



Full scale bioaugmentation for cost-efficient remediation of a large groundwater contamination with CAH

<http://www.bioaugmentatie.be>

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Full Scale setup

In November 2013 a first of 40 injection wells and associated piping have been installed. In January 2015 5 more injection filters were installed and finally in June 2015 another 15 injection wells were added. The injection systems consists of two tanks (see picture below) where the mixing of groundwater with glycerine and bicarbonate takes place. After mixing, the groundwater is pumped into cubitainers. By gravity the mixture then flows in the injection wells which each have their own control valve.



Full Scale demonstration

Based on the experience that was gained in the push and pull tests and small scale tests each injection well is fed with 20 kg glycerine and 25 kg bicarbonate once every month. The injections of the first 40 wells have started in December 2013, the next 5 wells in February 2015 and the last series of 15 wells in August 2015.

In comparison with the earlier smaller scale tests, it has taken longer to reach the desired (geo)chemical conditions. This is probably due to the larger volume of groundwater that must be covered (the distance between injection wells in the full Scale area is 10 m versus 5 m in small scale tests) and the diluting factor ('clean' groundwater with less favourable conditions must be used to inject the additives following Flemish regulations).

The first transfer of groundwater with the dehalogenating bacteria from the small scale pilot test area has been conducted in April 2014, followed by transfers in May 2014 (2), December 2014 (2), July 2015 (2), October 2015 (5), February 2016 (10), April 2016 (5) and June 2016 (4). This gives a total of 30 transfers or 30 injection wells that were inoculated with the desired bacteria.

In a first stage CAH-concentrations were followed in the injection wells. This gave a very disturbed image because the injection wells are injected with 'clean' groundwater where the glycerine and bicarbonate is mixed in. To cope with this problem, a set of 10 monitoring wells was installed in which CAH-concentrations have been monitored. Geochemical parameters are still monitored in the injection filters.

Before the start of the injections and 8, 14, 18, 22 and 26 months after the first injections molecular analyses have been done by VITO for selected injection wells.



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Full Scale results

The Full Scale demonstration area is not yet inoculated completely due to the problems encountered to reach the desired geochemical conditions (see earlier newsletters). But the zone that has been inoculated is successful.

The upstream monitoring well in the above mentioned zone has relatively high concentrations of PCE and TCE (mother products). The monitoring wells in the treated zone show a gradual decrease of the mother products and a rise of the degradation products (cDCE and VC). In the monitoring wells downstream of the treated zone (P356 and P357) the CAH-levels have reached the remediation targets (see graph on the right side with the results of P357) or otherwise said, the remediation target is met.

The molecular analyses conducted by VITO 8 months after the first transfer show that microbial DNA of *Dehalococcoides* (strain that converts VC to the harmless end product ethylene) has increased. Analyses after 26 months have demonstrated that the bacteria did not grow significantly but that they have persisted (despite the very challenging environmental conditions).

Conclusion: the results of the Full Scale are more or less satisfying. It takes more time than expected to reach the desired conditions. The growth of bacteria is also slower than foreseen (6 weeks were expected according to the literature). On the other hand, in the area where conditions are favourable and the culture is injected, results are excellent. The remediation targets are met in this zone.

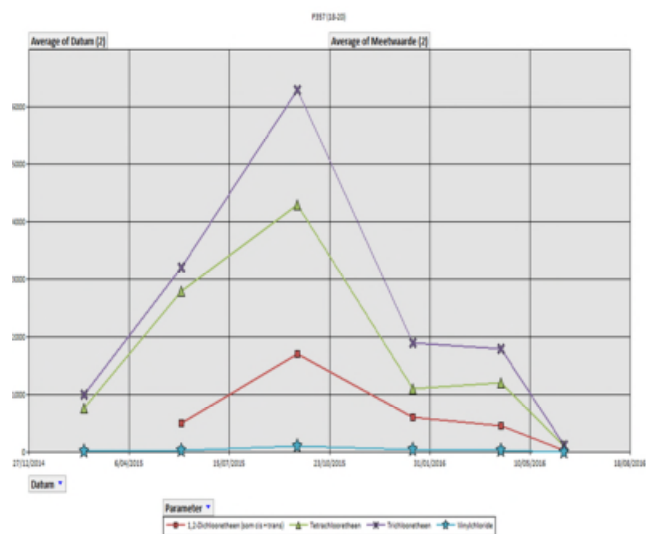
Challenges after LIFE

Ameliorate the injecting system to make it more anaerobic (on another site RSK is working on this is already done).

Reach the desired geochemical conditions in the entire Full Scale treatment zone.

Transfer the bacteria across the whole Full Scale treatment zone.

Demonstrate the technique on other sites with other environmental conditions (RSK has several other sites where (variants of) the technique are applied).



More information?

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