UPSOIL: New frontiers in cost-effective sustainable in-situ remediation approaches

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Abstract:
Based on recent estimates, clean up is required for at least 250,000 contaminated sites in the European Union. Increased cost-effectiveness of soil remediation techniques thus will generate significant benefit. A major drive for remediation is urban redevelopment of former industrial sites, where cost and time constraints pose the main boundary conditions for the remediation strategy. In addition recent awareness and regulatory developments demand greater emphasis on sustainability.

For the organic contaminants, which pose the largest risk, a wide range of in-situ treatments based on degradation through chemical and biological reduction-oxidation (redox) reactions have already become available. However, the advances made mainly originated from a narrow engineering perspective, focussing on the intended interaction between contaminant and remedial agents. This has led to remediation practices in which the physically and chemically heterogeneous and reactive soil system is not taken into account sufficiently.

Upon this realization, within UPSOIL[1] robust technologies and approaches are developed that optimize the application of in-situ soil and groundwater remediation technologies with respect to cost, time and sustainability in such a way that:

- soil structure, properties and functions are integral factors in selecting the type of remedial treatment,
- side-effects of treatment, for example at multi-contaminant sites, on overall risk are taken into account,
- active remediation (chemical or biological) allows natural attenuation potential to be fully utilized and stimulated,
- the injected remedial agent is better targeted at the location/distribution of the contaminant within the soil,
- modelling and dynamic monitoring of the remediation progress are used in real-time to allow feed-back driven remediation,
- reactant species are more selective towards the contaminant and less degrading towards the soil matrix,

[1] UPSOIL is a collaborative EU project within the 7th Framework Programme. Partners are: [a]Deltares (NL), [b] VITO (BE), [c]ECOIND (Rom), Labein (SP), WUR (NL), IETU (PL), SGI (SVE), ENACON (CZ), ECOREM-Baltija (LT), Dekonta (CZ), POWIZ (PL), Ejskov (DK), RDS (SP), Biutec (AU), Geocisa (SP)

- indicators can diagnose whether viable microbial soil populations are present and that microbial dynamics are such that the natural attenuation capacity of the soil has been restored.

The research is conducted in the lab and at four European field sites with different hydrogeological characteristics (heterogeneous/homogeneous) and contaminant types (LNAPL/DNAPL). The general approach is based on fast reduction in contaminant levels allowing site redevelopment, followed by slow further soil recovery towards natural soil functions. The primary impact of UPSOIL will be a significant increase in the costs-effectiveness, and a significant reduction in time required for soil remediation, in support of the implementation by EU member states of their soil remediation programmes.