Utilization of long term (passive) sampling methods combined with in situ microcosms for assessment of (bio)degradation potential/ PASSES

Czech-Norwegian Research Programme CZ09

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November 8th, 2016

Prague

Project consortium

- **Project Promoter - FoS Charles University in** Prague
  - Provides a state-of-the-art expertise in environmental chemistry, microbial ecotoxicology, soil biology, biochemistry and analytical chemistry
- **Partner 1 – ALS Laboratory group Norway**

  ALS provides expertise in analytical chemistry and optimisation of analytical procedures. ALS will further provide experience with passive sampling.
- **Partner 2 – Dekonta, a.s.**
  - Dekonta provides an expertise in field sampling and testing, hydrogeology, site monitoring and contaminated sites management. Dekonta will further provide access to contaminated sites.
- **None of the participants would be able to perform the objectives and tasks of this project on their own.** Together they dispose of a unique set of skills and are highly likely they meet the stated project objectives.
- **Future cooperation of the partners is very likely** both on commercial and scientific projects – Eurostars project submission might follow up this project.

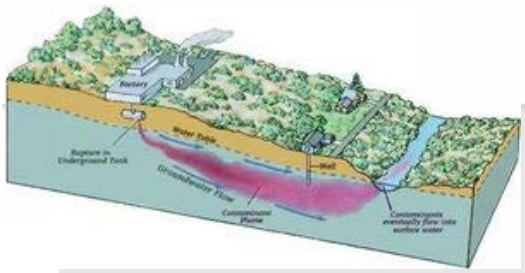
Contaminated Sites

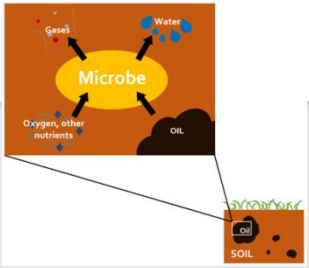


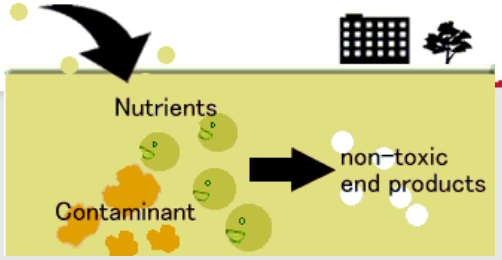

- According to the report: “Progress in the management of Contaminated Sites in Europe” (*European Environment Agency*) there are about **2.5 million potentially contaminated sites in Europe**, of which about **14% are expected to be contaminated and likely to require remediation**.

- Contaminated soil continues to be commonly managed using ‘traditional’ techniques, e.g. excavation and off-site treatment and/or disposal, which accounts for more than 70% of management practices. However, increasing regulatory control of landfill operations and associated rising costs, combined with the development of improved **in-situ remediation techniques, are altering the pattern of remediation practices.**

Bioremediation

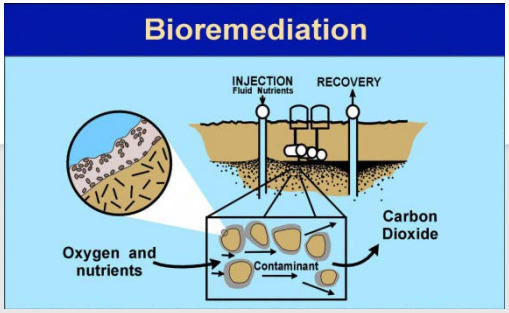






- **Bioremediation is a waste management technique that involves the use of organisms to remove or neutralize pollutants from a contaminated site**.
- According to the United States EPA, bioremediation is a "**treatment that uses naturally occurring organisms to break down hazardous substances into less toxic or non toxic substances**".
- **In situ bioremediation** involves treating the contaminated material **at the site**, while ex situ involves the removal of the contaminated material to be treated elsewhere.
- Among possible in-situ remedial strategies, **bioremediation** is considered to be **an effective, cheap and environmental friendly solution**.

Bioremediation



- Bioremediation is one of the most often used remediation strategies because **it may not require as much equipment, labour, or energy** as some clean-up methods and therefore it can be cheaper (*US EPA 2012*).

- It is attractive also because of raising demand on remediation activities to be as **sustainable** as possible (*ITRC 2011*).

- In-situ microbial bioremediation is being used as an effective means of mitigating: **hydrocarbons, halogenated organic solvents, halogenated organic compounds, pesticides and herbicides, nitrogen compounds, metals and radionuclides** (*Flathman et al 1993; National Research Council 1993; Leeson et al 1999*).

- A number of **site characteristics** and contaminant characteristics **affects in situ bioremediation** (*US EPA 2004*).

Why is project needed?




- A comprehensive **characterization of site-specific biodegradation processes is essential** in order to verify if in-situ biodegradation is taking place and to determine if these processes are efficient enough or can be enhanced to replace conventional clean-up technologies. (*Bombac et al 2010*).

- A **need to test feasibility of bioremediation** is stressed in a number of guidelines and books (*e.g. US EPA 2004, EPA SOUTH AUSTRALIA 2005, CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL 2006, UK-EA 2000, King et al 1997*)

- The main objective of the project is therefore to **design and verify technology for assessment of (bio)degradation potential on specific contaminated sites**

Why is project needed?




- In practice, use of **several different remediation methods step by step** ("remedial treatment trains") **proved to be advantageous** for clean-up of some sites starting with the most invasive and efficient method utilized to lower high contaminant concentrations and to provide good conditions for further biodegradation.
- In this case detailed knowledge on **how the remedial action affects microbial communities** (the ecotoxicity of the remedial action) is crucial.
- The ecotoxicity of remedial actions is nowadays gaining higher attention due to the **sustainability requirements of remediation** as well as **unknown consequences of the utilization of innovative remediation methods**
- Secondary objective of the project is therefore **to develop ecotoxicity passive sampler for assessment of ecotoxicity of various remedial actions.**

What are the project's objectives?

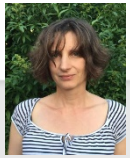
- The above mentioned main objectives are followed by a number of sub-objectives that should **provide high impact of the project on the current state of the art**
- We already published **3 scientific papers** (with 4 more to come) and **organized 3 workshops** both in Czech Republic and Norway + presentations on conferences and fairs



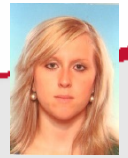


- **4 articles** has been published already both **in national and international magazines**

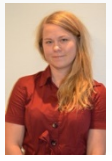
What are the project‘s objectives?




- Project partners **visited partner workplaces** and learned how the issues concerning the project are addressed elsewhere.
- We are gaining experience on how to work on international project and **broadening our expertise** in the field of environmental monitoring.
- We have the opportunity to **improve our language skills and establish professional contacts** in other countries.
- The research results of the project will **boost our competence and strengthen our position within the scientific community**.
- Participating organizations will **strengthen their competence in the field of environmental monitoring and remediation**.

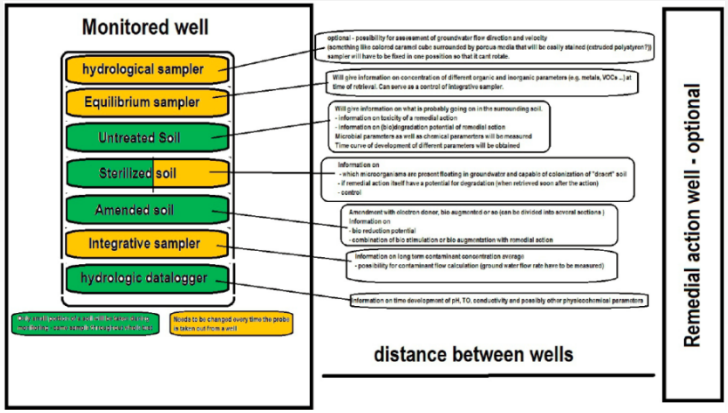



What is the project expected to achieve?

- Main idea of the project is simply to **use a combination of different existing monitoring methods (both active and passive) together with our innovative in-situ microcosms to gain** all the information necessary to predict the possibility to bio-remediate different contaminated sites.

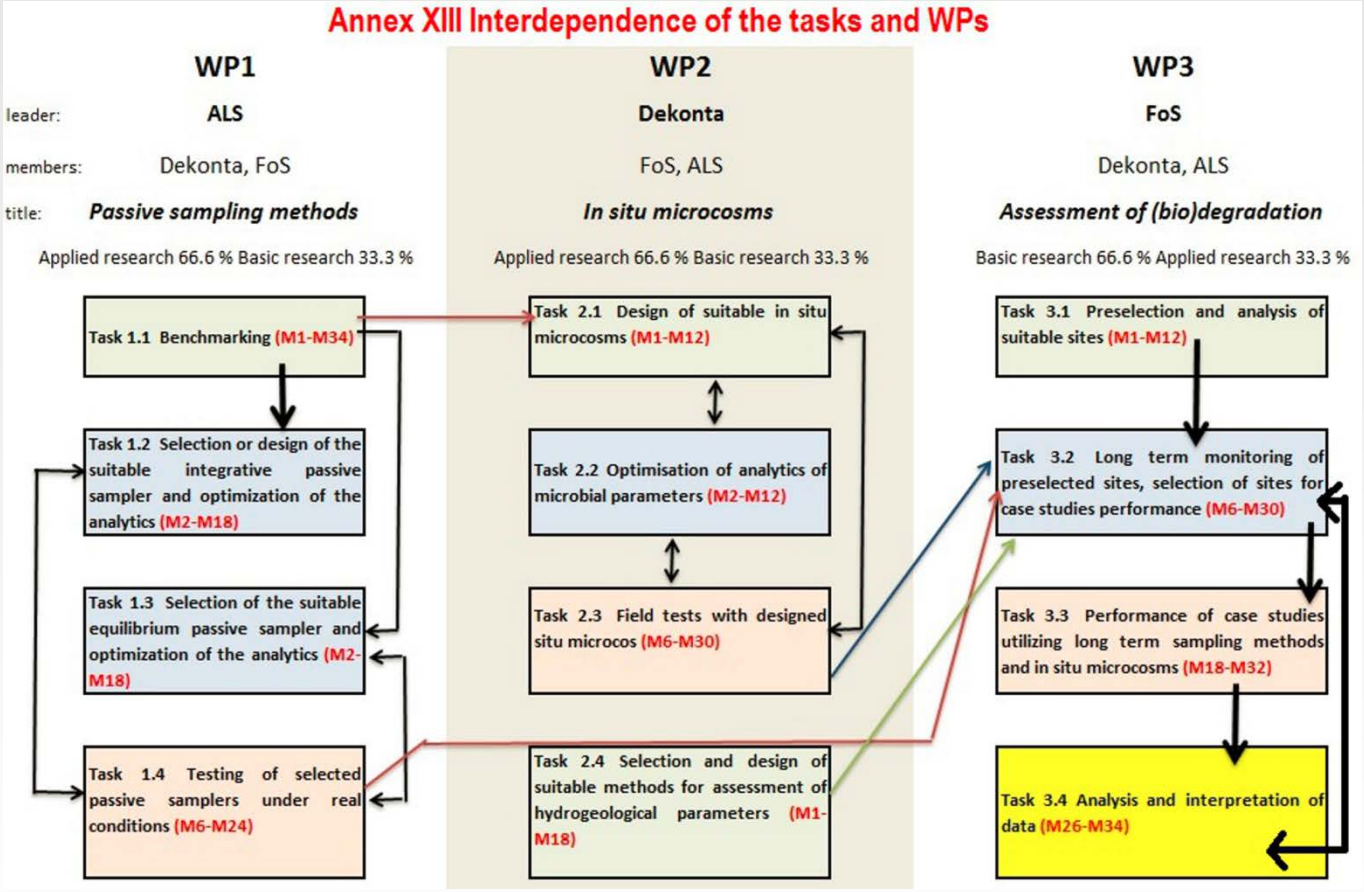
- Our technology should be a useful **tool that will provide information for decision making on how to remediate different contaminated sites** as well as **how to optimize different in situ remediation technologies.**

- The expected impact is that **in situ remediation technologies** especially bio-remediation will be utilized more often as the technology developed could help to **overcome some of the current bottlenecks** of these technologies



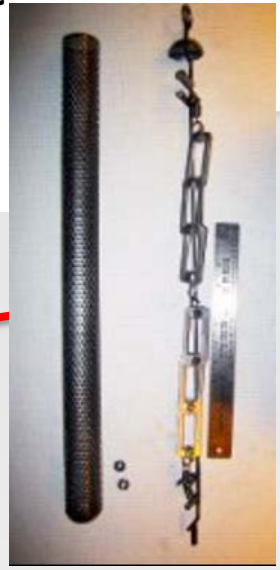
How are you going to address these challenges?

3 interdependent WPs – each partner is responsible for one + one management WP

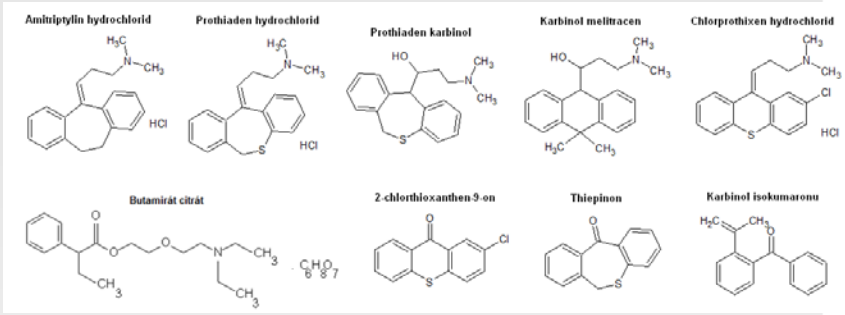


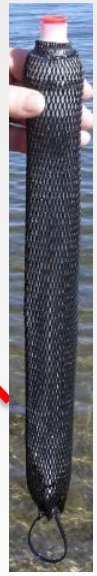
PASSIVE SAMPLING METHODS

Monitoring tool used to quantify the amount of different chemical substances in the groundwater

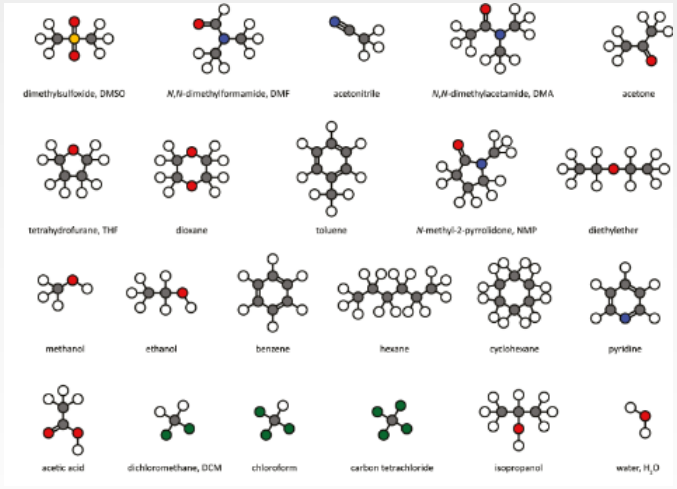


Integrative samplers – PS POLAR



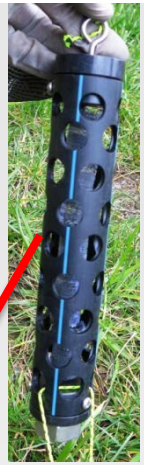


Equilibrium samplers – PS VOCs



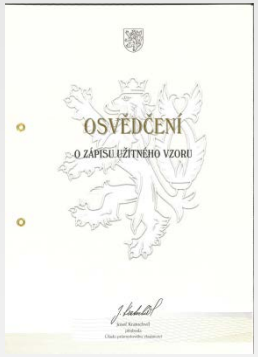
IN SITU MICROCOSMS

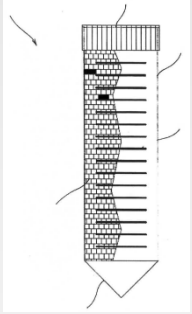
Monitoring tool used to quantify the abundance of naturally occurring bacteria and quality



Nanofiber microbes carriers

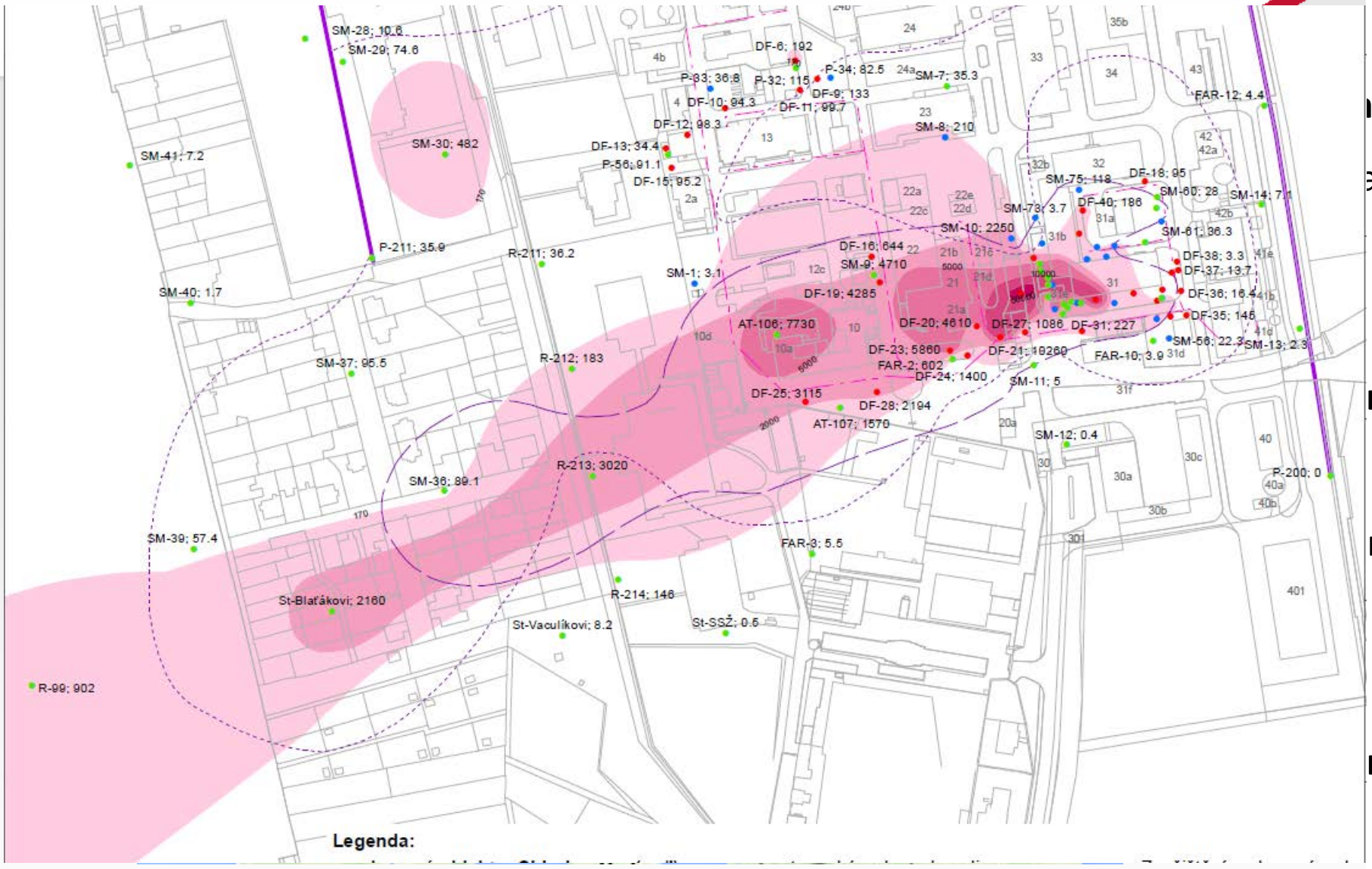
Utility model of our in-situ microcosm gained 13th of September 2016





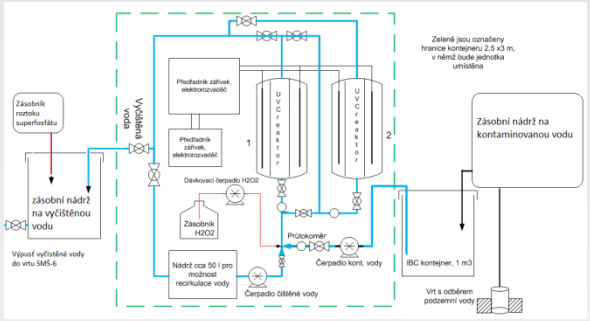
In-situ microcosms

BIODEGRADATION ASSESSMENT CASE STUDY

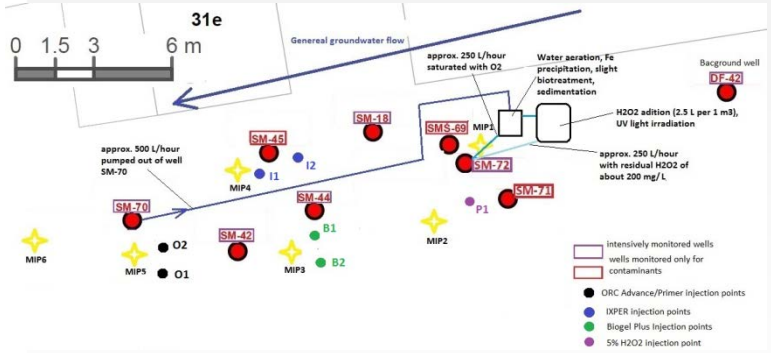


CASE STUDY – pictures

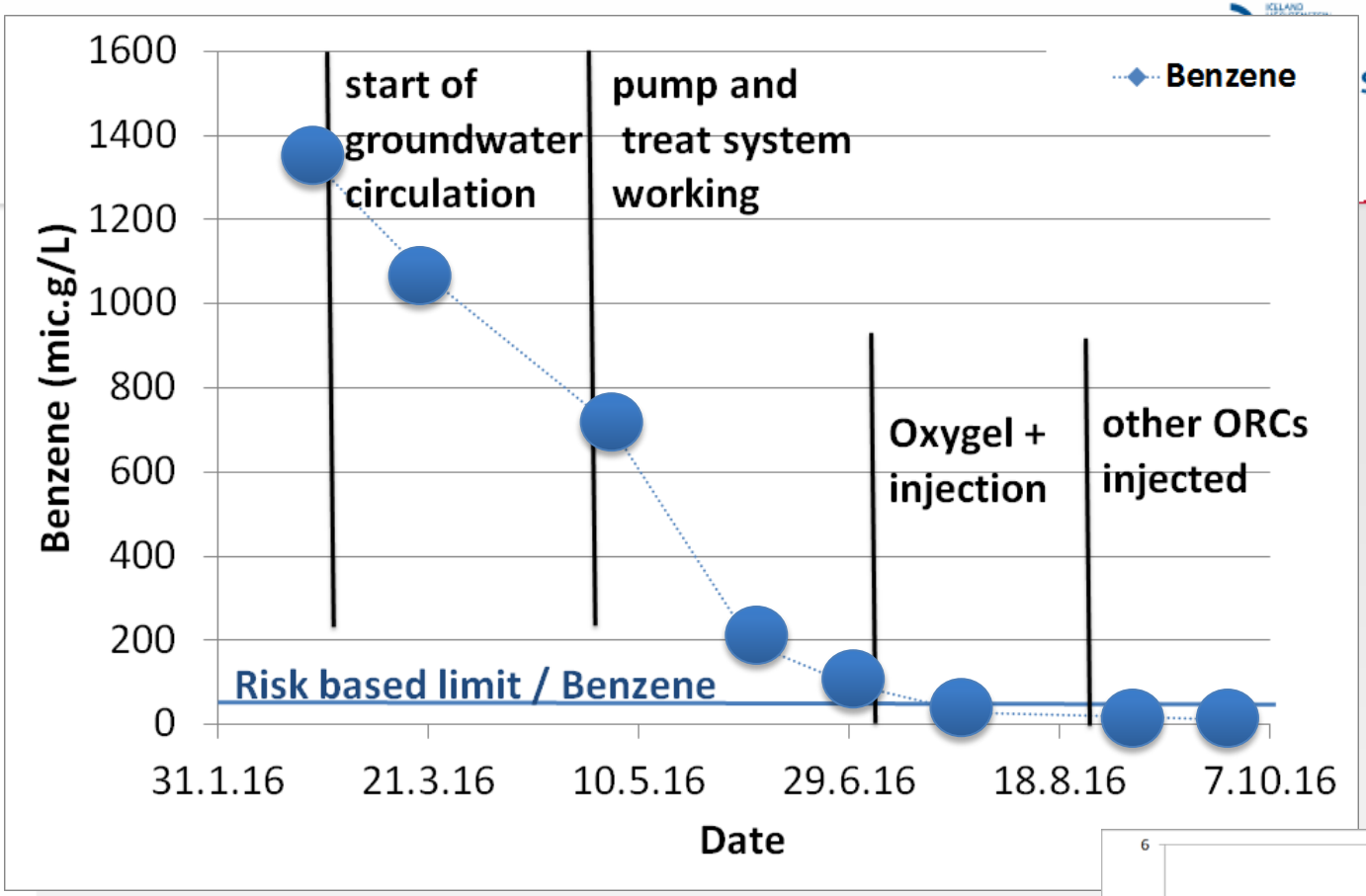
Pump and treat („fotooxigenation“) system – continuously working from 2/2016

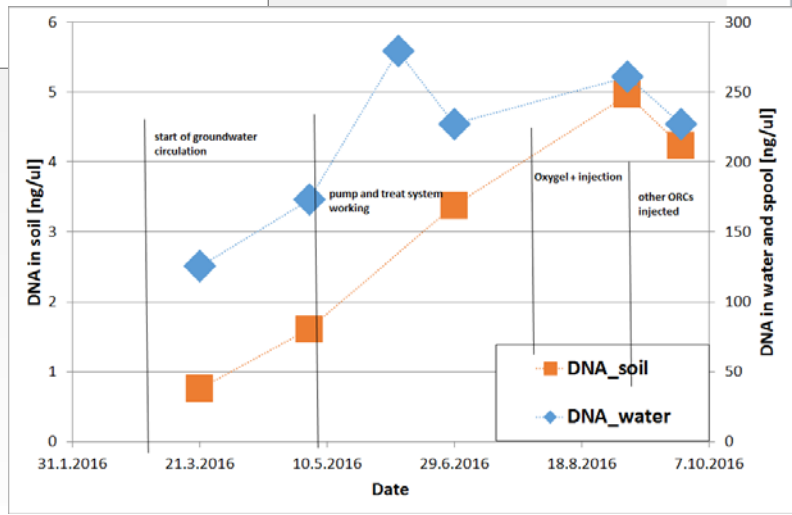


Direct push injection of 4 different reagents performed in 7-9/2016



Case study - results





Who is going to benefit from the project?

- Implementation of the verified technology designed within the project will provide both the **cost effective and environmental friendly solution to test remediation feasibility** as well as to provide precise information for subsequent decision making.
- Therefore the main beneficiary will be the **NATURE** ☺ (or **the parties responsible for clean up of the contaminated sites** – in case of the Czech Republic mainly the government) as our technology should help to clean it up in the more sustainable and cheap way
- Of course all the partners involved will benefit from the project as the results should help them to **strengthen their competence and competitiveness in the field of environmental monitoring and remediation.**
- Also the personnel involved is **broadening its expertise**, **improving language skills and establishing professional contacts** in other countries.
- The research results of the project are **boosting our competence and strengthening our position within the scientific community**.

Thank you very much! Tusen takk!

Speaker :

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