Creation of Technosols to decrease metal availability in pyritic tailings with addition of biochar and marble waste

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Creation of Technosols with the use of different materials is a sustainable strategy to reclaim mine tailings and reduce metal mobility. For this purpose, a short-term incubation experiment was designed with biochars derived from pig manure (PM), crop residues (CR) and municipal solid waste (MSW) added to tailings alone or in combination with marble waste (MaW). We aimed to assess the efficiency of the different amendments to decrease Cd, Pb and Zn availability in the Technosols and the fractions where metals were retained. Results showed that all amendments reduced metal mobility, directly related to increases in pH. Those materials with higher content of carbonates were more effective to immobilize metals ($\sim$99%). MSW was highly effective to decrease metal mobility owing to the higher carbonate content, but addition of MaW was needed to enhance metal immobilization with PM and CR. Decreases in Cd mobility were related to retention by the carbonate, Mn/Fe oxides and oxidizable (organic compounds) fractions. Decreases in Pb mobility were related to retention in the Mn/Fe oxides and residual fractions, while decreases in Zn mobility were related to retention in Mn/Fe oxides and oxidizable fractions. The increase in the retention of metals in all fractions was directly associated to increases in pH. Association of Zn and Pb with the oxidizable fraction was also related to the recalcitrance of the organic compounds, and so dependent on biochar type. SEM/EDX showed that biochar showed great affinity to interact with iron oxides, calcium sulfates and phyllosilicates.