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Organic matter dynamics in Technosols created with metalliferous mine residues, biochar and marble waste

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Creation of Technosols by use of different materials can be a sustainable strategy to reclaim mine tailings spread on the environment. A proper selection of materials is critical to efficiently contribute to soil creation, with development of soil structure, organic matter stabilization and stimulation of microbial growth. For this purpose, a short-term incubation experiment was designed with biochars derived from different feedstocks, added to tailings alone or in combination with marble waste (MaW). We aimed to assess the effects of the different materials on the evolution of C and N contents and pools, greenhouse gas (GHG) emissions, aggregate stability, and microbial biomass and activity. Results showed that carbonates provided by MaW increased pH around the target value of 8, with significant decrease in salinity by precipitation of soluble salts. Organic C and total N remained stable during the incubation, with high recalcitrant indices. Labile and soluble C and N pools were low in Technosols, with no differences with unamended tailings at the end of incubation. All biochars increased aggregate stability with regard to control by [U+F07E]40%, with no effect of addition of MaW. Biochars significantly increased microbial biomass C during the first 7 days of incubation; however, from this date, there were no significant differences with unamended tailings. The β-glucosidase activity was below detection limit in all samples, while arylesterase activity increased in biochar-amended samples favored by increases in pH. CO_2 emissions were not significantly affected by any amendment, while N2O emissions increased with the addition of biochars with lower recalcitrance. CH4 emissions decreased in all Technosols receiving biochar. Thus, the combined use of biochar and MaW contributed to soil C sequestration and improved soil structure. However, labile sources of organic compounds would be needed to stimulate microbial populations in the Technosols.

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