Long-term recovery of mining soils functioning using waste materials from the pulp and paper industry

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Several sites affected by mine exploration, namely at the Iberian Pyrite Belt in Portugal and Spain present extremely acidic soil pH values (pH < 3.5), low content of organic matter, high concentration of potentially toxic elements (PTEs), low water holding capacity, compaction, and scarce vegetation. Thus, there exist an urgent need for searching sustainable strategies that are cost-effective in the recovery of functions of mining degraded soils. Here, we describe a recovery strategy that is focused on the re-use of waste materials from pulp and paper industry (PPI).

In this study, new soil improvers were prepared using different combinations of three waste materials from PPI: fly ash (FA), biological sludge (BS) and biological sludge effluent (BSE). Different formulations prepared by granulation (100%wt. FA, 88%wt. FA with 12%wt. BS, 79%wt. FA with 21%wt BS and 99.5%wt. FA with 0.5%wt. BSE) were characterized. We aimed at the determination of the suitable dosages of these soil improvers to be applied for fuctions recovery of degraded mining soils (neutralize soil acidity, increase soil organic carbon, increase available pool of nutrients, boost biomass production and plant growth), and at the evaluation of the safety and efficacy of these materials through both laboratory (pot experiment) and field tests (*in-situ* pilot experiment at São Domingos mine in Portugal). This study is being developed in the scope of project LIFE No_Waste (LIFE14 ENV/PT/000369, URL: lifenowaste.pt).

All formulations used in this study were suitable for the improvement of soils properties, allowing the neutralization of soil acidity from pH 3.3-4.5 (control plots) to pH 4.8-7.6 (treated plots); the increase of the total organic carbon content in soils from 0.4-0.7 % (control plots) to 0.7-4.0 % (treated plots); imobilized metal pollutants and led to a significant increase in the concentration and bioavailability of macro- and micronutrients which enabled plant growth in the mining soils tested. The long-term variation in mining soil properties upon *in-situ* field apllication of the new waste-based soil additives and the overall effects of the different fomulations of the materials in the recovery of soil functions will be presented and discussed thoroughly.