

# Treatment of a Large Scale Chlorinated Solvent Plume

## A Single Injection of 3-D Microemulsion<sup>®</sup>, using a Wide Injection Grid

Geology	Gravel
Contaminant Of Concern	PCE and cis-DCE
COC Range	5,500 µg/L PCE, 2,000 µg/L cis-DCE
Target Level	3.5 m to 6 m BGL
Treatment Area	13,800 m <sup>2</sup>
Former Site Use	Industrial
Project Driver	Redevelopment
Product Design details	<ul style="list-style-type: none"> <li>• 10 m x 10 m Injection Grid</li> <li>• 126 Injection Points</li> <li>• 252,000 litres 3DMe injected</li> <li>• Injection Works Completed in 12 days</li> </ul>



### Summary

The groundwater under a larger former industrial site was impacted with chlorinated solvents, which required remediation as part of the redevelopment of the property. The contamination had entered permeable saturated gravels and was distributed over a wide area to a depth of 6 m BGL. This meant that any solution needed to be not only technically suitable, but also cost effective.

### Treatment

3-D Microemulsion (3DMe) was injected across the site to drive enhanced reductive dechlorination of the chlorinated solvents. 3DMe is designed to self-distribute in the subsurface, without washing out of the target area. This produces very large radii of influence from the injection locations, allowing the application grid to be widened, reducing the cost and time onsite. Because of this, the site works only took 12 days to inject 126 locations on a 10m by 10m injection grid, using 2 direct push rigs and a mobile injection unit.

### What's Special

- The 3DMe produced enhanced reductive dechlorination of the contamination across the site; reducing the parent compounds and fully mineralising the breakdown products.
- The site redeveloped stalled and so the site was monitored for an extended period. Some small influxes of residual parent compounds were encountered, but as 3DMe is active for 4-5 years, these were quickly reduced once more.
- The self-distribution and longevity of 3DMe allowed for the cost effective treatment of a very large contaminant plume.

### Technology Description

3DMe is developed and manufactured by RegenesiS and is a uniquely engineered molecule, specifically designed to provide a self-distributing source of hydrogen for periods of up to five years.

The 3DMe molecule (Figure 2) uses a three stage donor release profile allowing for the immediate, mid-range and long-term release of hydrogen into groundwater. The hydrogen is used to increase the mass and activity of the indigenous microorganisms performing reductive dechlorination. A single



Figure 1  
Mixing tank with 3-D Microemulsion

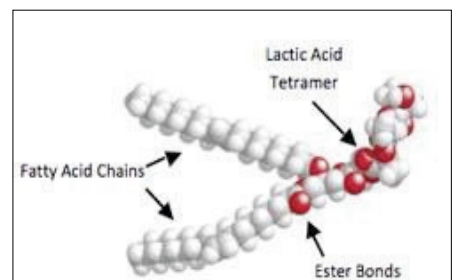


Figure 2  
3-D Microemulsion molecule

application will often be sufficient to supply the required amount of hydrogen to achieve full dechlorination of the target compounds, reducing the number of product applications needed.

The molecular structure of 3DMe has been specifically engineered to achieve a high radius of influence. Concentrated 3DMe is mixed with water to form a microemulsion for injection. Once injected, the emulsified material moves out into the subsurface pore spaces via the physical process of advection. At the Critical Micelle Concentration (CMC~300ppm), 3DMe micelles (Figure 3) form as colloids and are free to transport through groundwater via the concentration driven forces of diffusion/dispersion. This self-distributing characteristic allows the product to be transported through the subsurface which reduces the amount of injection points needed to treat an area. This dramatically reduces the application time and costs to the project.

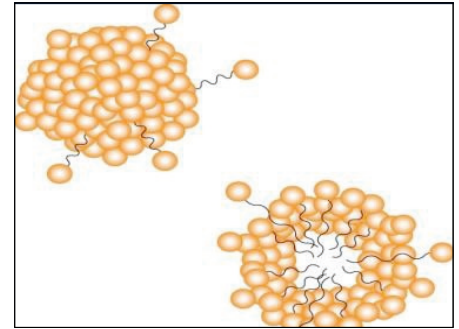


Figure 3  
3-D Microemulsion micelles

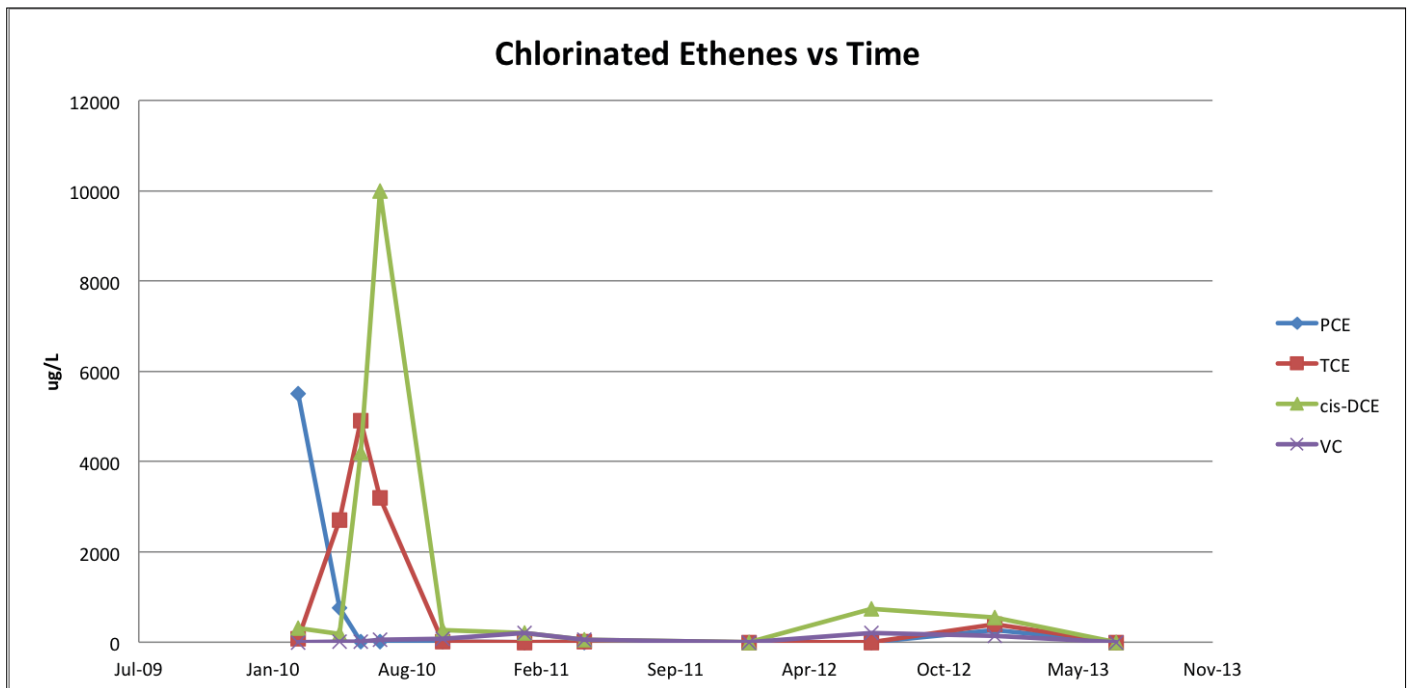


Figure 4  
Monitoring Results Borehole 1  
March 2010 - July 2013

### Injection Spacing

Due to the advanced subsurface distribution characteristic of 3DMe, injections could be spaced in a 10 m by 10 m grid. Wide spacing is critical in minimising the time, work and cost of a project. For illustrative purposes, Table 1 compares the costs and specifications of 10 m and 3 m application spacings

Injection Spacing	Injection Points	Time OnSite	Injection Costs
3 m x 3 m (Example Site)	1,560	97 days	£210,000
10 m x 10 m (This Project)	126	12 days	£ 95,000

Table 1: Comparative Costs and Specifications for Treatment Options for a 13,800m<sup>2</sup> Site

### Results

- Reducing conditions were established within the first three months after application;
- The parent compound (PCE) was reduced by 45 - 99% at all locations throughout the site;
- Monitoring data (Figure 4) over 3.5 years clearly demonstrates the sequential creation and destruction of chlorinated solvent compounds, achieving a total contaminant mass reduction.

For more information or to discuss your project, please contact:

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