Pasture species behaviour on sulfide mine tailings rehabilitated with a designed Technosol

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The uranium mineralization from Fé mining area (Spain) contains sulfides, resulting mine wastes generators of acid mine drainage rich in potentially hazardous elements (PHE). The improvement of the physicochemical characteristics and biogeochemical processes of sulfide mine tailings as well as their socioeconomic valorisation can be achieved by the application of a green technology based on circular economy: Technosol. The efficiency of the application of a superficial layer of a designed Technosol with specific properties to the rehabilitation of the sulfide tailings from Fé mining area was tested. Also, the risk assessment of the land recovery by this technology to pasture was evaluated through a microcosm experiment.

After 20 months of the Technosol application in the field, composite samples of Technosol, recovered tailing (bottom of the Technosol) and tailings without recuperation (control tailing) were collected. These samples were used for microcosm assay and characterized for pH, electric conductivity, fertility, PHEs concentration in total fraction and available fraction extracted with rhizosphere-based method. The substrate effect on development of *Lollium perenne* and *Trifolium pratense* (visual signs of phytotoxity, percentage of plant cover and dry shoots biomass) and multielemental composition in their of shoots was evaluated in microcosm assay under greenhouse conditions.

Mine wastes from control tailing had pH ≈4 and high total concentrations of several PHEs (g/kg; Al: 46.2; As, Co and Pb: 0.02-0.03; Cu: 0.04; Fe: 63.2 Mn: 1.3; Ni and Zn: 0.1-0.2). Potentially toxic concentrations of Co, Mn and Ni were identified in the available fraction pointing out the serious environmental risk posed by the control tailing. These chemical characteristics together lack of structure in mine wastes from control tailing contributed to total inhibition of *Lollium* germination and a significant diminution of *Lollium* growth. Both species growing in Technosol and recovered tailing produced significant plant cover and quite similar amounts of shoot biomass.
The improvement of the overall physicochemical properties in the recovered tailing materials (e.g. the decrease of the hazardous element concentrations in available fraction, and the improvement of the fertility and structure) allowed a quick and secure plant cover with pasture species. The results evidenced the efficiency of the designed Technosol in the sulfide mine tailing rehabilitation and potential land recovery to pastures.

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