IN SITU AEROBIC BIOSTIMULATION OF GROUNDWATER AT A NATIONAL PRIORITY SITE IN ITALY

Sarroch plant (CA, Italy) is an **industrial area** of about 90 hectares. Pollution in groundwater has been addressed thanks to the design of a **remediation action** based on the **aerobic biodegradation** promoted by the injection of oxygen-releasing compounds containing CaO_2.

Overview

Sarroch plant is an area where monoaromatic solvents and short-chain aliphatic hydrocarbons affect groundwater.

FEATURES:

- Hydraulic barrier active close to the seafront at the eastern boundary.
- LNAPL widely reported in the past and currently present in some monitoring wells, equipped with recovery systems.
- Groundwater under anoxic conditions, with dissolved oxygen below 3 mg/L.
- Groundwater aquifer composed of sandy river deposits, which extends to different depths in the area of the plant
- Hydraulic conductivity varies between 10^{-6} and 10^{-4} m/s.

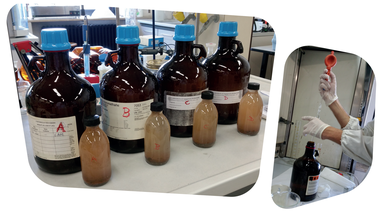
Materials and methods

1 – FEASIBILITY TESTS

The feasibility of biostimulation at the site was preliminarily evaluated by laboratory tests, carried out at Politecnico di Milano.

TEST SETTINGS:

- Bioreactors installed using polluted soil and groundwater from the site.
- Three bioreactors (named B, C and D) were added with different commercial products containing calcium peroxide (0.35% of the soil weight).
- A control reactor (named A) without CaO_2 was set by dosing sodium azide as a biocide.
- All the reactors were added with a buffer solution (1.4 mol KH_2PO_4 / mol K_2HPO_4) to maintain the pH value at neutrality.
- The experiments lasted about two months.



2 – FULL-SCALE DESIGN

Based on laboratory tests, which showed:

– Aerobic biodegradation of the pollutants at the site can be promoted, starting from the aliphatic compounds.

– The treatment can be immediately applied where the pollutant concentration in groundwater is **up to 100 mg/L**.

– At the most polluted areas of the site, likely affected by LNAPL, the application has to be postponed to free- phase recovery.

THE TREATMENT WAS SIZED AT THE FULL SCALE ASFOLLOWS:

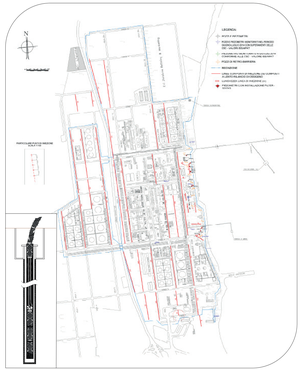
- The solid oxygen-releasing product will be injected as a slurry by direct-push technique. The injection system will be equipped with suitable rods infixed into the soil down to the established maximum injection depth, in order to proceed with a bottom-up approach.
- The direct-push injection of the product is foreseen at 2800 points, distributed along lines perpendicular to the groundwater flow direction, over a total length of approximately 8 km and a total area of 90 hectares.
- According to the pollutant concentration measured in the different zones of the site, a different number of injection campaigns and injection frequency has been scheduled (3 to 10 campaigns, every 5-12 months).
- In some specific areas, with significant logistical problems, the use of socks dropped in piezometers has been envisaged.

RESULTS

A clear decrease (at least one order of magnitude) of the concentrations of all compounds in soil in all the microcosms was observed between the beginning and the end of the tests. In summary:

– On the basis of mass balance for the different organic compounds, the most significant mass reduction after 63 d was observed for **TPHs**, with removals of about **95%** in the ORC-added reactors and 85% in the control reactor A.

– The oxygen consumption rate obtained at the laboratory scale was **0.5 ÷ 1.2 mg O_2/L H_2O/d**.



Conclusions

– The results obtained in the lab tests highlighted the possibility of using aerobic bioremediation for the treatment of groundwater, with the removal of pollution starting from **TPHs**.

– Treatment immediately applicable in areas with dissolved organic contamination up to 100 mg/L.

– The benefits on concentrations in groundwater are expected after significant removal of contaminants sorbed on the solid phase of the soil.

– In terms of dosage to be carried out in situ to support the biodegradation of the organic compounds of concern, values between approximately **170** and **410 g ORC/m³** of treated soil a year are estimated for areas with dissolved contamination of the order of **100 mg/L**.

– The estimated cost for the full-scale bioremediation action is **23 million Euros**, involving about **90 hectares**.

– Compared to the previous project, the in situ injection of the oxygen-releasing compound is an improvement toward a more effective, quicker and more sustainable remediation of groundwater at the site.

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