Results of field scale phytoremediation experiments on a former Uranium mining site

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Extended Abstract

In the past large heavy metal contaminated sites represented a problem for remediation; especially former mining sites with AMD impact result in a demanding challenge for long-term and sustainable remediation efforts. Since a few years phytoremediation as an alternative remediation method is investigated; the low treatment costs make it feasible even for such sites. Robust phytoremediation plants, which tolerate acidic soils and slight to medium HM concentrations represent one convenient approach for acidic mining areas. Phytoremediation is an emerging, sustainable and very convenient technology for the stabilization and environmental improvement of former mining sites as well as of their ground water quality.

Field scale investigations were applied to an area of the former uranium mining in East Thuringia, Germany. During active mining operations, a low grade uranium leaching dump was situated on this area. After closedown of mining operations, the dump was removed during the remediation process of the site. The remaining underground currently is slightly to moderately contaminated with heavy metals and radionuclides (HM/R) and the actual and future land use of this area is restricted.

In an interdisciplinary research project, concepts for the remediation of HM/R- contaminated sites and for the subsequent utilization of HM/R-loaded plant residues were developed. The application of phytoremediation was investigated in laboratory-, green house– and field experiments by interdisciplinary working groups. One challenge of the experiments was the subsequent utilization of the plants from phytoremediation.

Field experiments were carried out with *Triticale, Helianthus annuus, Brassica juncea* and *Sorghum bi-color* by application of different biological additives (mycorrhiza, HM-resistant streptomyces) and soil amendment strategies (increasing pH and organic matter). As a main result, phytoremediation in combination with the different soil improvement strategies predominantly showed an immobilization of HM/R in the upper topsoil layer (rhizosphere) by sorption and sequestration processes (phytostabilization), as well as a substantial reduction of the seepage water rate.

Different experiments were carried out for the investigation of utilization of the plant material from the field experiments and possible restrictions. A subsequent utilization of the plant biomass as CO2-neutral energy source would represent a convenient solution. The utilization of the HM/R-loaded plant residues after the harvest can contribute to the minimization of wastes, to the winning of energy, and therefore to a reduction of the remediation costs. The processing of the heavy metal loaded plant residues was investigated by different methods. In fermentation experiments with *Solanum tuberosum* and *Secale cereale* good results were achieved compared to industrial standards. Biogas experiments were carried out with *Triticale, Helianthus annuus* and *Brassica juncea*. In the anaerobic biogas process, heavy metals can be precipitated and accumulated in the sludge as a sink. In combustion process, U is immobilized predominantly (80 – 85 %) in the ashes, and finally these remainders (often less than 5-10% of the original plant dry mass) can be deposited .

From the results of the project can be concluded, that phytoremediation is a convenient method for the stabilization and remediation of large sites with slight to medium contaminations, and a further utilization of the plant residues by fermentation, biogas production and thermal utilization, respectively, is feasible.

Key words: Remediation of mining sites, phytoremediation, phytostabilization, uranium, heavy metals