



ITRC TECHNOLOGY/METHODOLOGY STATUS REPORT POST-IMPLEMENTATION

In Situ Bioremediation of Chlorinated Ethene: DNAPL Source Zones
BioDNAPL Team
June 2010
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TECHNOLOGY STATUS

Status of the Technology

In situ bioremediation (ISB) of DNAPL source zones involves in situ degradation mechanisms in DNAPL source zone remediation efforts. The primary mechanism for this engineered in situ application is reductive dechlorination (destruction) of DNAPL in an anaerobic environment. This application often involves biostimulation (stimulation of the microbial activity in the saturated zone by the addition of an electron donor) and possibly bioaugmentation (the addition of selected microorganism to the treatment zone). Reductive dechlorination only occurs with chlorinated ethene in the dissolved phase and has been a known mechanism for over a decade. Its application to DNAPL source removal progressed primarily with the realization that, by increasing the concentration gradient at the DNAPL-water interface, the rate of DNAPL dissolution can be increased.

New information is continually emerging on methods to stimulate the organisms, materials used as electron donors, distribution/injection methods, source characterization tools, and methods; however, the reaction mechanisms and concept of reductive dechlorination at the DNAPL/water interface remains valid.

Evolution of the Technology

During the two years since ITRC implementation began, the BioDNAPL Team Leader has observed that this source destruction technology has been used as a common practice when site conditions accommodate ISB of DNAPL, risk encourages source removal, and source removal can be measured. ISB of DNAPL may require long treatment periods, and the effect of source removal may not be measured in the plume for months or years; however, the increased use of mass flux estimates in the analysis of site remediation are encouraging increased use of ISB of DNAPL source zones to reduce mass flux as an interim remedial objective.

Since June 2008, team members have described the use and usefulness of the guidance through presentations and training to the following:

- New Jersey DEP by Greg Rapp and Trevor King;
- Colorado Department of Public Health and Environment by Ryan Wymore and Wilson Clayton



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- USCOE Kansas City by Donovan Smith
 - USCOE Concord, Mass. by Ian Osgerby
 - Langan Engineering by Trevor King
 - Battelle, short course by Dave Major, Larry Syverson, Wilson Clayton, Fred Payne 2009 and 2010
 - SERDP poster by Ryan Wymore in 2008 and 2009
 - AEHS poster by Ryan Wymore in 2010
 - NGWA short course by Ryan Wymore and Mary DeFlaun
 - AIPG short course by Larry Syverson, Wilson Clayton, and Ryan Wymore
 - AFCEE article in their newsletter for fall and winter 2008
 - AFCEE presentation by Naji Akladiss and Fred Payne
 - Battelle poster by Ryan Wymore in 2008 and 2009
 - Battelle platform presentation by Ryan Wymore in 2009
 - American Academy of Civil Engineers presentation by Tamzen Macbeth and Naji Akladiss in 2010
 - Central Valley Regional Water Quality Control Board presentation by Alex MacDonald, 2010

Feedback during these events provided reinforcement for the increased use of ISB to reduce the mass of DNAPL in the subsurface.

1374 students have attended the Internet-based training. These included 350 state employees, 50 EPA, 29 DOD, 15 DOE, 2 from other federal agencies, 647 consultants, 40 site owners, 19 technology vendors, and 113 from academia. The technical feedback from these courses was positive and encouraging for the use of less aggressive and sustainable technologies to treat subsurface chlorinated organic contamination.

ITRC GUIDANCE STATUS

Condition of the Guidance

The guidance document *In Situ Bioremediation of Chlorinated Ethene: DNAPL Source Zones* continues to be valid, useful, and used. A follow-up proposal has been prepared to update the *Introduction to Characterizing Sites Contaminated with DNAPL* (2003) to the level of a technical/regulatory guidance document and update information on DNAPL site characterization tools. This update will add value to the ISB of chlorinated ethene guidance.

Recommendation

The guidance is still valid, should remain on the ITRC site, and should continue to be promoted.