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Dehydrogenase activity and quality of leachates in Technosols with gossan and sulfide materials from the São Domingos mine

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Wastes produced by mining activity in São Domingos (Portuguese Iberian Pyrite Belt) were disposed over a large area. To speed up the ecological rehabilitation in this mine, an integrative strategy using different amendments+mine wastes was used to produce Technosols with enhanced soil functions. To evaluate the efficiency of these Technosols the dehydrogenase activity and chemical quality of leachates were monitored.
Technosols were composed of different mine wastes (gossan and sulfide materials), collected at the São Domingos mine, and mixtures of amendments applied at 30 and 75 Mg/ha (rockwool+agriculture wastes+wastes from liquors distillation of strawberry tree fruits (Arbutus unedo L.) and/or carobs (Ceratonia siliqua L. fruits)).
Three assays, under controlled conditions, were carried out: (1 and 2) Sulfide or gossan materials with/without amendments; (3) Sulfide wastes, with/without amendments, incubated during four months and then with application of an overlayer of gossan ($\sim$3 cm thick) with/without the same amendments.
Dehydrogenase activity (DHA) and chemical characteristics of leachates (multielemental concentration, pH, and electric conductivity) were determined after four/seven/thirteen months of incubation.
Sulfide wastes had more hazardous characteristics (pH$\sim$2 and total concentrations (g/kg) of Al (58.1), As (1.1), Cu (2.1), Fe (107.3), Pb (11.7), S (65.3) and Zn (1.1) than the gossan materials (pH=4.3; g/kg, Al: 24.8, As: 3.0, Cu: 0.2, Fe: 129, Pb: 9.2, S: 13.7, Zn: 0.04).
Amendments application to gossan (assay 2) enhanced DHA in both sampling periods (μg TPF g dry weight 16 h-1, Control: 0,72-1,78; Amended treatments: $2.49^{-1}6.36$ depending on mixture/application rate/sampling period). Greater application rates stimulated DHA (more than 1.5-fold with 75 Mg/ha). No differences were observed in DHA in the gossan layer with/without amendments (assay 3) suggesting a negative impact on gossan microrganisms from sulfide materials located below. In fact, for sulfide materials (assays 1 and 3), the amendments did not lead to increases in DHA (μg TPF g dry weight 16 h-1, Control: $0.87-2.72$; Amended treatments: $0.23-2.11$, depending on assay/sampling period/treatment). In assay 3, the DHA of each mine waste presented, in general, smaller enzymatic activity compared to the same treatments from the other assays.
The amendments reduced the electrical condutivity ($35-60$ %) in the leachates from Technosols with sulfide materials but the pH of leachates increased in all cases between 0.5 and 1.5 units, depending on assay/treatment/sampling period.