



## **Release of zinc and lead from sulfide bearing flotation residues depending on redox conditions**

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Redox conditions have a profound influence on speciation, mobility and plant availability of zinc and lead in contaminated soils and sediments. This influence was investigated at the flotation dump of a former ore mine in the western part of Germany, where sulfide bearing flotation residues with zinc contents up to 16000 mg/kg and lead contents up to 18000 mg/kg were deposited. At depths below about 50 cm, the local hydrology and the presence of sulfide minerals result in anoxic conditions and pH values around 7. Oxidation of the deposited material in contact with the atmosphere leads to an oxic topsoil with pH values around 5.

The release of Zn and Pb from the sediment into the soil water was studied with different leaching tests and soil water sampling strategies. Seasonal variations were investigated by periodical sampling of soil water with suction lysimeters. Oxidation kinetics was quantified by repeated leaching tests after increasing storage times between 0 and 325 days. Heavy metal speciation along a depth profile was determined using sequential extractions and Zn-K-edge EXAFS spectroscopic analysis of untreated and extracted samples.

The results show that the oxidized and acidified topsoil is depleted in Zn and that only 10% of the remaining Zn is present in a labile form. In contrast, Pb is enriched in the topsoil and more than 70% of the total Pb is present in the labile fraction. Zinc concentrations in soil water greater 10 mg/L and Pb concentrations up to 0.4 mg/L can be found. In the anoxic subsoil, Pb and Zn mainly occur in immobile forms. Sphalerite was identified as the dominant Zn species. The concentrations of Zn and Pb in the

anoxic pore water are smaller than 0.1 mg/L.

Our leaching studies demonstrate that the oxidation and concomitant acidification of sediment samples may lead to a substantial increase in the extractable (labile) heavy metal fractions. Thus, standard leaching tests performed under oxic conditions may result in a significant overestimation of the current heavy metal release from anoxic sediments. We therefore propose a simple modification of current test methods for anoxic samples. This method may provide a more realistic estimate of the current metal mobility in anoxic sediments. On the other hand our study shows that an increasing oxidation in the future would lead to a serious release of heavy metals.