

Mgr. Petra Innemanová: Two different approaches in toxic pollution remediation – pilot scale tests

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SUMMARY

Large amount of organic substances has been leached into subsurface as a result of human activities and/or related accidents. A lot of new information concerning possibilities of their subsequent removal from the living environment is published every year. A very important step for an application of new methods as functional technologies is their pilot scale testing or other verification under service conditions. It is clear, that the experimental treatment of tons of contaminated soils or vast volumes of water often requires solving of specific problems, not occurring on the microcosms scale.

Two different approaches (natural attenuation and enhanced biodegradation) for removal of contamination were verified by means of proprietary applied research conducted at the DEKONTA company.

I) At many contaminated sites the subsurface is capable of natural attenuation of pollutants thus potentially decreasing the cost of remediation. This reduction in concentration of pollutants is due to a number of processes, including simple dilution, dispersion, sorption, volatilisation, biotic and abiotic transformation. The use of natural attenuation as a remedial approach is referred to as 'Monitored Natural Attenuation' by the U.S. Environmental Protection Agency. Reliance on natural attenuation requires a reliable monitoring method of the process.

To confirm the effect of natural attenuation, necessary data was collected on a petroleum contaminated filling station, belonging to the agricultural cooperative of 'Rýcholka', Choustníkovo Hradiště (CZ). During one-year concentrations of petroleum hydrocarbons, living aerobic and anaerobic microorganisms, electron acceptors (O_2 , NO_3^- , SO_4^{2-}) and other products of bacterial metabolism (Fe^{II} , Mn^{II}) were monthly monitored in the groundwater and the soil. The practical experience together with recently published data led into creation of the guidelines titled as 'Monitored Natural Attenuation of the Petroleum and Aliphatic Chlorinated Hydrocarbons', which was published by the Ministry of Environment in 2001. Detail risk analysis of contamination situation on the site of 'Rýcholka' and design of further treatment of present residual contamination were other results of the project and also goals of the first part of the submitted thesis. Based on the obtained results it was concluded, that this is a depleted source of contamination, probably henceforward retreatin recovered by natural attenuation processes. Thus it is not necessary to realise any active remedial intervention, which means indispensable decrease of expenditure for site re-treatment.

II) In contrast to natural attenuation, a highly active approach is required for such types of pollution as polychlorinated biphenyles (PCBs). The pilot scale test, which establishes a necessary connection link between experience from laboratory studies and a full establishment of a PCBs remediation method into practice, was carried out on a fully protected landfill site in Ústí nad Labem (CZ) from April 2001 to November 2003. Sites of samples origin (the Milovice military training area and the Milevsko asphalt mixing plant, CZ) belong to highly exposed cases of PCBs contamination widely covered in Czech media.

The biological remediation of the 10 tons soil samples (containing PCBs at concentrations of hundreds and tens mg.kg⁻¹) was based on a so-called 'sequential' anaerobic-aerobic process. The remediation process was evaluated on the basis of chemical and microbiological analyses. PCB concentration, including congener characterization, concentration of mineral nutrients, total microflora and respiration intensity were determined at the start, during the process and at the end of the experiment.

Starting concentrations of contamination were chosen with regard to expected lower efficiency of the method and the requirement of subsequent waste landfilling according to the active legislation. This fact, however, emerged to be in contrast to the biodegradation method principle itself. The tested residual concentrations were probably of negligible benefit to the microorganisms. In addition, there was a strong effect of contaminant ageing leading to irreversible sorption of contamination to solid particles resulting in further decrease of its biological availability.