Botany Groundwater Cleanup Project

Fact Sheet 3 **Updated February 2005**

Fact sheets are designed to provide the community with simple and easy-to-understand information on environmental science and technology. Readers requiring greater detail should contact Orica:

- by email to info@oricabotanygroundwater.com
- by phoning our Community Feedback Line - 1800 025 138
- by writing to - Community Matters, 16-20 Beauchamp Road, Matraville 2036

Bioremediation

How does it work?

Intrinsic bioremediation is a naturally-occurring process in which bacteria break down chemicals. Enhanced bioremediation involves giving a 'helping hand' to the naturally-occurring process. Nutrients are injected into contaminated water and they encourage bacteria that are already present in the groundwater to break down the pollutant chemicals. *In situ* bioremediation refers to the treatment of the groundwater where it is (i.e., without treating it in an above-ground facility).

Orica has been trialing active bioremediation to treat Botany groundwater for several years. This moved into field trials around February 2004 and these trials are continuing.

What is the difference between active and passive bioremediation?

Active bioremediation is necessary in situations where the concentration of pollutants is too high for the naturally-occurring bacteria to survive. It involves extracting groundwater, blending the high concentration with a low concentration and reinjecting it into the ground at a concentration that allows the contaminant-consuming bacteria to survive and do their job.

Passive bioremediation does not require the water to be extracted from the ground. It requires a row of suitably spaced injection wells, which are used to add the nutrients to the water.

Where has it worked elsewhere in the world?

At approximately 400,000 sites across the United States, soil and groundwater are contaminated with chlorinated solvents. Bioremediation is often used in conjunction with other technologies such as groundwater pump-and-treat (hydraulic containment).

In 1998 a test was carried out at the Dow Chemical Company's operating site in Pittsburgh, California. The test confirmed that bioremediation would prevent any significant migration of contaminants in groundwater underneath the facility to surface water. Based on the positive results, full-scale implementation of enhanced *in-situ* bioremediation was commissioned in March, 2000 at the site.

What are the certainties and uncertainties?

Certainties:

- Laboratory tests have confirmed that bioremediation can effectively break down 100% of targeted organic contaminants. If the same conditions can be recreated *in-situ*, it should be very effective.

Uncertainties:

- The degree of cleanup achievable varies from site to site, due to the nature of the soil, groundwater and contaminants.
- There is the potential to create toxic by-products, but this will be thoroughly researched and bioremediation will not proceed if it seems likely that such products will be created.

Botany Groundwater Cleanup Project

How will it be applied to the Botany Groundwater?

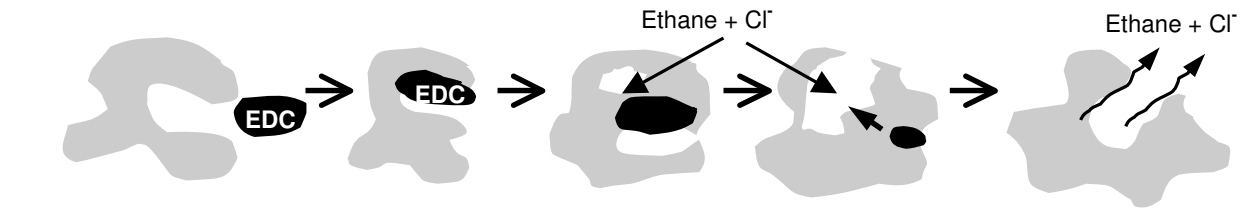
Orica would like to use bioremediation as a major part of the Botany groundwater cleanup. To establish whether or not it will be effective, Orica is undertaking field trials. Nutrients, known as electron donors, will be added to the groundwater. These electron donors include ethanol, emulsified vegetable oil and potassium oleate (which is similar to a liquid soap). They should accelerate the natural biodegradation process taking place in the aquifers beneath the Orica Southlands site.

The field trials are taking place at two locations:

Area A is situated on the northern section of Block 2 of Southlands, about 50m west of Springvale Drain. Passive bioremediation is being trialed, injecting electron donors into the shallow aquifer. Degradation of the contaminants will be monitored using a line of monitoring wells.

Area B is situated in the southwestern quadrant of Block 2, set in about 50m from Mcpherson St and Floodvale Drain. Active bioremediation is being trialed, extracting groundwater from three wells, blending high concentrations with low concentrations, and reinjecting with electron donors.

It is hoped that the microorganisms will break down one of the chlorinated hydrocarbon contaminants, which include a chemical called EDC, into harmless ethane gas and chloride salt.



Field trial results

Latest results from the most recent bioremediation field trials have shown very encouraging results, with almost complete degradation of CHCs. While there are no plans to change the Groundwater Treatment Plant proposal because of the urgent need to stop the high concentrations of contaminants from reaching the Bay and Estuary, Orica is keen to extend the application of bioremediation to other parts of the project.

Links to reference papers:

Bosma T.N.P., M.A. van Aalst-van Leeuwen, J.Gerritse and E. van Heiningen, 1998, Intrinsic dechlorination of 1,2-dichloroethane at an industrial site. In: *Remediation of Chlorinated and Recalcitrant Compounds*, Volume 2(3): 7-12. Battelle Press.

Cauwenberghe van L & D.S. Roote, 1998, *In Situ Bioremediation* Technology Overview Report Groundwater Remediation Technologies Analysis Center, accessed at http://www.gwrtac.org/pdf/insbio_o.pdf on 16.02.04.

Cox E.E., D.W. Major and E. Edwards, 2000, Natural attenuation of 1,2-dichloroethane in groundwater at a chemical manufacturing facility. In: *Remediation of Chlorinated and Recalcitrant Compounds*, Volume 2(3): 217-224. Battelle Press.

Droy B.F., F. Manale, R. Copeland, C. Creber, G. Klecka, 2002, Evaluating Enhanced In Situ Anaerobic Bioremediation as a Primary Site-wide Remediation Strategy. To be published in: *Remediation of Chlorinated and Recalcitrant Compounds*. Battelle Press.

Fountain J.C., 1998, *Technologies for Dense Nonaqueous Phase Liquid Source Zone Remediation* Technology Evaluation Report for Groundwater Remediation Technologies Analysis Center, accessed at http://www.gwrtac.org/pdf/e_dnapl.pdf on 19.02.04.