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THEME 6 ENVIRONMENT

upsoil

Sustainable Soil Upgrading by Developing Cost-effective, Biogeochemical Remediation Approaches

FP7 Collaborative Project
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Soil contamination requiring clean up is present at approximately 250000 sites in the EEA member countries and this number is expected to grow.

Potentially polluting activities are estimated to have occurred at nearly 3 million sites (including the 250000 sites already mentioned).

The number of sites needing remediation may increase by 50% by 2025" (EEA 2007).

Background

Dealing with soil and groundwater contamination is becoming an integral part of plans for the development of industrial locations or derelict urban sites.

The **great effort and substantial cost** associated with **conventional soil remediation** is frequently seen as the major obstacle for redevelopment of contaminated sites.

Increased cost-effectiveness of soil remediation techniques will generate **significant benefit** for problem owners and society as a whole.

Given a steady yearly budget, it will also **significantly decrease the total time-span** involved for the soil remediation programs of the member states.

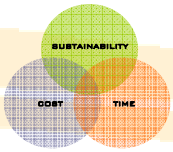
The Concept

The concept of UPSOIL is that for the enhancement of cost-effective sustainable remediation of contaminated soil on a European scale, **3 optimization dimensions** need to be addressed:

1.- **SUSTAINABILITY**: the technologies employed should ensure that there are no pending (post remediation) liability issues and that soil functions are maintained or restored.

2.- **COST**: the cost effectiveness of remediation should be significantly increased as compared to current practices

3.- **TIME**: the technologies employed should allow fast release of sites for urban/industrial or ecological redevelopment



Aims and Objectives

The project's objective is to make the required breakthrough in ***in-situ* biochemical remediation for organic contaminants**, by developing **robust, new technologies** for **fast, cost-effective and sustainable soil treatment** that result in both **allowable (risk) levels** and **maximal use of the natural soil rehabilitation potential** at a longer term:

- Soil structure, properties and functions are integral factors in selecting the type of remedial treatment,
- Side-effects of treatment on overall risk are taken into account,
- Active remediation is designed in such a way that the natural attenuation potential is fully utilized and stimulated,
- Indicators are developed for biological activity diagnosis,
- The injected remedial agent is better targeted at the location/distribution of the contaminant within the soil,
- Reactant species are developed that are more selective towards the contaminant and less degrading towards the soil matrix,
- Modeling and dynamic monitoring of the remediation progress are used in real-time to allow feed-back driven remediation.

Three main research lines

Technologically, UPSOIL aims at optimizing biochemical treatment technologies for organic contaminants following three main lines of research lines:

UPSOIL aims at developing robust technologies and approaches that optimize in-situ soil and groundwater remediation for cost, time and sustainability

Technologies	Dimensions		
	cost	time	sustainability
conventional			
excavation (source zone)	-	+	-
pump-and-treat (plume)	-	-	-
in-situ			
bioremediation (plume)	+	-	+
natural attenuation (plume and source)	+	-	+
chemical treatments (plume and source)	-	+	-
aimed for by UPSOIL			
smart coupling of *in-situ* (source and plume)	+	+	+
frontier technologies (source and plume)	+	+	+

Research Line `a´.
Smart coupling: smart coupling of existing chemical and biological techniques
In this key line research the following issues will be targeted:
- System-Based Process Technology
- Soil System Sustainability
- Heavy metals mobilization – Remediation effects.

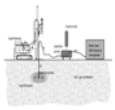
In System-Based Process Technology: existing technologies will be combined either in space or time so that their weaknesses are cancelled and strong points reinforced. Changes in biodiversity conditions after chemical treatment of soils will be monitored and documented.

Additionally, chemical treatment side effects on heavy metals mobility will be investigated and key factors will be identified to minimize the risks.

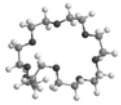
BIO + CHEM

Research Line `b´.
System driven injection: improved injection system for more efficient delivery of the reactant
The efforts in this area will result in a cost-effective and sustainable injection technology for the delivery of remedial reactants determined previously to achieve optimal contaminant degradation.

Optimal interaction between the injected remedial agents and the target contaminant is crucial requirement for efficient remediation approaches. It is important to minimize addition of e.g. oxidative chemicals to the subsurface as this will reduce total costs of a remediation project, reduce the impact on natural conditions, and avoid unwanted side effects assessed in other research areas of the project. This part of the project will develop an improved injection system for an efficient delivery of oxidants.



Research Line `c´.
Specific targeting: injection of specifically developed chemical oxidants to target them to the right place
This research topic is focused on the development of a unique new technology in which the oxidant will be pre-treated to avoid reaction with the soil matrix components.



The mayor drawback of the injection of chemical oxidants or reductants is the fact that they react also with the soil matrix. Within this research line, an existing oxidant/reductant will be chemically treated to avoid reaction with the soil matrix components.

Dynamic Monitoring

DYNAMIC MONITORING

Research Line `d´.
A fourth line of research directed towards the automated monitoring of the technologies on site will be developed.

Real time monitoring will be followed by groundwater modelling in order to have a continuous understanding and control of the new technologies effect on contaminants, soil and groundwater properties.

In this way, technologies efficiency will be significantly improved.

Field Sites

Newly developed technologies will be tested both on laboratory and ON SITE. In order to take into consideration the natural, cultural and legal diversity across Europe, and to easier involve regional SME and local stakeholders, the following 4 sites have initially been selected:

a) for the research line of 'smart coupling'
A DNAPL site in **Austria** – **Brückl** SME involved: 14 Biutec)
A LNAPL site in **Poland** – **Wegliniec** (SME involved: 11 Powiz)

b) for the research line of 'coupled detection/injection'
A LNAPL site in **FLanders** - **Antwerp** (SMEs involved: 10 Dekonta and 12 Ejlskov with methodology development, 9 Ecorem-Baltija for site testing)

c) for the research line of 'specific targeting'
A LNAPL/DNAPL site in **Spain** – **Andalucía** (SME involved: 13 RDS, in collaboration with contractor 15 Geocisa)

Results and impacts

- **Well-documented and tested in-situ biochemical remediation technologies,**
- **Increase in the cost-effectiveness,** and a significant **reduction in time** required for soil remediation, in support of the EU soil remediation programs,
- It will allow taking soil properties and functions into account in the choice for the remediation approach, **enhancing soil sustainability within Europe,**
- **Economic vitality enhancement** of post industrial areas,
- **Field-application and involvement of various stakeholders**
  - The Stakeholder panel is formed by: BAYER, REPSOL YPF, NICOLE, PKP, EUCETZA, SPRILUR, SBNS, European group of Brownfield redevelopment, Rata Madencilic, INOBE, WORLD BANK, Romanian government, Common Forum, Polish National Environmental Fund -
- **An impulse to remediation technology providing companies/SMEs.**