

# Enhanced Reductive Dechlorination of TCE in a Basalt Aquifer



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# Field Evaluation Objectives

- Supply an appropriate electron donor to the residual source area
- Increase biological activity
- Decrease the redox potential of the aquifer
- Demonstrate that in situ biodegradation of TCE can be significantly enhanced

# Start-Up Period

- Operate the system continuously for one month without electron donor addition
- Establish baseline conditions
  - Geochemical parameters
  - Chloroethenes
- Evaluate Flow and Transport
  - Bromide tracer test

# Electron Donor Addition

- Injection
  - Initial strategy: weekly injection of 300 gal of 60% sodium lactate solution
  - Subject to change based on monitoring
- Monitoring
  - Biweekly at 8 wells, monthly at 3 wells
  - Analytes: chloroethenes, ethene, ethane, DO,  $\text{NO}_3$ ,  $\text{Fe(II)}$ ,  $\text{SO}_4$ ,  $\text{CH}_4$ , electron donors, COD,  $\text{CO}_2$ , alkalinity,  $\text{PO}_4$ , ammonia, tritium
  - In situ monitoring of ORP, DO, pH, sp. cond., T

# Lactate Transport and Utilization

- Initial injection measured 130 ft downgradient
- Rapid acclimation observed
- Complete microbial utilization of each injection (140 kg/wk) within about 1 month
- Density-driven flow significant for 60% solution
- CO<sub>2</sub> concentrations indicate significant increase in biological activity

# Redox Results

- $\text{NO}_3$  concentrations reduced up to 250 ft downgradient from the injection point
- $\text{Fe(II)}$  concentration increases observed up to 130 ft downgradient
- $\text{SO}_4$  concentrations reduced at least 50 ft from the injection point
- Methane present, but not consistently

# Enhanced Reductive Dechlorination

- Significant reductive dechlorination observed at the 3 wells within 50 ft of the injection point in less than 3 months
- Onset of dechlorination coincides with sulfate-reducing conditions
- In 2 of the 3 wells, cis-DCE generation exceeds initial aqueous TCE concentrations
- Lactate injection strategy a key factor

# Conclusions

- In the first 3 months of the field evaluation, the addition of sodium lactate has:
  - Increased biological activity
  - Driven redox conditions from limited nitrate-reducing to sulfate-reducing
  - Reduced TCE concentrations from 3800  $\mu\text{g/L}$  to less than 70  $\mu\text{g/L}$  through dechlorination
- The remaining goals are to:
  - Increase the size of the reductive dechlorination zone through optimization of injection strategy
  - Evaluate the fate of daughter products

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