

Treatment of Cr(VI) and CHC groundwater contamination under a residential development

CASE STUDY

In situ remediation of hexavalent chromium (VI) and chlorinated solvents using combined anaerobic biodegradation and immobilisation in Northampton, UK

BACKGROUND

On the site of a former chrome plating works, construction and inhabitation had begun on a new residential development. Hexavalent chromium (Cr(VI)) and some chlorinated hydrocarbon compounds (CHCs) had been discovered in the groundwater beneath the development. It was determined by the environmental consultant that the Cr(VI) was driving a risk on the site. The house builder required rapid achievement of site targets in order to continue the development of the site.



SUMMARY

REGENESIS was approached to provide an in situ remedial approach and a combination of Enhanced Reductive Dechlorination (ERD) and metal immobilization was suggested. A pilot study was conducted on a hotspot of Cr(VI). Following injection, the validation results showed that the contamination levels had been reduced to below detection limits (<20 µg/L).

A full-scale remediation strategy was then completed, comprising a of a series of rows of injection points to fit in between the residential properties, services etc. These 'barriers' allowed the continued movement of groundwater through, whilst remediating the contamination advecting into the treatment zones.



SITE TYPE

Construction site – residential properties



GEOLOGY

Made ground underlain by fractured Limestone 0-4m BGL with clay / mudstone at 7m BGL



CONTAMINANTS

Cr(VI) upto 15,000 µg/L



TECHNOLOGIES

3-D Microemulsion (3DMe)[®] and Metals Remediation Compound (MRC)[®]



TREATMENT

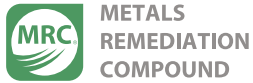
Enhanced Reductive Dechlorination (ERD) and *In Situ* Immobilization



PROJECT DRIVER

Site Redevelopment

TREATMENT



It was decided that a combination of ERD and in-situ immobilisation using **3-D Microemulsion (3DME)** and **Metals Remediation Compound (MRC)** would be applied in the pilot study primarily to treat the Cr(VI) contamination.

The organosulfur compound in MRC is a direct chemical reductant for soluble Cr(VI) and produces insoluble trivalent chromium (Cr(III)). MRC can stimulate Cr(VI) reduction indirectly by providing lactic acid, which is rapidly metabolized by subsurface microbes and creates reduced species, like ferrous iron and sulfide which are known to chemically reduce Cr(VI) to the insoluble Cr(III) state.

The addition of 3DMe enhances cost effective distribution of the MRC as well as providing a controlled release of hydrogen for up to five years from a single injection. 3DMe creates reducing conditions to target both Cr(VI) contamination and the CHCs, which are then fully reductively dechlorinated by anaerobic dehalogenating bacteria in the subsurface.

Remediation was focussed on Cr(VI), which was present in concentrations of up to 15,000µg/L. The products were co-injected at the **11,000m²** site by Regenesis Remediation Services, using direct push injection. This avoided the need to construct wells at the site and left no structures in the ground or at the surface. A total of **78 injections** provided treatment zones or 'barriers' across the plume and also targeted sewers and their gravel bedding, which were thought to act as a preferential pathway for contaminant migration on the site. The injection works were completed in 13 days.

Injection between:
2.5-7m BGL

Injection period:
13-days

Remediation cost:
£117,000

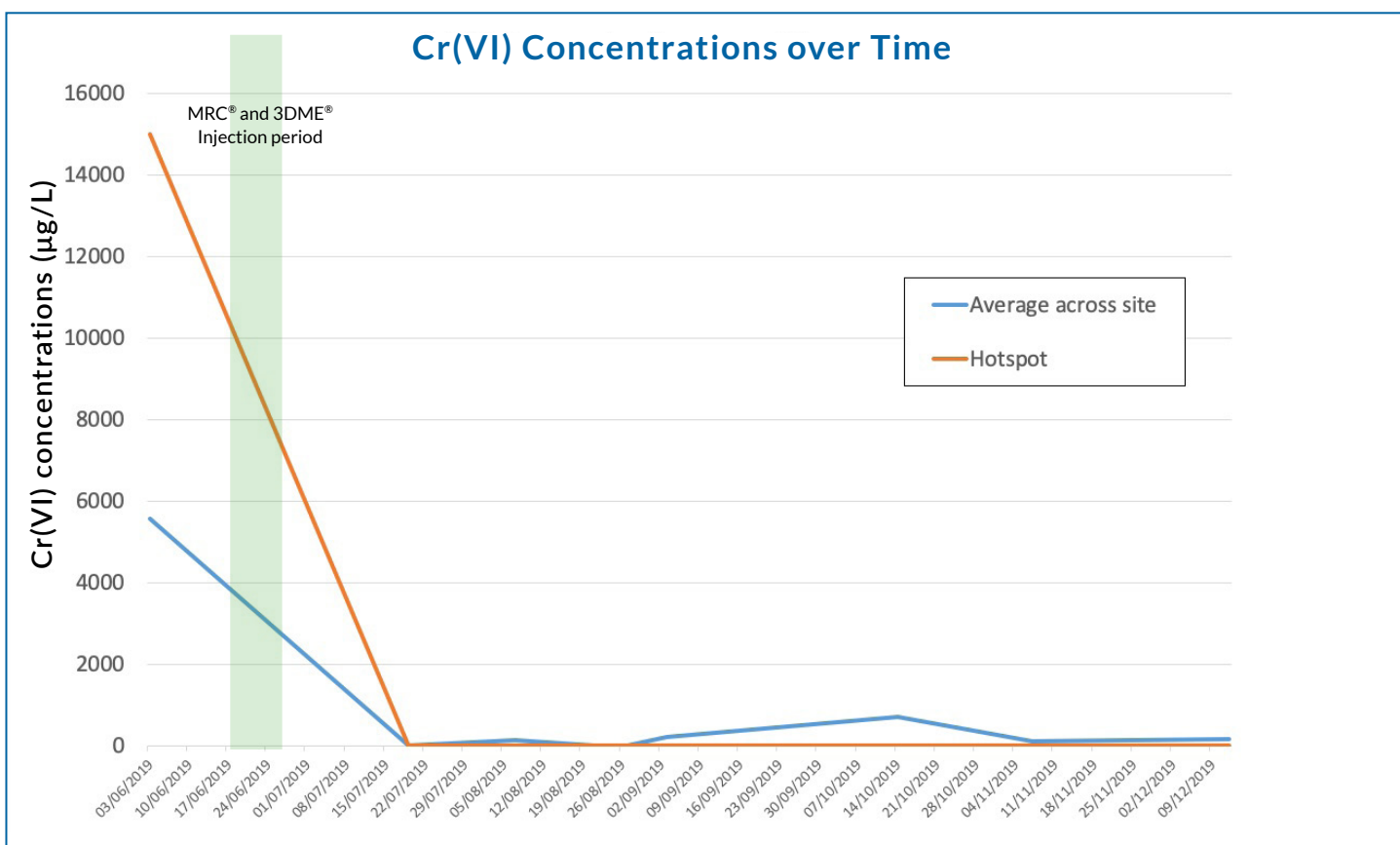
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RESULTS

The full scale treatment provided a rapid reduction of the Cr(VI) both in the hotspot area and across the site resulting in a mean reduction of **98% across the site** and **99.9% in the hotspot area**.



CONCLUSION

- REGENESIS worked closely with the consultant to provide an accurate and pragmatic design approach for a busy and difficult site.
- A mixed plume of CHCs and Cr(VI) was treated concurrently using a combination of complementary substrates
- A pilot study allowed confirmation of the approach and fine-tuning of the final design
- The works were completed rapidly with minimal disruption to the construction project and existing residents
- The use of barriers, targeting hotspots and pathways provided a cost-effective and efficient treatment of the plume
- In situ remediation means that no further works are required, simply validation monitoring by the environmental consultant.

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