INSIMEP, a sustainable alternative for remediation of metal-contaminated groundwater?

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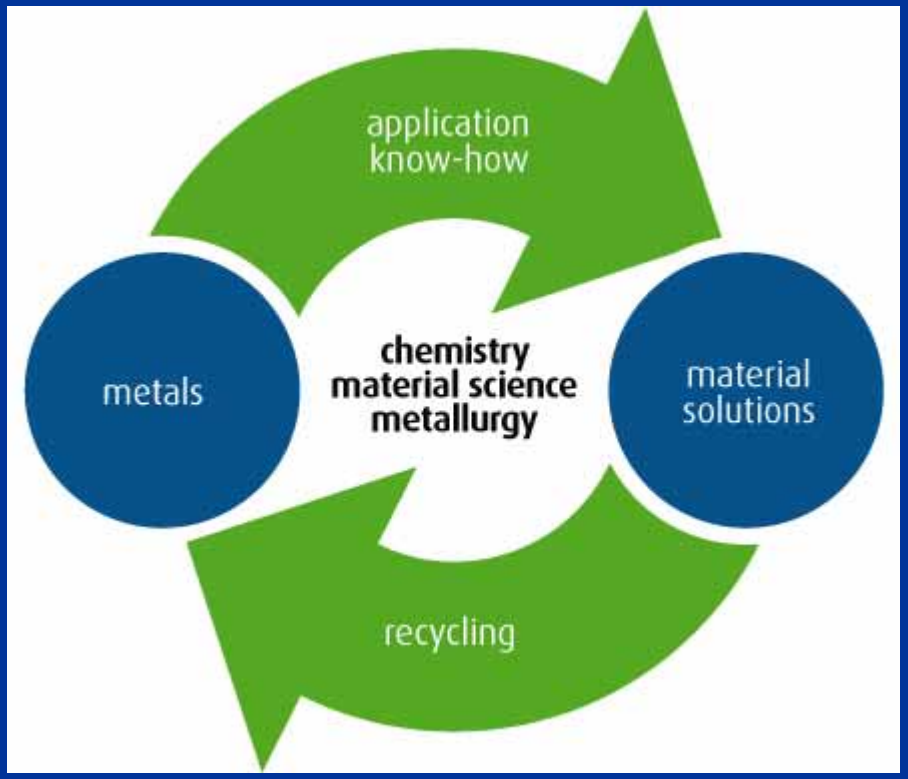
I-SUP, 23/04/2008

A materials technology group

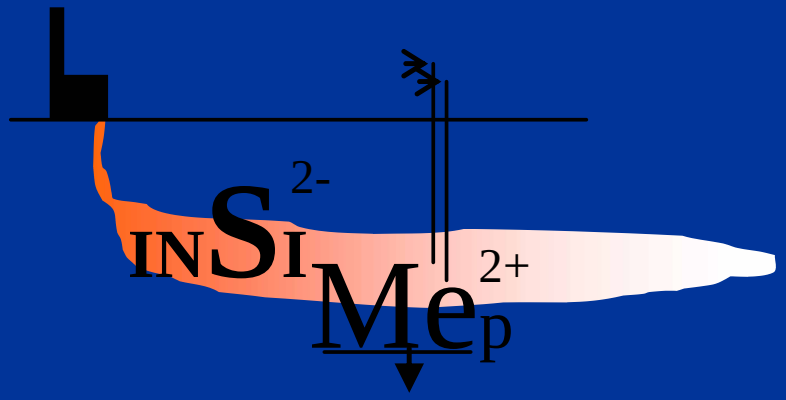
The Umicore approach to materials technology



Sustainable approach towards environmental legacy in Flanders

April 2004 - Umicore signed a covenant with the Flemish Government and the Flemish Waste Authority (OVAM) by which Umicore committed to remediate historic soil and groundwater pollution on and around Umicore's Flemish plants

Project



INSIMEP, an acronym for **in situ metal precipitation for remediation of groundwater contaminated with non ferrous metals**, is a project realized with a contribution of the LIFE financial instrument of the European Community (agreement number LIFE05 ENV/B/000517)

The project has started in **October 2005** and will be operational until **June 2009**.

Partnership

<u>Project leading</u> = Umicore

<u>Partners</u>:

MWH is an environmental consultant with a large experience in treatment of wastewater, hydrogeological modelling, drilling activities and remediating contaminated groundwater

Smet G.W.T. is specialized in drilling works, pumping systems and infiltration systems, both for civil engineering and in environmental works

VITO is a research institute where one of the aims is to examine the use of new soil and groundwater remediation methods

<u>Since September 1st, 2007</u>:
NYRSTAR is the world's largest producer of zinc metal and alloys, operating on four continents and employing over 4,000 people.

Background

- Non-ferrous metals industry in Europe
  - has a history of over 100 years of exploitation,
  - contaminated groundwater with non-ferrous metals and sulphates
- Pumping up groundwater and treating it in a wastewater treatment plant (Pump & Treat)
  - at present the best available technique
  - is a long and costly operation and in many cases the remediation target is never met.

In situ metal precipitation

- The aim of this project is to demonstrate an alternative remediation approach:
  - to precipitate the metals *in situ* by acceleration of biogeochemical processes that may occur naturally,
  - and to irreversibly fix them in the soil in a form that is stable under naturally occurring groundwater conditions.
- Processes:
  - Biological (ISBP)
    - Inject electron donor (glycerol, lactate, …) used by bacteria to reduce sulphate to sulphides => precipitation of metals as metal sulphides
  - Chemical (ISCP)
    - Directly inject chemicals, e.g. Fe° or CaS_x
  - Combination of chemical and biological approach

In situ metal precipitation

- Optimal strategy = combination of INSIMEP and P&T
  - Concentrated plume: P&T for a limited time and at low flow, for removal of bulk pollutant
  - For low concentrations: INSIMEP

Task 1: Demonstration sites characterisation

Three demonstration sites have been selected in such a way that they represent very different (hydro)geological situations and presence of different metals.

Site	Depth	Aquifers	Pollution (mg/l)	
Site 1	10 m bgl	Kasterlee	Co: 10 - 400	Ni: 0,01 - 2
Site 2	30 m bgl 60 m bgl 130 m bgl	Mol, Kasterlee, Diest	Zn: 139 101 2,5	Cd: 5,2 1,0 0,013

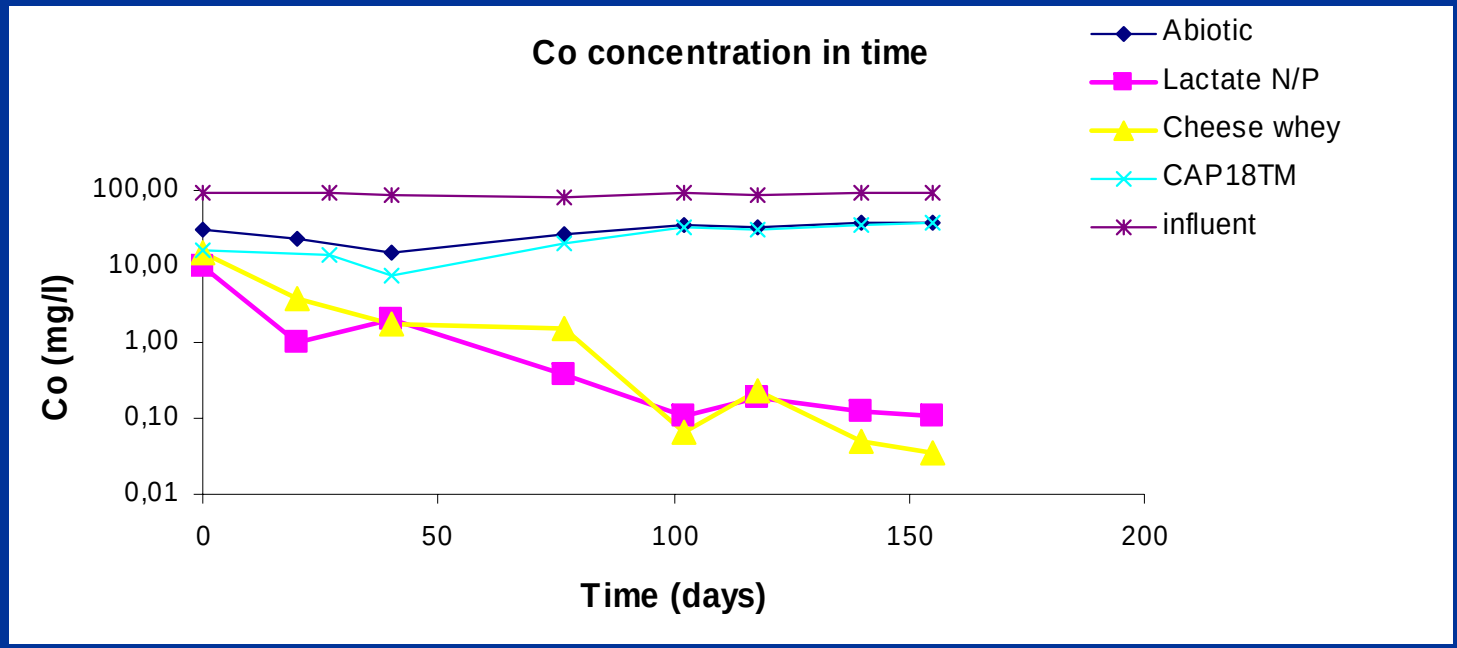
Task 3 : Lab activity tests

Test set-up of batch experiments

Column tests of 2 best conditions

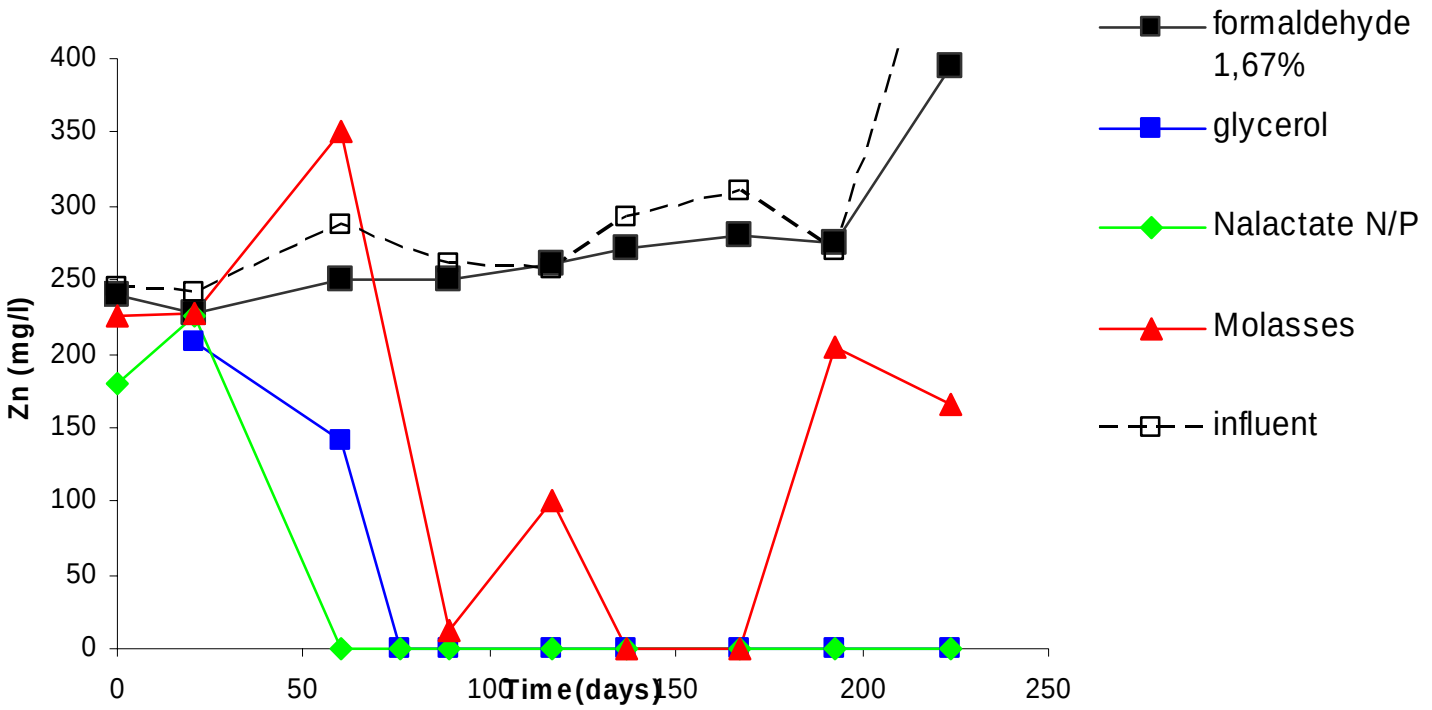
Site 1 : columns

Successfull ISBP with lactate-NP and cheese whey



Site 2 : columns

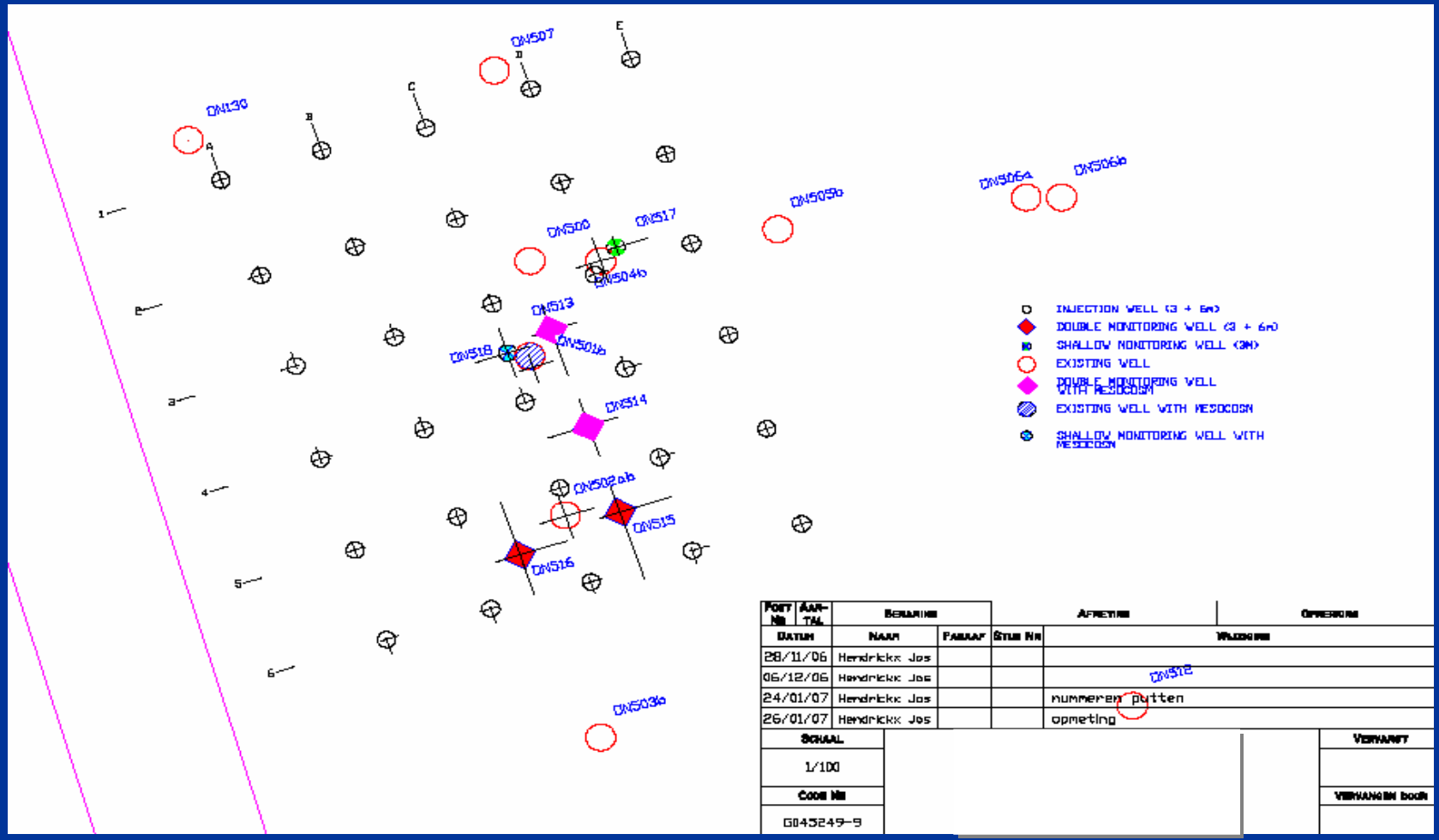
Successfull ISBP with lactate-NP and glycerol



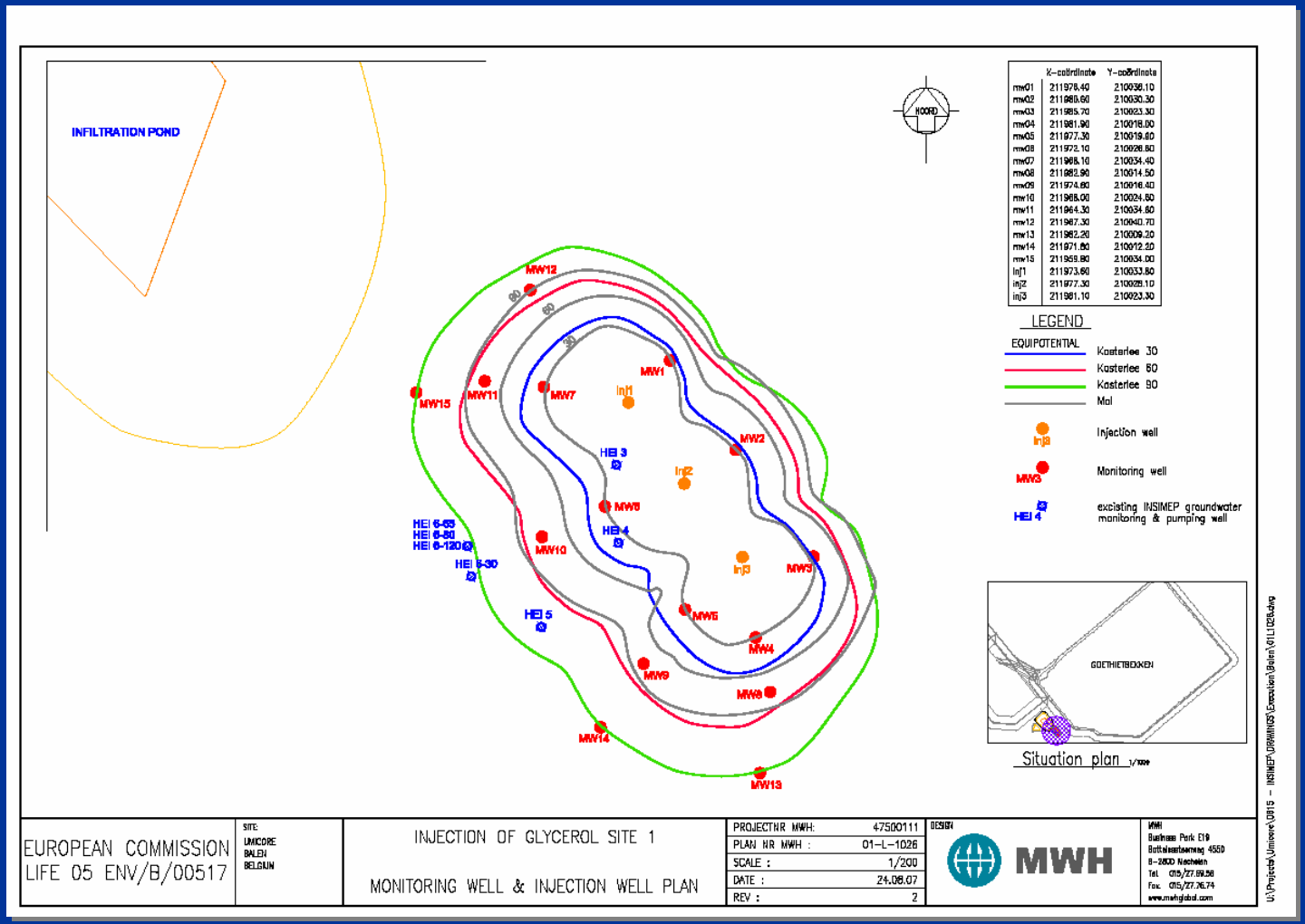
Task 2 : hydrogeological modelling

- development and calibration of a hydraulic & hydrochemical groundwater model;
- development of several simulations of the INSIMEP test on the basis of the models
- determination of the filter configurations in the injection wells and monitoring wells

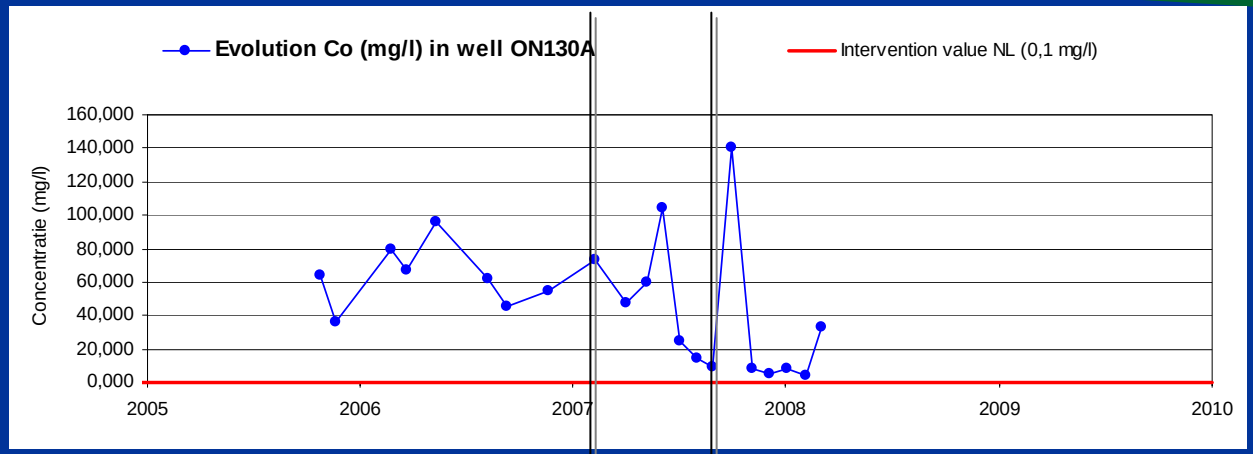
Task 5: Lay-out injection system Site 1

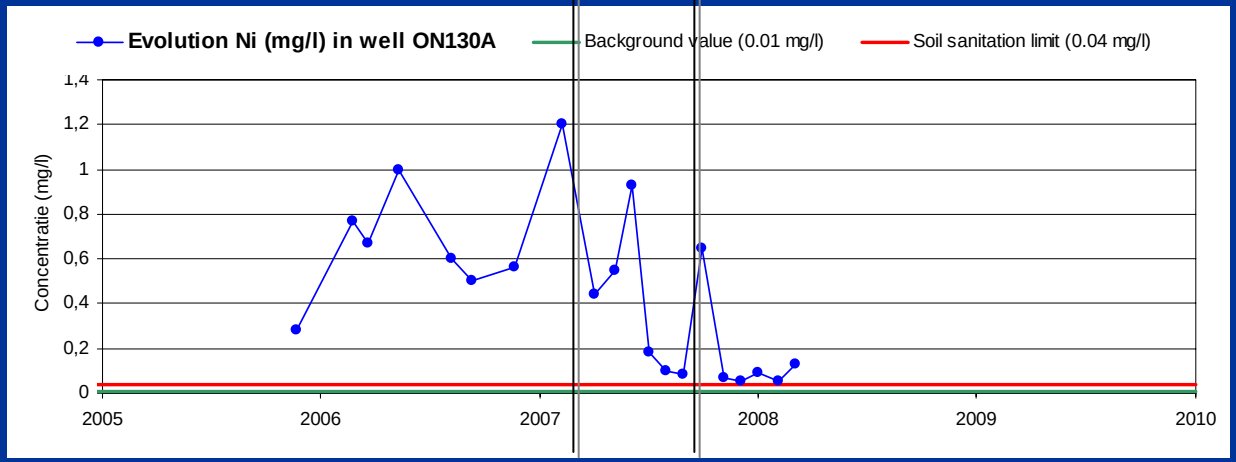


Task 5: Lay-out injection system Site 2



Task 6: Results site 1





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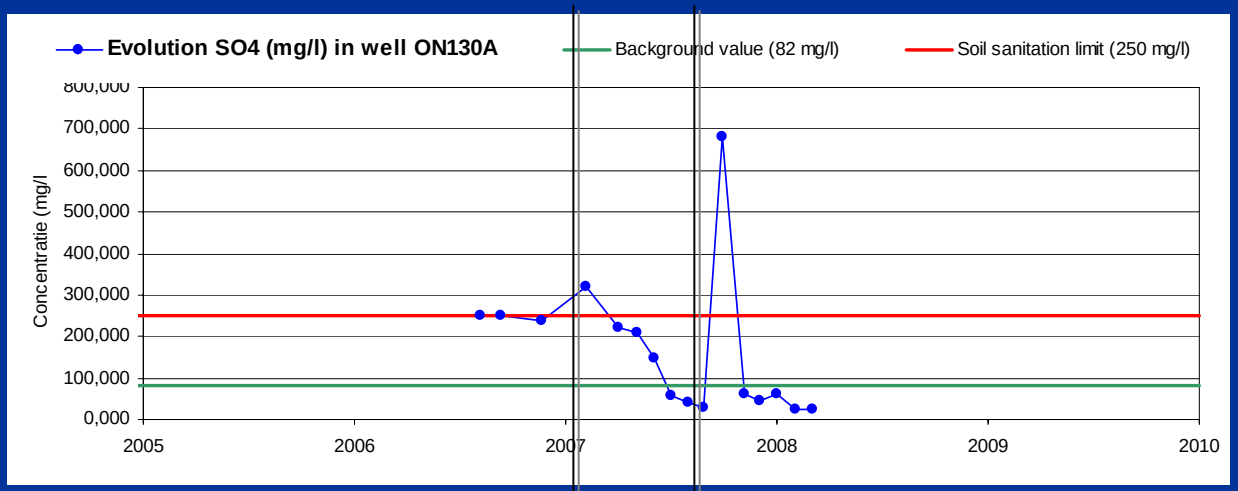

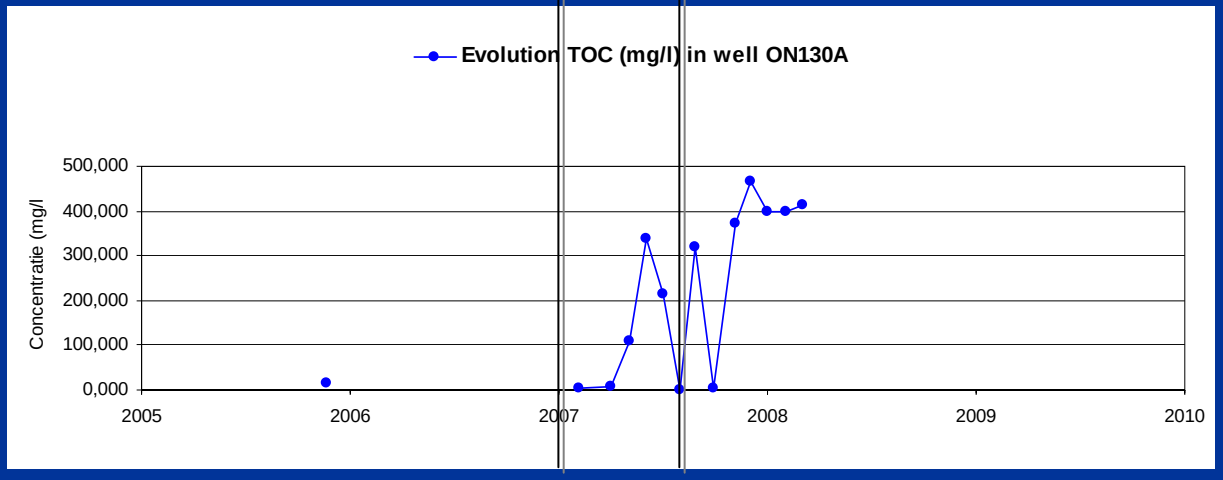

Task 6: Results site 2

- Injection of glycerol started mid January 2008;
- Results after two months:
  - TOC-levels of 2 g/l reached in several monitoring wells
  - H_2S formation in wells with highest TOC level
- Estimated test duration = 400 days

Evaluation

- Evaluation of the technique based on
  - Feasibility of reaching soil remediation targets
  - Irreversibility of the precipitates
  - Economical benefits

- Sustainable alternative for pump&treat?
  - Groundwater level is not influenced
  - Faster remediation
  - No waste is produced
  - No hazardous chemicals and less energy are used

Questions?