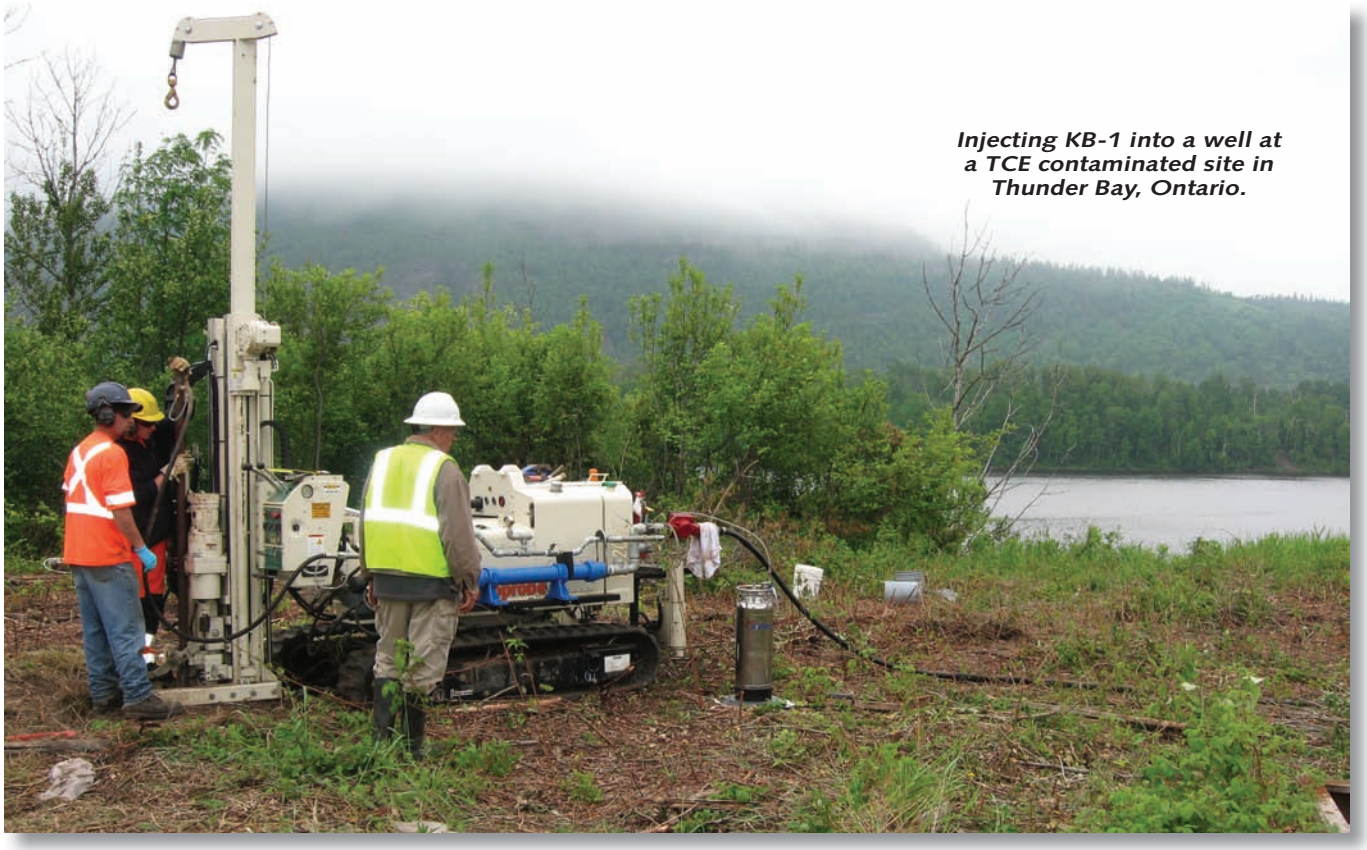
## THE CASE FOR USING IT AT CONTAMINATED SITES

# BIOAUGMENTATION



*Injecting KB-1 into a well at a TCE contaminated site in Thunder Bay, Ontario.*

With an estimated 10,000 contaminated sites in Canada, there are plenty of opportunities to use a variety of treatment methods to clean them up. Bioaugmentation is one method that has received mixed reviews over the years.

The approach is thought of as "pixie dust" by some consultants and others in the clean-up industry that were burned by the claims of salesmen that their product could clean up a site within days merely by injecting the "snake oil" down some wells. When the promised results never came, there was always some explanation as to why (e.g., not enough wells, different flow regime, improper application, etc.).

*by John Nicholson*

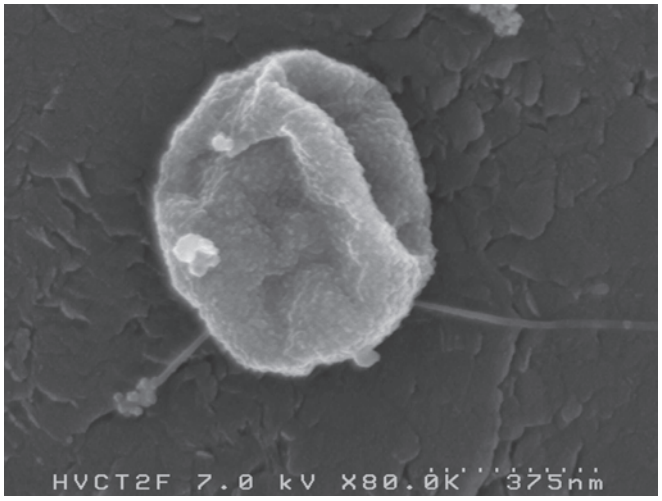
*"In the case of the Thunder Bay project, a total of 65 litres of KB-1 was injected into 65 locations on the contaminated site."*

Although there were (and likely still are) pretenders out there, there are legitimate products that actually can clean up a site.

Bioaugmentation involves the addition of beneficial microorganisms to improve the rate or extent of biodegradation. Theoretically, any soil or groundwater contaminant containing carbon can be biodegraded by microorganisms. The key is to find the right microbial culture and ensure the conditions are optimal to allow them to eat their food — the contaminant of concern.

### Canadian success story

In Canada, an anaerobic culture of beneficial microorganisms called Dehalococcoides (Dhc) was developed at the University of Toronto (UofT) under the direction of professor Elizabeth Edwards. Dhc are anaerobic bacteria that




***Dehalococcoide bacteria commercially developed as KB-1***

are very good at degrading tetrachloroethene (PCE) and tricholorethene (TCE) in groundwater.

Anaerobic cultures grow in the absence of oxygen (in fact, oxygen in poisonous to them). This allows remediation specialists to inject the cultures directly into the soil and/or groundwater without the hassle of ensuring adequate oxygen supply as well.

The disadvantage of anaerobic microorganisms is that there growth rate is slower than aerobic cultures. Nonetheless, their application can be very effective depending on the site.

The Dhc developed at UofT are now produced commercially and sold as KB-1® by SiREM, based in Guelph, Ontario. More than 180 sites in the USA and Europe have used KB-1® as the bioaugmentation culture. Geological conditions at these sites have ranged from clay to fractured rock. Groundwater temperatures at these sites have ranged from 8°C to 30°C. The number of injection wells used has ranged from one to over 800.

KB-1 was used extensively at contaminated sites in the United States and Europe before SiREM completed the costly and time consuming process of registering the product under the New Substances Notification (NSN) Regulation governed by Environment Canada and Health Canada.

The NSN Regulation is a doubled-edged sword for any company looking to commercialize a new microbial culture in Canada. For SiREM, the process of registering KB-1® was a challenge. However, the regulatory hurdle it crossed in registering the product is now a competitive advantage as it is the only provider of such a product in Canada.

## First commercial site in Canada

The first successful application of KB-1 in Canada was in Thunder Bay, Ontario during the summer of 2009. Located in the northwest shore of Lake Superior, Thunder Bay is known for its grain elevators and pulp and paper production. It may also become known as the first place where the application of a dechlorinating microbial culture was used to enhance the cleanup of TCE.

TCE is a chlorinated hydrocarbon commonly used industrial solvent, including the degreasing of metal parts. In the past, its widespread use and poor waste disposal (who hasn't heard stories about the practice of throwing the bucket of dirty solvent out the back door), TCE is a very common contaminant at brownfield sites across North America.

One challenge of treating TCE anaerobically is that it can be transformed into vinyl chloride, which is far more toxic than TCE. The Dhc found in KB-1 converts TCE to ethene, a non-toxic gas. (Ethene is the same gas given off by bananas as they age in a fruit bowl.)

In the case of the Thunder Bay project, a total of 65 litres of KB-1® was injected into 65 locations on the contaminated site. Within 12 weeks there was up to 60 per cent reduction in TCE in the wells. Once all the TCE is consumed, the microorganisms die off as there is no more food for them.

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