

**Chemical fractionation in investigation of heavy metals mobility
in industrial waste polluted soils**

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Proper evaluation of the effect of heavy metals on the natural environment is possible on the basis of knowledge about their forms and bindings with soil, sediment, sludge or solid waste components found. Sequential extraction could be the source of the above mentioned information, enabling identification and quantitative determination of various forms of the same chemical element. It is therefore widely used as a tool for the study of fate of metals in the environment. The loading of ecosystems with heavy metals can be due to pollution by waste materials. Landfill leachates are still one of the major sources of heavy metals discharged to the surrounding environment. The aim of this work was to identify the mobility of heavy metals in polluted soils and environmental impact of industrial waste disposal.

In experiments dewatered galvanic sludge from electroplating plant and three types of soils: sandy forest, agriculture and loamy, were used. The soil samples were taken from the top 20cm. Investigations were performed for air-dry weight of the sludge and soils samples. Each soil and galvanic sludge were mixed in the ratio of 50 to 1. The experiment was carried out on three parallel soil-sludge samples using polypropylene columns. During experiments demineralized water was added to each column. The leachates were collected to determine the quantity of leached metals. Before the start of the experiment and after 1 week, 1, 3 and 6 months, the sequential extraction of metals was carried out.

A five-step sequential fractionation scheme was used to partition the metals into exchangeable (F I), acid-soluble (F II), reducible (F III), organic matter (F IV) and residual (F V) fractions. The metals forms occurred in fractions F I - F IV can be released to ecosystems under changeable natural conditions. The metals forms occurring in the residual fraction (FV) are permanently immobilized. The sequential extraction of heavy metals from the industrial sludge and soils used different extraction buffers: (i) $\text{CH}_3\text{COONH}_4$ (for the exchangeable fraction); 10ml of 1M $\text{CH}_3\text{COONH}_4$ for 1h in room temperature; (ii) $\text{CH}_3\text{COONH}_4/\text{CH}_3\text{COOH}$ (for the acid-soluble fraction); 20 ml of 1M $\text{CH}_3\text{COONH}_4$ adjusted to pH = 5 with acetic acid for 5h in room temperature; (iii) $\text{NH}_2\text{OH}\cdot\text{HCl}$ and CH_3COOH (for the reducible fraction); 20 ml of 0,04M $\text{NH}_2\text{OH}\cdot\text{HCl}$ in 25% (v/v) CH_3COOH for 5h in 95°C; (iv) HNO_3 , H_2O_2 and $\text{CH}_3\text{COONH}_4$ (for the organically bound fraction); 5 ml of 0,02M HNO_3 and 10 ml of 30% H_2O_2 adjusted to pH = 2 with 65% HNO_3 for 5 h in 85°C and 10 ml of 3,2M $\text{CH}_3\text{COONH}_4$ in 20% (v/v) HNO_3 for 0.5 h in room temperature; and (v) HNO_3 and H_2O_2 (for the remaining metals); 3 ml HNO_3 and 6 ml 30% H_2O_2 for 1 h in boiling temperature and 10 ml H_2O for 0.5 h in boiling temperature. The extracts were measured in a flame atomic absorption spectrophotometer (AAS).

The amounts of metals (Cu, Ni, Fe, Zn) leaching from sludge-soil samples were increasing during the studied period of time successively. The occurrence of Cu, Ni, Fe and Zn in particular fractions of sequential extraction depends on the type of investigated soil (sandy forest, agricultural or loamy).