

Risk assessment of the land recovery to pastures on sulfide tailings closed with different systems: Conventional Vs Technosol



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INTRODUCTION: A promising planning for recovery and closure of mining tailings must include environmental and socioeconomic approaches. Buenaventura group and La Zanja mine are evaluating, in different closure systems of tailing deposits, the integrated rehabilitation of the ecosystem and its recovery to other secure land uses which promote the regional socio-economic valorization.

OBJECTIVE: to evaluate, at long term, the chemical and microbiological characteristics of the soil, and development and environmental potential risk of the herbaceous strata growing in mine tailings closed with two conventional closure systems and a Technosol designed specifically for environmental problems of the mining tailing.

MATERIALS & METHODS:

Three tailing deposits, composed of mine wastes rich in sulfides, from La Zanja mining area (Cajamarca, Peru)

Closure systems tested

Conventional system A: superficial layer of amended local topsoil (40 cm)

Conventional system B: superficial layer of amended topsoil above of layer of materials with low permeability (25 cm + 20 cm, respectively)

Designed Technosol: superficial layer of Technosol designed with andic, eutrophic and reductive properties (45 cm)

Soil amendments: agricultural lime (2000 kg/ha) + chicken manure (2000 kg/ha)

Vegetalization: mixture of several herbaceous species, mainly fast growing grasses (e.g. *Lolium* sp. and *Trifolium repens* L.)

Chemical and biological characterization of the soil: pH, fertility and PHE concentration in pseudototal and available fractions, dehydrogenase activity, microbial biomass



Plants characterization from herbaceous cover: multielemental composition in shoots

RESULTS:



Tailing deposit closed with conventional system B



Tailing deposit closed with Technosol

Table 1. Chemical and biological characteristics of the soils (min - max).

	System A (n=6)	System B (n=6)	Tecnosol (n=19)
pH	2.7 – 4.3	4.3 – 4.9	7.0 – 8.9
Organic C (g/kg)	23 – 31	20 – 45	21 – 51
Total N (g/kg)	3.0 – 4.6	4.8 – 7.7	1.5 – 3.0
Available PO₄ (mg/kg)	<0.02 – 1.9	<0.02 – 1.2	0.3 – 77
Microbial biomass (µg C/g)	686 – 1220	857 – 2165	302 – 1242
Dehydrogenase activity (µg INTF/(g 2h))	<19.8 – 56.2	<19.8 – 73.9	43 – 236

Technosol compared to soils from conventional systems

Chemical quality

- Higher pH
- Higher availability of macro- and micro-nutrients
- Stabilized organic matter and with different decomposition rates

Biological quality

- Similar microbial biomass
- Higher activity of overall microbial community
- More efficient microbial community

Table 2. Chemical composition of the herbaceous plants (min - max).

	System A (n=6)	System B (n=6)	Tecnosol (n=19)	MTL*
As	1.1 – 6,6	4.1 – 35	<0.1 – 1.0	30 ^{a,c}
Cu	12 – 43	6.1 – 10	<0.4 – 17	15 ^a , 40 ^b , 250 ^c
Hg	0.02 – 0.05	0.02 – 0.03	< 0.02	0,2 ^{a-c}
Mn	256 – 1499	590 – 1398	34 – 269	2000 ^{a-b} , 400 ^c

MTL: Maximum tolerable level for animals grazing in adjacent areas to La Zanja mining area (sheep, cattle, horse)