

CASE STUDY

CARBON TETRACHLORIDE REMEDIATION IN SILTY SAND



Background

CLIENT: Industrial

DURATION: 3 Week

LOCATION: Calgary, Alberta

Under a commercial property surrounded by multi-tenant residential buildings just outside of Calgary, Alberta, a lingering carbon tetrachloride (CTET) groundwater plume required remediation. The former site of an oil industry component manufacturer that had used carbon tetrachloride as part of their manufacturing process, the plume had been identified in the 1990's. Since then, the contamination had been addressed with limited success using a variety of remediation methods, including pump & treat, air sparging, and soil vapour extraction.

Based on pressure from a regulatory agency, the landowner retained IRSL to develop and implement an in-situ program to address the remaining dissolved phase impacts within the heterogenous silty sand aquifer. Due to the location of the site near an active, populated location, the remediation program required a discrete solution with a minimal surface footprint.

Approach

An environmental consultant hired by the landowner characterized the site and determined that the groundwater was still impacted with carbon tetrachloride (CTET). Located in a shallow aquifer, the CTET plume covered an area of approximately 750 m² and penetrated the aquifer to approximately 2 m below the water table. IRSL was retained by the client based on their innovative design and successful approach at other sites impacted with chlorinated compounds.

IN-SITU ANAEROBIC BIOREMEDIATION WITH EMULSIFIED VEGETABLE OIL (EVO)

To treat the remaining dissolved phase impacts, IRSL designed a Direct Push Injection program that used Emulsified Vegetable Oil (EVO) to provide a carbon donor that would enhance the anaerobic bioremediation reactions already occurring within the aquifer.

ANALYSIS

To develop an optimal injection design, IRSL used their proprietary analytical and numerical models, which incorporated contaminant concentrations, groundwater flow rates, reaction rates, temperature and inorganic parameters, within the subsurface. Through this process, they discovered the required mass and injection pattern that led to the successful remediation of the remaining impacts.



GEOLOGY: Glacial Till

PLUME SIZE: Approx. 750 m²

CONSTRUCTION

Based on their analysis, IRSL created and implemented a design that covered the groundwater plume while minimizing the possibility of rebound.

Direct Push Technology: To ensure coverage of the plume laterally and vertically, IRSL used Direct Push Technology over a 2.3-m grid with discrete vertical intervals to create geochemical conditions conducive to stimulating the native micro-organisms. The remediation solution required a very small footprint in order to minimize the impact on the client operations and ensuring their revenue stream was not affected.

TREATMENT

To remediate the carbon tetrachloride (CTET) within the groundwater to below the remedial targets, IRSL worked with the manufacturer of the donor solution to create the most effective formula to stimulate anaerobic bioremediation, based on site data.

IRSL completed one injection of Emulsified Vegetable Oil (EVO) enhanced with nutrients and buffering agents:

- **EVO** stimulated the natural attenuation reactions already occurring in the aquifer by providing a carbon donor to the native bacteria which degraded the CTET into harmless by-products.
- **Nutrients** helped the native bacteria to build cell mass, thereby overcoming limiting reactions.
- **Carbonate Buffering Reagent** kept the pH of the system within the bacteria's preferred range.

Monitoring

Throughout the project, an independent consultant monitored the process and conducted a rigorous Quality Assurance-Quality Control program. Their subsequent monitoring of the groundwater quality confirmed that the remedial goals had been reached within the target timeframe and budget.

Challenges

- The non-homogenous, silty sand had resistant previous remedial efforts and required a more robust remedial design.
- Ensuring that a sufficient mass of electron donors was injected along with appropriate buffering and nutrient reagents required careful analysis and preparation.

Results

- The remedial program was executed in three weeks.
- The CTET was treated to below the remedial targets developed for the program.
- Long-term monitoring indicated that the groundwater concentration remained below the remedial targets for the one-and-half years since remediation.



InSitu Remediation Services Ltd. (IRSL) is one of Canada's most experienced remediation companies. Our team has designed, implemented, and optimized, soil and groundwater remediation programs in diverse geological environments in North, Central, and South America, Asia, Europe, and the Middle East.

We confidently implement innovative solutions, based on sound knowledge, using seasoned field staff. Our pragmatic, flexible approach reduces effort, cost to our clients, and environmental risk.

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