8 and 35 mS/cm, with low organic matter. Total concentrations of Vanadium (V) (10.80 to 175.00 mg/kg), Lead (Pb) (7.31 to 90.10 mg/kg), Antimony (Sb) (0.83 to 101.00 mg/kg), and Arsenic (As) (9.53 to 2691.00 mg/kg) exceeded several times the EPA's recommended values for soils. At 100 mg/L HA the removal efficiencies for V, Pb, Sb, and As were 32, 68, 77, and 82% respectively. According to the extraction procedure V, Pb, Sb, and As species are mainly as oxidizable and residual fractions.

According to the results, the target mine site is contaminated with harmful elements. It can be concluded that the use of humic acid is a good alternative as a treatment to minimize the harmful element mobility. More test must be conducted in order to increase the efficiency of heavy metal removal by using humic acid.