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Effect of Technosol application way on chemical quality of percolated leachates from sulfide-rich tailing

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Sulfide mine tailings present particular challenges in terms of risks of environmental recovery due to the acid lixiviation rich in several metal(oids) and sulfates. The conventional closure systems of these tailings have very high cost of implementation and, especially, maintenance of plant cover and continuous leachates treatment. Therefore, the improvement of the chemical characteristics of the tailings and their leachates is a more cost-effective strategy, especially if sustainable technologies are used. The use of designed Technosols is an option. The current study advances past field and laboratory findings by integrating a circular-economy approach into the chemical and soil science-based treatment of such tailings.

A column assay under controlled conditions was set up in order to evaluate the efficiency of a designed Technosol, applied into two ways, on the chemical improvement of the leachates from sulfide-rich tailing. A designed Technosol with alkaline and eutrophic properties was mixed with tailing material (TEC1) or applied as a superficial and distinct layer (TEC2). Tailing without treatment was used as control. The evolution of pH, Electrical conductivity (EC), Fe and sulfates levels was evaluated during 6 weeks in percolated leachates.

The tailing material was previously assessed as having pH ≈2.5 and total concentrations of 104-110 g Fe/kg and 60.0-67.5 g S/kg. Percolated leachates had a pH values between 1.73 and 2.68 and high EC (≈10 mS/cm) that indicate the high amount of several elements and, consequently, their environmental risk.

The first week's pH increased to ≈6.5 for the TEC1 while in TEC2 was ≈2.5. Following weeks, the pH stabilized at around 7.3 in the TEC1 and 2.6 in the TEC2.. The EC decreased in the first week 73% in the TEC1 and 81% in the TEC2, compared to control. In control, EC presented upwards spikes within the first two weeks, reaching almost 14 mS/cm, and then more stable values. . Notably, the EC for TEC 1 was low (<1.6 mS/cm) and rather stable throughout the experiment, for TEC2 it presented large, gradual drops in the first two weeks, followed by rather stable value and slightly lower than control. Fe concentrations largely mirrored these EC patterns. Iron concentrations in

control were high varying 60 and 7546 mg/L during the assay. Technosol application was effective in the diminution of Fe concentrations in the leachates (TEC1 > 1000-fold and TEC2 2-100 fold lower than control).

Overall, both application mode of the Tecnhosol contribute to improvements in the leachates quality. Nonetheless, these results showed that TEC1 approach might result in more stable and better chemical quality of the leachates. Importantly, these findings also suggest the improvement in the tailing structure of TEC1 compared to TEC2, contributing to lower risk of lixiviation into the lower layers.

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