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Effect of Several Soil Amendments on Water Quality in Mine Soils: Leaching Columns

Carmela Monterroso, Marc Romero-Estonillo, Carlos Pascual, Beatriz Rodriguez-Garrido

Abstract— The mobilization of heavy metals from polluted soils causes their transfer to natural waters, with consequences for ecosystems and human health. Phytostabilization techniques are applied to reduce this mobility, through the establishment of a vegetal cover and the application of soil amendments. In this work, the capacity of different organic amendments to improve water quality and reduce the mobility of metals in mine-tailings was evaluated. A field pilot test was carried out with leaching columns installed on an old Cu mine ore (NW of Spain) which form part of the PhytoSUDOE network of phytomanaged contaminated field sites (PhytoSUDOE/Phy2SUDOE Projects (SOE1/P5/E0189 and SOE4/P5/E1021)). Ten columns (1 meter high by 25 cm in diameter) were packed with untreated mine tailings (control) or those treated with organic amendments. Applied amendments were based on different combinations of municipal wastes, bark chippings, biomass fly ash and nanoparticles like aluminum oxides or ferrihydrite-type iron oxides. During the packing of the columns, rhizon-samplers were installed at different heights (10, 20 and 50 cm) from the top and pore water samples were obtained by suction. Additionally, in each column, a bottom leachate sample was collected through a valve installed at the bottom of the column. After packing, the columns were sown with grasses. Water samples were analyzed for: pH and redox potential, using combined electrodes; salinity by conductivity-meter; bicarbonate by titration, sulfate, nitrate and chloride, by ion chromatography (Dionex 2000); phosphate, by colorimetry with ammonium molybdate/ascorbic acid; Ca, Mg, Fe, Al, Mn, Zn, Cu, Cd and Pb by flame atomic absorption/emission spectrometry (Perkin Elmer). Purewater and leachate from the control columns (packed with unamended mine tailings) were extremely acidic and had a high concentration of Al, Fe and Cu. In these columns, no plant development was observed. The application of organic amendments improved soil conditions, which allowed the establishment of a dense cover of grasses in the rest of the columns. The combined effect of soil amendment and plant growth had a positive impact on water quality and reduced mobility of aluminum and heavy metals.

Keywords—Leaching, Organic Amendments, Phytostabilization, Polluted Soils

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