

Giving Bioremediation a Chance at a Challenging Site

Despite proven effectiveness and low cost to treat chlorinated compounds, in situ bioremediation (ISBR) is often overlooked as a remediation alternative when unfavourable biological conditions such as low pH and low microbial activity exist. However, even these sites can be treated successfully and affordably through careful planning using the right amendments.

Since 2002, EOS Remediation products have been used worldwide in enhanced reductive dechlorination (ERD) projects. At a former production site, bioremediation was seen as a difficult option due to groundwater conditions. Nevertheless, it was decided to try bioremediation, due to cost considerations. Alternative remediation strategies were in fact considerably more expensive. In the bioremediation strategy, EOS® Pro and CoBupH™ were used alongside BAC-9 bioaugmentation cultures as alternative remediation strategies. These products provide a long-lasting substrate, sufficient nutrients and a pH-optimising buffer.

The soil and groundwater possessed high concentrations of chlorinated compounds such as perchloroethylene (PCE) in groundwater (Figure 1A) which had migrated along storm and sanitary sewers, influencing the plume distribution. All potential remedies were up against challenging site conditions including:

- High concentrations of contaminants in the overlying clay-rich confining layer which, because of its low permeability, allows for diffusion of the chlorinated compounds into the underlying sands and gravels
- Low pH (3.2 to 6.5) from a discharge of sulphuric acid from an adjacent site
- Low numbers of halo-respiring bacteria (<10 cells/mL).

The selected IBSR approach to overcome these challenges included injection of:

1. A dehalogenating culture BAC-9
2. EOS® XR, an extended release, emulsified-oil substrate to allow long-lasting enhanced reductive dechlorination (ERD) and ensure removal of chlorinated compounds that would diffuse from the clay confining layer
3. CoBupH™, a colloidal buffer designed to increase and maintain an optimal aquifer pH for microbial growth throughout remediation

After this injection, PCE was reduced by over >99% (Figure 1B) and daughter product chlorinated compounds such as cis-dichloroethylene

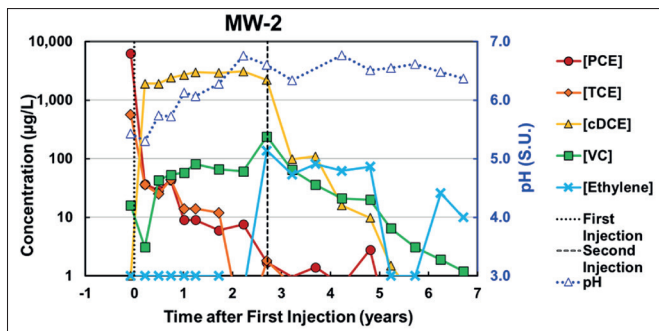


Figure 2: Concentration of chlorinated compounds, ethylene, and pH in a representative monitoring well in the treatment area. Vertical lines represent injection events.

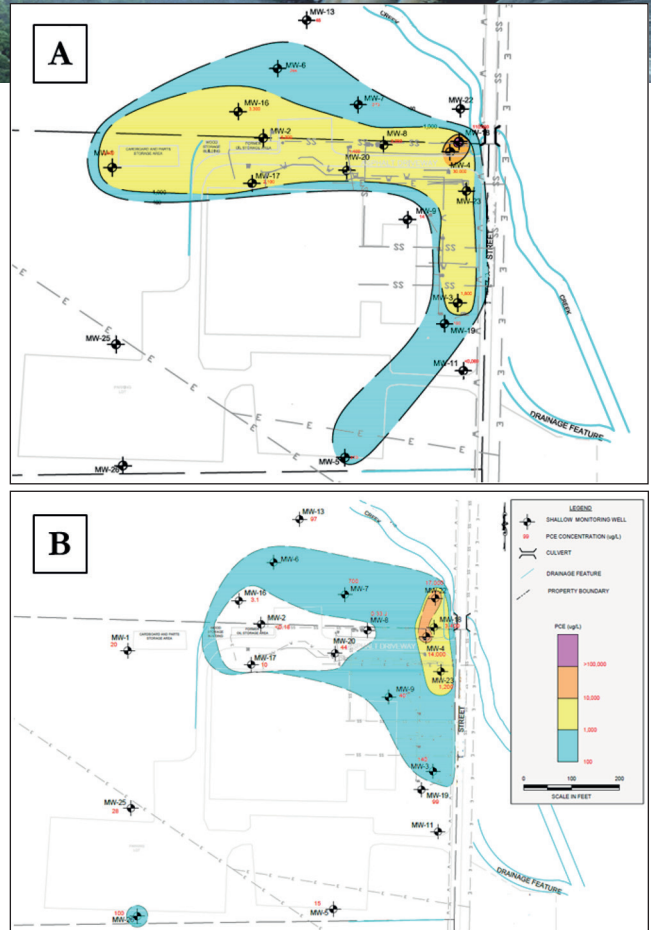


Figure 1: Distribution of perchloroethylene (PCE) A) before treatment and B) seven years after first injection.

(cDCE) appeared, proving amendment addition stimulated reductive dechlorination. However, a faster removal of cDCE was desired.

Bench scale studies and field pilot tests indicated that addition of nutrients including vitamin B12, nitrogen, and phosphorus resulted in higher dechlorination rates. Therefore, the site was amended with EOS® Pro to add the required nutrients and supplemented with additional CoBupH™ to achieve and maintain a neutral pH faster and for a longer duration to optimise bacterial growth. Injection of these amendments allowed complete dechlorination, evidenced by cDCE reduction (>99%), a stable pH around 7, and detection of ethylene (the non-hazardous end-product of reductive dechlorination) throughout the site (Figure 2).

For more details (and a plot twist!), visit <https://qmes.eu/?p=24935> to read the extended case study from this project.

Using EOS® Pro and CoBupH™ alongside BAC-9 bioaugmentation cultures provides long-lasting substrate, adequate nutrients, and a pH-optimising buffer, ensuring successful site treatment even when the conditions do not seem favourable for biological growth.

QM Environmental International, the European representative of EOS products, will be exhibiting at the Contamination & Geotech Expo from 14 to 15 September at the NEC Birmingham, stand no. CT-C30.