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Capacity of phytoacumulation of Hg in plants developed in contaminated soils with different concentrations of Hg in the area of La Manjoya (Oviedo, N Spain)

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Soils and vegetation contaminated close to an abandoned Hg-Fulminate (Hg (OCN)2) Production Plant (1866-1996) located in La Manjoya (Asturias, NW Spain) were studied.

The Production Plant is located on a low hill with a dense deciduous forest of .90 ha. of Quercus robur, Aesculus hippocastanum and Acer pseudoplatanus, as dominant plants, and shrubs (Buxus sp, Euonymus sp, Laurus nobilis) and spontaneous (Rubus fruticosus, Taraxacum officinalis, Hedera sp, Juncus sp, and ferns, Osmunda cinnamonea, Polystichum setiferum,..).

Main causes of pollution are Hg losses in production and storage areas and accidental explosions (Camps et al., 2008). The highest values (30-40 g kg-1) were found promptly in the area where the wastewater produced during the washing procedures carried out at the Production Plant used to be discharged. Elemental Hg was visually identified as droplets in the A horizon (0-30 cm).

Mean temperature was 12ºC and precipitation is 1100 mm. Natural soils are Leptic and Cambic Umbrisols (WRB, 2006) developed from schists. In the industrial zone are “Technic Regosols and Ekranic and Urbic Technosol”. Soil pH-H2O values of the natural soils are 4-5. pH in anthropic soils ranged from 3.9 to 7.8, according “artefacts” added, principally pyrite cinder wastes and demolition wastes. Organic C contents of mineral surface horizons ranged from 12-120 g kg-1.

Hg was determined in dry soil samples. The concentration in natural soils (<0.01 mg kg-1) are similar to surrounding schists-derived soils. The highest concentrations are punctual, descending rapidly to 1-10 g kg-1 in the industrial area, and from 0.1 to 1 g kg-1 in their environment. Digital maps of Hg distribution in soils around the Hg-fulminate facilities were generated.

Soil remediation actions, consisting in excavation and removal of all horizons containing more than 1000 mg kg-1Hg, from the site to a secure dump site, were made. In order to phytoremediation actions were selected 9 plots of 10 m2, Hg concentration were determined in the first 30 cm of 10 samples at random, and in plant leaves. Average concentrations of Hg in soils were <0.1, 1, 15, 28, 38, 115, 181, 607, 750 and 14465 mg kg-1. Oaks and horse chestnuts with 0.5 and 1.8 mg kg-1 appear in soils with <15 mg kg-1. Ferns, Rubus, Acer and Euonymus in concentrations of <1-14465, Hedera 115-14465, Taraxacum 28-750, Sambucus nigra <1-606; Juncus, Laurus and Buxus in <15mg kg-1. The highest foliar concentrations were 11 mg kg-1 in Hedera and 13 mg kg-1 in the ferns, taking into uncontaminated soil values <0.1 mg kg-1, which means a concentration factor >100. Ferns show the best relationship with the concentration in soil up to 180 mg kg-1. Taraxacum varies from 1.7-9.6 but non-clear relation exist with the soil. Buxus sp. presents the highest value (5.9) at concentrations <15 mg kg-1. Acer (0.8-2.4), Euonymus (0.7 to 2.2) and Rubus (0.3-2.7) respond to soil concentration but with low values. Juncus (0.4-0.7) and Laurus (0.5 to 1.1) do not have high values.

Since Eh-pH conditions as set Hg0 more stable species, pollution must come through foliar uptake of volatilized Hg, showing the differences between plants. We conclude that the toxicity of Hg does not prevent the growth of plants and ferns. Hedera and ferns can store 100 times the concentrations of the same species in unpolluted soil. Maple and horse chestnut trees have lower factors, 10-20, but may be adequate for its greater biomass production.

REFERENCES

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