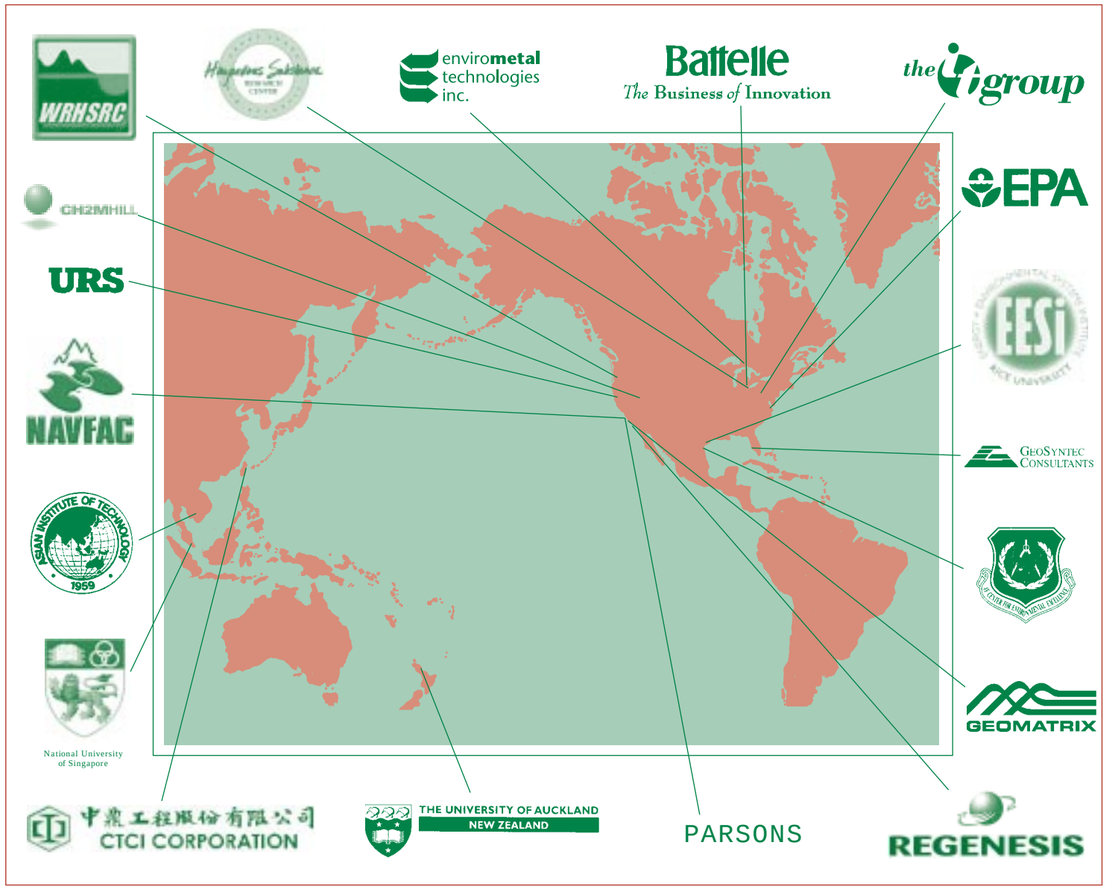

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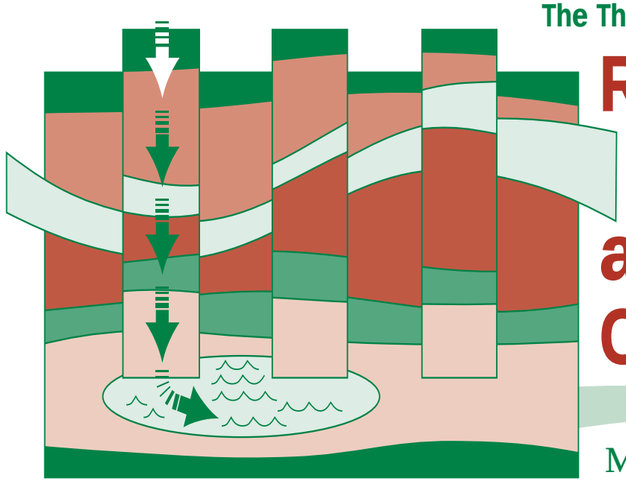

The Third International Conference on

Remediation of Chlorinated and Recalcitrant Compounds

May 20-23, 2002

DoubleTree & Marriott Hotels/Monterey Conference Center
Monterey, California

Sponsored by Battelle The Business of Innovation

Co-Sponsors

GeoSyntec Consultants · environmetal technologies inc. · GEOMATRIX · the igroup · NAVFAC · PARSONS · REGENESIS

CO-SPONSORS

Battelle is the organizer and sponsor of this conference. Co-sponsors and the descriptions they provided appear below.

The Air Force Center for Environmental Excellence (AFCEE) provides a full range of environmental remediation capabilities to support customers' requirements. These include study, design, and remedial action contracts; world-class remediation technology development and the support needed to implement it; and environmental consultant capabilities for our own needs and those of our customers. AFCEE's Technology Transfer Division develops and executes new technology development and current technology optimization initiatives in support of U.S. Air Force and Air Force Base Closure Agency cleanup programs worldwide.

EnviroMetal Technologies Inc. (ETI) is the worldwide leader in applications of permeable reactive barrier (PRB) technology for the remediation of contaminated groundwater, with experience in North America, United Kingdom, Europe, and Australia. ETI provides a range of advisory and support services to site owners, remediation consultants, and contractors to assist them with the design and installation of our patented PRB systems and other passive remediation technologies.

Geomatrix Consultants, Inc. Sixteen years ago, a group of recognized authorities in the earth sciences founded Geomatrix. Their goal was to create a company large enough to solve their clients' most challenging problems, yet small enough to deliver consistently excellent results and personal service. Today, with a staff of nearly 300 people, Geomatrix performs a broad range of consulting services in the fields of engineering and applied earth and environmental sciences. Geomatrix areas of expertise include soil and groundwater investigation, fate and transport modeling, natural attenuation, in situ treatment, risk assessments, and remedial design. Our clients include utilities and municipalities; local, state, and federal agencies; engineering firms; and industrial, agricultural, mining, and development corporations.

The **IT Group** addresses the infrastructure and environmental needs of both private- and public-sector clients as a leading provider of diversified services, including construction, environmental, consulting, engineering, facilities management, water, remediation, liability transfer, and information management.

The Naval Facilities Engineering Command (NAVFAC) is the Navy's facilities, installation, and contingency engineering support center. For the Navy's environmental program, NAVFAC provides high quality services in environmental planning, environmental compliance, pollution prevention, natural resources, and past waste site restoration. Innovative environmental technologies used throughout the Navy are identified, developed, and demonstrated through a variety of programs and initiatives. NAVFAC's ten Engineering Field Divisions/Activities (EFD/As) and its engineering service center (NFESC) partner closely with other military services, agencies, academia, private industry, regulators, environmental organizations, and community groups to bring forth the best mix of new technologies and management techniques and to deliver expert solutions to our clients.

Parsons is one of the world's largest engineering and construction firms, with strong capabilities in environmental consulting and project management. Parsons offers cost-effective solutions emphasizing in situ, risk-based remediation that includes natural attenuation and enhanced bioremediation. The company's key service areas include wastewater and solid waste treatment, soil and groundwater investigation/remediation, risk assessment, pollution prevention, waste minimization, hazardous waste management, air emissions modeling, and Title V permitting.

Regenesis is the world's leader in the development of innovative products to aid in the cost-effective remediation of contaminated groundwater and soil. Regenesis's passive, slow-release products, Oxygen Release Compound (ORC) and Hydrogen Release Compound (HRC), have revolutionized groundwater cleanup by proving to be effective and low-cost alternatives to the standard engineering-intensive remediation approaches of the past. ORC is used to treat aerobically degradable contaminants, such as gasoline, MTBE, BTEX, and other petroleum-based constituents. HRC is specifically designed to treat anaerobically degradable, chlorinated contaminants, such as PCE, TCE, perchlorate, and certain pesticides. Both products are designed to be applied into the subsurface and to stimulate the rapid degradation of pollutants by activating natural microbial populations. Regenesis products have been used at more than 6,000 sites and have shown tremendous results in removing unwanted contaminants from groundwater environments in an economical and energy-efficient manner.

PARTICIPATING ORGANIZATIONS

The following organizations assist with distribution of information about the Conference.

Asian Institute of Technology (Thailand)

CTCI Corporation (Taiwan, R.O.C.)

Energy & Environmental Systems Institute (Rice University)

Great Lakes & Mid-Atlantic Center for Hazardous Substance Research, GLMAC (University of Michigan)

National University of Singapore

U.S. Environmental Protection Agency

University of Auckland (New Zealand)

Western Region Hazardous Substance Research Center (Oregon State & Stanford Universities)

The Third International Conference

The biennial Conference on Remediation of Chlorinated and Recalcitrant Compounds is designed to provide scientists, engineers, regulators, remediation site owners, and other environmental professionals from around the world an opportunity to discuss current work and future directions for research and application. The focus of the May 2002 Conference is the innovative use of existing or new technologies/approaches to address the challenges of characterizing, remediating, monitoring, and closing sites contaminated with chlorinated solvents and other recalcitrant compounds. The program will emphasize field applications, along with laboratory, pilot, and modeling studies leading to innovative remediation approaches.

The four-day Conference program will consist of 43 sessions, 4 panel discussions, and approximately 40 exhibits. In conjunction with the program, a student paper competition is being conducted, and short courses will be offered on topics related to the general scope of the Conference. This Preliminary Program lists the more than 600 platform and poster presentations scheduled for the program as of November 30, 2001. Presentations will cover technological advances in characterization, remediation, and monitoring of soil, sediment, fractured bedrock, groundwater, and surface water contaminated with chlorinated solvents and other recalcitrant compounds, such as MTBE, PCBs/dioxins, 1,4-dioxane, pesticides/herbicides, PAHs, perchlorates, heavy metals, explosives/nitroaromatics, UXOs, and endocrine disruptors.

The Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds will be chaired by Arun R. Gavaskar and Abraham S.C. Chen, Ph.D., both of Battelle. Co-sponsors and participating organizations include governmental, academic, and private organizations engaged in site remediation work.

About the Sponsor

Battelle
The Business of Innovation

Based in Columbus, Ohio, Battelle is a not-for-profit organization engaged in technology development and implementation, national laboratory management, and technology commercialization. Battelle puts technology to work in the areas of environment, pharmaceuticals, medical products, agrifood, chemicals, energy, automotive, health and human services, national security, aerospace and transportation. With a staff of more than 7,500 scientists, engineers, and support specialists, Battelle has major operations in America and Europe, as well as specialized facilities and offices in 70 cities throughout the United States.

Contents

PLENARY SESSION SPEAKERS

Keynote Speaker: Robert F. Kennedy, Jr.

"A Contract With Our Future"

Robert F. Kennedy, Jr., has extensive experience in environmental law, having successfully prosecuted governments and companies for polluting the Hudson River and Long Island Sound, arguing cases to expand citizen access to the shoreline, and suing sewage treatment plants to force compliance with the Clean Water Act.

His career continues a family tradition of public service. After receiving a degree from Harvard University and studying at the London School of Economics, Mr. Kennedy earned a law degree from the University of Virginia Law School and a master's degree in environmental law from Pace University School of Law. Early in his legal career, he served as assistant district attorney for New York City and has worked in several national political campaigns. He is the author of several books and newspaper and journal articles.

Mr. Kennedy currently is chief prosecuting attorney for the Hudson Riverkeeper, senior attorney for the Natural Resources Defense Council, and a clinical professor and supervising attorney at the Environmental Litigation Clinic at Pace University School of Law in New York. He has worked on environmental issues across the Americas and has assisted several indigenous tribes in Latin America and Canada in negotiating treaties protecting traditional homelands. On behalf of environmentalists and New York City watershed consumers, he negotiated the New York City watershed agreement, which is considered an international model in stakeholder consensus negotiations and sustainable development.

Mr. Kennedy's keynote topic, "A Contract With Our Future," will argue that good environmental policy is good policy for business, the economy and posterity.

Brian C. Griffin

"A Regulator's Perspective on Balancing Economic Growth and Environmental Protection"

The Honorable **Brian C. Griffin** (Oklahoma's Secretary of Environment) has responsibility for all environmental matters within the State of Oklahoma. Moreover, Secretary Griffin chairs several executive task forces created to address the most pressing environmental issues in Oklahoma. In addition to his duties in the State of Oklahoma, Secretary Griffin chairs several committees sponsored by the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the U.S. Department of Defense. In these roles, Secretary Griffin has endeavored to strike that delicate balance between sound economic policy and sound environmental policy.

Secretary Griffin is a native Oklahoman, a Harvard graduate, and a Rhodes Scholar. He holds both an American law degree and a British law degree earned as a Rhodes Scholar at Oxford University. Before being appointed as Oklahoma's Secretary of Environment, Secretary Griffin served as one of the highest-ranking officials in the first Bush Administration.

William Stack

"The Oxygenated Fuels Controversy: An Assessment of Environmental Benefits and Problems"

William J. Stack (head of the litigation department at ExxonMobil) is admitted to practice in several states and various federal courts and has extensive experience in environmental law. After receiving his degree from Seton Hall University School of Law in 1974, Mr. Stack worked for the executive branch of the State of New Jersey, serving as assistant counsel to the Department of Labor and Industry, the Department of Environmental Protection, and the Public Utilities Commission. In 1977, he began working for Exxon Corporation, providing legal advice on all aspects of environmental law to management in the refining, chemical, product distribution, mining, marine, and retail marketing operations.

In 1984, Mr. Stack became responsible for all environmental tort litigation for Exxon. He and his staff supervise a regional counsel network and handle all aspects of litigation, including utilization of alternative dispute resolution and trial practice. He has "first chair" tried toxic and environmental tort cases in state and federal courts in more than 20 states and has represented Exxon in Daubert hearings and class certification hearings in numerous environmental and toxic tort cases throughout the United States.

Location and Schedule

All technical sessions, panel discussions, meals, exhibits, and short courses will be held at the DoubleTree and Marriott Hotels/Monterey Conference Center complex. Exhibits and Group 1 Poster Display will open Sunday evening, May 19, concurrent with the early registration period and a light welcome reception; exhibits will remain open through noon Thursday. The plenary session will begin at 8:00 A.M. Monday, and the technical sessions will begin on Monday afternoon and conclude on Thursday afternoon. No presentations will be made Wednesday afternoon. Short courses (see pages 38-39) will be conducted on Sunday, Wednesday afternoon, and Friday. The course schedule will not conflict with the technical program. For more information on the schedule, see the Program at a Glance and the Poster Schedule, pages 20-22.

Technical Sessions and Panel Discussions

The program was developed by Conference Chairs Arun R. Gavaskar and Abraham S.C. Chen and the session chairs. More than 600 platform and poster presentations are scheduled in 43 sessions and 4 panel discussions. The Preliminary Program Schedule (pages 7-36) lists all sessions and chairs and the presentations in each session (as of November 30). The platform papers will be presented in five concurrent daytime tracks, as illustrated in the Program at a Glance, which appears on pages 20-21. Posters are marked with asterisks (*) and will be displayed and presented in two successive groups, Sunday evening through Wednesday midday; see page 22 for a list of sessions in each poster group and details on display and presentation times.

In addition to the sessions made up of platform and poster presentations, the Conference program will include panel discussions on several key topics. The objective is to stimulate discussion on issues of interest to the environmental community. Each panel will consist of several prominent persons in the field, one of whom will serve as the moderator. Each panelist will make a short opening statement, following which the panel will field questions from the audience and from the moderator. The panel topics and the session codes assigned to each are: DNAPL site remediation (D5), site closure and exit strategy (B8), contaminated sediments and dredged material (C4), and future directions for technology development for remediation of chlorinated solvents and other recalcitrant contaminants (D9). More information on the theme and participants in each panel can be found under the session codes in the Preliminary Program Schedule section (pages 7-36).

The schedule is subject to change. Upon arrival at the Conference, each registrant will receive the Final Program and spiral-bound sets of short abstracts, arranged by session and presentation sequence. ***Only those registered for the technical program will be admitted to the sessions.***

Meals and Receptions

Daily continental breakfasts, morning and afternoon breaks, two lunches (Tuesday and Thursday), and four light receptions, will be provided on site at no additional cost to program registrants and exhibit booth staff. For other meals, there are many restaurants in the headquarters hotels and nearby. ***Registrants may purchase meal tickets for guests at the Conference Registration Desk. Guest tickets will be priced equal to the cost incurred by the Conference for each meal.***

Exhibits

Schedule. Organizations that conduct remediation activities or supply equipment used in such work are invited to exhibit at the Conference. Exhibits will be on display from Sunday evening, May 19, through noon Thursday, May 23, in the Serra Ballroom. The Exhibit Hall is adjacent to the platform and poster presentation, registration, breakfast, lunch, break, and reception areas. Because of the Exhibit Hall's central location, exhibitors will have the opportunity to present information to a large, focused audience of people who acquire and use environmental-management products and/or services at industrial and government sites around the world.

Fees. The fee for an 8-ft x 10-ft booth is US$2,495. The booth fee includes badges for two booth staff, permitting them to attend all meals and refreshment breaks; badges can be purchased for additional booth staff. Exhibit booth staff badges will not permit attendance at platform and poster sessions, but an exhibit staff registration can be upgraded to a full technical program registration for US$425 each (maximum two upgrades per company).

Reserving Exhibit Space. Space is limited, and booths will be assigned on a first-come/first-served basis. For more information or to request an

Continued on the next page

exhibit application form, call 800-783-6338 or 614-424-5461 or send an e-mail to info@confgroupinc.com.

Short Course Overview

The courses to be offered at the Conference are described briefly on pages 38-39, and additional information will be added to the Conference Web site (www.battelle.org/chlorcon). The schedule will complement, rather than overlap, the Conference technical program schedule. Courses will be offered on Sunday, Wednesday afternoon, and Friday. Courses are open to both Conference registrants and non-registrants, although Conference registrants will receive discounted course fees. Discounts also apply to fees paid by April 18. Prospective short course attendees should pre-register by April 18, using the Short Course Registration Form on page 40. Classroom space allocation and production of course materials will be determined by the number registered for each course by April 18. ***If insufficient registrations are received for a given course by April 18, the course will be canceled, and registrants' course fees will be refunded or transferred to another course selected by the registrant.*** Registrations will be accepted after April 18 only if space is available.

Conference Publications

Materials from the Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds will be available in two forms: a collection of abstracts and a published proceedings.

Abstracts. Spiral-bound sets of one-page abstracts for all platform and poster presentations will be distributed to technical program registrants upon arrival at the Conference. The volumes will be arranged according to the program schedule so that Conference registrants can use them to plan which sessions and presentations to attend.

Proceedings. All platform and poster presenters were asked to submit short papers (maximum 8 pages) expanding upon their presentations. Each paper will be reviewed for quality by the technical committee and proceedings editors. The indexed proceedings will be mailed at no additional cost shortly after the Conference to all registrants who paid standard rates ($775/$865 government or university; $825/$915 industry). After June 1, 2002, the proceedings can be ordered from Battelle Press (800-451-3543 or 614-424-6393; fax: 614-424-3819). Proceedings of previous Battelle-sponsored remediation conferences also can be ordered from Battelle Press, and tables of contents can be viewed at www.battelle.org/bookstore.

Student Paper Competition

Submissions were due November 30. Papers will be reviewed by members of the selection committee, which is headed by Dr. Bruce Sass, of Battelle. Each of the winning papers will be scheduled for presentation at the Conference, and the presenters will be recognized during the Plenary Session. The primary authors of the top papers will receive complimentary Conference registrations, the proceedings, and, through the generosity of corporate sponsors, cash awards to help cover travel and related costs. ***For information about sponsoring student paper awards, send an e-mail to chlorcon@battelle.org.*** Student paper sponsors confirmed as of November 30 were GeoSyntec, CH2M Hill, and URS Corporation.

GeoSyntec Consultants CH2MHILL URS

Conference Registration/Policy

Exhibit-booth staff will be registered by their exhibit managers. Holders of booth-staff badges will be admitted to the continental breakfasts, group lunches, breaks, and general receptions; booth staff also will receive registration materials (i.e., the final program and a spiral-bound set of abstracts). However, booth-staff registrants will not be permitted to attend the technical program (poster and platform sessions), nor will they receive the proceedings.

Because registration fees are the major source of funding for the Conference and a significant percentage of registrants will make presentations and/or chair sessions, all presenting authors and session chairs are expected to register and pay the applicable technical-program registration fees.

To register for the technical program, go to www.battelle.org/chlorcon or complete the Conference Registration Form on page 37 and send it with payment to the address given on the form. Technical registration fees cover admission to platform and poster sessions as well as exhibits and group food functions. In addition to the final program and abstract books, which will be distributed at the Conference, each person registering at the full-program fee will receive the proceedings soon after the Conference. Full-time students may

register for the technical program at the reduced rate specified below; however, individuals registering at the student rate will not receive the Conference proceedings. A copy of valid student I.D. must accompany the student registration. Technical-program registration fees are as follows:

	Paid by 28 Feb 02*	Paid After 28 Feb 02
Full-Program Fee:		
Industry	US$825	US$915
Government**/ University	US$775	US$865
Full-Time Student Fee:		
Student***	US$375	US$425

* Purchase orders will be accepted, but the early registration fee discount applies only if payment is received by February 28, 2002.

** The government rate is extended to government employees only and does not apply to government contractors.

*** Please provide copy of valid student I.D. Proceedings not included.

We encourage you to register early — registrations will be limited to the number that the facility can accommodate efficiently. Checks should be drawn on a U.S. bank, payable in U.S. funds to "The Conference Group, Inc., FEID#31-1157243" and referencing "Chlorinated Conference." Payment can be made also by American Express, Diners, Discover, MasterCard, or Visa. For cancellations received by April 1, 2002, the registration fee will be refunded, less a $35 service fee. No refunds will be made after April 1, but paid no-shows will receive all materials covered by their registration fees. Substitutions will be accepted at any time, preferably with advance notice. If Battelle cancels the event due to circumstances beyond Battelle's reasonable control such as, but not limited to, acts of God, acts of war, government emergency, labor strikes, and/or unavailability of the event or exhibition facility, Battelle shall refund to attendee his/her previously paid registration fee less a share of event costs incurred by Battelle. This refund shall be attendee's exclusive remedy and Battelle's sole liability for cancellation of the event for reasons generally described in this paragraph.

Professional Development Credit

Participation in the Conference may help fulfill professional development requirements imposed by state licensing boards. If you are subject to such requirements and need to determine whether your board will accept your attendance to fulfill this requirement, please contact your board directly. The Program at a Glance (pages 20-21) and the listing of presentation titles should provide the board with the necessary information about the content and length of the Conference schedule. If you find that you need additional information, please contact the Conference Program Office at 614-424-7604, or send an e-mail to chlorcon@battelle.org.

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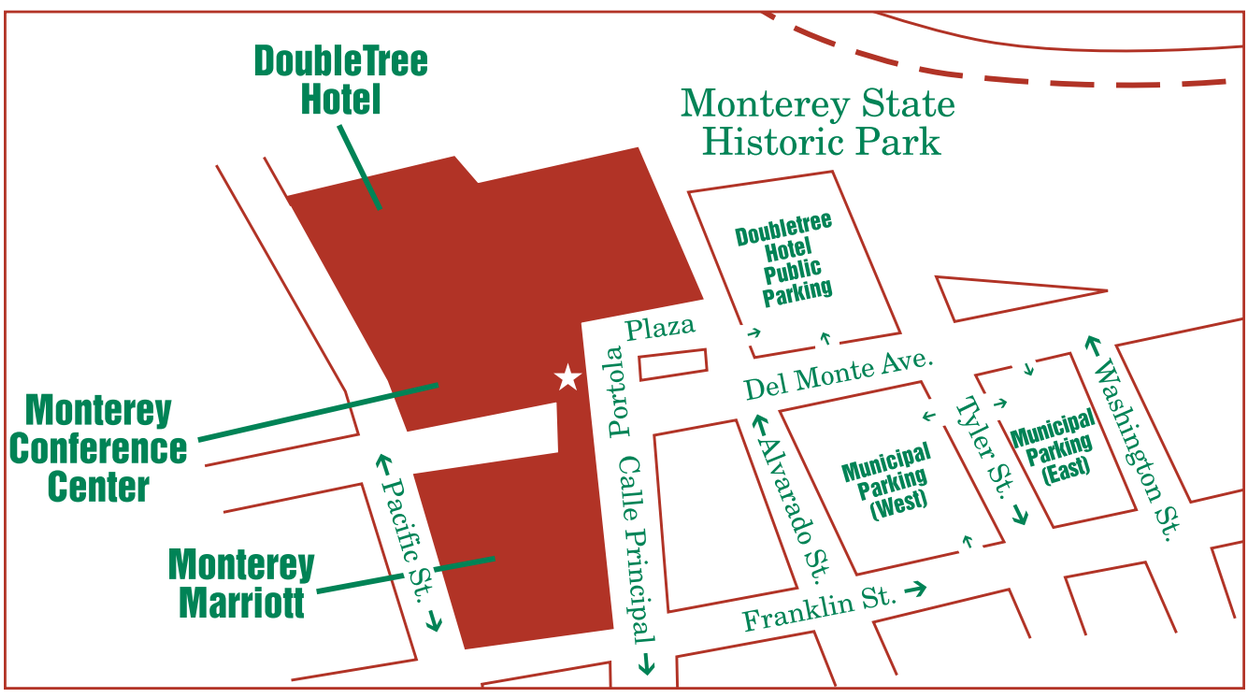


Hotel Accommodations/Travel

Meeting Headquarters. The DoubleTree and Marriott Hotels/Monterey Conference Center Complex is situated on Portola Plaza, within walking distance of Fisherman's Wharf, Cannery Row, the Monterey Bay Aquarium, shopping areas, restaurants, and other attractions of downtown Monterey, California. Many scenic and historic sites and championship golf courses are just a short drive away along the seacoast north or south of Monterey. Both hotels are connected to the Conference Center, and some Conference functions will be held at each.

Hotel Accommodations. Conference registrants can reserve rooms at the DoubleTree Hotel at the reduced group rate of $175/night (single or double) or the Marriott Hotel at the reduced group rate of $175/night (single) or $190/night (double), plus tax. Comparable discounts in rates for suites are available. These rates will be in effect for reservations made by April 18, 2002, subject to availability. To make a reservation, contact the Reservations Department at either hotel and mention you are attending the "Battelle Chlorinated Conference." Be sure to inquire about the hotel's cancellation policy.

DoubleTree Hotel	Phone: 831-649-4511 Fax: 831-649-3109
Marriott Hotel	Phone: 831-649-4234 Fax: 831-647-4022

A percentage of rooms will be available to qualified individuals at the prevailing U.S. Government per diem rate (plus tax). ***If you are an employee of a U.S. federal, state, or local government agency, you must obtain a special form to make your reservation.*** Contact The Conference Group (telephone: 800-783-6338 or 614-424-5461; fax: 614-488-5747; e-mail: info@confgroupinc.com) to request the government-rate hotel reservation form.

Travel and Local Transportation. Discount airline rates (typically 10% off lowest applicable fares) are available for travel within the USA on most major carriers. To obtain these fares, you must book your flight through Battelle's Travel Department. Call 800-551-7055 (U.S., Canada) or 614-424-6400 8:00 A.M. - 5:00 P.M. EST, Monday-Friday, send a fax to 614-424-6160, or send an e-mail to travel@battelle.org and refer to the Battelle Chlorinated Conference. All major credit cards are accepted; electronic tickets will be issued. Major air service is available into the Monterey Peninsula Airport, but flying into San Francisco International or San Jose International also is an option. The Monterey/Salinas Airbus Shuttle (831-883-2871) and rental cars are available from these cities. Approximate driving time is 2-1/2 hours from San Francisco and 1-1/2 hours from San Jose. Detailed information on the shuttle will be included with registration confirmation. Transportation from Monterey Peninsula Airport to the hotels is available one way by taxi for $10 or city bus for $3. Airport transportation is not provided by the hotels.

Hotel Parking. As of November 2001, parking rates at the hotels included in and out privileges at the following rates:

DoubleTree	$14 per day valet $12 per day self-park
Marriott	$14 per day valet no self-park

There are also nearby city parking lots at a cost of $5 each time you exit the lot. ***Note: the Conference cannot validate parking.***

Employment Opportunities

A message board will be available near the Conference Registration Desk for posting employment-available and employment-wanted notices (maximum 5 inches by 7 inches). Be sure to include contact information.

Inquiries

For information regarding Conference or short course registration, exhibits, or possible availability of small meeting rooms, contact:

Conference Coordinator
The Conference Group
1580 Fishinger Road
Columbus, Ohio 43221 USA
Telephone: 800-783-6338 (U.S. and Canada) or 614-424-5461
Fax: 614-488-5747
E-mail: info@confgroupinc.com

Direct questions about the program schedule to:

Carol Young
Battelle
505 King Avenue
Columbus, Ohio 43201-2693 USA
Telephone: 614-424-7604
Fax: 614-424-3667
E-mail: chlorcon@battelle.org

PLATFORM AND POSTER PRESENTATION TITLES

Plenary Session

Welcome and Opening Remarks. Conference Chairs Arun Gavaskar and Abraham Chen, Battelle.

Keynote Address: A Contract with Our Future. Robert F. Kennedy, Jr. (Chief Prosecuting Attorney for Hudson Riverkeeper; Professor, Pace University School of Law).

A Regulator's Perspective on Balancing Economic Growth and Environmental Protection. Brian C. Griffin (Secretary of Environment, State of Oklahoma).

The Oxygenated Fuels Controversy: An Assessment of Environmental Benefits and Problems. William Stack (Head of Litigation, ExxonMobil).

Presentation of Student Paper Awards.

Technical Sessions

The following list includes all platform and poster presentations scheduled for each session as of November 30, 2001, when this preliminary program was compiled. Each title preceded by an asterisk (*) is to be presented as a poster discussion on Monday or Tuesday evening, depending on the session. The authors are listed in the order given on the abstracts that were submitted for review. The name and affiliation of the person expected to make each presentation follows the author list. See the Program at a Glance (pages 20-21) and the poster schedule (page 22) for the days and the approximate times each platform and poster session will be presented. ***The schedule is subject to revision.***

A1. Treatment Technologies for Explosives Residue

Platform Papers Monday/Posters (*) Monday Evening

Chairs: *Jeff S. Cornell (U.S. Air Force) & Jeffrey J. Morse (Battelle)*

*** Bench-Scale Analysis of In Situ Dinitrotoluene Bioremediation for Vadose Zone Soils.** *C. Zhang, J.D. Fortner, K.E. Finnessy, and J.B. Hughes.*
Chunlong Zhang (University of Houston-Clear Lake/USA)

Bench-Scale Reductive Treatment of Explosives-Contaminated Groundwater from Massachusetts Military Reservation (MMR). *P.W. Barnes, M.S. Heaston, and K.R. Weeks.*
Paul W. Barnes (Earth Tech, Inc./USA)

Case Studies of In Situ Chemical Oxidation to Treat Explosives-Contaminated Groundwater. *M.L. Hampton and I.P. May.*
Mark L. Hampton (U.S. Army Environmental Center/USA)

Explosives-Contaminated Soil Bioremediation at the Joliet Army Ammunition Plant. *A. Bailey, J. Cummings, and W. Murray.*
William J. Murray (Montgomery Watson Harza/USA)

*** In Situ Fenton's Reagent Pilot Tests for Dissolved Explosives.** *D. Bryant and J. Wilson.*
Dan Bryant (Geo-Cleanse International, Inc./USA)

In Situ Oxidation Treatment of High Explosives in Groundwater. *W. Clayton, T. Harris, B. Marvin, and A.M. Struse.*
Todd Harris (BWXT Pantex/USA)

*** Involvement of Anthranilic Acid and 3-Hydroxy-anthranilic Acid in the Biodegradation Pathway of O-Nitrobenzoic Acid by *Arthrobacter protophormiae*.** *G. Pandey and R.K. Jain.*
Rakesh K. Jain (Institute of Microbial Technology/INDIA)

*** Laboratory Studies for In Situ Treatment of an RDX-Contaminated Aquifer.** *M.L. Adam, S.D. Comfort, M.C. Morley, and P.J. Shea.*
Michael L. Adam (University of Nebraska/USA)

*** A New Mechanism for the Reduction of Nitroaromatics with Iron.** *S. Oh, P.C. Chiu, and D.K. Cha.*
Pei C. Chiu (University of Delaware/USA)

Physical Separation and Availability Characterization of Nitroaromatics in Biotreated Soils. *J.W. Talley and S.L. Larson.*
Jeffrey W. Talley (University of Notre Dame/USA)

Potential Strategy for Ring Fission of TNT by *Clostridium acetobutylicum*. *J.B. Hughes and C. Wang.*
Joseph B. Hughes (Rice University/USA)

Push-Pull Tests: Field Evaluation of In Situ Chemical Oxidation. *A.M. Struse, B. Marvin, T. Harris, and W. Clayton.*
Amanda M. Struse (IT Group/USA)

*** Reduction of Nitrobenzene in Aqueous Solutions of Fe(II)-Dendrimer Complexes.** *S.Christie, M.S. Diallo, L. Balogh, J.H. Johnson, and W.A. Goddard III.*
Simone Christie (Howard University/USA)

Reduction of TNT and Sequestration of the Byproducts by Iron Metal. *T.L. Johnson, R.L. Johnson, and P.G. Tratnyek.*
Paul G. Tratnyek (Oregon Graduate Institute/USA)

Treatment of Energetic Contaminants in Unsaturated Sediments Using Ozone/Hydrogen Peroxide Gaseous Mixtures. *T. Gilmore, K. Cantrell, and E. Thornton.*
Tyler J. Gilmore (Battelle/USA)

A2. Permanganate Oxidation of Chlorinated Solvents

Platform Papers Tuesday/Posters (*) Monday Evening

Chair: *Sandip Chattopadhyay (Battelle)*

Chemical and Engineering Challenges to In Situ Permanganate Remediation. *B. Marvin, J. Chambers, and C.G. Schreier.*
Jane D. Chambers (Northgate Environmental Mgt, Inc./USA)

*** Destruction of TCE DNAPL Pool Using $KMnO_4$: Semipassive Approach.** *C.S. Bourne, B.L. Parker, and J.A. Cherry.*
Clare Stewart Bourne (University of Waterloo/CANADA)

A2. Continued

*** A Field Test of Potassium Permanganate Solution for In Situ Oxidation of TCE to Enhance Groundwater Remediation at Air Force Plant 44, Tucson.** *T.J. Allen, J. Dablow, B. Marvin, M.L. Barackman, J. Baker, and B. Blanford.*
Jay Dablow (The IT Group/USA)

Full-Scale Permanganate Remediation of a Solvent DNAPL Source Zone. *B.L. Parker and T.A. Al.*
Beth L. Parker (University of Waterloo/CANADA)

In Situ Oxidation of DNAPL Using Permanganate: Cape Canaveral Demonstration. *W.C. Leonard, E. Mott-Smith, and J. Ramirez.*
Wendy Leonard (IT Group/USA)

*** Is Bromide a Conservative Tracer During ISCO?** *K.G. Mumford, C. Lamarche, N.R. Thomson, and E.D. Hood.*
Kevin G. Mumford (University of Waterloo/CANADA)

*** Kinetic Study of Permanganate Oxidation of Tetrachloroethylene at pH 10.60+/-0.1.** *Q. Dai and S. Reitsma.*
Qunli Dai (University of Windsor/CANADA)

Monitoring In Situ Oxidation of TCE by Permanganate Using Carbon Isotopes. *D. Hunkeler, R. Aravena, B.L. Parker, and J.A. Cherry.*
Ramon Aravena (University of Waterloo/CANADA)

Observed Reductive Dechlorination Processes due to Chemical Oxidation Remediation Testing. *E.X. Droste, M.C. Marley, J.M. Parikh, A.M. Lee, B.A. Woody, P.M. Dinardo, G.E. Hoag, and P.V. Chheda.*
Edward X. Droste (Xpert Design and Diagnostics, LLC/USA)

PCE Treatment in Low-Permeability Soils with Permanganate. *C.A. Montero, S.R. Nelson, and J. Henthorne.*
Charles A. Montero (Rosengarten, Smith & Assoc., Inc./USA)

*** Pilot Demonstration of Chemical Oxidation Treatment for TCE-Contaminated Groundwater.** *M.R. Napolitan, F. Blickle, M.T. Balba, D. Coons, C. Lin, and A.F. Weston.*
Alan F. Weston (Conestoga-Rovers & Associates/USA)

*** Pilot Test Using Potassium Permanganate Solution for VOCs-Impacted Groundwater Cleanup.** *G.J. Hu, R. Chou, R. Crother, and J.M. Shipley.*
G. Jeffrey Hu (California Regional Water Quality Control Board/USA)

*** Soil Oxidant Demand Laboratory Tests Versus Field Test Kit.** *D.C. Pohlmann, A. Van Hout, D.K. Root, and J.L. Klens.*
Dirk C. Pohlmann (IT Corporation/USA)

*** Testing Benzene's Effect on Permanganate Oxidation of TCE.** *K.L. Pennell and S.A. Jones.*
Kelly L. Pennell (ARCADIS G&M/USA)

A3. Fenton's Reagent Treatment of Chlorinated Solvents

Platform Papers Tuesday/Posters (*) Monday Evening

Chair: *Richard J. Watts (Washington State University)*

*** Combined Effects of MNA and In Situ Fenton's Oxidation.** *W.E. Collins, M. Bonsavage, J. Shiple, J. Myers, and R.L. Wong.*
Judy Shiple (IT Corporation/USA)

*** Destruction of DNAPLs by Modified Fenton's Reagent.** *B.A. Smith, R.J. Watts, and D.A. Atkinson.*
Brant Smith (Washington State University/USA)

*** Efficacy of Chemical Pre-Oxidation for Enhanced Biological Treatment of MGP-Contaminated Soils.** *J. Butler, B. Alleman, K. Hartzell, E. Foote, J. Abbott, R. Brenner, and P. McCauley.*
Jenny M. Butler (Battelle/USA)

In Situ Chemical Oxidation and Reduction: A Federal Facilities Regulatory Perspective. *W. Brandon, M. Barry, M. Daly, C. Keating, M. Sanderson, and P.M. Whittemore.*
William C. Brandon (U.S. EPA/USA)

Measuring In Situ Fenton's Application Success. *D.D. Carvel.*
Doug Carvel (ManTech Environmental Corp./USA)

*** Mechanism of Enhanced Contaminant Desorption by Modified Fenton's Reagent.** *J. Corbin and R.J. Watts.*
Joseph Corbin (Washington State University/USA)

Pilot-Scale In Situ Chemical Oxidation Without Aquifer Acidification. *R.E. Campbell, W.E. Collins, J. Shiple, M. Coons, and H. Abedi.*
Judy Shiple (IT Corporation/USA)

Post-Treatment Evaluation of Fenton's Reagent Used for In Situ Chemical Oxidation. *B. DeHghi, A. Hodges, and T.H. Feng.*
Alan Hodges (Parsons, Inc./USA)

Reagent Delivery Effects Involving Modified Fenton Reactions in Subsurface Systems. *S.A. Kohtz and R.J. Watts.*
Shawn A. Kohtz (Washington State University/USA)

*** Reduction of Chlorinated Compounds (CT, HCA) in Fenton's Reagent.** *Y.-S. Kim and S.-H. Kong.*
Yong-Soo Kim (Hanyang University/KOREA)

*** Successful In Situ Application of Modified Fenton's Reagent.** *C. Nelson, S. Haskins, T. Eilber, P. Gallagher, and M. Tanner.*
Christopher H. Nelson (In-Situ Oxidative Technologies, Inc./USA)

Use of In Situ Chemical Oxidation in the Netherlands. *W. Plaisier.*
Wim Plaisier (In-Situ Technieken bv/THE NETHERLANDS)

A4. Innovative Oxidation Techniques for Remediation of Recalcitrant Compounds

Platform Papers Tuesday/Posters (*) Monday Evening

Chair: *Godage B. Wickramanayake (Battelle)*

* **Chemical Oxidation of Bioremediated Soils Contaminated with Crude Oil.** *J.A. Dunn and S.R. Lunn.*
James A. Dunn (Imperial Oil Resources/CANADA)

Chemical Oxidation Treatment of HVOC-Impacted Groundwater Sources. *F.W. Blickle and M. Napolitan.*
Frederick W. Blickle (Conestoga Rovers & Associates, Inc./USA)

* **Chlorobenzene NAPL Oxidation Using Potassium Permanganate: Bench- and Field-Scale Demonstration.** *J.F. Horst, K.A. Beil, F.C. Lenzo, and S.S. Suthersan.*
John F. Horst (ARCADIS G&M/USA)

*** Cyclodextrin-Modified Fenton Oxidation for In Situ Remediation.** *M.A. Tarr, B. Wei, and G. Xu.*
Matthew A. Tarr (University of New Orleans/USA)

* **Evaluation of Technologies for In Situ Remediation of 1,1,1-Trichloroethane.** *R.J. Fiacco, D. Brown, G. Skladany, and M. Lee.*
R. Joseph Fiacco (Environmental Resources Management/USA)

* **HiPOx (AOP) Remediation of MTBE and TBA in Contaminated Groundwater.** *R.H. Bowman.*
Reid H. Bowman (Applied Process Technology, Inc./USA)

*** In Situ Chemical Oxidation of Chlorobenzene and Dichlorobenzene in Groundwater.** *P. Favara, D. Williamson, T. Beisel, and D. Bryant.*
Paul Favara (CH2M Hill, Inc./USA)

* **In Situ Chemical Oxidation with Colloidal-Metal Oxides.** *K.C. Bower, C.M. Miller, K.H. Gardner, and J. Spear.*
Kevin Bower (University of Akron/USA)

In Situ Ozonation to Remediate Recalcitrant Organic Contamination. *J. Dablow, M. Seaman, and B. Marvin.*
Jay Dablow (The IT Group/USA)

In Situ Ozone Remediation of Adsorbed PAHs in Soil. *K.P. Wheeler, S.A. Miller, and J.C. Dey.*
Kevin P. Wheeler (Resource Control Corporation/USA)

*** Iron-Catalyzed Persulfate Oxidation of Chlorinated Solvents.** *K.L. Sperry, M. Marley, C.J. Bruell, C. Liang, and J. Hochreiter.*
Kenneth Sperry (Xpert Design and Diagnostics, LLC./USA)

ISCO of a Creosote Source Zone by Permanganate. *C. Lamarche, N.R. Thomson, and S. Forsey.*
Coby Lamarche (University of Waterloo/CANADA)

*** IVI Environmental Remediates Contaminated Properties Using In Situ Chemical Remediation Technology.** *J.F. Vorbach and D.R. Lent.*
Jerry Vorbach (IVI Environmental, Inc./USA)

*** Pilot Testing of Electrochemical Destruction of Chlorinated Solvents at a Closed Naval Air Station.** *M. Allen and T. Simpkin.*
Matthew S. Allen (U.S. Navy/USA)

Remediation of a VOC Plume at an Industrial Park. *W.L. Lundy, H.E. Nuttall, and S. Allin.*
William Lundy (BMS, Inc./USA)

* **Removal of Organochlorine Pesticides from Soil by Chemical Oxidation.** *E.J. Tollefsrud and C.G. Schreier.*
Eric J. Tollefsrud (Geomatrix Consultants, Inc./USA)

Successful Strategies for Integration of In Situ Chemical Oxidation (ISCO) with Existing Technologies to Support Site Closure. *R. Lewis and D. Egan.*
Richard W. Lewis (IT Corporation/USA)

* **Ultrasound-Enhanced Chemical Oxidation of PCBs and TCE in Soil.** *J. Maher, F. Blickle, G. Hotchkiss, M.T. Balba, D. Coons, C. Lin, and A.F. Weston.*
M. Talaat Balba (Conestoga-Rovers & Associates/USA)

A5. Containment with Pump-and-Treat Systems

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chair: *Ian T. Osgerby (U.S. Army Corps of Engineers)*

* **A Case Study of a Groundwater Extraction System for Remediation of TCE.** *D.S. Oliver, S.L. Eyzaguirre, M.D. Loucks, and J.H. Olsen.*
Douglas S. Oliver (Montgomery Watson Harza/USA)

Confined Aquifer Horizontal Recovery Wells for Contaminant Source Reduction. *T.W. Griffin and D.S. Bardsley.*
Terry W. Griffin (HSW Engineering, Inc./USA)

Cost Effectiveness of Long-Term Hydraulic Control (Pump & Treat): When is it Better to Switch or Not to Switch Technologies? *R. Lewis, T. Pac, and D. Lentz.*
Richard W. Lewis (IT Corporation/USA)

The Economic Case for Innovative Remediation Technologies. *A.R. Gavaskar, N. Gupta, C. Reeter, and L. Yeh.*
Arun R. Gavaskar (Battelle/USA)

An Integrated Remediation Approach at Tenneco Automotive. *C. Spiers, T.P. Swingle, E. Snider, and T. Harbage.*
Charles A. Spiers (GeoSyntec Consultants, Inc./USA)

Lessons Learned from Optimization of Pump-and-Treat Systems Nationwide. *D.J. Becker, R. Greenwald, P. Nadeau, D.J. Sutton, and K. Yager.*
Kathleen Yager (U.S. EPA/USA)

Survey Says . . . Pump and Treat. *T. P. Swingle, M.A. Orcino, and N.D. Weeks.*
Todd P. Swingle (GeoSyntec Consultants/USA)

A6. Treatment of Chlorate and Perchlorate in Groundwater

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chair: *Bruce C. Alleman (Battelle)*

* **Biological Perchlorate Reduction of High-Salinity Wastewaters.** *C. Park and E.A. Marchand.*
Chanjae Park (University of Nevada/USA)

* **Bioremediation of Perchlorate in the Vadose Zone by the Infiltration of Calcium Magnesium Acetate.** *S.L. Nevill and R.S. Borch.*
Scott L. Neville (Aerojet General Corp./USA)

Electron Donor Requirements and Redox Conditions for Perchlorate Degradation. *J.D. Shrout and G.F. Parkin.*
Joshua D. Shrout (University of Iowa/USA)

In Situ Bioremediation of Perchlorate: Comparison of Results from Multiple Field Demonstrations. *E.E. Cox, R. Borch, T. McAlary, M. McMaster, S. Neville, and L. Bonsack.*
Evan E. Cox (GeoSyntec Consultants/CANADA)

* **Passive Bioremediation of Perchlorate in Soils Using Wet Composted Manure.** *R.S. Borch, S.L. Neville, and G.B. Swanick.*
Scott L. Neville (Aerojet General Corp./USA)

Perchlorate Remediation Technology Pilot Tests at NASA's Jet Propulsion Laboratory. *R.J. Zuromski and P. Robles.*
Richard J. Zuromski (Naval Facilities Engineering Service Center/USA)

Pilot Testing of a Bioreactor for Perchlorate-Contaminated Groundwater Treatment. *P. Evans, S. Liao, S. Price, B. Min, and B. Logan.*
Patrick J. Evans (Camp Dresser & McKee, Inc./USA)

Remediating Perchlorate-Containing Groundwater Using Continuous Ion-Exchange and Catalytic Destruction. *J. Weigle and N.R. Pollack.*
John Weigle (Calgon Carbon Corp./USA)

* **Remediation of Chlorate-Contaminated Water with Barriers Containing Soybean Oil.** *W.J. Hunter.*
William J. (Jim) Hunter (U.S. Dept of Agriculture/USA)

A7. Surfactant- and Other Chemical-Based Treatments

Platform Papers Thursday/Posters (*) Tuesday Evening

Chair: *Gary A. Pope (University of Texas at Austin)*

*** Changes in Dechlorination Pathways Under the Catalysis of Cationic Surfactants.** *Z. Li, C. Willms, and J. Alley.*
Zhaohui Li (University of Wisconsin - Parkside/USA)

* **Clay Mobilization and Permeability Alteration in Sand Induced by Surfactant Addition.** *C. Berg, K. Gardner, and P. Gidley.*
Christopher Berg (University of New Hampshire/USA)

*** Concurrent Injection of Cosolvent and Air for Enhanced PCE Removal.** *S.W. Jeong, A.L. Wood, and T.R. Lee.*
Seung-Woo Jeong (U.S. EPA/USA)

Density-Modified Displacement of DNAPLs Using Partitioning Alcohol and Low Interfacial Tension Surfactant Floods. *C.A. Ramsburg and K.D. Pennell.*
C. Andrew Ramsburg (Georgia Institute of Technology/USA)

*** Designing a Surfactant Formulation for a Viscous LNAPL.** *V. Dwarakanath, T. Malik, B. Lorenzo-Rigney, L. Britton, V. Weerasooriya, and J.S. Ginn.*
Varadarjan Dwarakanath (Duke Engineering and Services, Inc./USA)

*** Electrokinetically Enhanced Surfactant/Cosolvent Flushing.** *K.R. Reddy and R.E. Saichek.*
Krishna R. Reddy (University of Illinois at Chicago/USA)

Field Demonstration of Surfactant-Enhanced Subsurface Remediation at Dover AFB. *M.A. Hasegawa, B.J. Shiau, D.A. Sabatini, R.C. Knox, J. Harwell, M. Annable, M. Brooks, S. Rao, and L. Wood.*
Mark Hasegawa (Surbec-ART Environmental, LLC/USA)

Full-Scale Field Application of Surfactant-Foam Process for Aquifer Remediation. *H.W. Meinardus, V. Dwarakanath, J.E. Ewing, K.D. Gordon, G.J. Hirasaki, C. Holbert, and J.S. Ginn.*
Hans W. Meinardus (Duke Engineering and Services, Inc./USA)

*** In Situ Propagation of Soil-Washing Fluids.** *F.C. Payne, S.S. Suthersan, and D.S. Liles.*
Frederick C. Payne (ARCADIS G&M/USA)

*** Iron Treatment of Chlorinated Waste in Cosolvent Solutions.** *C.J. Clark, P. Suresh, C. Rao, and M. Annable.*
Clayton J. Clark (Univeristy of Florida/USA)

Performance Assessment of a Surfactant-Enhanced Aquifer Remediation Application. *C. Holbert, S.R. Opp, H.W. Meinardus, M. Jin, J. Silva, and J.S. Ginn.*
Charles Holbert (URS Corporation/USA)

*** Reductive Dehalogenation of DNAPLs Using Emulsified Zero-Valent Iron.** *S. O'Hara, T. Krug, D. Major, E. Hood, J. Quinn, C. Clausen, C. Geiger, and D. Reinhart.*
Suzanne O'Hara (GeoSyntec Consultants/CANADA)

Remediation of Coal-Tar Contamination by Polymer-Surfactant Flooding. *C.M. Young, V. Dwarakanath, J. Ewing, T. Malik, L. Milner, J. Chitter, V. Weerasooriya, and G. Pope.*
Carl M. Young (Duke Engineering and Services, Inc./USA)

*** SEAR Process Efficiency: A Novel Approach to an Open Question.** *T.P. Lockhart, S.L. Bryant, A. Bevilacqua, M. Rosti, G. Dotelli, and M. Levi.*
Thomas P. Lockhart (Enitecnologie S.p.A./ITALY)

Surfactant Flushing Pilot Test Results: Enhanced Solubilization and Biodegradability of PCE. *C.D. Drummond, E. Petrovskis, K.D. Pennell, and L.M. Abriola.*
Chad D. Drummond (Montgomery Watson Harza/USA)

* **Surfactant Recovery in a Novel Three-Phase Soils Washing System.** *B.F. Severin, S. Harris, and A. Webb.*
Blaine F. Severin (MBI International/USA)

Wastewater Treatment Options from Surfactant-Enhanced Aquifer Remediation (SEAR). *L.N. Britton and V. Dwarakanath.*
Larry N. Britton (Southwest Texas State University/USA)

A8. Alternative Permeable Barrier Materials

Platform Papers Thursday/Posters (*) Tuesday Evening

Chair: *Scott D. Warner (Geomatrix Consultants, Inc.)*

Biphasic and Competitive Desorption of Chlorophenols in Surfactant-Modified Clays. *W.S. Shin, D.-I. Song, Y.K. Kim, and J.H.K. Kim.*
Won Sik Shin (Research Institute of Science & Technology/SOUTH KOREA)

Demonstration of a Permeable Barrier Technology for In Situ Pentachlorophenol Bioremediation. *J. Cole, S. Woods, and K. Williamson.*
Jason D. Cole (CH2M Hill/USA)

Electrically Induced Redox Barriers for Treatment of Contaminated Groundwater. *T. Sale and D. Gilbert.*
Tom Sale (Colorado State University/USA)

In Situ Bioremediation of Chlorinated and Nonchlorinated VOCs in Landfill Groundwater Using a Sulfate Biobarrier. *E.E. Cox, C. Elder, E. Hood, E.A. Edwards, J. Klaiber, B. Smith, and J. Berry.*
Evan E. Cox (GeoSyntec Consultants/CANADA)

* **Integrated Electrochemical Degradation and Biodegradation of Perchloroethene-Contaminated Groundwater.** *K.F. Reardon, S.A. Allen, A.M. Feist, T. Sale, and D. Gilbert.*
Kenneth F. Reardon (Colorado State University/USA)

MTBE Oxidation by Bifunctional Aluminum. *H.-L. Lien and R. Wilkin.*
Hsing-Lung Lien (National Research Council/USA)

Permeable Reactive Barrier Treatment Technology for Remediation of Inorganic Contaminated Groundwater. *T.P. Taylor, J.L. Conca, J.P. Kaszuba, P. Longmire, D. Meadows, N.N. Sauer, and B.A. Strietelmeier.*
Tammy P. Taylor (Los Alamos National Laboratory/USA)

Redox Manipulation of Silawa Soil for Reductive Dechlorination of Trichloroethylene. *W. Lee and B. Batchelor.*
Woojin Lee (Texas A&M University/USA)

Steel Production Wastes for Use in Permeable Reactive Barriers (PRBs). *D.J.A. Smyth, D.W. Blowes, C.J. Ptacek, M.J. Baker, and C.W.T. McRae.*
David J.A. Smyth (University of Waterloo/CANADA)

Use of Natural Zeolite Materials in Treatment Walls. *A.J. Rabideau, R. Steiner, and W.T. Frederick.*
Alan J. Rabideau (State University of New York at Buffalo/USA)

* **The Use of a PRB to Treat Groundwater Impacted by Coal-Combustion Byproducts.** *R. McGregor, S. Hansler, V. Kovac, E. Laratta, and D. Blowes.*
Rick McGregor (XCG Consultants Ltd./CANADA)

B1. Treating Arsenic and Mercury in the Environment

Platform Papers Monday/Posters (*) Monday Evening

Chair: *Paul Randall (U.S. EPA)*

Anaerobic/Aerobic Bioremediation Process of Chlorinated Organic and Mercury-Polluted Sites. *M. Camilli, R. Sisto, A. Bernardi, and G. Franzosi.*
M. Camilli (EniTecnologie S.p.A./ITALY)

* **Characterization and pH-, Eh-Based Leaching Tests of Mining Wastes Containing Mercury.** *S. Chattopadhyay, J. Ickes, P. Randall, and J. Lipps.*
Sandip Chattopadhyay (Battelle/USA)

Control of a Groundwater Arsenic Plume by Air Sparging. *R.J. Miller, B. Thompson, S. Mason, and M. Walker.*
Robert J. Miller (Hydrometrics, Inc./USA)

* **Geochemical Conditions Affecting Metals Attenuation at a Former Chlor-Alkali Facility.** *H. Goldemund, J. Bartos, K. Kessler, and J.M. Kamilow.*
Herwig Goldemund (GeoSyntec Consultants. Inc./USA)

* **In Situ Redox Manipulation for Arsenic Remediation.** *W.J. Deutsch, M. Dooley, S. Koenigsberg, B. Butler, and R. Post.*
William J. Deutsch (Geochemistry Services/USA)

In Situ Treatment of Arsenic in Groundwater by a Zero-Valent Iron Reactor. *D. Vlassopoulos, J. Pochatila, K. Chiang, G. Thrupp, M.T. Rafferty, C.B. Andrews, D. Sorel, and N. Nikolaidis.*
Dimitrios Vlassopoulos (S.S. Papadopulos & Associates, Inc./USA)

* **Mercury Sequestration in CHL004 and Bacteria from Around the World.** *W.J. Davis-Hoover.*
Wendy J. Davis-Hoover (U.S. EPA/USA)

Remediation of Arsenic: Review of Cleanup Methods and Case Histories. *R.M. Markey, D. Leszczynska, and A. Dzurik.*
Richard M. Markey (Gulf Power Co./USA)

Remediation of Mercury-Contaminated Lagoon Sludge Using Silica Microencapsulation. *A. Anderson.*
Amy Anderson (KEECO/USA)

B2. Treatment of Heavy Metals

Platform Papers Monday/Posters (*) Monday Evening

Chair: *Edward R. Bates (U.S. EPA)*

*** Characterization of PB^{2+} Uptake and Sequestration in *Pseudomonas aeruginosa* CHL004.** *D.J. Slomczynski and W.J. Davis-Hoover.*
David J. Slomczynski (University of Cincinnati/USA)

*** Chromium Removal with Low-Cost Adsorbents.** *J. Lal and D. Reuben.*
Jyotsna Lal (Christ Church Degree College/INDIA)

Electrochemical Remediation Technologies for Soil, Sediment, and Groundwater. *F. Doering, N. Doering, J.L. Iovenitti, D.G. Hill, and W.A. McIlvride.*
Joe L. Iovenitti (Weiss Associates/USA)

In Situ Bioprecipitation of Heavy Metals in Groundwater: From Feasibility Testing to Pilot Scale. *L. Diels, J. Gemoets, L. Bastiaens, L. Hooyberghs, Q. Simons, J. Vos, J. Geets, K. Van Nieuwenhove, and D. Nuyens.*
Ludo Diels (VITO/BELGIUM)

Metal Removal Mechanisms in Constructed Wetlands Treating Neutral Mine Drainage. *Y. Song, M. Fitch, J. Burken, C. Ross, and A. Feeler.*
Ying Song (University of Missouri-Rolla/USA)

Remediation of Metal-Contaminated Soil and Groundwater Using Apatite. *L.J. Matheson, W.C. Goldberg, G.J. Huddleston, and W.D. Bostick.*
Leah J. Matheson (MSE Technology Applications, Inc./USA)

*** Soil Washing of Heavy-Metal-Contaminated Soil with Chemical Extractants.** *T.-T. Lim, J.-Y. Wang, and J.-H. Tay.*
Teik-Thye Lim (Nanyang Technological University/ SINGAPORE)

B3. Site Closure Strategies

Platform Papers Tuesday/Posters (*) Monday Evening

Chairs: *Philip Jagucki (Battelle) & Robert B. Casarona (Roetzel & Andress)*

Evaluation of DNAPL Site Remedial Efforts — Site Closure Implications. *G.P. Sabadell and D.S. Lipson.*
Gabriel P. Sabadell (Blasland, Bouck, & Lee, Inc./USA)

Exit Strategies for Soil Vapor Extraction and Air Sparging Systems. *K.A. Fields and W.E. Condit.*
Keith A. Fields (Battelle/USA)

*** Expedited Closure of a PCE/TCA Site Using IRZ™ Technology.** *E.M. Panhorst, G.B. Page, J.B. Stephenson, and D. Glenn.*
Eric M. Panhorst (ARCADIS G&M/USA)

Innovative Closure Approaches at Four Sites Impacted by Chlorinated Solvents. *T.V. Adams, D.J. Sopcich, and A.C. Senn.*
Timothy V. Adams (ENSR Corporation/USA)

Remedial Process Optimization. *J. Cornell, M. Ierardi, M. Ingoglia, J. Santillan, and D. Welch.*
Javier Santillan (U.S. Air Force/USA)

*** Remediation of PCB- and HVOC-Impacted Soil and DNAPL at a Former Manufacturing Facility.** *F.W. Blickle, J. Maher, and G. Hotchkiss.*
Frederick W. Blickle (Conestoga Rovers & Associates, Inc./USA)

Statistical Sampling Approach for Closing a Soil Venting Project. *M.A. Simon.*
Michelle A. Simon (U.S. EPA/USA)

Technical Impracticability: The Process and Current Utilization Trends. *F.W. Blickle.*
Frederick W. Blickle (Conestoga Rovers & Associates, Inc./USA)

B4. Long-Term Monitoring Strategies

Platform Papers Tuesday/Posters (*) Monday Evening

Chairs: *James T. Gibbs (Battelle) & Robert J. Kratzke (U.S. Navy)*

Innovative Sampling Systems to Support Monitored Natural Attenuation of TCE. *R.A. Wymore, K.S. Sorenson, and L.N. Peterson.*
Ryan A. Wymore (INEEL/USA)

Integrating Data Sources to Optimize Long-Term Monitoring, Operation, and Stewardship. *W.J. Michael, B.S. Minsker, A.J. Valocchi, G.P. Williams, J.J. Quinn, L.A. Durham, D.K. Tcheng, and V. Babovic.*
William J. Michael (University of Illinois/USA)

*** Multiple-Sensor, Long-Term Monitoring System for Volatile Organic Compounds.** *S.R. Burge.*
Scott R. Burge (Burge Environmental, Inc./USA)

Passive-Diffusion Bag Groundwater Sampling at the Sunnyvale Iron Reactive Barrier. *D. Sorel, B.L. Longino, S.D. Warner, and L.A. Hamilton.*
Dominique Sorel (S.S. Papadopulos & Associates, Inc./USA)

*** Performance Monitoring Using PDB Samplers at the Somersworth Superfund Site.** *K. Berry-Spark, S. O'Hara, and T. Sivavec.*
Karen L. Berry-Spark (GeoSyntec Consultants, Inc./CANADA)

A Statistical Protocol for Evaluating Temporal Trends in Long-Term Monitoring. *S.J. Naber, S. Liyanarchchi, and J.T. Gibbs.*
Steve Naber (Battelle/USA)

*** Transitioning from Standard Groundwater Sampling to Diffusion Sampling as Part of a Long-Term Monitoring Program.** *A. Barton and J. Gibbs.*
Andrew C. Barton (Battelle/USA)

B5. Advances in Ex Situ Treatment Technologies

Platform Papers Tuesday/Posters (*) Monday Evening

Chairs: *Volker Birke (University of Applied Sciences-NE Lower Saxony) & Eric Drescher (Battelle)*

* **Catalytic Dehalogenation of Chlorinated Compounds.** *F. Murena and F. Gioia.*
Fabio Murena (Universita degli Studi di Napoli/ITALY)

* **Dehalogenation of Polychlorinated Aromatics Using the APEG-PLUS™ Technology.** *V. Birke.*
Volker Birke (University of Applied Sciences-NE Lower Saxony/GERMANY)

* **Ex Situ Abiotic Treatment of Soils to Remove High Ammonia Concentrations.** *S.R.D. Lunn, J.L. Roy, M. St. Cyr, M.T. Mraz, and D.G. Rancier.*
Stuart R.D. Lunn (Imperial Oil Resources/CANADA)

Fate of Dioxins Treated by Low-Temperature Thermal Processes. *K.G. Sadler and W.L. Troxler.*
Kenneth G. Sadler (Focus Environmental, Inc./USA)

* **Ozonation Treatment Studies Using Dioxin-, Furan-, and Hydrocarbon-Contaminated Water.** *W. Schaal and N. Hey.*
William Schaal (IT Corporation/USA)

Photochemical Degradation of PCBs in Transformer Oils. *A. Urkiaga, V. Marina, L. De las Fuentes, and I. Susaeta.*
Inaki Susaeta (Gaiker/SPAIN)

* **Pilot-Scale Remediation of Chlorinated Ethylenes Using Novel Photoreactor.** *K. Kato, K. Fukutake, and T. Miura.*
Kinya Kato (Canon, Inc./JAPAN)

* **Reductive Dechlorination Using Modified Green Rusts in Degradative Solidification/Stabilization.** *S. Son and B. Batchelor.*
Sukil Son (Texas A&M University/USA)

Reductive Dehalogenation of Recalcitrant Polyhalogenated Pollutants Using Ball Milling. *V. Birke.*
Volker Birke (University of Applied Sciences-NE Lower Saxony/GERMANY)

Remediation of PCB-Contaminated, Predominantly Aragonite Soils in Saipan Using Modified Fenton's Chemistry. *I.T. Osgerby, H.Y. Takemoto, R. Watts, and A. Beaudin.*
Ian T. Osgerby (U.S. Army Corps of Engineers/USA)

* **Removal of PCBs from Transformer Oils by Supercritical Fluid Extraction (SCFE).** *I. Garay, M. Acilu, and I. Susaeta.*
Inaki Susaeta (Gaiker/SPAIN)

* **Test Control of Dioxins and Furans Formation by Waste Incineration.** *C. Mandujano Mejia, I.S. Secora, and J.L. Mondragon.*
Carlos Mandujano Mejia (Instituto Mexicano del Petroleo/MEXICO)

B6. Advances in Ex Situ Treatment of Groundwater

Platform Papers Tuesday/Posters (*) Monday Evening

Chair: *Ellen E. Moyer (Tighe & Bond, Inc.)*

* **Biological Treatment of Photoindustrial Wastewater — Removal of 1,3-PDTA.** *A. Hille, A.-C. Baass, Y. Gocke, B. Nortemann, and D.C. Hempel.*
Andrea Hille (TU Braunschweig/GERMANY)

* **Development of a Remediation System for CHC, MTBE, Uranium, and Arsenic in Groundwater.** *U. Desery, J. Woerner, H. Brunner, and B. Sohnius.*
Ulrich Desery (ERM Lahmeyer International/GERMANY)

* **Extracted Groundwater Treatment Utilizing an Iron Reactor and Air Stripper.** *G. Hocking and S.L. Wells.*
Grant Hocking (Golder Sierra LLC/USA)

* **Full-Scale Groundwater Remediation Concepts for the Hanlin-Allied-Olin Site, Moundsville WV.** *K. Kessler, J. Deitsch, and M. McMaster.*
Kirk Kessler (GeoSyntec Consultants, Inc./USA)

* **Groundwater Dectontamination by Stripping and Hydrodechlorination in the Gas Phase.** *F.-D. Kopinke, K. Mackenzie, R. Koehler, H. Weiss, C. Schueth, and P. Grathwohl.*
Frank-Dieter Kopinke (UFZ - Centre for Environmental Research/GERMANY)

A Hybrid Bioinorganic Catalytic Process to Detoxify Chlorinated Aromatic Pollutants. *V.S. Baxter-Plant and L.E. Macaskie.*
V.S. Baxter-Plant (The University of Birmingham/UNITED KINGDOM)

* **Investigation of Reductive Dechlorination of Chlorinated Ethylenes Using Electrochemical Techniques.** *R. Kataky and L.A. Wylie.*
Lisa A. Wylie (University of Durham/GREAT BRITAIN)

* **A Model for Palladium-Catalyzed Destruction of Chlorinated Ethenes in Groundwater.** *C.M. Stoppel, A. Agrawal, and M.N. Goltz.*
Christopher M. Stoppel (U.S. Air Force/USA)

* **Novel Dual-Use GAC System Design Eliminates Sludge Generation and Disposal Costs.** *J.A. Bourdeau, D.R. Foster, P. Marchesi, and N.J. Misquitta.*
Jacob A. Bourdeau (Key Environmental, Inc./USA)

* **Palladium-Catalyzed Dehalogenation of Chlorinated Organic Pollutants in Groundwater.** *K. Pallavi, S.W. Niekamp, K.G. Boggs, M.N. Goltz, and A. Agrawal.*
Krishna Pallavi (Wright State University/USA)

* **Pd-Catalyzed Hydrodehalogenation: Field-Scale Design and Laboratory Tests.** *N. Munakata, J. Cunningham, R. Ruiz, C. Lebron, and M. Reinhard.*
Naoko Munakata (Stanford University/USA)

* **Photocatalysis — Increased Destruction Attributed to Unique Oxidative and Reductive Pathways.** *T. Powell.*
Tony Powell (Purifics Environmental Technologies, Inc./CANADA)

B6. Continued

* **Photocatalytic Degradation of Monochlorophenol in Surfactant Micelles Solution.** *S.M. Ahmed, A.M. Badawi, A. El-Nagar, and S. El-Zahar.*
Abdelfattah M. Badawi (Egypt Petroleum Research Institute/EGYPT)

* **Results of Dioxin/Furan Air Sampling Performed at a Remediation Site.** *J. Gundarlahalli, T. MacHarg, and M. Liang-Spencer.*
Jagadish R. Gundarlahalli (Earth Tech, Inc./USA)

Simultaneous Anaerobic and Aerobic Dechlorination of PCE in Granular Sludge. *C.-S. Hwu, C.-J. Lu, and H.-P. Liu.*
Ching-Shyung Hwu (Hungkuang Institute of Technology/TAIWAN)

* **Solar Photocatalytic Degradation of Aldrin.** *E.R. Bandala, I. Gomez, S. Gelover, and T. Leal.*
Erick R. Bandala (Instituto Mexicano de Technologia del Agua/MEXICO)

Sulfur-Modified Iron: A Versatile Medium for Ex Situ Water Treatment. *C.G. Schreier and P.F. Santina.*
Cindy G. Schreier (PRIMA Environmental/USA)

* **Technical Implementation of EDTA Biodegradation for Industrial Wastewaters.** *Y. Gocke, A.C. Baass, A. Hille, P. Otto, B. Nortemann, and D.C. Hempel.*
Yvonne Goecke (TU Braunschweig/GERMANY)

Trickling Filter Decontamination of MTBE from Groundwater: 15 Field Applications. *A. Prandi, G. Romano, C. Xella, and M. Bottarelli.*
Alberto Prandi (Water & Soil Remediation S.r.1/ITALY)

B7. Design and Modeling for Planning of Remediation Projects

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chair: *Neeraj Gupta (Battelle)*

* **Designing Aqueous Amendment Delivery Systems for In Situ Groundwater Remediation.** *T. McAlary, J. Rosen, M. McMaster, D. Major, and E. Cox.*
Jamey Rosen (GeoSyntec Consultants/CANADA)

* **Design-Phase Geologic Framework Modeling for Large Construction Projects.** *C. Vilardi and T. Kincaid.*
Christine L. Vilardi (STV Incorporated/USA)

* **Estimation of Phase Behavior and Thermophysical Properties of Organic and Aqueous Mixtures with a UNIFAC-Based Algorithm.** *S.A. Grant, G.E. Boitnott, and M.V. Mironenko.*
Steven A. Grant (U.S. Army/USA)

* **Evaluation and Design of Large-Scale In Situ Bioremediation Using Computer Modeling.** *M.A. Killen, B.F. Droy, F. Manale, C. Creber, and G. Klecka.*
Mark A. Killen (Toxicological & Environmental Associates, Inc./USA)

* **Evaluation of Natural Flushing Using Three-Point and Partitioning Theory Analysis.** *A.D. Laase, J.E. Wilson, and D.W. Greene.*
Alan D. Laase (AIMTech/USA)

* **Evaluation of Vadose Zone Biodegradation of Organic Vapors.** *C.-S. Fen.*
Chiu-Shia Fen (Feng Chia University/ROC)

* **Full-Scale Design of a Biobarrier. . . Bioaugmentation or Biostimulation?** *E. Petrovskis, N. Durant, and P. Adriaens.*
Erik A. Petrovskis (GeoTrans, Inc./USA)

* **Groundwater Flow Modeling: A Program Management Tool.** *J.R. Hale and N.J. Misquitta.*
Jeffrey R. Hale (Key Environmental, Inc./USA)

Hydraulic Containment Using Phytoremediation and a Slurry Wall to Prevent Arsenic Migration. *D. Sorel, M.T. Rafferty, C.B. Andrews, and C.J. Neville.*
Dominique Sorel (S.S. Papadopulos & Associates, Inc./USA)

* **In Situ Chemical Oxidation: Potential Effects on Inorganic Water Quality.** *R.E. Campbell, W.E. Collins. M. Wunderly, C. Ross, J. Shiple, M. Coons, and H. Abedi.*
Judy Shiple (IT Corporation/USA)

* **In Situ Treatability Test for Biotransformation of High-Concentration Chloroethene Contamination.** *C.D. Johnson, M.J. Truex, and S.S. Granade.*
Christian D. Johnson (Battelle/USA)

* **Modeling Adsorption Competition Between TCE and NOM Using a Competitive Adsorption Framework.** *J. Kilduff and A. Wigton.*
James Kilduff (Rensselaer Polytechnic Institute/USA)

* **Modeling Chlorinated Ethene Degradation with Spatially Varying Aerobic/Anaerobic Conditions.** *J. Su and T.H. Feng.*
Joy Su (Parsons/USA)

Modeling of a Full-Scale SVE System in Glacial Till. *J.A. Wilkie, R.O. Ball, and J.P. Imse.*
Jennifer A. Wilkie (Environ International Corp./USA)

Modeling of PCE and MTBE Transport and Remediation in the Unsaturated Zone. *A.G. Christensen, C.E. Riis, A. Korsgaard, and P. Johansen.*
Anders G. Christensen (NIRAS A/S/DENMARK)

Modeling Vegetable Oil Injection for Enhanced Biodegradation of Chlorinated Solvents. *D.W. Waddill, C.C. Casey, and M.A. Widdowson.*
Dan W. Waddill (U.S. Navy/USA)

* **New Geospatial Model Tracks Chloroethene Subsurface Contamination.** *V.M. Madrid, Z. Demir, S.D. Gregory, R.U. Halden, J.E. Valett, and J.P. Ziagos.*
Vic M. Madrid (Lawrence Livermore National Laboratory/USA)

* **Oxidant Diffusion into Low-Permeability Media to Degrade Aqueous Contaminants.** *E. Hood and N. Thomson.*
Eric D. Hood (GeoSyntec Consultants/CANADA)

Simulation of Fate and Transport of NAPLs in Fractured Media. *M. Delshad, G.A. Pope, and K. Sepehrnoori.*
Mojdeh Delshad (The University of Texas at Austin/USA)

* **Soil Permeability Estimation Using Vacuum Differential Measurements During Two-Phase Extraction.** *P.G. Mihopoulos and M. Pehlivan.*
Philip G. Mihopoulos (Tait Environmental Management, Inc./USA)

* **Systematic Development of Hydrogeochemical Framework Model for Bioremediation Pilot Study.** *W. Schneider, M. McCaughey, T. Cornuet, D. Green, and A. Miller.*
William Schneider (Roy F. Weston, Inc./USA)

* **Technical Highlights of EPA Peer Review of NAPL Web Site.** *M. Mercer and M. Fitzpatrick.*
Mark Mercer (U.S. EPA/USA)

* **Two-Dimensional Permanganate Flushing of Pooled DNAPL Experiments and Numerical Model Validation.** *Q. Dai and S. Reitsma.*
Qunli Dai (University of Windsor/CANADA)

* **Use of Groundwater Profiling to Locate Sources of Hexavalent Chromium at a Former Paint Factory Site, Wellesley, MA.** *R.A. Schuck, S.M. Carroll, J.B. Bode, and J.A. Mullen.*
Russell A. Schuck (Haley & Aldrich Inc./USA)

B8. Determining Site Closure or Exit Strategies

Panel Discussion Wednesday

Moderator: *Robert B. Casarona (Roetzel & Andress)*

Site owners and federal and state regulators continue striving to reach agreement on criteria for site closure. Site owners face technical and cost limitations in achieving federal- or state-mandated maximum contaminant levels (MCLs) throughout the affected aquifer or at the site boundary. At the same time, regulatory agencies face the challenge of assessing the risks to current and future receptors posed by pre- and post-remediation contamination and, at many sites with potentially multiple sources, the difficulty of identifying all the responsible parties. Given these uncertainties, site owners often do not perceive a clear endpoint for their remediation efforts and are faced with the prospect of continuing to run the interim remedy (generally a pump-and-treat system) for the foreseeable future, despite efforts to clean up the source. Even with these challenges, progress is being made at individual sites and in negotiating site-specific criteria, and some states are making serious efforts to determine more general criteria for closure. The discussion will assess the progress made on this front and look at the work still needed.

B9. Impacts of Chemical Oxidants on Treated Aquifers

Platform Papers Thursday/Posters (*) Tuesday Evening

Chair: *Bruce M. Sass (Battelle)*

Contaminant Shielding by Soil Organic Matter During Permanganate Oxidation. *F.C. Payne, S.S. Suthersan, F.C. Lenzo, and V.A. D'Amato.*
Frederick C. Payne (ARCADIS G&M/USA)

* **Effect of Modified Fenton's Reagent on Subsurface Heavy Metal Mobility.** *M.J. Monahan and R. J. Watts.*
Mary Jo Monahan (Washington State University/USA)

* **The Fate of Manganese Introduced During In Situ Permanganate Oxidation.** *M. Crimi and R.L. Siegrist.*
Michelle Crimi (Colorado School of Mines/USA)

First Voluntary $KMNO_4$ Study Under the LARWQCB: Regulations and Results. *R.A. Crother and R.A. Vogl.*
Rodney A. Crother (LFR Levine Fricke/USA)

In Situ Field Permanganate Oxidation and Impacts on Dechlorinating Anaerobes. *M. Rowland.*
Martin A. Rowland (Lockheed Martin/USA)

Investigating the Kinetic Nature of the Natural Oxidant Demand During ISCO. *K.G. Mumford and N.R. Thomson.*
Kevin G. Mumford (University of Waterloo/CANADA)

Porous Media Permeability Reduction Due to Manganese Dioxide Precipitation. *S. Reitsma and J. Randhawa.*
Stanley Reitsma (University of Windsor/CANADA)

B10. Technology Trains for Achieving Compliance

Platform Papers Thursday/Posters (*) Tuesday Evening

Chairs: *Doug Zillmer (U.S. Navy) & Susan Brauning (Battelle)*

* **Biodegradation of Nonylphenol Under Aerobic and Anaerobic Conditions.** *A. Soares, B. Guieysse, and B. Mattiasson.*
Ana Soares (Lund University/SWEDEN)

Chemical Oxidation and Biological Dehalogenation of Chloroform. *D.B. Vance and C. Bernardes.*
David B. Vance (ARCADIS G&M/USA)

* **Combined Biological and Chemical Treatment of Groundwater Contaminated with Chlorinated Solvents.** *E. Sogaard, I.A. Fuglsang, T. Nielsen, S.R. Christensen, M.L. Sorensen.*
Erik Sogaard (University of Aalborg, Esbjerg/DENMARK)

* **Combining Fe^0 with GAC or ORC® and Resulting Downstream Processes of Such PRBs.** *R. Kober, V. Plangentz, F. Dethlefsen, D. Schafer, M. Ebert, and A. Dahmke.*
Ralf Kober (University of Kiel/GERMANY)

A Comprehensive Remediation System for the Cleanup of Trichloroethene DNAPL and Associated Dissolved Plume at the Kennedy Space Center, Florida. *K.W. Watson, A. Foley, and R. Santos-Ebaugh.*
Ken W. Watson (HSE Engineering, Inc./USA)

Coupled Permeable Reactive Barrier and Natural Attenuation Remediates Chlorinated Solvents. *J. Klens, R. Rogers, J. Bartel, D. Graves, J. Chytil, and T. Streckfuss.*
Julia L. Klens (IT Corporation/USA)

B10. Continued

*** Degradation of Pentachlorophenol by Ozonation and Biodegradability of Intermediates.** *P.K.A. Hong and Y. Zeng.*
P.K. Andrew Hong (University of Utah/USA)

*** Laboratory Evaluation of Sequential Application of Chemical Oxidation and Bioaugmentation.** *B. Sleep, L. Hrapovic, E. Hood, L. MacKinnon, and N. Thomson.*
Brent Sleep (University of Toronto/CANADA)

*** Remediation of a Site Impacted with Chlorinated and Petroleum Hydrocarbons.** *R. Sturm, M.R. Piotrowski, and J.E. Cunningham.*
Michael Piotrowski (AMEC Earth & Environmental/USA)

*** Sequential Biological and Oxidative Destruction of Mixed Recalcitrant Groundwater Contaminants.** *W.E. Collins, A.S.-Amiri, D.A. Jackson, W. de Waal, H. Abedi, C. Liles, and M. Coons.*
Merry A. Coons (IT Corporation/USA)

A Slurry Wall/Phytoremediation Solution at Beale AFB. *G. Vogt and M. O'Brien.*
Gerald T. Vogt (CH2M Hill/USA)

B11. Air Sparging/SVE

Platform Papers Thursday/Posters (*) Tuesday Evening

Chairs: *Andrea Leeson (U.S. Dept of Defense) & Cristin L. Bruce (Arizona State University)*

*** Biosparging Barrier Implementation for PCP Remediation in Groundwater.** *R. Britto, M. Patel, M. Lybrand, and H. Borazjani.*
Ronnie Britto (EnSafe, Inc./USA)

DNAPL Removal During In Situ Air Sparging. *K.R. Reddy and L. Tekola.*
Krishna R. Reddy (University of Illinois at Chicago/USA)

*** Enhanced Degradation of Phenoxy Acids and Chlorophenols in Aquifers.** *P.L. Bjerg, N. Tuxen, L. Ask, and H.-J. Albrecthsen.*
Poul L. Bjerg (Technical University of Denmark/DENMARK)

*** Evaluation of LNAPL Recovery Using Soil Vapor Extraction.** *J. Ewing, V. Dwarakanath, K.D. Gordon, H.W. Meinardus, and J.S. Ginn.*
Hans W. Meinardus (Duke Engineering and Services, Inc./USA)

*** Flameless Oxidizer Treats Variable-Concentration VOCs in Thermally Enhanced Remediation Project.** *A.C. Minden, D.F. Bartz, W.A. Plaehn, L.T. Tagawa, and D. Bollman.*
Andrew C. Minden (Alzeta Corp./USA)

Large-Scale Experiments with Thermal Wells to Develop an Enhanced Remediation Technology. *U. Hiester, T. Theurer, A. Winkler, H.-P. Koschitzky, and A. Farber.*
Uwe Hiester (University of Stuttgart/GERMANY)

*** Multiphase Fluid Flow Evaluation of LNAPL Recovery Using Containment Trenches.** *K.D. Gordon, M. Jin, H.W. Meinardus, and J.S. Ginn.*
Hans W. Meinardus (Duke Engineering and Services, Inc./USA)

*** Performance of a Fracture-Enhanced Dual-Phase Soil Vapor Extraction System.** *G. Hocking and S.L. Wells.*
Grant Hocking (Golder Sierra LLC/USA)

Performance of a Large ISA/SVE System on a Navy Mole. *L. Wang, A.S.C. Chen, C. Coonfare, S. Serpa, and K. Fields.*
Lili Wang (Battelle/USA)

Performance of Aerosol-Surfactant Enhanced Air Sparging: Laboratory Results. *T.J. Kremer, J.S. Gierke, P.T. Imhoff, J.W. Drelich.*
Theodore J. Kremer (Michigan Technological University/USA)

Physical Removal and Induced Cometabolism of PCE and TCE Using Air Sparging and Propane Injection. *E.S. Mysona and W.D. Hughes.*
Eric S. Mysona (Parsons Engineering Science, Inc./USA)

*** Reactive Wall Microbubble Ozone Sparging Demonstration for HVOC Removal.** *W.B. Kerfoot and E.M. Kellar.*
William B. Kerfoot (K-V Associates, Inc./USA)

*** Sensitivity Analysis for the Evaluation of a SVE Scheme at an Industrial Site.** *M.M. Maia Nobre and R.C. Maia Nobre.*
Manoel de Melo Maia Nobre (Maia Nobre Engenharia/BRAZIL)

Source Control by Hydrological Isolation: Application of the Ankeny Moat. *P. Kaiser and J. Wilson.*
Philip Kaiser (U.S. EPA/USA)

X-AIR Probe: In Situ Diagnostic Tool for Sparging System Optimization. *A.M. Lee, M.C. Marley, H.S. Hutchins, and J.W. Davis.*
Annette M. Lee (Xpert Design & Diagnostics, LLC./USA)

C1. Sediment Characterization, Risk Assessment, and Natural Recovery

Platform Papers Monday/Posters (*) Monday Evening

Chairs: *Donald Gunster (Battelle Ocean Sciences) & Michael J. Pound (U.S. Navy)*

Biological Effects Associated with Sediment Contamination in San Francisco Bay. *S.I. Hartwell, E. Long, and J. Hameedi.*
S. Ian Hartwell (National Oceanic and Atmospheric Admin/USA)

*** Detection of 3,4-Benzopyrene Content in Sediments of Aquatic Systems by HPLC & Fluorescence-Spectrometry Methods.** *N. Krylenkova.*
Nataliya Krylenkova (Russian Academy of Sciences/RUSSIA)

* **Enantioselective Reductive Transformation of Chiral Polychlorinated Biphenyls in Lake Sediment Microcosms.** *W.L. O'Niell, W.J. Jones, A.D. Whittemore, and J.K. Avants.*
Walter L. O'Niell (National Research Council/USA)

Evaluating Human Health Risks Associated with Contaminated Sediment. *N. Bonnevie, D.G. Gunster, V. Lau, T. Bernhard, and M. Pound.*
Nancy Bonnevie (Battelle/USA)

* **PCB Contamination and Transport at an Aluminum Reduction Plant.** *R.K. Will, S. McCraven, and D.K. Todd.*
Raymond K. Will (Todd Engineers/USA)

*** PCB Volatilization from Sediments.** *S. Qi, M.T. Suidan, P. de Percin, V. Magar, J. Abbott, E. Foote, and C. Peven-McCarthy.*
Shuang Qi (University of Cincinnati/USA)

Sediment Site Assessment Using Weight-of-Evidence Approach. *D.G. Gunster, J. Holder, D. Michael, J. Ward, and M. Pound.*
Donald Gunster (Battelle/USA)

Strategies for Remediation of Sediment Contamination and Biomagnification of Heavy Metals (Zinc and Copper) in a Select Stretch of the River Krishna in India. *V. Rajkumar, M.M. Hussain, M.A. Khan, and J.V. Ramana Rao.*
Mohd. Masood Hussain (Osmania University/INDIA)

*** Use of Sediment Transport Measurements to Evaluate Natural Recovery Potential.** *K. Israel, D. Cacchione, G. Tate, P. White, and M. Pound.*
Kenneth P. Israel (Woods Hole Group/USA)

C2. Sediment Treatment Technologies

Platform Papers Monday/Posters (*) Monday Evening

Chairs: *Eric A. Stern (U.S. EPA) & Wanda Holmes (U.S. Navy)*

* **Biodegradation of Diethylenetriaminepentaacetate (DTPA).** *A.-C. Baass, Y. Gocke, A. Hille, B. Nortemann, and D.C. Hempel.*
Anne-Christina Baass (TU Braunschweig/GERMANY)

* **Dechlorination of PCBs in Sediments Using Colloidal Zero-Valent Iron.** *K.H. Gardner and D. Aulisio.*
Kevin H. Gardner (University of New Hampshire/USA)

Enhanced Wet Air Oxidation of Sediments Contaminated with PCBs. *J.E. Duffy and J. Ray.*
James E. Duffy (Montana State University/USA)

* **Enhancing the Biodegradation of Polychlorinated Biphenyls Through Elemental Iron Addition.** *J.P. Rysavy, T. Yan, and P.J. Novak.*
Jason Rysavy (University of Minnesota/USA)

Evaluation of a Two-Stage Base-Catalyzed Decomposition (BCD) Process to Remediate New York/New Jersey Harbor Sediment. *E. Drescher, A. Gavaskar, A. Chen, and B. Alleman.*
Eric Drescher (Battelle/USA)

Feasibility Evaluation of Contaminated Lagoon Sediment Bioremediation with SS-SBR. *A. Giordano, L. Luccarini, R. Farina, A. Spagni, and G. Bortone.*
Andrea Giordano (ENEA/ITALY)

Hydrogen-Enhanced Bioremediation of Sediments Contaminated with Halogenated Aromatic Compounds. *C.L. Gruden, A.I. Khijniak, and P. Adriaens.*
Cyndee L. Gruden (The University of Michigan/USA)

* **Nutrient Delivery and Bioaugmentation Processes Using Membranes and Gel Beads for In Situ Bioremediation of Contaminated Sediments.** *H.H. Tabak and R. Govind.*
Henry H. Tabak (U.S. EPA/USA)

Pilot-Scale Demonstration of In-Pile Thermal Destruction of Chlorobenzene-Contaminated Sediments. *R.S. Baker, R.J. Bukowski, J.P. Galligan, J.M. Bierschenk, and S.L. Walker.*
Ralph S. Baker (TerraTherm, LLC/USA)

C3. Enhanced Bioremediation of Recalcitrant Contaminants

Platform Papers Tuesday/Posters (*) Monday Evening

Chair: *Victor S. Magar (Battelle)*

* **Advances in Understanding and Predicting Enhanced Anaerobic CAH Bioremediation.** *C. Lutes, M. Hansen, J. Burdick, S. Suthersan, and J. Hansen.*
Chris Lutes (ARCADIS G&M/USA)

* **An Integrated Remedial Technology for PAH-Contaminated Soil Cleanup.** *S.S. Lee, J.Y. Wang, J.H. Tay, and T.T. Lim.*
Jing-Yuan Wang (Nanyang Technological University/SINGAPORE)

* **Analysis of the 2,4-Dichlorophenoxyacetic Acid-Degradative Plasmid pEST4011 of *Achromobacter xylosoxidans* Subsp. *denitrificans* Strain EST4002.** *E. Vedler and A. Heinaru.*
Eve Vedler (Tartu University/ESTONIA)

* **Bioaugmentation Visualization Studies.** *S. Braunschneider and P.C. Johnson.*
Paul C. Johnson (Arizona State University/USA)

* **The Biodegradation of Recalcitrant Effluent from an Olive Mill Using *Geotricum candidum*, *Aspergillus fumigatus*, and *Candida tropicalis*.** *K. Fadil, A. Chahlaoui, and A. Zaid.*
Khalid Fadil (Faculte des Sciences de Meknes/MOROCCO)

The Biodegradation of Volatile Fluorinated Compounds in Groundwater Ecosystems. *C. Balsiger, D. Werner, and P. Hoehener.*
Christian Balsiger (Swiss Federal Institute of Technology/SWITZERLAND)

Bioremediation of a Pesticide Formulation Plant. *N.C.C. Gray, P.R. Cline, A.L. Gray, B. Boyd, G. Moser, H. Guiler, and D.J. Gannon.*
Neil C.C. Gray (AstraZeneca Canada, Inc./CANADA)

C3. Continued

* **Bioremediation of Digested Distillery Spent Wash for Pollution Control.** *B.S. Saharan, D. Singh, and R. Singh.*
Ranbir Singh (CCS Harayana Agricultural University/INDIA)

* **Bioremediation of MTBE and BTEX Using Super-Saturated Dissolved Oxygen.** *W.S. Mulica, J. Snider, and J.H. Archibald.*
Walter S. Mulica (Global Technologies, Inc./USA)

* **Bioremediation of Soil Contaminated with Polycyclic Aromatic Hydrocarbons (PAHs).** *J. Yang and X. Liu.*
Jiangang Yang (Tsinghua University/CHINA (PRC))

* **Biosparge Treatment of Phenols-Contaminated Groundwater.** *V. Kremesec, R. Kolhatkar, C. Yukawa, and J. Imbrie.*
James Imbrie (URS Corporation/USA)

* **C/N Ratio and Vegetable Oil to Mineralize ^{14}C-Hexachlorobenzene by White Rot Fungi.** *D.R. Matheus and V.L.R. Bononi.*
Dacio R. Matheus (Instituto de Botanica/BRAZIL)

* **Chemical-Biological Treatment of Recalcitrant Contaminated Soil: Laboratory Tests.** *P. Carrera, M. Marangon, E. Dodero, and C. Bernini.*
Manuel Marangon (Ambiente SpA - Eni Group/ITALY)

* **Chlorocatechol Catabolic Enzymes from *Achromobacter xylooxidans* A8 Plasmid DNA.** *V. Jencova, P. Ulbrich, H. Strnad, and V. Paces.*
Vera Jencova (Institute of Chemical Technology of Prague/CZECH REPUBLIC)

* **Coupling Biodegradation and Microbial Processes Using Stable Carbon Isotopes.** *M.A. Mills, R. Herrmann, J.R. Haines, E.J. Kleiner, and S.L. Wright.*
Marc A. Mills (U.S. EPA/USA)

* **Degradation of Polychlorinated Dioxins and Furans in Soil by White Rot Fungi.** *R. Kondo, M. Yoshimitsu, M. Hirose, and K. Wakao.*
Ryuichiro Kondo (Kyushu University/JAPAN)

* **Effects of the Exposure to Oxygen on the Methanogenic Activity and Chlorophenol Removal of Flocculent Anaerobic Sludge.** *H.M. Poggi-Varaldo, C. Estrada-Vazquez, E. Rios-Leal, H. Macarie, and M.T. Kato.*
Hector M. Poggi-Varaldo (CINVESTAV del IPN/MEXICO)

* **Enhanced Bioremediation of Hydrocarbons in a Shallow Aquifer.** *J. Mohoney, D.E. Troutman, and E. Schaper.*
Josh Mahoney (Enviro-Logical Solutions, Inc./USA)

* **Enhanced Reductive Dechlorination of Pentachlorophenol and Precipitation of Chromium in Groundwater.** *R. Fitzpatrick, D.L. Jacobs, and J.S. Burdick.*
Ryan Z. Fitzpatrick (ARCADIS G&M/USA)

* **Field-Scale Demonstration: Use of Nitrate as Terminal Electron Acceptor.** *S. Kelly, S. MacEwen, P. Lamarche, and C.W. Greer.*
Steve Kelly (Royal Military College/CANADA)

* **Full-Scale Bioremediation of Dieldrin-Contaminated Soil.** *D. Jerger, M. Sarmiento, K. Thomas, H. Guiler, and N. Gray.*
Douglas E. Jerger (IT Corporation/USA)

* **In Situ DARAMEND® Bioremediation of Chlorinated Pesticides in Soil.** *A. Seech, G. Bell, D. Raymond, and J.T. Slater.*
Alan G. Seech (Grace Bioremediation Technologies/CANADA)

* **In Situ Denitrification Field Demonstration.** *H.E. Nuttall and B. Faris.*
H. Eric Nuttall (University of New Mexico/USA)

* **In Situ Remediation of Chlorinated Pesticides, Nitrates, and Chromium in Groundwater.** *K.A. Beil, J.S. Burdick, F.C. Lenzo, and S.S. Suthersan.*
Kurt A. Beil (ARCADIS G&M/USA)

In Situ Transformations of Freon® 11 and Freon® 113 in Groundwater. *E.E. Mack, D.J. Barsotti, J.E. Vidumsky, J. Payne, and M.M. Thomson.*
E. Erin Mack (E.I. du Pont de Nemours & Co./USA)

* **Influences of Cationic Surfactant on Biodegradations of Organic Compounds in Bentonite.** *J. Choi and J.-W. Park.*
Jae-Woo Park (Ewha Womans University/SOUTH KOREA)

* **Physiological Comparison of an ETBE (MTBE)-Degrading Strain and Some Derived Mutants.** *S. Chauvaux, A. Urios, F. Fayolle, P. Beguin, and F. Monot.*
Francoise Fayolle (Institut Francais du Petrole/FRANCE)

* **Properties of a Petroleum Hydrocarbon-Polluted (Sandy) Lekki-Beach Remediated Using Microorganisms.** *U.R. Otu.*
Uwem Robert Otu (Urthor Consultants/NIGERIA)

Rapid Removal of Toxaphene Using Anaerobic Bioremediation Technology. *H.L. Allen, M. Torres, C.L. Eng, and T.F. Miller.*
Harry L. Allen (U.S. EPA/USA)

* **Remediation of a Polyaromatic Hydrocarbon Release at a Railroad Switchyard.** *H.E. Nuttall, L. Holish, and W.L. Lundy.*
H. Eric Nuttall (University of New Mexico/USA)

* **Remediation Options for Pesticide-Contaminated Groundwater: Results of a Biotreatability Study.** *J.M. Whitmer, T.A. Peel, and E. Cox.*
Jill M. Whitmer (GeoSyntec Consultants/USA)

* **Sorption/Desorption Hysteresis and Biodegradation in 1,4-Dichlorobenzene-Contaminated Soil.** *S. Lee, J.H. Pardue, and K.T. Valsaraj.*
Sangjin Lee (University of California-Riverside/USA)

* **Thermally Enhanced Bioremediation of PAH-Contaminated Soil.** *M.N. Carvalho, T.C. Harmon, and B.K. Ahring.*
Moises N. Carvalho (University of California-Los Angeles/USA)

* **Toxicity, Persistence, and Influence of Pyrene-4,5-Dione on PAH Biodegradation.** *M. Vanderford and F. Pfaender.*
Mindy Vanderford (University of North Carolina/USA)

Treatment of PAHs Using a Two-Phase Partitioning Bioreactor. *M.M. Punt, D. Velicogna, A. Obenauf, and A.J. Dauglis.*
Monique M. Punt (SAIC Canada/CANADA)

* **The Use of Organic Nutrients (Pig Droppings) and Investigation of Maize (*Zea mays*) Planted in a Crude Oil-Polluted Site.** *U.R. Otu.*
Uwem Robert Otu (Urthor Consultants/NIGERIA)

* **Utilization of Treatability and Pilot Tests to Predict CAH Bioremediation.** *C. Lutes, M. Hansen, J. Burdick, S. Suthersan, D. Liles, J. Hansen, D. Kampbell, and D. McInnes.*
Chris Lutes (ARCADIS G&M/USA)

* **Volatile Fatty Acids as Indicators of Bioremediation.** *P. McLoughlin and R. Pirkle.*
Patrick W. McLoughlin (Microseeps, Inc./USA)

C4. Contaminated Sediments and Dredged Material — What Remains To Be Done?

Panel Discussion Tuesday

Moderator: *Donald Gunster (Battelle)*

Sediments contamination in waterways around the world continues to be a daunting challenge for characterization and remediation. The sheer volume of the medium involved, the large areas over which it is spread, and the difficulty of accessing underwater material without resuspending the contaminants in the water column drive up the costs of any effort to characterize or remediate sediments. Because the risk to human health and the environment is difficult to assess, cleanup targets cannot be determined easily. Natural recovery and capping are being studied as low-cost ways to address sediments that do not need to be dredged. At sites where dredging is necessary, better options are needed for dealing with the dredged material. To add to the uncertainty, it is not clear who will share the responsibility for cleanup. Despite these challenges, the government agencies involved have been trying to find ways to regulate, characterize, and manage sediments. How much have we achieved and what still is needed to improve the way we manage sediments?

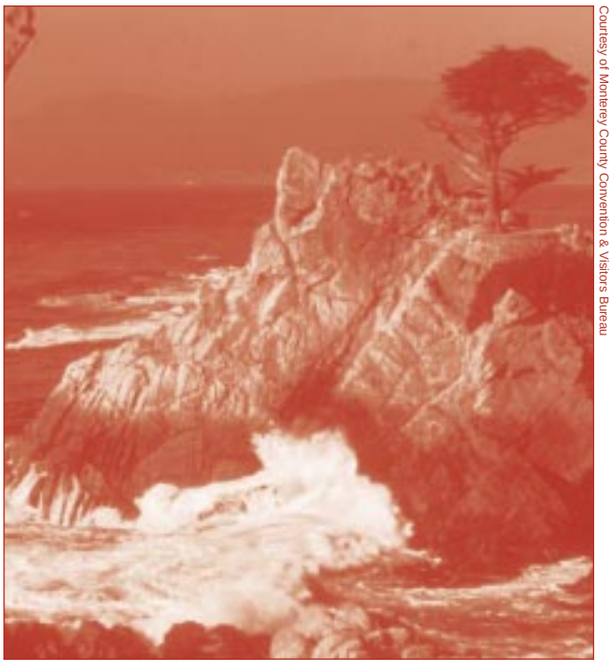
C5. Phytoremediation

Platform Papers Tuesday/Posters (*) Monday Evening

Chairs: *Joel G. Burken (University of Missouri-Rolla) & Eric A. Foote (Battelle)*

* **Characterization of Degradation Mechanisms for PAH Compounds by Poplar Trees.** *J.T. Novak and M.A. Widdowson.*
Mark A. Widdowson (Virginia Polytechnic Inst & State Univ/USA)

Characterizing the Remedial Performance of a Phytoremediation Pilot Study. *S. Hirsch, J. Burken, H. Compton, W. Schneider, and J. Wrobel.*
William Schneider (Roy F. Weston, Inc./USA)



Courtesy of Monterey County Convention & Visitors Bureau

* **Chlorinated Solvent Phytoremediation: Uptake and Transfer to the Atmosphere.** *J.G. Burken and X. Ma.*
Joel G. Burken (University of Missouri-Rolla/USA)

* **Developing Phytoremediation for Chloroform in a Semitropical Area.** *C. Bernardes, M. Sabbag, C. Simonetti, P. Nogueira, and D. Vance.*
Cyro Bernardes (AMBITERRA Ltda./BRAZIL)

* **Effect of Root Exudates on Phenanthrene Degradation by Two Hawaiian Soil Isolates.** *R. Kamath and P.J.J. Alvarez.*
Roopa Kamath (The University of Iowa/USA)

* **Evaluation of Different Plant Species for Phytoremediation.** *G. Shabbir and S.A. Shahid.*
Ghulam Shabbir (Kuwait Institute for Scientific Research/KUWAIT)

Evaluation of Using Trees to Achieve Remedial Goals at Contaminated Sites. *J.E. Landmeyer.*
James E. Landmeyer (U.S. Geological Survey/USA)

Evidence of Perchlorate (ClO_4^-) Reduction in Plant Tissues (Poplar Tree). *B. Van Aken and J.L. Schnoor.*
Benoit Van Aken (University of Iowa/USA)

Fluorescent, Root-Colonizing Recombinant Bacteria to Enhance the Rhizosphere Degradation of TCE. *A.W. Gilbertson, J.G. Burken, J.S. Gibbons, and T.K. Wood.*
Amanda W. Gilbertson (University of Missouri-Rolla/USA)

* **Groundwater Containment Design for Phreatophyte Plantations with Seasonal Dormancy.** *D.S. Lipson, M.J. Gefell, and A. Ferro.*
David S. Lipson (Blasland, Bouck & Lee, Inc./USA)

* **Hybrid Poplar Uptake Kinetics.** *P.L. Thompson.*
Phillip L. Thompson (Seattle University/USA)

Continued on page 23

	MORNING		
SUNDAY MAY 19, 2002			
MONDAY MAY 20, 2002	Continental Breakfast 7:00-8:00 A.M.	Keynote/Plenary Session	No Schedule Program
	Exhibit Hall, Group 1* Poster display and Registration Desk open, 7:00 A.M. – 7:30 P.M.		
TUESDAY MAY 21, 2002	Continental Breakfast 7:00-8:00 A.M.	**Morning Platform Sessions**	
		A2. Permanganate Oxidation of Chlorinated Solvents	A3. Fenton's Reagent Treatm
		B3. Site Closure Strategies	B4. Long-Term Monitoring S
		C3. Enhanced Bioremediation of Recalcitrant Contaminants	C4. Panel: Contaminated Sediments Dredged Material
		D3. Assessing the Longevity of Permeable Reactive Barriers (PRBs)	
		E3. Natural Attenuation of Recalcitrant Contaminants	
	Exhibit Hall and Registration Desk open, 7:00 A.M. – 7:30 P.M. General lunch served. Group 2* Posters displayed after 4:00 P.M.		
WEDNESDAY MAY 22, 2002	Continental Breakfast 7:00-8:00 A.M.	**Morning Platform Sessions**	
		A5. Containment with Pump-and-Treat Systems	A6. Treatment of Chlorate and Perchlorate in Groundwater
		B7. Design and Modeling for Planning of Remediation Projects	B8. Panel: Determining Site Closure or Exit Strate
		C6. Steam Treatment of DNAPL Source Zones	C7. Electrical Heating and Its Effect on Treatment
		D6. Remediation of Wood Preservative Sites	D7. Characterization of Recalcitrant Compounds
		E6. Characterization of Fractured Bedrock Sites	E7. Innovative Remediation Technologies fo Fractured Bedrock Sites
	Exhibit Hall, Group 2* Posters display, and Registration Desk open, 7:00 A.M. – 1:00 P.M.		
THURSDAY MAY 23, 2002	Continental Breakfast 7:00-8:00 A.M.	**Morning Platform Sessions**	
		A7. Surfactant- and Other Chemical-Based Treatments	
		B9. Impacts of Chemical Oxidants on Treated Aquifers	B10. Technology Trains for Achievin Compliance
		C8. Thermal Treatment of Recalcitrant Contaminants	C9. Enhanced Bioremediation of Chlorina Solvents
		D8. Design and Construction of Permeable Reactive Barriers (PRBs)	
		E8. Chemical and Biological Techniques for Treatment in Fractured Bedrock	
	Exhibit Hall open until noon, and Registration Desk open through 6:30 P.M. General lunch served.		
FRIDAY MAY 24, 2002		**Short Courses, 8:00 A.M.-NOON:** Application of In Situ Chemical Oxidation (ISCO) Natural Attenuation Potential of MTBE and Alternative Oxygenates Phytoremediation Project Design and Implementation	

AFTERNOON

	Short Courses, 1:00-5:00 P.M.: Advances in Permeable Reactive Barrier Technologies Application of Environmental Isotopes in Contaminant Hydrogeology Natural Attenuation of Metals	Registration Exhibits Light Reception Poster Display – Group 1* 6:00-9:00 P.M.
	Afternoon Platform Sessions	
eduled am	A1. Treatment Technologies for Explosives Residue	Poster Presentations Group 1* Light Reception 5:30-7:30 P.M.
	B1. Treating Arsenic and Mercury in the Environment / B2. Treatment of Heavy Metals	
	C1. Sediment Characterization, Risk Assessment, and Natural Recovery / C2. Sediment Treatment Technologies	
	D1. Challenges in Characterization of DNAPL Source Zones / D2. Hydraulic and Reactive Performance of Permeable Barriers	
	E1. Bioaugmentation at Chlorinated Solvent Sites / E2. Issues in Risk-Based Corrective Action	

	Afternoon Platform Sessions	
reatment of Chlorinated Solvents	A4. Innovative Oxidation Techniques for Remediation of Recalcitrant Compounds	Poster Presentations Group 2* Light Reception 5:30-7:30 P.M.
ing Strategies	B5. Advances in Ex Situ Treatment Technologies / B6. Advances in Ex Situ Treatment of Groundwater	
nents and	C5. Phytoremediation	
D4. Improved Delivery Mechanisms for In Situ Treatment	D5. Panel: Remediating DNAPL Sites — What Are the Solutions?	
E4. Remediation Cost Estimates	E5. Remediation Strategies for Site Owners	
P.M.		

	Afternoon Short Courses
rate trategies ment Zones nds es for	No presentations scheduled after 1:00 P.M. **Short Courses, 1:30-5:30 P.M.:** Enhanced Reductive Dechlorination (ERD) Using In Situ Reactive Zone (IRZ) Technology – Practical Applications Bioaugmentation to Remediate Chlorinated Solvents in Groundwater Introduction to Surface and Borehole Geophysics

A8. Alternative Permeable Barrier Materials	
ieving	B11. Air Sparging/SVE
orinated	C10. Data Management Tools for Optimizing Remediation
D9. Panel: Chlorinated Solvents and Other Recalcitrant Compounds — Directions for Future Technology Development Efforts	
E9. MTBE Characterization and Treatment	

Closing Reception
4:30-6:00 P.M.

***Poster Schedule.**

Poster sessions will be divided into two groups. Group 1 will be displayed Sunday evening through Monday, and Group 2 Tuesday afternoon through Wednesday midday. Presentations for Groups 1 and 2 will be made on Monday and Tuesday evenings, respectively. See page 22 for a list of sessions in each poster group.

POSTER SCHEDULE

The poster presentations in each session are the titles marked with an asterisk (*) on pages 7-36. The poster area will be open for viewing by all technical-program registrants from Sunday evening through Wednesday midday. Posters will be divided into two groups for purposes of display and presentation. During the Monday and Tuesday evening poster presentation periods, presenters will be standing at their displays to discuss their work, and light hors d'oeuvres will be served. The tentative grouping of poster sessions is as follows:

Poster Group 1

Display: Sunday 6:00 P.M. – Monday 7:30 P.M.
Presentation: Monday 5:30–7:30 P.M.

A1. Treatment Technologies for Explosives Residue
A2. Permanganate Oxidation of Chlorinated Solvents
A3. Fenton's Reagent Treatment of Chlorinated Solvents
A4. Innovative Oxidation Techniques for Remediation of Recalcitrant Compounds
B1. Treating Arsenic and Mercury in the Environment
B2. Treatment of Heavy Metals
B3. Site Closure Strategies
B4. Long-Term Monitoring Strategies
B5. Advances in Ex Situ Treatment Technologies
B6. Advances in Ex Situ Treatment of Groundwater
C1. Sediment Characterization, Risk Assessment, and Natural Recovery
C2. Sediment Treatment Technologies
C3. Enhanced Bioremediation of Recalcitrant Contaminants
C5. Phytoremediation
D1. Challenges in Characterization of DNAPL Source Zones
D2. Hydraulic and Reactive Performance of Permeable Barriers
D3. Assessing the Longevity of Permeable Reactive Barriers (PRBs)
D4. Improved Delivery Mechanisms for In Situ Treatment
E1. Bioaugmentation at Chlorinated Solvent Sites
E2. Issues in Risk-Based Corrective Action
E3. Natural Attenuation of Recalcitrant Contaminants

Poster Group 2

Display: Tuesday 4:00 P.M. – Wednesday 1:00 P.M.
Presentation: Tuesday 5:30–7:30 P.M.

A5. Containment with Pump-and-Treat Systems
A6. Treatment of Chlorate and Perchlorate in Groundwater
A7. Surfactant- and Other Chemical-Based Treatments
A8. Alternative Permeable Barrier Materials
B7. Design and Modeling for Planning of Remediation Projects
B9. Impacts of Chemical Oxidants on Treated Aquifers
B10. Technology Trains for Achieving Compliance
B11. Air Sparging/SVE
C6. Steam Treatment of DNAPL Source Zones
C7. Electrical Heating and Its Effect on Treatment Zones
C8. Thermal Treatment of Recalcitrant Contaminants
C9. Enhanced Bioremediation of Chlorinated Solvents
C10. Data Management Tools for Optimizing Remediation
D6. Remediation of Wood Preservative Sites
D7. Characterization of Recalcitrant Contaminants
D8. Design and Construction of Permeable Reactive Barriers (PRBs)
E4. Remediation Cost Estimates
E5. Remediation Strategies for Site Owners
E6. Characterization of Fractured Bedrock Sites
E7. Innovative Remediation Technologies for Fractured Bedrock Sites
E8. Chemical and Biological Techniques for Treatment in Fractured Bedrock
E9. MTBE Characterization and Treatment

C5. continued from page 19

* **Phytoremediation of Chlorinated Solvents in Shallow Groundwater.** *R. Vazquez, W.A. Plaehn, and V.L. Hauser.*
Rafael E. Vazquez (U.S. Air Force/USA)

* **Phytoremediation of Chlorinated Solvents Using Trench and "Sand Pipe" Design.** *D.E. Rieske, J.G. Burken, G.W. Snyder, and D.C. Pentecost.*
David E. Rieske (Pro2Serve Technical Solutions/USA)

Phytoremediation of High-Volume Agricultural Antibiotics: Uptake Studies with Aquatic Macrophytes. *R. Bhadra and K. Krupa.*
Rajiv Bhadra (Colorado State University/USA)

* **Phytoremediation of Petroleum Hydrocarbons in Pacific Island Ecosystems.** *J.L. Jordahl, M.F. Madison, H.M. Emond, C.S. Tang, F. Robert, and W.H. Sun.*
James Lee Jordahl (CH2M Hill/USA)

* **Phytoremediation of Volatile Aromatic Hydrocarbons.** *L. Bickis, J.S. Poland, and A. Rutter.*
Allison Rutter (Queen's University/CANADA)

* **Phytoremediation Potential in Semiarid Soils: New Mexican Uranium-Accumulating Plants.** *J. Rosen, D. Ulmer-Scholle, and J.B.J. Harrison.*
Joy M. Rosen (New Mexico Institute of Mining & Technology/USA)

* **Potential for Phytoremediation of PCBS.** *B.A. Zeeb, M.D. Pier, and K.J. Reimer.*
Barbara A. Zeeb (Royal Military College/CANADA)

Quantifying the Phytovolatilization of Trichloroethylene in the Field. *W.J. Doucette, B. Bugbee, N.W. Zaugg, and J. Ginn.*
William J. Doucette (Utah State University/USA)

* **Relationship Between Trichloroethylene Concentrations in Tree Cores and Groundwater for Plume Delineation at Hill Air Force Base, UT.** *K.L. Lewis, W.J. Doucette, B. Bugbee, and J. Ginn.*
William J. Doucette (Utah State University/USA)

Root Exudates Increase PAH Degradation in the Rhizosphere. *J.R. Shann and K. Yoshitomi.*
Jodi R. Shann (University of Cincinnati/USA)

Sequestration and Detoxification of Chlorinated Phenols by Aquatic Plants. *J.M. Tront and F.M. Saunders.*
Jacqueline M. Tront (Georgia Institute of Technology/USA)

* **Sustainable Phytoremediation: Treating Soil with PAHs and Heavy Metals Using In Situ Vegetation.** *H.F. Henry and J.R. Shann.*
Heather F. Henry (University of Cincinnati/USA)

* **Techniques for Evaluating Hydrologic Data to Assess Phytoremediation System Performance.** *W. Schneider, S. Hirsh, H. Compton, A. Burgess, and J. Wrobel.*
William Schneider (Roy F. Weston, Inc./USA)

* **Treating Wastewater from Dairy Parlors in a Constructed Wetland.** *N. Marmiroli, M. Marmiroli, E. Maestri, S. Tagliavini, P. Mantovi, and S. Piccinini.*
Nelson Marmiroli (University of Parma/ITALY)

Use of Phyto-Irrigation to Remediate VOC-Contaminated Groundwaters at SRS. *L.A. Newman and C.L. Bayer.*
Cassandra L. Bayer (Bechtel Savannah River, Inc./USA)

C6. Steam Treatment of DNAPL Source Zones

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chair: *Roger D. Aines (Lawrence Livermore National Laboratory)*

Bench-Scale Comparison of Thermal Methods for Free Product Removal. *M. Basel and P. Lundegard.*
Michael D. Basel (Montgomery Watson Harza/USA)

* **Design and Deployment of Dynamic Underground Stripping and Hydrous Pyrolysis/Oxidation for In Situ Chlorinated Solvent Removal and Destruction at Savannah River Site.** *D. Parkinson, E. Sorensen, N. Brown, C. Eischen, J. Dablow, and J. Kupar.*
Dave Parkinson (Integrated Water Resources, Inc./USA)

Full-Scale Cleanup of PCE and Turpentine Under Buildings by Steam Stripping. *T. Heron, B. Haugaard Heron, and G. Heron.*
Tom Heron (NIRAS A/S/DENMARK)

Full-Scale Thermal Remediation of Trichloroethylene by In Situ Steam Stripping. *J. Cole, J. Gentry, K. Scheffler, A. Montgomery, and C. Eaker.*
Jason D. Cole (CH2M Hill/USA)

In Situ Removal and Destruction of Chlorinated Solvent Source Contamination by Dynamic Underground Stripping and Hydrous Pyrolysis/Oxidation at Savannah River Site. *N. Brown, D. Parkinson, J. Kupar, and T. Kmetz.*
Norm Brown (Integrated Water Resources, Inc./USA)

Laboratory Microcosm Experiments of Oxidation Processes After Steam Injection. *E.L. Davis.*
Eva L. Davis (U.S. EPA/USA)

* **Single-Well Steam Injection and In Situ Destruction of Chlorinated Solvents.** *S. Carroll, S. Schima, R.D. Aines, R.L. Newmark, K. Greene, A. Gavaskar.*
Steve Carroll (SteamTech Environmental Services, Inc./USA)

* **Steam Increases SVE Effectiveness to Remove TCE in Weathered LNAPL.** *W.E. Collins, C. Liles, L. Wilson, M. Coons, and H. Abedi.*
Chris M. Liles (IT Corporation/USA)

* **Steam-Enhanced Remediation Treatability Testing to Develop Design Criteria.** *E. Alperin, J. Dablow, J. Colbert, and S. Shealy.*
Ed Alperin (IT Corporation/USA)

C6. Continued

*** Thermal In Situ Destruction of Dissolved Contaminants: Beale AFB Demonstration.**
R.L. Newmark, R.D. Aines, K. Greene, C. Reeter, A. Gavaskar, S. Carrol, G. Heron, and J. Sanchez.
Robin L. Newmark (Lawrence Livermore National Laboratory/USA)

*** Thermal-Enhanced SVE of PCE Under a Dry Cleaning Establishment — A Case Study.**
J. Dall-Jepsen, T. Jorgensen, H. Skov, I.A. Fuglsang.
Jarl Dall-Jepsen (COWI Consulting Engineers & Planners AS/DENMARK)

C7. Electrical Heating and Its Effect on Treatment Zones

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chairs: *William A. Plaehn (Parsons Engineering Science, Inc.) & Keith A. Fields (Battelle)*

Electrical Resistive Heating Under an Active Industrial Plant. *S. Fain, C. Holloway, W. Heath, W.R. Lundberg, and G. Walters.*
Stephen Fain (URS Corporation/USA)

*** Evaluation of Six-Phase Heating™ for DNAPL Removal at Cape Canaveral.** *W. Heath, C. Thomas, and E. Maki.*
William O. Heath (Current Environmental Solutions/USA)

*** Evidence of Thermophilic Biodegradation for PAHs, Diesel, and TCE in Soil.** *M.H. Huesemann, M.J. Truex, T.S. Hausmann, and T.J. Fortman.*
Michael H. Huesemann (Battelle/USA)

Hydraulic Control and its Effect on Thermal Remediation. *R.R. Millan.*
Rudolph Millan (IT Corporation/USA)

In Situ Remediation of Low-Permeability Soils Using Electrical Resistive Heating. *J.L. Pope, M.M. Nienkerk, W.T. Wirtanen, and C. Thomas.*
Jeffery L. Pope (Clayton Group Services, Inc./USA)

NAPL Remediation Using Steam-Enhanced Extraction and Electrical Resistive Heating. *G. Beyke and G. Heron.*
Gorm Heron (SteamTech Environmental Services, Inc./USA)

*** Remediation of Trichloroethylene Underneath an Operating Facility Using Electrical Resistive Heating.** *S. Fain, C. Holloway, and G. Beyke.*
Stephen Fain (URS Corporation/USA)

Remediation of VOCs in Buried Drums and Landfill Debris Using Electrical Resistance Heating. *W. Plaehn, G. Beyke, L. Tagawa, and D. Bollman.*
William A. Plaehn (Parsons Engineering Science, Inc./USA)

*** Source Zone (Enhanced) Reductive Dechlorination in Belgium.** *D. Nuyens, M. Meyer, D. Wanty, and V. Miles.*
Dirk Nuyens (Environmental Resources Mgt/BELGIUM)

Tetrachloroethene Source Area Reduction Using Electrical Resistance Heating. *C. Hudson, D. Williamson, T. Beisel, T. Simpkin, and G. Beyke.*
Casey Hudson (CH2M Hill Constructors, Inc./USA)

C8. Thermal Treatment of Recalcitrant Contaminants

Platform Papers Thursday/Posters (*) Tuesday Evening

Chair: *Jay Dablow (The IT Group)*

The Fate of Dioxin in Superheated Steam.
D.H. Holcomb, K.G. Sadler, and J.P. Cleary.
David H. Holcomb (Focus Environmental, Inc./USA)

Field Demonstration of Thermally Enhanced Multiphase Extraction on Chlorinated Solvent-Impacted Soils and Groundwater. *D.M. Conley, J.G. Savarese, S. Gupta, and R.S. Baker.*
Denis M. Conley (Haley & Aldrich, Inc./USA)

*** Full-Scale Application of In Situ Thermal Destruction of MGP Waste in a Landfill Setting.**
J.M. Bierschenk, R.J. Bukowski, J.P. Galligan, R.S. Baker, S.L. Walker, and K. Bowden.
John M. Bierschenk (TerraTherm, Inc./USA)

Full-Scale Cleanup by In Situ Thermal Destruction at Rocky Mountain Arsenal Hex Pit. *R.S. Baker, J.P. Galligan, R.J. Bukowski, J.M. Bierschenk, K. Bowden, and S.L. Walker.*
Ralph S. Baker (TerraTherm, LLC/USA)

*** Results and Reaction Mechanisms for the Treatment of Concentrated Chlorinated Organics Using GeoMelt Vitrification.** *L. Tompson.*
Leo E. Thompson (AMEC Earth and Environmental, Inc./USA)

Steam-Enhanced Recovery of PCB-Contaminated Heavy Oils. *J. Dablow, B. Cote, K. Chelkowska, and G. Gordon.*
Jay Dablow (The IT Group/USA)

C9. Enhanced Bioremediation of Chlorinated Solvents

Platform Papers Thursday/Posters (*) Tuesday Evening

Chairs: *Terry C. Hazen (University of California) & James M. Gossett (Cornell University)*

*** Aerobic Biotransformation of Trichloroethylene, *cis*-Dichloroethylene, and Vinyl Chloride by a Benzyl Alcohol-Grown Culture.** *S. Tejasen and L. Semprini.*
Sarun Tejasen (Oregon State University/USA)

*** Aerobic, Growth-Coupled Vinyl Chloride and *cis*-Dichloroethene Oxidation at Camp Lejeune Marine Corps Base, NC.** *T. Mattes and J. Gossett.*
Timothy Mattes (Cornell University/USA)

*** Apparent Stalling During Treatment of a TCE Plume Using HRC.** *J. Ninteman, C. Jacob, N. Garson, and C. Bach.*
Jerry R. Ninteman (Landau Associates, Inc./USA)

* **Assessing Full-Scale HRC® Performance from Source Area to Property Line.** *J.K. Sheldon and K.G. Armstrong.*
Jack K. Sheldon (Montgomery Watson/USA)

* **Bioassays: A Novel Method for Assessing the Progress of In Situ Anaerobic Bioremediation.** *S. Fogel, M. Findlay, D. Smoler, B.F. Droy, F. Manale, P. Jin, C. Creber, and G. Klecka.*
Samuel Fogel (Bioremediation Consulting, Inc./USA)

* **Bioremediation of a PCE Plume at a Dry Cleaner Site.** *K. Parrett and C.A. Sandefur.*
Kevin Parrett (Oregon Dept of Environmental Quality/USA)

* **Bioremediation of TCE Source Area at the Mobile Launch Platform Rehabilitation Sites and Vehicle Assembly Building.** *M.R. Castellanos, M.L. McMaster, J. Adkisson, T.A. Peel, and S. Dworatzek.*
Mayra R. Castellanos (GeoSyntec Consultants/USA)

Chlorinated Ethene Dechlorination and Growth Kinetics Under Dual-Substrate Limitation. *A.M. Cupples, A.M Spormann, and P.L. McCarty.*
Alison M. Cupples (Stanford University/USA)

Cometabolic Degradation of Chloroform with Butane: Study of the Influence of System Features on Adaptation. *D. Frascari, D. Pinelli, and M. Nocentini.*
Dario Frascari (University of Bologna/ITALY)

* **Comparison of Three PCE Dechlorination Enrichments Under Anaerobic Conditions.** *D. Seepersad, M. Duhamel, P. Cheung, K. Mo, P. Morrill, B. Sherwood Lollar, B. Sleep, E. Edwards, D. Major, and P. Dennis.*
David Seepersad (University of Toronto/CANADA)

* **Competition Among H_2 Utilizers During Reductive Dehalogenation of Chlorinated Solvents.** *J.-H. Bae, I.-S. Lee and P.L. McCarty.*
Jae-Ho Bae (Inha University/KOREA-ROK)

* **Conservative Chemical Tracer Evaluation of Large-Scale Circulating In Situ Bioremediation.** *J.G. Booth, P. Jin, B.F. Droy, F. Manale, C. Creber, and G. Klecka.*
J. Greg Booth (Toxicological & Environmental Associates, Inc./USA)

* **Dechlorinization of Halogenated Volatile Organic Compounds by Enhanced Microbial Degradation.** *J.K. Meyer and T.D. Johnson.*
John K. Meyer (Environmental Resolutions, Inc./USA)

* **Defining Success for a Full-Scale In Situ Anaerobic Bioremediation System.** *F. Manale, B.F. Droy, R. Copeland, C. Creber, and G. Klecka.*
Frank Manale (Toxicological & Environmental Associates, Inc./USA)

Dehalogenation of Tetrachloroethene and Trichloroethene with Tetrabutoxysilane Using a Binary Mixed Culture. *S. Yu and L. Semprini.*
Seungho Yu (Oregon State University/USA

* **A Demonstration of Enhanced Bioremediation of Chlorinated Hydrocarbons.** *J.A. Miller and S. Madill.*
John A. Miller (Schlumberger Oilfield Services/USA)

* **Development of an AFCEE/ESTCP Substrate-Enhanced CAH Bioremediation Protocol.** *C. Lutes, M. Hansen, J. Burdick, S. Suthersan, and J. Hansen.*
Chris Lutes (ARCADIS G&M/USA)

* **Enhanced Bioremediation of a Chlorinated Solvent Plume at a Former Bomarc Missile Site in Niagara Falls, NY.** *R.M. Watt and G. Hromowyk.*
Richard M. Watt (Ecology and Environment, Inc./USA)

* **Enhanced Bioremediation of Chlorinated Solvents by HRC® Injection in Japan.** *M. Nakashima, X. Wu, and R. Okada.*
Makoto Nakashima (Kokusai Kogyo Co. Ltd./JAPAN)

* **Enhanced Bioremediation of DNAPL in Clay Formation.** *W. Murray, D. Tremaine, and M. Dooley.*
Willard A. Murray (Harding ESE/USA)

* **Enhanced Bioremediation of High TCA Concentrations in Difficult Geological Conditions.** *V.B. Dick, S.L. Boyle, and N.L. Case.*
Vincent B. Dick (Haley & Aldrich, Inc./USA)

Enhanced CAH Dechlorination in a Low-Permeability, Variably Saturated Medium. *J.P. Martin, R.A. Brennan, K.S. Sorenson, Jr., L.N. Peterson, C.J. Taylor, and G.H. Bures.*
Jennifer P. Martin (North Wind Environmental, Inc./USA)

* **Enhanced In Situ Biodegradation of Chlorinated Solvents in a DNAPL Zone.** *D.S. Lipson and J.L. Persico.*
David S. Lipson (Blasland, Bouck & Lee, Inc./USA)

* **Enhanced In Situ Reductive Dechlorination of High Concentration Chlorinated Aliphatic Hydrocarbons.** *N.V. Shetty and S.S. Suthersan.*
Nanjun V. Shetty (ARCADIS G&M/USA)

* **Enhanced Reductive Dechlorination Results in Conditional Closure at a Texas Dry Cleaner Facility.** *R. Railsback and R. Gillespie.*
Rick Railsback (ProGEA, Inc./USA)

* **Enhanced Reductive Dechlorination Using Food-Grade Substrates: State-of-the-Practice.** *F. Lenzo, S.S. Suthersan, M. Hansen, and J.Burdick.*
Frank C. Lenzo (ARCADIS G&M/USA)

* **Evaluation of Soybean Oil and Dissolved Substrates for In Situ Bioremediation.** *C.C. Casey, J. Reed, R. Britto, J. Stedman, B. Henry, and T. Wiedemeier.*
Clifton C. Casey (U.S Navy/USA)

* **Evaluation of the Effectiveness of Various Types of Carbon Donors to Promote Reductive Dechlorination.** *L.T. LaPat-Polasko, B. Harre, and B.S. Aiken.*
Laurie T. LaPat-Polasko (Parsons Corporation/USA)

* **Facilitated Desorption and Incomplete Dechlorination: Observations from 220 Applications of HRC®.** *S. Koenigsberg, C. Sandefur, and K. Lapus.*
Stephen S. Koenigsberg (Regenesis Bioremediation Products/USA)

* **Field-Scale Bioremediation of Chlorinated Ethenes in Constructed Wetland Bioreactors.** *A. Guin, T.J. Slusser, M.L. Shelley, and A. Agrawal.*
Arijit Guin (Wright State University/USA)

C9. Continued

*** Full-Scale Remedial Action Using HRC® Under the FDEP State Dry Cleaning Program.** *J.J. Watts, M.O. Jaynes, J.A. Farrell, and R. Gillespie.*
Juliette J. Watts (Mactec Harding ESE, Inc./USA)

*** Groundwater Biogeochemical Study for Evaluating Feasibility of In Situ Anaerobic Bioremediation.** *P. Jin, B.F. Droy, F. Manale, R. Copeland, C. Creber, and G. Klecka.*
Peikang Jin (Toxicological & Environmental Assoc. Inc./USA)

*** Groundwater Remediation at Low-Flow, Low-Permeability Sites Using HRC®.** *A. Primrose, L. Butler, and N. Castaneda.*
Annette L. Primrose (Kaiser-Hill RFETS/USA)

*** HRC®-Enhanced Bioremediation in High-Flow Aquifers and Lessons Learned.** *S.S. Schankweiler and A. Lorenz.*
S. Scott Schankweiler (Versar, Inc./USA)

Hydraulic Effects of Hydrogen Delivery for Treatment of Chlorinated DNAPL. *N.L. Capiro, J.M. McDade, D.T. Adamson, P.B. Bedient, and J.B. Hughes.*
Natalie L. Capiro (Rice University/USA)

*** In Situ Remediation of Carbon Tetrachloride and Chloroform in Groundwater.** *N.V. Shetty, M.R. Pahr, S.S. Suthersan, and E. Rhine.*
Michelle R. Pahr (ARCADIS G&M/USA)

*** Innovative Field Approach for Chlorinated Solvent Remediation at Charleston Naval Complex, South Carolina.** *W. Elliott, D. Williamson, T. Hunt, and R. Gillespie.*
William Elliott (CH2M Hill, Inc./USA)

*** Kinetics of 1,1,1-Trichloroethane Transformation by Iron Sulfide and Methanogenic Consortia.** *J.W. Gander, M.M. Scherer, and G.F. Parkin.*
Gene F. Parkin (University of Iowa/USA)

*** Laboratory Studies for Biofilter Treatment of Soil Vapour Contaminated with Chlorinated Solvents.** *M.L. Sorensen, L. Haastrup, N.T. Eriksen, M. Kristensen, I.A. Fuglsang, T. Nielsen, and B. Hvidberg.*
Majbrith Langeland Sorensen (Carl Bro A/S/DENMARK)

Methane-Enhanced In Situ Biological Degradation of Chlorinated Hydrocarbons — Case Study. *S.D. Andrews, W. Mahaffey, and T. Santangelo-Dreiling.*
Scott Andrews (ARCADIS G&M/USA)

Microbial Community Analysis of TCE-Dechlorinating Enrichments Using Various Electron Donors. *R.A. Freeborn, V.K. Bhupathiraju, S. Chauhan, K. West, R. Richardson, T. Goulet, and L. Alvarez-Cohen.*
Ryan Freeborn (University of California-Berkeley/USA)

*** Monitoring the Effectiveness of Large-Scale In Situ Anaerobic Bioremediation.** *P. Jin, B.F. Droy, F. Manale, R. Copeland, C. Creber, and G. Klecka.*
Peikang Jin (Toxicological & Environmental Assoc. Inc./USA)

*** Obstacles to Complete PCE Degradation During Reductive Dechlorination.** *J.A. Kean, D. Graves, K. Bishop, and M. Lodato.*
Duane Graves (IT Corporation/USA)

*** Operation & Maintenance of a Full-Scale In Situ Anaerobic Bioremediation System.** *F. Manale, B.F. Droy, R. Copeland, C. Creber, and G. Klecka.*
Frank Manale (Toxicological & Environmental Associates, Inc./USA)

*** Optimizing Reductive Dechlorination in a Large-Scale In Situ Bioremediation System.** *M. Findlay, S. Fogel, D. Smoler, B.F. Droy, F. Manale, P. Jin, C. Creber, and G. Klecka.*
Margaret Findlay (Bioremediation Consulting, Inc./USA)

*** Pilot Test of Enhanced Reductive Dechlorination of TCE and Full-Scale Design.** *J.S. Burdick, K.A. McGuinnes, E. Rodriguez, and D.J. Wanamaker.*
Kevin McGuinness (ARCADIS G&M/USA)

*** Post-Remedial Geochemical Activity at an Enhanced Reductive Dechlorination Site.** *R. Britto and J. Stedman.*
Ronnie Britto (EnSafe, Inc./USA)

Post-Treatment Biological Attenuation at a Site Contaminated with Mixed Chlorinated Solvents. *S. Lesage, S. Brown, K. Millar, C.S. Mowder, T. Llewellyn, S. Forman, D. Peters, G. DeLong, D.J. Green, and H. McIntosh.*
Suzanne Lesage (Environment Canada/CANADA)

*** Prospects for Bioremediation of Source Zones Containing 1,2-Dichloroethane.** *L.N. Britton.*
Larry N. Britton (Southwest Texas State University/USA)

*** Pulsed Injection Flow Strategy for Aerobic Cometabolism of Vinyl Chloride.** *M.J. Truex, C.D. Johnson, D.P. Leigh, and S. Granade.*
Michael J. Truex (Battelle/USA)

*** Push-Pull and Natural Gradient Drift Tests for Evaluating In Situ Aerobic Cometabolism of Chlorinated Solvents.** *Y. Kim, J.D. Istok, M.R. Hyman, and L. Semprini.*
Young Kim (Oregon State University/USA)

*** Reducing Fieldwork and Increasing Cost Effectiveness of Monitoring Natural Attenuation.** *R. Pirkle, P. McLoughlin, and D. Frolini.*
Robert J. Pirkle (Microseeps, Inc./USA)

*** Remediation of TCE and Nickel Via an In Situ Reactive Zone.** *K.A. Beil, E. Vanyo, J.F. Horst, and M.A. Hansen.*
Kurt A. Beil (ARCADIS G&M/USA)

*** The Role of Microorganisms on DNAPL Interfacial Properties and Transport.** *T. Doty and S. Grimberg.*
Thomas Doty (Clarkson University/USA)

*** Statistical Analysis of Groundwater Chemistry Data of Large-Scale In Situ Bioremediation.** *S. Liu, B.F. Droy, F. Manale, C. Creber, and G. Klecka.*
Shuang Liu (Toxicological & Environmental Associates, Inc./USA)

* **TCE/Phenol Degradation by a "High Performance Bioreactor."** *H. Futamata, S. Harayama, K. Watanabe, and A. Hiraishi.*
Hiroyuki Futamata (Toyohashi University of Technology/ JAPAN)

* **Technology Verification: The Added Benefits.** *R.W. Brekke and L.D. Ochs.*
Rhea Brekke (New Jersey Corporation for Advanced Technology/USA)

* **Tetrachloroethylene and Uranium Remediation Using IRZ®.** *C.S. Morie, J. Greene, M. Ledford, G.B. Page, C.T. Hughes, and B.D. Ilgner.*
C. Scott Morie (Nuclear Fuel Services, Inc./USA)

* **Time-Release Electron Donor Application in Low-Permeability PCE-Contaminated Aquifer.** *D.E. Skoff, J.S. Holmes, and D. Peterson.*
Dale E. Skoff (Earth Tech, Inc./USA)

* **The Use of Sulfate to Control and Enhance Reductive Dechlorination.** *J.A. Peeples, J.M. Warburton, and J. Haff.*
James A. Peeples (Parsons Engineering Science, Inc./USA)

* **Utility of Enzyme-Activity-Dependent Probes for Monitoring TCE Degradation.** *S.R. Clingenpeel, M.E. Watwood, and W.K. Keener.*
Scott R. Clingenpeel (Idaho State University/USA)

* **Vegetable Oil Injection for Enhanced Reductive Dechlorination at Multiple Sites.** *T.H. Wiedemeier, B.M. Henry, D.R. Griffiths, and P.E. Haas.*
Todd H. Wiedemeier (Parsons Engineering Science, Inc./USA)

C10. Data Management Tools for Optimizing Remediation

Platform Papers Thursday/Posters (*) Tuesday Evening

Chairs: *Michael R. Wild (Newfields, Inc.) & Sam Yoon (Battelle)*

Appropriate Application of Statistical and Geostatistical Methods for Remedy Decisions. *M.R. Wild and S. Rouhani.*
Michael R. Wild (Newfields, Inc./USA)

* **A Case Study of GIS Applied in a Remediation Project at MCB Camp Pendleton.** *D. Meggyesy and S. Yoon.*
Danielle Meggyesy (Battelle/USA)

* **Digital Environmental Data Management.** *K. Milholland, I. Farrar, and J. Arena.*
Kent E. Milholland (Columbia Gas Transmission Corporation/ USA)

Evaluation of a Large, Multisource VOC-Contaminated Groundwater Site Using GIS Tools. *B.S. Aiken and L.T. LaPat-Polasko.*
Brian S. Aiken (Parsons Corporation/USA)

GIS/Modeling of Chlorinated Solvents. *E. Roaza.*
Ernie Roaza (URS Greiner Woodward Clyde/USA)

Integrated Environmental Database Management. *R. Boudra.*
Robert A. Boudra (URS Corporation/USA)

* **Multimedia Data Mining to Facilitate the In Situ Monitoring of DNAPL Destruction by MNO_4^-.** *Y.C. Fang, Y. Seol, and F.W. Schwartz.*
Y.C. Fang (The Ohio State University/USA)

D1. Challenges in Characterization of DNAPL Source Zones

Platform Papers Monday/Posters (*) Monday Evening

Chair: *Thomas Holdsworth (U.S. EPA)*

* **Characterization of a Deeply Impacted Chlorinated Solvent and Heavy Metals Source Area Utilizing Innovative Methods.** *J.N. Clarke, P. Cook, and T. DiDomizio.*
James N. Clarke (Law Engineering & Environmental Services, Inc./USA)

A Comparison of Field Techniques for Confirming Dense Nonaqueous-Phase Liquids (DNAPLs). *T.W. Griffin and K.W. Watson.*
Terry W. Griffin (HSW Engineering, Inc./USA)

Evaluating Presence of TCE Below the Confining Layer in a DNAPL Source Zone. *W.-S. Yoon, A.R. Gavaskar, J. Sminchak, C. Perry, E. Drescher, and J.W. Quinn.*
Sam Yoon (Battelle/USA)

Geostatistical Analysis of TCE Concentrations Before and After Remediation of DNAPL Source Zone at Cape Canaveral. *B.E. Buxton and A.R. Gavaskar.*
Bruce Buxton (Battelle/USA)

Identification of DNAPL Contamination from Vapor-Phase Concentrations. *C. Holbert, G.D. Sayles, P. dePercin, and J.S. Ginn.*
Charles Holbert (URS Corporation/USA)

Innovative Strategy to Locate VOC Sources Deep in the Subsurface. *L. LaPlante.*
Laurie L. LaPlante (Kleinfelder, Inc./USA)

* **Trichloroethene Source Area Characterization Using the Membrane Interface Probe.** *C. Hudson, D. Williamson, T. Beisel, and J. Sohl.*
Casey Hudson (CH2M Hill Constructors, Inc./USA)

* **Using Passive Soil Gas to Locate DNAPL Source Areas.** *D.R. Beal, J.W. Hodny, and O. Songonuga.*
Douglas Beal (BEM Systems, Inc./USA)

D2. Hydraulic and Reactive Performance of Permeable Barriers

Platform Papers Monday/Posters (*) Monday Evening

Chair: *Steve White (U.S. Army Corps of Engineers)*

Designing and Verifying the Hydraulic Performance of Permeable Barriers. *N. Gupta, A. Gavaskar, J. Sminchak, B. Sass, W.-S. Yoon, C. Reeter, and S. White.*
Neeraj Gupta (Battelle/USA)

D2. Continued

Full-Scale Demonstration of Permeable Reactive Barrier Technology Using Zero-Valent Iron. *P. Kjeldsen, I.A. Fuglsang, V. Birkelund, and J.E. Klindt.*
Peter Kjeldsen (Technical University of Denmark/DENMARK)

* **Groundwater Performance Monitoring of an Iron Permeable Reactive Barrier.** *G. Hocking and S.L. Wells.*
Grant Hocking (Golder Sierra LLC/USA)

Isotopic Analysis: A New Tool for Evaluating Abiotic Degradation on FE^0. *N. VanStone, R. Focht, S. Mabury, and B. Sherwood Lollar.*
Nancy A. VanStone (University of Toronto/CANADA)

* **Permeable Reactive Barrier Performance Monitoring — F.E. Warren Air Force Base.** *F.C. Heneman, M.R. May, B.G. Powers, and E.J. Perez.*
Brian G. Powers (URS Corporation/USA)

* **A Permeable Reactive Iron Barrier for Treatment of a Groundwater Highly Polluted with TCE.** *L. Bastiaens, K. Van Nieuwenhove, M. Maesen, J. Vos, L. Kinnaer, S. O'Hannesin, D. Nuyens, and L. Diels.*
Leen Bastiaens (VITO/BELGIUM)

Post-Construction Monitoring of a ZVI PRB at the Somersworth Superfund Site. *T. Krug, K. Berry-Spark, S. O'Hara, C. Elder, M. Jordan, T. Sivavec, and R. Focht.*
Thomas Krug (GeoSyntec Consultants/CANADA)

D3. Assessing the Longevity of Permeable Reactive Barriers (PRBs)

Platform Papers Tuesday/Posters (*) Monday Evening

Chairs: *Richard T. Wilkin (U.S. EPA) & Charles Reeter (U.S. Navy)*

* **Accelerated Column Testing for Evaluating Permeable Barrier Longevity.** *E. Drescher, A. Gavaskar, B. Sass, S. Yoon, J. Sorg, and C. Reeter.*
Eric Drescher (Battelle/USA)

Co-Solute Effects on the Reactivity of Iron with Groundwater Contaminants. *P.J. Vikesland, J. Klausen, T. Kohn, D.R. Burris, W.P. Ball, and A.L. Roberts.*
Peter J. Vikesland (Virginia Polytechnic Institute & State University/USA)

Effect of Humic Acids on Heavy Metal Removal by Zero Valent Iron. *J. Dries, A. Kemps, L. Bastiaens, D. Springael, S.N. Agathos, and L. Diels.*
Jan Dries (Vito/BELGIUM)

* **Effects of Groundwater Alkalinity on 1,1,1-Trichloroethane Dechlorination by Iron Metal.** *A. Agrawal, W.J. Ferguson, and P.G. Tratnyek.*
Abinash Agrawal (Wright State University/USA)

Field Application of Ultrasound to Iron-Containing PRBs. *C.L. Geiger, C.A. Clausen, D.R. Reinhart, and J. Quinn.*
Cherie L. Geiger (University of Central Florida/USA)

Geochemical Factors Affecting Performance and Longevity of Permeable Reactive Barriers. *B. Sass, A. Gavaskar, W.-S. Yoon, E. Drescher, and C. Reeter.*
Bruce M. Sass (Battelle/USA)

The Influence of Geochemical Conditions on Carbon-Tetrachloride Dechlorination Rates and Product Distributions in Magnetite-Mediated Systems. *K. Danielsen and K.F. Hayes.*
Karlin Danielsen (University of Michigan/USA)

Inhibiting Substances as Tracers for the Reactivity Assessment of FE^0-PRBS. *N. Silva-Send, M. Ebert, R. Kober, D. Schafer, and A. Dahmke.*
Nilmini Silva-Send (University of Kiel/GERMANY)

Longevity of Zero-Valent Iron for Removing Vanadium from Contaminated Groundwater. *S.J. Morrison, C.E. Carpenter, and D.R. Metzler.*
Stan J. Morrison (Environmental Sciences Laboratory/USA)

Permeable Reactive Barrier Performance Monitoring: Long-Term Trends in Geochemical Parameters at Two Sites. *R. Wilkin.*
Richard T. Wilkin (U.S. EPA/USA)

*** The Useability of Laboratory Experiments for Long-Term Performance Predictions.** *M. Ebert, R. Kober, D. Schafer, N. Silva-Send, and A. Dahmke.*
Markus Ebert (University of Kiel/GERMANY)

D4. Improved Delivery Mechanisms for In Situ Treatment

Platform Papers Tuesday/Posters (*) Monday Evening

Chair: *John S. Fruchter (Battelle, Pacific Northwest National Laboratories)*

* **Accelerated Anaerobic Bioremediation of PCE at a Large Industrial Site.** *T.O. Meiggs, J. Fleischman, and W.R. Mahaffey.*
Theodore O. Meiggs (FOREMOST Solutions, Inc./USA)

* **Alternative Substrate Delivery Systems for In Situ Reactive Zone Perchlorate Treatment.** *S.T. Potter, F. Lenzo, S.S. Suthersan, and M.P. Kladias.*
Scott T. Potter (ARCADIS G&M/USA)

* **An Injection System for Delivering Amendments to Enhance Reductive Dechlorination.** *J.M. Warburton, J.A. Peeples, and J. Haff.*
Joseph M. Warburton (Parsons Engineering Science/USA)

* **Bioenhanced In-Well Vapor Stripping Treatment of TCE Contamination Source.** *P.L. McCarty, S.M. Gorelick, M.N. Goltz, G.D. Hopkins, L.H. Smith, R.K. Gandhi, and F.J. Eisenberg.*
Perry L. McCarty (Stanford University/USA)

* **A Comparison of Permanganate Delivery Methods in an Unsaturated Setting.** *D.J. McKay and C.M. Berini.*
Daniel J. McKay (U.S. Army Corps of Engineers/USA)

* **Creation of Permeable Barriers Containing Innocuous Oils: Laboratory Injection Studies.** *W.J. Hunter.*
William J. (Jim) Hunter (U.S. Dept of Agriculture/USA)

Designing In Situ Anaerobic Bioremediation as Primary Remediation for a Manufacturing Facility. *S.A. Fam, B. Dynkin, B.F. Droy, F. Manale, R. Copeland, M. Findlay, S. Fogel, C. Creber, and G. Klecka.*
Sami A. Fam (Innovative Engineering Solutions, Inc./USA)

* **Direct Injection for In Situ Abiotic Reduction of Chlorinated Solvents.** *C.S. Mowder, T. Llewellyn, S.R. Forman, S. Lesage, K. Millar, S. Brown, D. Green, H. McIntosh, and G. DeLong.*
Carol S. Mowder (ARCADIS G&M/USA)

* **Engineering Details for Enhanced Reductive Dechlorination (ERD) Technology.** *M.A. Hansen, K.A. Beil, F.C. Lenzo, and S. Suthersan.*
Michael A. Hansen (ARCADIS G&M/USA)

* **Enhanced Reductive Dechlornation — Treatment and Vapor Control Below an Active Building.** *J. Burdick, D.L. Jacobs, P. Rowland, and G. Lock.*
Jeffrey S. Burdick (ARCADIS G&M/USA)

* **Groundwater Circulation Well Technology Evaluation.** *J.R. Hicks, R.L. Johnson, J. Gonzales, and R.E. Hinchee.*
John R. Hicks (Parsons Engineering Science, Inc./USA)

* **Hydraulic Analysis of a Recirculation Well.** *T. Llewellyn, S. Forman, C. Mowder, S. Morgan, S. Lesage, K. Millar, S. Brown, D. Green, H. McIntosh, G. DeLong, and F. Tenbus.*
Sarah R. Forman (URS Corporation/USA)

* **A Novel Membrane System for Stimulating Bioremediation of PCE.** *R.M. Hozalski, X. Ma, L.W. Clapp, P.J. Novak, and M.J. Semmens.*
Raymond M. Hozalski (University of Minnesota/USA)

Rapid Closure Using ISCO and Enhanced MNA to Achieve Source Removal at NAS Dallas ASA-5. *R. Adams, B. Mahaffey, and B. Slack.*
Ronald Adams (EBSI, Inc./USA)

* **Rational Approaches for Remediation of Landfills with VOCs in Groundwater.** *K.J. Quinn.*
Kenneth J. Quinn (Montgomery Watson Harza/USA)

* **Significance of Hydraulic Conductivity in Optimizing In Situ Reductive Dechlorination in a Fractured Bedrock Aquifer.** *T. Klutz, D. Baird, G. Maalouf, D. McDonnell, and C. Sandefur.*
Drew Baird (Rogers & Callcott Engineers, Inc./USA)

Stimulation of Dechlorination by Membrane-Delivered Hydrogen: Small Field Demonstration. *P.J. Novak, J.A. Edstrom, L.W. Clapp, R.M. Hozalski, and M.J. Semmens.*
Paige J. Novak (University of Minnesota/USA)

TCE Reduction by Atomized Injection of Zero Valent Iron Powder: A Case Study. *S.J. Markesic, M. Klein, D. Hunt, J. Pawlik, and K. Friesen.*
Steve J. Markesic (ARS Technologies, Inc./USA)

D5. Remediating DNAPL Sites — What Are the Solutions?

Panel Discussion Tuesday

Moderator: *Robert E. Hinchee (Battelle)*

Characterization and treatment of DNAPL source zones continues to be a challenge at many sites contaminated with chlorinated solvents or other DNAPL compounds. Site owners face uncertainties in defining the boundaries of the DNAPL source, characterizing the hydrogeology of the affected region, selecting the most effective technologies, determining the lowest-cost alternative, negotiating a suitable endpoint for the cleanup, monitoring the cleanup and potential migration of DNAPL from the treatment zone, and achieving site closure. A number of promising technologies have been field-tested in the last two years. How effective have these technologies been in removing the source? Are any of these technologies more cost-effective in the long run than conventional pump-and-treat systems? Can they be implemented without spreading the DNAPL? Is it better to contain the plume or treat the source?

D6. Remediation of Wood Preservative Sites

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chair: *Douglas W. Grosse (U.S. EPA)*

Biological Treatment of Pentachlorophenol Using a GAC Fluidized-Bed Reactor. *D.J. Bach, K.J. Quinn, and J.V. Rouse.*
Douglas J. Bach (Montgomery Watson Harza/USA)

Design and Operation of Land Treatment Units at Wood-Treating Sites. *J.C. Harris.*
James C. Harris (U.S. EPA/USA)

Solidification/Stabilization: A Low-Cost Treatment for Wood-Preserving Sites. *E.R. Bates.*
Edward R. Bates (U.S. EPA/USA)

* **Steam Injection Pilot Test at the Wyckoff/Eagle Harbor Superfund Site, Bainbridge Island, Washington.** *M.M. Easterly, T.C. Shaw, K. LeProwse, and H. Gold.*
Travis C. Shaw (U.S. Army Corps of Engineers/USA)

Use and Disposal of Arsenically Preserved Wood. *G. Parris.*
George E. Parris (American Wood Preservers Association/USA)

Vertical Transport of Dissolved Naphthalene in Creosote from a Shallow to a Deep Aquifer. *R.W. Lee.*
Roger W. Lee (U.S. Geological Survey/USA)

D7. Characterization of Recalcitrant Contaminants

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chair: *Richard L. Johnson (Oregon Graduate Institute)*

* **Application of Off-Line Solid-Phase Extraction (SPE) to Extraction of Aqueous-Phase Organophosphate Pesticides.** *J.L. Burnam, J.A. Pedersen, and I.H. Suffet.*
Joshua L. Burnam (U.S. Army Corps of Engineers/USA)

* **Assessment and Interpretation of a Petroleum Hydrocarbon-Impacted Site in Northeast Maine.** *G.M. Calderone and P.A. Conde.*
Gina M. Calderone (EA Engineering, Science, & Technology/USA)

* **Data Evaluation: The Culmination of Site Characterization.** *W.F. Goforth.*
William F. Goforth (RMT, Inc./USA)

Defining TCE Plume Source Areas Using the Membrane Interface Probe. *K. Heinze and B. DiGuiseppi.*
Kim L. Heinze (University of Waterloo/CANADA)

* **Deployment of Passive Diffusion Bag Samplers for Chlorinated VOCs in Groundwater: Regulatory Perspectives on Data Useability.** *G.H. Nicholas, M.E. Ierardi, and C. Casey.*
George H. Nicholas (State of New Jersey/USA)

* **Diffusive Sampling of Groundwater and Vapour Near the Capillary Fringe.** *S.D. Kelly and P.E. Hardisty.*
Sean D. Kelly (KOMEX Europe/ENGLAND)

* **Evaluation of a Groundwater Plume Using Innovative Techniques.** *M.A. Orcino and N.D. Weeks.*
Michael A. Orcino (GeoSyntec Consultants/USA)

* **Field Tests of Diffusion Samplers for Inorganics at a Groundwater-Discharge Zone and in Wells.** *D.A. Vroblesky, M.D. Petkewich, and T.R. Campbell.*
Don A. Vroblesky (U.S. Geological Survey/USA)

* **Homologue Quantitation Technique for PCB Analysis by SIM GC/MS.** *S.L. Crump and J.E. Young.*
Stephen L. Crump (Westinghouse Savannah River Company/USA)

* **Impacts of Non-Equilibrium Desorption and Hydrolysis on Determination of Downstream Organophosphate Pesticide (OP) Loads in Suspended Agricultural Sediment.** *J.L. Burnam, J.A. Pedersen, and I.H. Suffet.*
Joshua L. Burnam (U.S. Army Corps of Engineers/USA)

In Situ Bioremediation Optimization Study — Evaluating Flow Properties with Borehole Flowmeters. *M.A. Killen, B.F. Droy, F. Manale, R. Copeland, C. Creber, and G. Klecka.*
Mark A. Killen (Toxicological & Environmental Associates, Inc./USA)

* **Investigation on MTBE Transport In Vadose Zone with Soil Columns.** *C.-H. Luo, C.-S. Hwu, and Y.-C. Lay.*
Chin-Hsiang Luo (Hungkuang Institute of Technology/TAIWAN)

* **Measurement of Partitioning Coefficient Robustness and Implications for Partitioning Tracer Tests (PTTs).** *C.E. Divine, P. Dugan, and J.E. McCray.*
Craig Divine (ARCADIS G&M/USA)

Mechanisms of the Membrane Interface Probe Sample Collection Process. *J. Costanza, K.D. Pennell, J. Rossabi, and B. Rhia.*
Jed Costanza (Georgia Institute of Technology/USA)

Membrane Interface Probe Technology for In Situ Delineation of a Chlorinated Solvent Plume. *G.M. Calderone, P.A. Conde, and M. Evans.*
Gina M. Calderone (EA Engineering, Science, & Technology/USA)

A Method for Quantifying Contaminant and Groundwater Fluxes at Hazardous Waste Sites. *M.D. Annable, K. Hatfield, and P.S.C. Rao.*
Michael D. Annable (University of Florida/USA)

* **Modeling Arsenic in Groundwater at Hill AFB, Utah.** *M. Loucks, P. Bitter, and C. Holbert.*
Mark Loucks (U.S. Air Force/USA)

* **Nonideal Solubilization of a Chlorinated Aliphatic Hydrocarbon from Fuel-Based Mixtures.** *P.J. Dugan and J.E. McCray.*
Pamela J. Dugan (Colorado School of Mines/USA)

* **NSO-Heterocyclic Compounds at MGP Sites — Characterization and Potential for Bioremediation.** *J. Gemoets, G. Vanermen, P. De Vries, G. Van de Sterren, and K. Weyting.*
Johan Gemoets (VITO/BELGIUM)

* **Performance Comparison Between Direct-Push and Conventional Hollow-Stem Auger Monitoring Wells.** *W. Major, M. Kram, and E. Lory.*
William R. Major (U.S. Navy/USA)

* **Pollut Eval: A Novel Tool for Direct Hydrocarbon Analysis in Contaminated Soils.** *Y. Benoit, F. Haeseler, and D. Blanchet.*
Yves Benoit (Institut Francais du Petrole/FRANCE)

* **Rapid PCB and HVOC Characterization During Plant Decommissioning and Demolition.** *F.W. Blickle, J. Maher, and G. Hotchkiss.*
Frederick W. Blickle (Conestoga Rovers & Associates, Inc./USA)

* **Rapid, Low-Cost Characterization of Chloroform- and Hexavalent Chromium-Contaminated Aquifer.** *W. Schaal and T.L. Liikala.*
William Schaal (IT Corporation/USA)

* **SRS M-Area Vadose Zone Remediation Assessment: History, Status, Direction.** *B.D. Riha, D.G. Jackson, B.B. Looney, J. Rossabi, and J. Kupar.*
Brian D. Riha (Westinghouse Savannah River Co./USA)

* **Techniques Used to Evaluate MTBE Plume Stability at DoDHF Novato, California.** *T. Williamson, J. Gibbs, and T. Macchiarella.*
Travis Williamson (Battelle/USA)

* **Transport of PCBs During Low-Flow Purging of Groundwater.** *J.R.Y. Rawson, S. Blaha, and T.M. Sivavec.*
James R.Y. Rawson (General Electric Corporate R&D/USA)

Use of Fiber Optic Biosensors to Monitor Dichloroethane in Groundwater. *K.F. Reardon, W.B. Willis, M.O. Herigstad, J.J. Eisenbeis, and R.L. Olsen.*
Kenneth F. Reardon (Colorado State University/USA)

D8. Design and Construction of Permeable Reactive Barriers (PRBs)

Platform Papers Thursday/Posters (*) Tuesday Evening

Chair: *John L. Vogan (EnviroMetal Technologies Inc)*

* **Abiotic In Situ Hexavalent Chromium Reduction in Groundwater, Charleston Naval Complex.** *P. Favara, D. Williamson, and T. Beisel.*
Paul Favara (CH2M Hill, Inc./USA)

Demonstration of Columnar Wall Jet Grouting with Zero-Valent Iron. *R.W. Edwards, C.E. Carpenter, G.K. Baur, and S.J. Morrison.*
Robert W. Edwards (The Texas Center for Applied Technology/USA)

Design, Contruction, and Installation Verification of a Deep Iron Permeable Reactive Barrier. *G. Hocking and S.L. Wells.*
Grant Hocking (Golder Sierra LLC/USA)

Feasibility Study, Design, and Implementation of a European Permeable Reactive Iron Barrier. *L. Bastiaens, K. Weythingh, E. Berndsen, J. Vos, M. Maesen, L. Kinnaer, S. O'Hannesin, A. Peene, A. van de Velde, and L. Diels.*
Leen Bastiaens (VITO/BELGIUM)

Field Performance of a Permeable Reactive Barrier Treating Carbon Tetrachloride and Chlorofluorocarbons. *J.E. Vidumsky and M.M. Thomson.*
John E. Vidumsky (E.I. du Pont de Nemours & Company/USA)

In Situ Chemical Reduction Tests — Marshall Space Flight Center, Huntsville, Alabama. *B. McElroy, A. Keith, J. Glasgow, and S. Dasappa.*
William J. (Bill) McElroy (CH2M Hill/USA)

Installation of a Full-Scale Permeable Reactive Barrier for the Treatment of Metal-Contaminated Groundwater. *K.J. Mountjoy and D.W. Blowes.*
Keith J. Mountjoy (Hemmera Envirochem Inc./CANADA)

* **Iron-Enhanced Bioremediation of RDX in Flow-Through Columns.** *B.-T. Oh, L. Sherbourne, and P.J.J. Alvarez.*
Byung-Taek Oh (The University of Iowa/USA)

Metals Removal from Groundwater Using Permeable Reactive Barriers (PRBs): Applications. *D.J.A. Smyth, D.W. Blowes, C.J. Ptacek, J.G. Bain, S.G. Benner, and C.W.T. McRae.*
David J.A. Smyth (University of Waterloo/CANADA)

Pilot Test Groundwater Monitoring of Zero-Valent Iron Source Injection. *B. Baker, M. Dowiak, and G. Smith.*
Gregory J. Smith (URS Corporation/USA)

PRB Technologies in Germany: Recent Progress and New Developments. *V. Birke, H. Burmeier, and D. Rosenau.*
Volker Birke (University of Applied Sciences-NE Lower Saxony/GERMANY)

* **A Sequential Reactive Barrier Concept for Remediation of Groundwater Containing Mixed Pollution.** *J. Dries, L. Bastiaens, D. Springael, S.N. Agathos, and L. Diels.*
Jan Dries (Vito/BELGIUM)

* **ZVI Injection Case Study.** *B. Baker, R. Froh, and J. Imbrie.*
James Imbrie (URS Corporation/USA)

D9. Chlorinated Solvents and Other Recalcitrant Compounds — Directions for Future Technology Development Efforts

Panel Discussion Thursday

Moderator: *Skip Chamberlain (U.S. Department of Energy)*

Despite the progress made in developing new technologies and testing them in the field, many sites and contaminants have proved unyielding to easy solutions. Sites with DNAPL, MTBE, perchlorate, and other recalcitrant compounds continue to challenge the environmental industry, and potential new threats, such as 1,4-dioxane, continue to be discovered. Difficult and complex geologies, such as fractured bedrock, are just beginning to be understood. The technologies developed thus far appear to have technical and cost limitations of their own. Consequently, site owners are left with a complex array of site characterization and modeling tools and remediation alternatives to select from. At the same time, there is no clear endpoint — despite their investments, many site owners are unsure whether a site can be successfully taken to closure. Given these challenges, where should future investments in risk assessment and technology development be made? A panel of site owners, government agency heads, and regulators will discuss their views of the future direction of technology development and how they are directing resources.

E1. Bioaugmentation at Chlorinated Solvent Sites

Platform Papers Monday/Posters (*) Monday Evening

Chairs: *Paul C. Johnson (Arizona State University) & Mark R. Harkness (GE Corporate R&D Center)*

Application and Value of Molecular Techniques to Detect the Members of the Dechlorinating Group, *Dehalococcoides*. *E.R. Hendrickson, L. Buonamici, J. Vidumsky, D.E. Ellis, M.L. McMaster, and D. Major.*
Edwin R. Hendrickson (DuPont Co./USA)

* **Bioaugmentation and Substrate Addition for Source Area Treatment at the Caldwell Trucking Superfund Site.** *J. Vidumsky, N. Bauer, S. Finn, and D. Major.*
John E. Vidumsky (E.I. du Pont de Nemours & Company/USA)

E1. Continued

*** Biofilm Transformation to Promote In Situ Biodegradation of Carbon Tetrachloride.** *C.A. Gussenhoven, M.S. Cortese, T.L. Green, T.F. Hess, and R.L. Crawford.*
Cheryl A. Gussenhoven (University of Idaho/USA)

*** Comparison of 2D Model Aquifers: Chlorinated DNAPL Bioremediation.** *D. Seepersad, M. Duhamel, P. Cheung, K. Mo, P. Morrill, B. Sherwood Lollar, B. Sleep, E. Edwards, E. Hood, D. Major, and M. McMaster.*
Eric D. Hood (GeoSyntec Consultants/CANADA)

*** Degradation of 2-Chlorobenzoate by Recombinant *Burkholderia* Under Hypoxic Conditions.** *M. Urgun Demirtas, K. Pagilla, and B. Stark.*
Meltem Urgun Demirtas (Illinois Institute of Technology/USA)

*** Field Demonstration of Bioaugmentation of DNAPL at LC34, Cape Canaveral.** *D. Major, L. MacKinnon, E. Hood, T. Peel, M. Castellanos, and J. Quinn.*
David W. Major (GeoSyntec Consultants/CANADA)

*** Field-Scale Demonstration of Bioaugmentation to Enhance PCE DNAPL Dissolution.** *M. McMaster, E. Hood, M. Bogaart, P. Dennis, D. Major, and C. LeBron.*
Michaye McMaster (GeoSyntec Consultants/CANADA)

Full-Scale Bioaugmentation for Anaerobic Dechlorination of PCE and DCE. *S.A. Fam, S. Fogel, M. Findlay, and M. Gaudette.*
Sami A. Fam (Innovative Engineering Solutions, Inc./USA)

*** Microcosm Study of TCE Degradation by KB-1 in High-Sulfate Groundwater.** *P.R. Chang, E. Edwards, S. Dworatzek, P.J. Zeeb, D. Major, and D.A. Wanty.*
Paula R. Chang (GeoSyntec Consultants/USA)

*** Molecular Characterization and Tracking of a Chlorinated Solvent Cometabolizing Mixed Bioaugmentation Culture.** *M.E. Dolan, L. Semprini, S. Giovanonni, H.K. Lim, K. Vergin, P.L. McCarty, and G.D. Hopkins.*
Mark E. Dolan (Oregon State University/USA)

Simulations of the In Situ Aerobic Cometabolism of 1,1-Dichloroethylene and 1,1,1-Trichloroethane with a Bioaugmented Butane-Utilizing Mixed Culture. *L. Semprini, M.E. Dolan, D. Rungkamol, H. Lim, M. Mathius, P.L. McCarty, and G.D. Hopkins.*
Lewis Semprini (Oregon State University/USA)

Source-Zone Bioremediation Demonstration in a Field-Scale Experimental Controlled-Release System. *D.T. Adamson, J.M. McDade, N.L. Capiro, P.B. Bedient, C.H. Ward, and J.B. Hughes.*
David T. Adamson (Rice University/USA)

Successful Field Demonstration of Bioaugmentation to Remediate Trichloroethene in Groundwater. *E.E. Cox, M. McMaster, D. Major, and S. Neville.*
Evan E. Cox (GeoSyntec Consultants/CANADA)

E2. Issues in Risk-Based Corrective Action

Platform Papers Monday/Posters (*) Monday Evening

Chairs: *Mark E. Kelley (Battelle) & Nick Ta (U.S. Marine Corps)*

*** An Administrative Policy for Indoor Air Risk Characterization.** *R.J. Cody.*
Raphael Cody (U.S. EPA/USA)

*** Assessing the Biosafety of Three Bioremediation Approaches in a Tetrachloroethylene (PCE)-Contaminated Environment.** *N. Ross, K. Millar, S. Brown, H. Steer, C. Robinson, P. Grande, T. McDaniel, P. Martin, C. Rouleau, B. Pauli, and S. Lesage.*
Nathalie Ross (National Water Research Institute/CANADA)

*** Intrusion of Subsurface Vapors into Buildings — Chlorinated Solvents Case Studies.** *K. Berry-Spark, T. McAlary, P. Dollar, and T. Krug.*
Karen L. Berry-Spark (GeoSyntec Consultants, Inc./CANADA)

Lifecycle Remedial Project Impact Analysis Model. *J. Cornell.*
Jeff S. Cornell (U.S. Air Force/USA)

*** Management Decisions for Assessing Subsurface Vapor Intrusion into Indoor Air.** *T.A. McAlary, K. Berry-Spark, P. Dollar, and T. Krug.*
Todd A. McAlary (GeoSyntec Consultants/CANADA)

More Realistic Soil Cleanup Standards Using Dual-Equilibrium Desorption Model. *W. Chen, A.T. Kan, C.J. Newell, and M.B. Tomson.*
Wei Chen (Brown & Caldwell/USA)

*** Oxyfluorfen Spill in Fifteenmile Creek, The Dalles, Oregon.** *R.P. Schwarz, M. Renz, and E. Phillips.*
Robert P. Schwarz (Oregon Dept. of Environmental Quality/USA)

*** The Rate-Limited Release of Aromatic Hydrocarbons from Soils.** *S. Kim and W.G. Rixey.*
Sungmi Kim (University of Houston/USA)

Raymark Industries: A Superfund Indoor Air Case Study. *R. Jennings, D. Mickunas, A. Zownir, R. Curran, R. Mosley, and R. Cody.*
Ronald Jennings (U.S. EPA/USA)

Revisiting the Concentration Term for "Reasonable Maximum Exposure." *R.O. Ball, B.R. Coughlin, and J.A. Wilkie.*
Roy O. Ball (Environ International Corp./USA)

*** Soil Vapor Sampling Analytical Solution for Characterizing Indoor Air Risk.** *J.E. Kilduff and R.J. Cody.*
James Kilduff (Rensselaer Polytechnic Institute/USA)

*** Soil Vapor Sampling and Modeling for Indoor Air Risk Characterization.** *M.C. Marley, M. Walsh, J. Polonsky, C. Mann, and R. Cody.*
Michael C. Marley (Xpert Design & Diagnostics, LLC/USA)

E3. Natural Attenuation of Recalcitrant Contaminants

Platform Papers Tuesday/Posters (*) Monday Evening

Chairs: *John T. Wilson (U.S. EPA) & Hanadi Rifai (University of Houston)*

Anaerobic Microbial Oxidation of Chloroethene Contamination in Groundwater and Surface Water Systems. *P.M. Bradley and F.H. Chapelle.*
Paul M. Bradley (U.S. Geological Survey/USA)

* **Application of BIOPLUME III to a Hexane Spill Site.** *M.T. Stanforth, D.E. Isaacson, and T.W. Garrison.*
Michael T. Stanforth (Excel Environmental Associates PLLC/USA)

* **An Approach to Achieve Site Closure at Former Underground Storage Tank Sites with Diesel Constituents.** *C.T. Zimmerman, K. Fields, T. Williamson, T. Zwick, B. Patel, and T. Sahagun.*
Christian T. Zimmerman (Battelle/USA)

Assessment of Degradation Pathways at Sites with Complex Contaminant Mixtures Using Isotopes. *D.Hunkeler, R. Aravena, and E. Cox.*
Daniel Hunkeler (University of Neuchatel/SWITZERLAND)

* **Attenuation of a Mixed Chromium and Chlorinated Ethene Groundwater Plume.** *L.A. Hellerich, M.A. Panciera, N.P. Nikolaidis, B.F. Smets, and G.M. Dobbs.*
Lucas Hellerich (Metcalf & Eddy/USA)

* **Barrier-Controlled Monitored Natural Attenuation.** *G.M. Filz, M.A. Widdowson, and J.C. Little.*
Mark A. Widdowson (Virginia Polytechnic Inst & State Univ/USA)

Characterizing the Intrinsic Remediation of MTBE at Field Sites in Texas. *G.L. Shorr and H.S. Rifai.*
Gretchen Shorr (University of Houston/USA)

* **Combination of Microbiological Methane Oxidation and Reductive Tetrachloroethene Dechlorination.** *M. Weltzin, P. Klag, A. Eisentraeger, and W. Dott.*
Wolfgang Dott (Aachen University of Technology/GERMANY)

Comparison of Predicted and Observed Plume Trends at Contaminated Sites. *T.H. Wiedemeier, B.M. Henry, J.R. Hicks, J. Bidgood, and J.E. Hansen.*
Todd H. Wiedemeier (Parsons Engineering Science, Inc./USA)

Complete Natural Attenuation of PCE and TCE Without Vinyl Chloride and Ethene Accumulation. *M. Ferrey and J. Wilson.*
Mark L. Ferrey (Minnesota Pollution Control Agency/USA)

* **Degradation of Carbon Tetrachloride in Groundwater Over 10 Years: Implications for Natural Attenuation.** *A. Davis, G.G. Fennemore, and C. Peck.*
Andy Davis (Geomega/USA)

* **Enhanced Natural Attenuation by Simultaneous Application of Aerobic Bioreactive Wall.** *G. Kim, S. Park, and C. Lee.*
Geonha Kim (Hannam University/REPUBLIC OF KOREA)

* **Ethane as an Indicator for Natural Attenuation.** *P. McLoughlin and R. Pirkle.*
Patrick W. McLoughlin (Microseeps, Inc./USA)

* **Evaluating Natural Attenuation of Chlorinated Solvents at a Complex Site.** *M.J. Truex, C.D. Johnson, J.R. Spencer, and T. Prabhakar.*
Michael J. Truex (Battelle/USA)

* **Evidence for Wetland-Mediated Destruction of Chlorinated VOCs.** *J. LaChance, J. Herberich, C. Johnson, and J.H. Pardue.*
John C. LaChance (ENSR International/USA)

* **Freshwater/Saltwater Interface — A Contaminant Migration Barrier.** *B.C. White, R. Wong, T. Latas, and W.E. Collins.*
Brian C. White (IT Corporation/USA)

* **In Situ Biodegradation of 1,2-Dichloroethane and 1,2-Dibromoethane in a Stratified Aquifer.** *M.M. Thomson, E. Mack, and J.E. Vidumsky.*
Michelle M. Thomson (URS Corporation/USA)

* **Landfill Closure Strategies to Promote Natural Attenuation of Chlorinated Solvents.** *J. Hicks, D. Downey, L. Benson, and C. Vogel.*
John R. Hicks (Parsons Engineering Science, Inc./USA)

* **Modeling Biological Transformation of Chlorinated Ethanes and Ethenes in Support of Natural Attenuation.** *J.R. Spencer, C.D. Johnson, M.J. Truex, and T.P. Clement.*
James R. Spencer (NPC Services, Inc./USA)

* **Monitored Intrinsic Remediation of Petroleum Hydrocarbons in the Vadose Zone.** *K. Dougherty, S. Arroyo, C. Glenn, J. Sheldon, K. Hawley, and T. Lanning.*
Christopher Glenn (MWH Global, Inc./USA)

* **Monitored Natural Attenuation Completes Remediation at Suburban St. Paul Site.** *M.R. Connolly.*
Michael R. Connolly (Minnesota Pollution Control Agency/USA)

* **Natural Attenuation Monitoring Strategy Implemented after Termination of Pump-and-Treat Remediation.** *F.W. Blickle and T. Stone.*
Frederick W. Blickle (Conestoga Rovers & Associates, Inc./USA)

Natural Attenuation of Co-Contaminated Chlorinated Solvent-Heavy Metals Plumes. *R. Britto and A. Harris.*
Ronnie Britto (EnSafe, Inc./USA)

Natural Attenuation of Freons and TCE in Fractured Rock. *M. Basel and L. Lehmicke.*
Michael D. Basel (Montgomery Watson Harza/USA)

* **Natural Attenuation of Tetrachloroethene by Biological and Tidal Processes.** *S.R. Walbridge, R.R. Rustad, and A.M. Dasinger.*
Stephen R. Walbridge (Harding ESE, Inc./USA)

* **Natural Attenuation of Vinyl Chloride by Oxidative Microbial Transformation.** *N.W. Shah, S.A. Banwart, and P. Morgan.*
Nadeem W. Shah (University of Sheffield/UNITED KINGDOM)

* **Practical Considerations for Collecting and Interpreting Monitored Natural Attenuation Data.** *S.M. Henry.*
Susan M. Henry (URS Corporation/USA)

E3. Continued

*** Soil Conditions Affecting Degradation of Atrazine and HCH.** *B. Putters and H. Prommer.*
Birgitta Putters (Delft University of Technology/ THE NETHERLANDS)

Verification of Biodegradation of Chlorinated Ethenes Using Stable Carbon Isotopes. *P. Morrill, G. Lacrampe-Couloume, E. Edwards, B. Sleep, B. Sherwood Lollar, M. McMaster, and D. Major.*
Penny L. Morrill (University of Toronto/CANADA)

E4. Remediation Cost Estimates

Platform Papers Tuesday/Posters (*) Tuesday Evening

Chair: *Robert W. Puls (U.S. EPA)*

Cost Analysis of Interagency DNAPL Consortium Demonstrations. *S.B. Antonioli and M.D. Hogan.*
Stephen B. Antonioli (MSE Technology Applications, Inc./USA)

Cost Analysis of Permeable Reactive Barriers for Remediation of Groundwater. *R. Puls.*
Robert W. Puls (U.S. EPA/USA)

Cost and Performance of Vegetable Oil Relative to Other Organic Substrates. *B.M. Henry, T.H. Wiedemeier, J.E. Hansen, and C. Casey.*
Bruce M. Henry (Parsons Engineering Science, Inc./USA)

Full-Scale Cost Study of Surfactant Flooding for DNAPL Removal. *S.L. Yeh, F. Holzmer, L. Smith, and L. Vane.*
Frederick J. Holzmer (Duke Engineering & Services/USA)

*** Internet-Based Remediation Technology Transfer Tools.** *K.A. Fields, J. Talley, K. Harre, L. Wang, P. Ahn, and M. Gaberell.*
Keith A. Fields (Battelle/USA)

*** Modeling Remediation of Soil Contamination and Cost Efficiency.** *Q. Wu and K. Zhang.*
Qiang Wu (Louisiana State University/USA)

*** Remediation Technology Evaluation Tool (RTET).** *K.A. Fields, R. Nash, K. Jenkins, and W. Condit.*
Keith A. Fields (Battelle/USA)

E5. Remediation Strategies for Site Owners

Platform Papers Tuesday/Posters (*) Tuesday Evening

Chair: *Jacqueline W. Quinn (National Aeronautics and Space Administration)*

Comparison of Innovative Technologies for Groundwater Remediation at Camp Edwards, Massachusetts. *D. Hill, B. Gregson, K.R. Weeks, S.C. Veenstra, and D.A. Taege.*
Katherine Weeks (AMEC Earth & Environmental, Inc./USA)

*** Death of a Microbe, Part II: Case Studies of the Effects of Remedial Actions on the Microbial Community.** *E.J. Raes.*
Eric J. Raes (Engineering and Land Planning Associates/USA)

Environmental Health and Safety Issues Associated with Chemical Oxidation Technologies. *B.K. Marvin, D.J. Bryant, and D. Root.*
Bruce K. Marvin (IT Corporation/USA)

Evaluating Enhanced In Situ Anaerobic Bioremediation as a Primary Site-Wide Remediation Strategy. *B.F. Droy, F. Manale, R. Copeland, C. Creber, and G. Klecka.*
Bradley F. Droy (Toxicological & Environmental Associates, Inc./USA)

Field Assessment of Multiple DNAPL Remediation Technologies. *A.L. Wood, T.R. Lee, and C. Enfield.*
A. Lynn Wood (U.S. EPA/USA)

*** Focusing the Army's Environmental Research and Development Through the Environmental Quality Technology Process.** *S.A. Hill, M.L. Hampton, and E.B. Hangeland.*
Mark L. Hampton (U.S. Army Environmental Center/USA)

Is Innovation Appropriate — A Case Study of TCE Source Remediation. *T.P. Swingle, M.A. Orcino, M. Castellanos, J. Whitmer, T.A. Peel, and R. Santos Ebaugh.*
Todd P. Swingle (GeoSyntec Consultants/USA)

Lessons Learned by the Interagency DNAPL Consortium at Cape Canaveral. *T. Holdsworth, J. Quinn, and S. Chamberlain.*
Thomas Holdsworth (U.S. EPA/USA)

*** Source Attenuation Decision Support System and Database for Estimating Remediation Timeframes.** *C.J. Newell, S.K. Farhat, P.C. de Blanc, and J.R. Gonzales.*
Charles J. Newell (Groundwater Services, Inc./USA)

*** Trends in Applying Innovative In Situ Chlorinated Solvents Remediation Technologies.** *D. Kaback, D. Roote, E, Berkey, F. Pohland, and J. Kim.*
Dawn Kaback (Ground-Water Remediation Technologies Analysis Center/USA)

E6. Characterization of Fractured Bedrock Sites

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chairs: *Gary P. Wealthall (University of Sheffield) & Joel R. Sminchak (Battelle)*

*** Challenges Encountered While Monitoring Reductive Dechlorination in a Saline Environment.** *M.A. Daley, G. Demers, C. Elder, and D.A. Wanty.*
Matthew A. Daly (Environmental Resources Mgt/USA)

Characterization of Fractured Bedrock for Steam Injection. *E.L. Davis.*
Eva L. Davis (U.S. EPA/USA)

Characterization of Vapour Transport in Fractured Rock. *T.A. McAlary and P. Dollar.*
Todd A. McAlary (GeoSyntec Consultants/CANADA)

Comparison of Three Groundwater Sampling Methods in Bedrock Wells. *T.E. Imbrigiotta, T.A. Ehlke, P.J. Lacombe, and J.M. Dale.*
Jeffrey M. Dale (U.S. Navy/USA)

* **A Cost-Efficient Approach to Evaluating Interconnectivity of Bedrock Fractures.** *M. Daly, H.J. Cho, R. Bagley, R.J. Fiacco, and J.W. McTigue.*
Matthew A. Daly (Environmental Resources Mgt/USA)

Dissolution of Entrapped DNAPLs in Variable Aperture Fractures. *S.E. Dickson and N.R. Thomson.*
Sarah E. Dickson (McMaster University/CANADA)

* **Evaluating Techniques to Locate DNAPL Globules in Fractured Bedrock.** *R.J. Fiacco, M. Daly, R. Bagley, and J.W. McTigue.*
R. Joseph Fiacco (Environmental Resources Management/USA)

Fractured Rock-Mass Characterization to Predict DNAPL Source Zones. *G.P. Wealthall and D.N. Lerner.*
Gary P. Wealthall (University of Sheffield/UNITED KINGDOM)

Hydraulic Pulse Interference Tests for Site Hydrogeologic Characterization. *G. Hocking and C. Young.*
Chris Young (de maximis, inc./USA)

* **Plume Characterization in Complex Alluvial/Basalt Subsurface: Oregon Case Study.** *D.E. King.*
David E. King (Squier Associates/USA)

E7. Innovative Remediation Technologies for Fractured Bedrock Sites

Platform Papers Wednesday/Posters (*) Tuesday Evening

Chair: *Richard B. Wice (IT Corporation)*

* **Design and Construction of a Groundwater Recirculation System in Hydraulically Dynamic Fractured Bedrock.** *C.R. Elder, M. Daly, P.J. Zeeb, S.J. Poulos, J. Drobinski, and D. Wanty.*
Carl R. Elder (GeoSyntec Consultants/USA)

Enhanced DNAPL Recovery from Fractured Limestone AFP4, Fort Worth, Texas. *R.B. Wice, G. Walters, and H.D. Ficklen.*
Richard B. Wice (IT Corporation/USA)

Injection of Zero-Valent Iron into a Shale Bedrock Formation for the Reduction of Trichloroethene. *S. Chen, S.J. Markesic, and S.H. Abrams.*
Steve Chen (ARS Technologies, Inc./USA)

Multi-Phase Remedial Approach for DNAPL Investigation and Remediation. *D. Beal, H. Faircloth, and E. Hunnewell.*
Douglas Beal (BEM Systems, Inc./USA)

Trichloroethylene Removal from Fractured Rock Using Steam-Enhanced Remediation. *G. Heron, S. Carroll, S. Palmer, K. Coleman, L. Oyelowo, and S. Watts.*
Gorm Heron (SteamTech Environmental Services, Inc./USA)

A Tunnel/Drain Collection System to Control Contaminant Migration in Fractured Bedrock. *J.H. Guswa, J.R. Bridge, A.E. Benjamin, L.E. Scheuing, J.G. Haggard, E. LaPoint, J.R.Y. Rawson, and B.H. Kueper.*
John H. Guswa (GeoTrans, Inc./USA)

E8. Chemical and Biological Techniques for Treatment In Fractured Bedrock

Platform Papers Thursday/Posters (*) Tuesday Evening

Chairs: *Nathalie Ross (National Water Research Institute) & Lydia Cumming (Battelle)*

Accelerated Bioremediation of Trichloroethylene: A Comparison Between Saprolite and Crystalline Bedrock Aquifers. *T. Klutz, G. Maalouf, and C. Sandefur.*
Tony Klutz (Schlumberger RMS/USA)

Biofilm Development in a Large-Scale Planar Fracture. *N. Ross, K. Novakowski, P. Lapcevic, J. Voralek, S. Brown, C. Kennedy, B.M. Yazicioglu, R. Samson, and S. Lesage.*
Nathalie Ross (National Water Research Institute/CANADA)

Chemical Oxidation of Tetrachloroethene (PCE) in a Fractured Saprolitic Bedrock Aquifer. *P.G. Werner.*
Paul G. Werner (Versar, Inc./USA)

Degradation of Trichloroethene (TCE) in a Fractured Bedrock Aquifer Using Sodium Permanganate. *C.L. Williams.*
Carrie L. Williams (GeoSyntec Consultants/USA)

Design and Implementation of a Pilot Test for Bioremediation of a Concentrated TCE Plume in Fractured Bedrock. *P.R. Chang, R. Leary, P.J. Zeeb, G. Demers, C. Elder, D. Major, and D.A. Wanty.*
Paula R. Chang (GeoSyntec Consultants/USA)

* **Enhanced Degradation of Chlorinated Solvents in Fractured Rock Groundwater Using Subsurface Injection of HRC®.** *M.S. Kozar, C.L. McIlvaine, B.E. Duffy, and W.M. Street.*
Michael S. Kozar (O'Brien & Gere Engineers, Inc./USA)

* **Evaluation of Oxidation and Bioremediation for CVOCs in Fractured Bedrock.** *L.K. MacKinnon, E.E. Cox, E.D. Hood, K.G. Mumford, and N.R. Thomson.*
Leah K. MacKinnon (GeoSyntec Consultants/CANADA)

* **In Situ Chemical Oxidation of PCE in Fractured Bedrock.** *M.D. Kauffman, J. LaChance, J. Robb, M.E. Krivansky, and M.W. Leipert.*
Mark D. Kauffman (ENSR International/USA)

* **Laboratory and Field Measurement of Potassium Permanganate Consumption by Fractured Sedimentary Bedrock.** *M.J. Gefell, K.L. Sperry, J. Rawson, E. Kolodziej, and P.P. Mlodzinski.*
Michael J. Gefell (Blasland, Bouck & Lee, Inc./USA)

Modified Fenton Treatment of Recalcitrant Chlorinated Contaminants in Fractured Bedrock. *P.K.C. Kakarla, and R.S. Greenberg.*
Richard S. Greenberg (In-Situ Oxidative Technologies, Inc./USA)

* **PCE Remediation in Bedrock Using Full-Scale Enhanced Reductive Dechlorination.** *D.L. Jacobs, F. Lenzo, and J. Burdick.*
Daniel L. Jacobs (ARCADIS G&M/USA)

Permanganate Interactions with Fractured Rock. *K.G. Mumford, N.R. Thomson, L.K. MacKinnon, and E.E. Cox.*
Kevin G. Mumford (University of Waterloo/CANADA)

E8. Continued

Regulatory Perspective: In Situ Chemical Oxidation Pilot Test in Fractured Granite. *B. Brandon, D. Chaffin, and P.M. Whittemore.*
William C. Brandon (U.S. EPA/USA)

E9. MTBE Characterization and Treatment

Platform Papers Thursday/Posters (*) Tuesday Evening

Chairs: *James E. Landmeyer (U.S. Geological Survey) & Paul M. Bradley (U.S. Geological Survey)*

* **Aerobic Biodegradation Rates of MTBE on Sand-Packed Columns.** *A. Martinez-Prado, K.J. Williamson, L.M. Ciuffetti, and K. Skinner.*
Adriana Martinez-Prado (Oregon State University/USA)

* **Case Study of the Influence of Denitrification on MTBE Degradation.** *S.E. Pfanstiel, M.M. Gates, and M.A. Hansen.*
Steven E. Pfanstiel (ARCADIS G&M/USA)

* **Degradation of MTBE by Psychrophilic Bacteria.** *D.J. Slomczynski and W.J. Davis-Hoover.*
David J. Slomczynski (University of Cincinnati/USA)

Effect of Redox Conditions on Anaerobic MTBE Biodegradation. *P.M. Bradley, F.H. Chapelle, and J.E. Landmeyer.*
Paul M. Bradley (U.S. Geological Survey/USA)

* **Effects of Gasoline Components on Cometabolic Biodegradation of MTBE.** *M. Hyman, J. Burdette, and K. O'Reilly.*
Michael R. Hyman (North Carolina State University/USA)

* **Evaluation of the Intrinsic MTBE Biodegradation Potential in MTBE-Contaminated Soils.** *D. Moreels, L. Bastiaens, R. Merckx, F. Ollevier, L. Diels, and D. Springael.*
David Moreels (Vito/BELGIUM)

Field Treatment Demonstration for USEPA on MTBE-Impacted Water Supplies. *P.M. Tornatore, M.G. Nickelsen, W.J. Cooper, A.E. Venosa, and K. Greene.*
Paul M. Tornatore (Haley & Aldrich, Inc./USA)

* **Groundwater Impacts from MTBE and Other Fuel Oxygenates at UST Sites in Arizona.** *P. Dahlen, E. Henry, M. Matsumura, and P.C. Johnson.*
Paul C. Johnson (Arizona State University/USA)

* **Immobilization of MTBE with Organo-Modified Soils.** *S. Chattopadhyay, B. Sass, and J. Sorg.*
Sandip Chattopadhyay (Battelle/USA)

* **Impact of Environmental Conditions on the Degradation of MTBE by a Mixed Culture.** *P. Piveteau, F. Fayolle, and F. Monot.*
Francoise Fayolle (Institut Francais du Petrole/FRANCE)

In Situ Biological Destruction of MTBE: Field Engineering Solutions. *R. Deeb and M. Kavanaugh.*
Rula Anselmo Deeb (Malcolm Pirnie, Inc./USA)

In Situ Bioremediation of MTBE Through Biostimulation and Bioaugmentation. *A. Bagga and H.S. Rifai.*
Ashish Bagga (University of Houston/USA)

Integrated Approach to Remediate a Large MTBE Groundwater Plume. *B. Barnes, D. Baum, R. Laljani, and D. Ochs.*
Bryant Barnes (B&C Services/USA)

* **Kinetic and Equilibrium Adsorption of MTBE onto Different Adsorbents.** *T.-F. Lin and S.-W. Hoang.*
Tsair-Fuh Lin (National Cheng Kung University/TAIWAN)

Large-Scale Mixed MTBE-BTEX Plume Containment at Port Hueneme, California, Using a Combination of Biostimulation and Bioaugmentation. *C. Bruce, P.C. Johnson, and K. Miller.*
Cristin L. Bruce (Arizona State University/USA)

MTBE Biodegradation by Indigenous Aquifer Microorganisms Under Artificial Oxic Conditions. *J.E. Landmeyer.*
James E. Landmeyer (U.S. Geological Survey/USA)

MTBE Bioremediation with Bionets Containing Isolite, PM1, SRO or Air. *W.J. Davis-Hoover, J. Goetz, M. Kemper, M. Roulier, J. Fleischman, S. Hunt, K. Hristova, K. Scow, K. Knutson, W. Mahaffee, D.J. Slomczynski, and S. Stavnes.*
Wendy J. Davis-Hoover (U.S. EPA/USA)

* **MTBE Oxidation with Fenton's Reagent in a Naturally Buffered Aquifer.** *A. Gavaskar and K. Hartzell.*
Kristen E. Hartzell (Battelle/USA)

* **Pilot-Scale Treatment Study of MTBE and Alternative Fuel Oxygenates.** *J.M. Sutherland, C.D. Adams, and J. Kekobad.*
Justin M. Sutherland (University of Missouri-Rolla/USA)

* **Simultaneous Source Reduction and Bioremediation of MTBE During Two-Phase Extraction.** *M. Pehlivan, and P.G. Mihopoulos.*
Mehmet Pehlivan (Tait Environmental Management, Inc./USA)

* **Transport of MTBE Through Laboratory-Scale Adsorbent-Based Permeable Reactive Barriers.** *S.-W. Hoang and T.- F. Lin.*
Shih-Wen Hoang (National Cheng Kung University/ TAIWAN)

* **Widespread Potential for Aerobic MTBE Biodegradation in Surfacewater Sediments.** *P.M. Bradley, F.H. Chapelle, and J.E. Landmeyer.*
Paul M. Bradley (U.S. Geological Survey/USA)
Wendy J. Davis-Hoover (U.S. EPA/USA)

CONFERENCE REGISTRATION FORM

Remediation of Chlorinated and Recalcitrant Compounds

May 20-23, 2002 Monterey, California

Please type or print clearly

Last Name (surname)_____ First/Middle Names_____

Employer_____

Mailing Address_____

City_____ State/Province_____

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REGISTRATION FEES. The following fees cover admission to platform and poster sessions, exhibits, group lunches, receptions, and daily continental breakfasts and refreshment breaks. (To register for short courses, see the form on page 40.) Registration materials will include the final program and a set of abstracts. Industry-, government-, and university-rate registrants will receive the proceedings by mail after the Conference; student registrants will not receive the proceedings.

	Paid by 28 Feb 02	Paid after 28 Feb 02
Industry	US$825	US$915
Government/University	US$775	US$865
Full-time Student	US$375	US$425

We encourage you to register early; registrations will be limited to the number that the facility can accommodate efficiently. Because registration fees are the major source of funding for the Conference and a significant percentage of registrants will make presentations, ***all presenting authors and session chairs are expected to register before the Conference and pay the standard fees.*** Purchase orders will be accepted, but ***the early registration discount will apply only if payment is received by February 28, 2002.*** The ***government rate*** is extended only to employees of government agencies and is not available to government contractors. To qualify for the ***student rate***, include a copy of current student ID with your registration.

CANCELLATION. For cancellations received by April 1, 2002, the registration fee will be refunded, less a $35 service fee. No refunds will be made after April 1, but paid no-shows will receive all materials covered by their registration fees. Substitutions will be accepted at any time, preferably with advance notice. If Battelle cancels the event due to circumstances beyond Battelle's reasonable control such as, but not limited to, acts of God, acts of war, government emergency, labor strikes, and/or unavailability of the event or exhibition facility, Battelle shall refund to attendee his/her previously paid registration fee less a share of event costs incurred by Battelle. This refund shall be attendee's exclusive remedy and Battelle's sole liability for cancellation of the event for reasons generally described in this paragraph.

METHOD OF PAYMENT. Payment is required to confirm your registration.

❑ Check (Checks must be drawn on a U.S. bank and payable in U.S. funds to The Conference Group, Inc. FEID #31-1157243, and reference the Chlorinated Conference.

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Direct: 614-424-5461

By Fax: 614-488-5747

E-mail: info@confgroupinc.com

Web: www.battelle.org/chlorcon

INFORMATION REQUESTS

❑ My organization would be interested in displaying its products or services at the conference. Please send an exhibit application.

❑ I will be unable to attend the conference. However, please send an order form for the abstract booklets when available.

❑ I will be unable to attend the conference. However, please send me a catalogue for the proceedings when available.

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SHORT COURSE DESCRIPTIONS

Courses will be offered on Sunday, before the Conference program begins; during the Wednesday afternoon recess in the program; and on Friday, after the Conference has ended. As of November 30, nine courses were scheduled; brief synopses are provided below. Additional courses are being planned, and the descriptions will be posted at www.battelle.org/chlorcon in January.

The Short Course Registration form (page 40) lists the fees. Prospective short course attendees should preregister by April 18 — classroom space allocations and production of materials will be determined by the number registered for each course by that date. If insufficient registrations are received for a given course by April 18, the course will be canceled, with registrants' course fees being transferred to other courses selected by the registrants or refunded. Course registrations will be accepted after April 18 only if space is available.

Sunday, May 19, 1:00-5:00 P.M.

Advances in Permeable Reactive Barrier Technologies

Stephanie O'Hannesin, John Vogan, and Mike Duchene (EnviroMetal Technologies, Inc.); David Smyth (University of Waterloo); and Bruce Sass (Battelle)

In the past seven years, permeable reactive barrier (PRB) technology has become an accepted alternative for in situ remediation of a variety of groundwater contaminants. Recent PRB applications have incorporated a number of design and construction innovations that have improved the cost-effectiveness of the technology. This course will focus on these developments. The course will include four broad topics: PRB process chemistry and design for volatile organic compounds (VOCs); innovative PRB construction methods; PRB longevity; and PRB technology for trace metals and other inorganics. A number of case studies will also be used to provide a summary of PRB long-term performance, and a short design exercise will be conducted.

Application of Environmental Isotopes in Contaminant Hydrogeology

Ramon Aravena (University of Waterloo) and Daniel Hunkeler (University of Neuchatel, Switzerland)

New techniques for measuring isotope ratios of individual compounds at low concentrations have exciting application in contaminant hydrogeology. Isotopes can be used to differentiate between different sources of contamination or to assess biotic and abiotic transformation processes. This course is designed to provide the information necessary for successful application of the new isotope methods to problems in contaminant hydrogeology. After a concise introduction on fundamental aspects of environmental isotopes and discussion of analytical methods, the course will focus on application of stable isotopes to distinguish sources of contamination, to evaluate natural attenuation, and to assess the performance of engineered remediation methods. Case studies will be presented, with emphasis on sites contaminated with chlorinated hydrocarbons and petroleum hydrocarbons, such as BTEX and MTBE.

Natural Attenuation of Metals

Duane Graves, Jonathan Myers, and Warren Brady (IT Corporation); Paul Grossl (Utah State University); Scott Fendorf (Stanford University); and Matthew Eick (Virginia Tech University)

This short course will provide a description of the mechanisms for metals attenuation in soils, sediments, and groundwater. Methods for demonstrating metal attenuation by modeling, analytical methods, and risk-based corrective action (RBCA) calculations will be provided. The target audience will be regulators, stake-holders, and other interested parties. The introductory section will provide a regulatory overview. Subsequent sections will cover metal attenuation mechanisms (metal immobilization processes; biological controls on metal attenuation) and methods of demonstrating metal attenuation (RBCA calculations; analytical methods; geochemical modeling), and the final section will provide a discussion of several case studies.

Wednesday, May 22, 1:30-5:30 P.M.

Enhanced Reductive Dechlorination (ERD) Using In Situ Reactive Zone (IRZ) Technology – Practical Applications

Suthan Suthersan, Frank Lenzo, Mike Hansen, and Jeff Burdick (ARCADIS Geraghty & Miller)

This course will provide attendees with a practical background and instruction for the use of in situ reactive zone (IRZ) technologies to treat chlorinated organic compounds via enhanced reductive dechlorination (ERD). ERD is a cutting-edge, state-of-the-art remediation technology that addresses chlorinated organics and can provide significant benefits in terms of accelerated cleanup and reduction in lifecycle costs. The course will be organized into the following sections: basic concepts, baseline data collection, engineered anaerobic systems, hydrogeological considerations for the design of IRZs, development of field pilot study designs, and design of full-scale systems. Specific technical issues related to the applicability of ERD technology for DNAPL remediation will be discussed. Engineering and design expertise derived from the experience of implementing more than 100 projects utilizing these technologies will be presented via case studies in a "lessons learned" format. The use of various electron donor amendments used to generate the IRZs will be compared and contrasted both on a technical and economic basis. A discussion of the application of IRZs for metals precipitation also will be included.

Bioaugmentation to Remediate Chlorinated Solvents in Groundwater

Dave Major and Evan Cox (GeoSyntec Consultants) and Elizabeth Edwards (University of Toronto)

Groundwater extraction and ex situ treatment (pump-and-treat) approaches for sites contaminated by chlorinated solvents such as PCE and TCE have generally proven ineffective in significantly restoring groundwater quality, even after decades of operation. By comparison, enhanced in situ bioremediation (EISB) has significant potential to reduce the duration and cost of remediating chlorinated solvent groundwater plumes and sources. To date, EISB technology

development has focused mainly on the selection and delivery of appropriate nutrients, but laboratory and field research demonstrates that the critical factor in EISB success (i.e., complete dechlorination of PCE and TCE to ethene) is the presence of specific dehalorespiring bacteria, particularly *Dehalococcoides ethenogenes*. Unfortunately, these microorganisms are absent at some PCE- and TCE-contaminated sites, with the result that PCE and TCE dechlorination stalls at cis-1,2-DCE, even with ample electron donor addition. To overcome this microbial limitation, several natural, non-pathogenic dehalorespiring microbial cultures have been developed for addition to contaminated aquifers to promote rapid and complete biodegradation of PCE and TCE to ethene. Multiple field demonstrations in porous media and fractured rock environments have shown this bioaugmentation process to have significant promise as a remedial approach for industrial and government sites, and the use of this technology is increasing rapidly. This short course will present: background on the bacteria and processes responsible for PCE and TCE degradation; case studies of bioaugmentation field demonstrations at half a dozen sites; methodologies for assessment of bioaugmentation as a remedial option; and methodologies for bioaugmentation design, application, and performance validation.

Introduction to Surface and Borehole Geophysics

Mark Blackey (Geophysical Applications, Inc.)

Well-planned geophysical surveys are an important early step in characterizing subsurface conditions at many sites. Applications range from locating buried man-made objects such as USTs, pipes, trenches, and drums, to identifying bedrock topography and hydraulically-active fracture orientations. This short course is intended to provide basic information regarding the underlying principles, capabilities, and limitations of the geophysical survey methods most likely to be utilized in characterizing chlorinated solvent sites. Participants will gain confidence in selecting appropriate geophysical surveys for a variety of objectives and site conditions. The course will cover both surface geophysics methods (ground-penetrating radar, or GPR; multi-electrode resistivity imaging, seismic refraction; p-wave and s-wave seismic reflection; magnetometry and EM terrain conductivity; pipe and cable-locating instruments) and borehole geophysics methods (conventional geophysics logs; flowmeter measurements; fracture characterization via acoustic and optical televiewer logs; GPR). Classroom instruction will be combined with outdoor demonstrations of selected techniques (probably including GPR, resistivity imaging, and pipe- and cable-locating instruments). At least two case histories will be presented, demonstrating applicability of surface and borehole geophysics methods to overburden and bedrock site characterization.

Friday, May 24, 8:00-NOON

Application of In Situ Chemical Oxidation (ISCO)

John T. Cookson and Ken Sperry (Expert Design & Diagnostics, LLC)

The course will introduce the basics of the various chemical oxidants, describing their chemistry and applicability for various contaminants and then will build from these basics to describe how ISCO technologies are handled and applied in the field. The course sections will deal with available oxidants (ozone, hydrogen peroxide, permanganate, persulfate) and oxidation chemistry principles (oxidation-reduction potential, direct oxidation, free radical oxidation). This will be followed by a discussion of factors to be considered in selecting oxidants, conducting laboratory treatability studies, and designing pilot-scale tests. The final section will cover full-scale application design issues, including selection of oxidant batching and injection equipment and oxidant delivery systems (hydraulic injection—infiltration galleries and injection wells; solid/slurry emplacement; and pneumatic injection).

Natural Attenuation Potential of MTBE and Alternative Oxygenates

Rula A. Deeb and Michael Kavanaugh (Malcolm Pirnie, Inc.), James Landmeyer (U.S. Geological Survey), and Pedro J. Alvarez (University of Iowa)

Natural attenuation is the remediation approach in use at tens of thousands of sites nationwide, either alone or in conjunction with engineered remediation systems. One potential application is the remediation of fuel oxygenates, such as methyl tert-butyl ether (MTBE), ethyl tert-butyl ether (ETBE), tert-amyl methyl ether (TAME), diisopropyl ether (DIPE), tert-butyl alcohol (TBA), methanol and ethanol. This course will provide an overview of the mechanisms responsible for attenuation of these compounds; the focus will be on the biodegradation of fuel oxygenates because biological destruction is a critical attenuation mechanism in subsurface environments. Laboratory and field reports of oxygenate biodegradability under aerobic and anaerobic conditions will be discussed, and the current understanding of the factors limiting fuel oxygenate bioattenuation in the environment will be evaluated. Finally, this course will define when monitored natural attenuation is the appropriate approach for the cleanup of groundwater and soil environments contaminated with oxygenate-blended fuels.

Phytoremediation Project Design and Implementation

Robert W. Tossell (CH2M Hill) and Eric Foote (Battelle)

This course is intended to be a hands-on primer for the selection and application of phytoremediation. Course instructors are recognized experts in the phytotechnology field who have conducted bench-scale research and also have implemented and maintained field- and full-scale phytotechnology-based solutions at sites contaminated with chlorinated solvents, petroleum hydrocarbons, nutrients, petroleum additives, metals, and PAHs. The course will briefly cover the fundamentals of the science and application of phytoremediation including case study examples of how the technology can be implemented as a stand-alone technology or as a component to a multitechnology solution. Participants will have the opportunity to conduct a hands-on evaluation and design a phytotechnology solution for a real-world site. This exercise is intended to provide participants with the fundamentals of screening and selecting a phytotechnology solution for these sites.

SHORT COURSE REGISTRATION FORM

Remediation Short Courses

May 19, 22, and 24, 2002 Monterey, California

The short courses listed below are offered in conjunction with the Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Course descriptions appear on pages 38-39. All courses will be conducted at the DoubleTree Hotel, which is part of the DoubleTree & Marriott Hotels/Monterey Conference Center complex used for the Conference program. Conference attendance is not required to attend the courses, but course fees are discounted for Conference registrants. (See page 37 for the Conference Registration Form and page 6 for information about accommodations at the DoubleTree or the Marriott.)

We encourage you to register early. Classroom space allocation and production of course materials will be determined by the number registered for each course by April 18; registrations received after that date will be accepted only if space is available. Registrations received through April 18 will be confirmed by April 25. ***If insufficient registrations are received for a given course by April 18, the course will be canceled, and each registrant's fee will be refunded or transferred to another course selected by the registrant.***

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COURSE SELECTION. Check the course(s) you would like to attend. (Note: Additional courses are being planned; descriptions will be posted at www.battelle.org/chlorcon in January.)

Sunday, May 19, 1:00 – 5:00 PM	Wednesday, May 22, 1:30 – 5:30 PM	Friday, May 24, 8:00 AM – NOON
[ ] Permeable Reactive Barriers	[ ] ERD Using IRZ Technology	[ ] In Situ Chemical Oxidation
[ ] Environmental Isotopes	[ ] Bioaugmentation	[ ] NA Potential of Fuel Oxygenates
[ ] Natural Attenuation of Metals	[ ] Surface and Borehole Geophysics	[ ] Phytoremediation

COURSE FEES. Multiply the number of courses selected by the applicable fee in the schedule below.

	Paid by April 18	Paid after April 18	
For Conference registrants	$100	$175	
If not attending Conference	$200	$275	**TOTAL COURSE FEES** **US$_____**

CANCELLATION. For cancellations received by April 18, 2002, the registration fee will be refunded, less a $10 service fee. No refunds will be made after April 18, but paid no-shows will receive all course materials. Substitutions will be accepted at any time, preferably with advance notice. If Battelle cancels the Conference due to circumstances beyond Battelle's reasonable control such as, but not limited to, acts of God, acts of war, government emergency, labor strikes, and/or unavailability of the event or exhibition facility, Battelle shall refund to attendee his/her previously paid short course registration fee(s) less a share of event costs incurred by Battelle. This refund shall be attendee's exclusive remedy and Battelle's sole liability for cancellation of the event for reasons generally described in this paragraph.

METHOD OF PAYMENT. Payment is required to confirm your reservation. Cancellations received by April 18, 2002, will be refunded, less a $10 service fee. No refunds will be made for cancellations received after that date, but paid no-shows will receive all course materials. Substitutions will be accepted at any time, preferably with advance notice.

❑ Check (Checks must be drawn on a U.S. bank and payable in U.S. funds to The Conference Group, Inc. FEID #31-1157243, and reference the Chlorinated Conference.)

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