

## 9. Feasibility study on phytoextraction of heavy metals in sludge fields derived from lake dredging nearby Hanover, Germany

MEUSER Helmut and MAKOWSKY Lutz

University of Applied Sciences Osnabrueck

### Abstract:

Continuously dredged lake sediment with partly elevated metal concentration (total concentration Cd: 1.9-2.7, Cr: 120-143, Cu: 36-44, Ni: 28-38, Pb: 122-133, Zn 287-356 mg kg<sup>-1</sup> in 0-30 cm) was pumped into different sludge fields surrounded by dams for recycle purposes in future after long-term drying. Due to proximity to the city of Hanover and discharges of leather industry particularly cadmium, chromium and zinc were accumulated in the sedimented sludge indicating high Total Organic Carbon content (TOC 19.4-35.2 %), acid pH value (2.6-4.4), low redox potential (146-230 mV) and black color. Depending on the age of the fields distinct vegetation (*Typha latifolia*, *Phragmites australis*, *Salix caprea* and *cinerea*, *Betula pendula*) established in a line with natural succession.

With reference to different seasons, after sampling of sludge material in several depths, heavy metals were analyzed based on aqua regia, NH<sub>4</sub>NO<sub>3</sub> and EDTA extraction method. Furthermore, soil water was collected by suction cups as well as aboveground plant material was cut, quantified and analyzed. The investigations were aimed at the phytoextraction potential and the determination of correlations between different soil concentrations and plant contents.

*Salix* was possible to accumulate high rates of Cd (mean values 14.5 g ha<sup>-1</sup> a<sup>-1</sup>) and Zn (2,960 g ha<sup>-1</sup> a<sup>-1</sup>). *Phragmites* revealed high amounts of Cr (230 g ha<sup>-1</sup> a<sup>-1</sup>), whereas *Betula* concentrated predominantly Cr (196 g ha<sup>-1</sup> a<sup>-1</sup>) and Zn (2,445 g ha<sup>-1</sup> a<sup>-1</sup>). However, the plant uptake would need long periods of time (minimum 49 years) to reach metal values enabling material recycle based upon German directives. The main reason for the limited plant uptake appeared to be the real pH values of soil solution. Taking the results from the suction cups into account that ranged between 6.2 and 8.1, enhanced metal mobility was not expectable. Apparently, low pH values of soil matrix derived from sulphide oxidation were detected even after drying in laboratory.

Results from NH<sub>4</sub>NO<sub>3</sub> and EDTA extraction were strongly correlated. For some elements aqua regia content and the mobile fractions (NH<sub>4</sub>NO<sub>3</sub>, EDTA) were tightly connected as well. Apart from Cu there was no relationship between TOC and EDTA extractable concentration recognizable. In general, pH value and mobile metal contents were negatively correlated.

Keywords: dredged sludge, phytoextraction, heavy metal, extraction method

Topic: C. Urban soils and ecosystem services

Sub-topic: C6. Remediation & cleanup standards of contaminated soils

Presentation type: Oral

Information of corresponding author

Full Name: Helmut Meuser

Organization: University of Applied Sciences Osnabrueck

Mailing address:

Tel: =49-541-9695028

E-mail: h.meuser@fh-osnabrueck.de