MULTISTAGE VERIFICATION OF SOIL REMEDIATION

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ABSTRACT

Many innovative soil and groundwater remediation technologies have been recently developed. These technologies are ready for application and some of them have proven their applicability and performance in demonstrations, but the widespread implementation of these innovative remediation technologies is very slow. Practical, useful and uniform evaluation and characterisation of the innovative technologies are necessary to shorten the time between development and application of a new technology. The decision makers, the owners and other stakeholders should be guided by valuable information ensured by a technology-assessment tool, which evaluates the technological, environmental, eco- and cost-efficiency of the technology.

Related to environmental technology verification a lot of information is available. The establishment of networks of testing centres, in order to develop common or co-ordinated protocols and practices of technology assessment in the water, soil or land use, is being promoted using Community research funding. The European Commission set up a European **„***Environmental Technologies Verification***"**(ETV) System in order to improve the competitiveness of European technologies on the Global market. One of the main aims of the *Hungarian MOKKA (2005–2008) project* (www.mokkka.hu) was to develop a science-based *technology-verification system* harmonised with ETV.

In the frame of MOKKA project a complex and uniform remediation technology-verification system was developed and applied, which makes possible better understanding and evaluation of the remediation technologies and is able to increase trust in remediation, including *in situ* biotechnologies. The developed evaluation/verification system can be applied generally both to bioremediation and *in situ* soil treatment.

The multistage MOKKA verification system includes quantitative and qualitative tools for the characterisation of the remediation technology: 1. material balance, that is the mass flow balance of the soil phases and the modified or eliminated pollutant amount, 2. quantitative characterisation of the environmental risk before, during and after the remediation, 3. cost-efficiency or cost-benefit assessment and 4. SWOT analysis.

This publication introduces As an example, in detail the complex verification system was applied for the detailed characterisation and evaluation of an *in situ* remediation technology, the cyclodextrin technology" (CDT), which is an innovative bioremediation developed and used for soil contaminated with hydrocarbons of limited bioavailability. Main goals of this first field application were to prove the findings of the laboratory experiments and to acquire data for the technology-verification.

The feasibility of the cyclodextrin-enhanced bioremediation (CDT) was demonstrated in a field application and the developed innovative tools for the verification of the technology proved the efficiency and the competitiveness of CDT technology.

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