

Stage 2. Technical solutions for biological treatment of soil contaminated with heavy metals – analysis

The presence of environmental risk and toxic compounds can be determined by numerous molecular and biochemical methods and toxicological tests. However, the data regarding the action of these techniques in bioremediation applications and assessment of environmental quality is still limited. There are still question marks. For example, microorganisms are able to degrade pollutants in soil and what method for biological treatment of soil will effectively remove pollutants?

Critical analysis of technical solutions for biological treatment of soils contaminated with heavy metals, applied in the rehabilitation of land was aimed mainly to establish soil microorganisms and interaction between metals and microorganisms, in terms of heavy metal concentration and the interaction between metals and microorganisms. Was done a review of both, *in situ* [in situ biodegradation, bio-immobilization, bio-leaching, phytoremediation (phytoextraction, phytostabilization)] and *ex situ* (Treatment in bioreactors, Bulk bioleaching, Current trends on the extraction of metal trough bio-leaching method) biological treatment methods of soils contaminated with heavy metals. In order to develop RESOLMET methods for remediation of contaminated soil with both heavy metals and petroleum products, were identified major factors for bioremediation and it was chosen the technology: site characteristics, soil type, water content, nature of contaminants, time (weather) constraints; volatilization, bio-stimulation, bio-growth and sampling and monitoring. It was established the optimal mode to realize the workflow in development of technology, such as: designing the micro-organisms used for bioremediation, some eventual chemical treatment / physical and biological combined; measurement mode of biodegradation capacity, the definition of the metabolic capabilities of microorganisms; setting limitations of microbial biodegradation; chemotaxonomy; the assessment of bioremediation technologies especially monitoring and evaluation methods applied in soil bioremediation.

Although molecular techniques are in early stages of investigation and application, which an important interdisciplinary element. Studies on the dynamics of communities, for microorganisms with bioremediation potential, will demonstrate the microbial diversity, but even molecular methodologies, immunochemical, directed towards to the characterization of new biocatalytic activities of groups of organisms.

Methods used in bioremediation for cleaning contaminated soil are: : physio-chemical methods, separation methods, thermal etc.

The most important factors in choosing technology for bioremediation are: site characteristics, soil type, water content, the nature of contaminants, time (weather), volatilization, bio-stimulation, etc.

A very good control and optimization of microbial processes require an elevated action, but also the costs are high. Since surfactants can inhibit biodegradation and they can be easily absorbed into the soil, reducing its effectiveness, they have been used successfully in bioreactors system for treating the muddy soil.

Beneficial effects of stimulating the biodegradation of recalcitrant compounds by adding leaching compounds was demonstrated, such as vegetable oil or refined hydrocarbons.

Also, in this stage were established qualitative and quantitative methods of analysis of soils contaminated with heavy metals, in order to determine the optimal applicable method in function by pollutants (load) quantity of soil. Are presented qualitative and quantitative analysis methods of contaminated soils, with emphasis on: the principles of choice of method, importance sampling method of soil, as well as how to choose the correct method of mineralization of soil samples and of sequential extraction used in species classification of metals from soil. This paper presents detailed methods of quantitative and qualitative determination of metals in soil samples that will be applied in this project: atomic absorption spectrometry in flame (determination of cadmium, chromium, cobalt, copper, lead, manganese, nickel and zinc in "aqua regia" soil extracts), special techniques in atomic spectrometry, atomic emission spectrometry in plasma inductively coupled, mass spectrometry plasma inductively coupled and X-ray fluorescence analysis.

Two seminars are organized in order to disseminate the results, at the Faculty of Environmental Sciences, Str. Fântânele no. 30, Cluj-Napoca (July 3, 2009) and at University Transylvania Brasov (November 9, 2009); it was published two ISI articles and three articles in Science Bulletins (Cat.B-NURC) and has participated in two profile events.