

Chemical and ecotoxicity evaluation of tailings rehabilitated using Technosol

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The Fé mining area was the most important uranium deposit in Spain. In this deposit, the uranium mineralization contains sulfides. Consequently, tailings are a source of polymetallic contamination requiring their rehabilitation in order to decrease the dispersion of potentially hazardous elements (PHEs). The main objective of this work is to evaluate the efficiency of a Technosol application on the rehabilitation of these tailings at chemical and ecotoxicological level.

In the field, a layer of 20 cm Technosol with andic and eutrophic characteristic was applied over the tailing (total area: 625 m²). After 20 months, composite samples of Technosol (TEC), recovered tailing (bottom of the Technosol, RT) and tailings without recuperation (T) were collected. These samples were characterized for pH, electric conductivity (EC), PHEs concentration in total fraction and available fraction extracted with rhizosphere-based method. Ecotoxicity bioassays were carried out with two species, *Lolium perenne* and *Trifolium pratense* following OECD Guidelines. Three bioassays were carried out: filter paper test and hydroponic test with leachates, and soil test. In leachates (extracted with DIN method) were determined pH, EC and same PHEs than in Technosol/Tailings. Visual aspects, germination, root and shoot elongation and dry biomass were evaluated. The substrate effect on growth of both species was evaluated in pot experiment (500 g Technosol/Tailings per pot, 70% of water-holding capacity) under greenhouse conditions after 69 days by dry shoot biomass.

Materials from T had pH ~4, EC: 1.2 mS/cm 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). However, PHEs concentrations in leachates and available fraction corresponded to <2.5% of total concentrations, except for Co, Mn and Ni where 7-18% of their total concentrations can be available to organisms. Leachates from RT showed a significant improvement of pH values (~6.5) and PHEs concentrations (>75% of reduction).

For both species, the germination percentage and dry biomass weight in filter paper test (*Lolium*: 62–70%, 38-41 mg; *Trifolium*: 73–80%, 24-31 mg) and soil test (*Lolium*: 43–51%, 1.1-2.3 mg; *Trifolium*: 66–70%, 18-23 mg) did not presented significant differences. In hydroponic test, both species presented significant differences in elongation of shoots and roots but not for dry biomass. Tailing leachates inhibited shoots and roots elongation of *Trifolium*, however none negative effect was obtained for *Lolium*. In general, plants growing in TEC leachates had the greatest development. By the three bioassays, no clear evidences were obtained on ecotoxicological effect of the studied materials.

In pot experiment, a total inhibition of *Trifolium* germination and a significant diminution of *Lolium* growth in T (<0.08 g) was obtained. Both species growing in TEC and RT produced quite similar shoot biomass (g; *Lolium*: 1.0-1.9, *Trifolium*: 1.9-2.7).

Differences between OCDE tests and pot experiment are related with time of contact/assay. Results from pot experiments evidenced the efficiency of Technosol in the tailing rehabilitation and its potential revegetation by pastures.

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