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Calvin H. (Herb) Ward

Professor

Foyt Family Chair of Engineering and Professor in Civil
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- Ph.D. (1960) Cornell University
- MPH (1978) University of Texas
- MS (1957) Cornell University
- BS (1955) New Mexico State University

Department of Civil and Environmental Engineering
Department of Ecology and Evolutionary Biology[More Info](#)

Research Areas

Environmental Microbiology; Remediation Technology Development; Chemical Transport and Fate

Research Statement

Source zone bioremediation harnesses the natural metabolism of dehalorespiring organisms, capable of thriving at high concentrations of chlorinated solvent contamination, to modify the dissolution characteristics of DNAPLs. A quantitative demonstration is being conducted in parallel environmental controlled release systems (ECRS) with known initial DNAPL mass and composition. One will be bioaugmented and the other will be an independent control.

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Teaching Areas

Environmental science and engineering; Remediation technologies; Technical writing and presentation;
Urban systems analysis

Selected Publications

Articles

Stroo HF, M Unger, CH Ward, MC Kavanaugh, C Vogel, JA Marqusee, BP Smith "Remediating Chlorinated Solvent Source Zones." *Environmental Science and Technology*, 37 (2003/6/1): 223A-230A.

Books

- C.H. Ward, M.R. Scalf, and J. Cherry, Editors "Subsurface Restoration." : 491.
- Lowe, D.F., C.L. Oubre, & C.H. Ward (Editors) "Surfactants & Co-Solvents for NAPL Remediation (A Technology Practices Manual)." : 412.
- Fiorenza, S.L., C.L. Oubre, and C.H. Ward (Editors) "Sequenced Reactive Barriers for Groundwater Remediation." : 730.
- Balshaw-Biddle, K., C.L. Oubre, C.H. Ward "Steam and Electro-Heating Remediation of Tight Soils." : 403.
- Fiorenza, S., C.L. Oubre, and C.H. Ward (Editors) "Phytoremediation of Hydrocarbon-Contaminated Soil." : 164.
- Balshaw-Biddle, K., C.L. Oubre, C.H. Ward "Subsurface Contamination Monitoring Using Laser Fluorescence." : 160.
- Lowe, D.F., C.L. Oubre, C.H. Ward "Soil Vapor Extraction Using Radio Frequency Heating (Resource Manual and Technology Demonstration)." : 328.
- Ward, C.H. and J.S. Schmandt (Editors) "Sustainable Development: Managing the Transition." .
- Lowe, D.F., C.L. Oubre, C.H. Ward "Remediation of Firing-Range Impact Berms." : 379.
- Balshaw-Biddle, K., C.L. Oubre, and C.H. Ward (Editors) "Subsurface Contamination Monitoring Using Laser Fluorescence." : 160.
- C.H. Ward and J. Schmandt, Editors "Sustainable Development." .
- Fiorenza, S., C.L. Oubre, C.H. Ward "NAPL Removal: Surfactants, Foams, and Microemulsions." : 552.
- Lowe, D.L., C.L. Oubre, and C.H. Ward (Editors) "Reuse of Surfactants and Cosolvents for NAPL Remediation." .
- Ward, C.H. and Academy Committee "Peer Review in Environmental Technology Development." : 80.
- Fiorenza, S., C.L. Oubre, and C.H. Ward (Editors) "NAPL Removal (Surfactants, Foams, and Microemulsions)." .
- Ward, C.H. and Academy Committee "Groundwater and Soil Cleanup: Improving Management of Persistent Contaminants." : 285.
- Lowe, D.F., C.L. Oubre, and C.H. Ward (Editors) "Remediation of Firing-Range Impact Berms." .
- Lowe, D.F., C.L. Oubre, and C.H. Ward (Editors) "Soil Vapor Extraction Using Radio Frequency Heating (Resource Manual and Technology Demonstration)." .
- Balshaw-Biddle, K., C.L. Oubre, and C.H. Ward "Steam and Electro-Heating Remediation of Tight Soils."
- Balshaw-Biddle, K., C.L. Oubre, and C.H. Ward (Editors) "Modular Remediation Testing System." : 276.

Book chapters

Hughes JB, CN Neale, CH Ward "Bioremediation." *The Desk Encyclopedia of Microbiology* (2003): 194-213.

Other

Hughes, J.B., C.N. Neale, and C.H. Ward "Bioremediation." *Encyclopedia of Microbiology* (In Press).

Neale, C. N., A. W. Holder, C. H. Ward and J. B. Hughes "Groundwater Reaeration and Hydrocarbon Plume Length: A Modeling Analysis." *Journal of Environmental Engineering* (Accepted).

Neale, C.N., J.B. Hughes, C.H. Ward "Impacts of Unsaturated Zone Properties on Oxygen Transport and Aquifer Reaeration." *Ground Water*, 38:5 (2000): 784-794.

Jee, V., D.M. Beckles, C.H. Ward, and J.B. Hughes "Aerobic Slurry Reactor Treatment of Phenanthrene Contaminated Sediment." *Wat. Res.*, 32, #4 (1998): 1231-1239.

Hughes, J.B., C.N. Neale, C.H. Ward "Bioremediation." *Encyclopedia of Microbiology, Second Edition*, 1 (2000): 587-610.

Hughes, J. B., K. L. Duston and C. H. Ward "Bioremediation." *Ground Water Remediation Technologies Analysis Center*.

Hughes, J. B., G. A. Pope, J. Spain, J. S. Fruchter and C. H. Ward "In-Situ Treatment Technologies." *Innovative Approaches to the In-Situ Assessment and Remediation of Contaminated Sites*.

C.H. Ward, F.K. Pfaender, J. Suflita "Introduction to Special Issue on Bioremediation." *Journal of Industrial Microbiology & Biotechnology*, 18 (1998): 73-74.

C.H. Ward and S. Fiorenza "Microbial adaptation to hydrogen peroxide and biodegradation of aromatic hydrocarbons." *Journal of Industrial Microbiology and Biotechnology*, 18 (1998): 140-151.

C.H. Ward, J.M. Thomas, C.L. Bruce, V.R. Gordy, S.R. Hutchins, and J.L. Sinclair "Assessment of the Potential for Nitrate-Enhanced Bioremediation of a JP-4 Fuel Contaminated Aquifer." *Journal of Industrial Microbiology and Biotechnology*, 18 (1998): 213-221.

J.B. Hughes, S.D. Chandra, and C.H. Ward "Utilization of Bioremediation Processes for the Treatment of PAH-Contaminated Sediments." *Journal of Industrial Microbiology & Biotechnology*, 18 (1998): 152-160.

Neale, C.N., J.B. Hughes, and C.H. Ward "Impacts of vadose zone properties of oxygen transport and aquifer reaeration." *Ground Water* (10/99).

Refereed Articles

DaSilva, M.L.B., R.C. Daprato, D.E. Gomez, J.B. Hughes, C.H. Ward and P.J.J. Alvarez "Comparison of Bioaugmentation and Biostimulation for the Enhancement of DNAPL Source Zone Bioremediation." *Water Environment Research* (2006).(In Press)

Gustavson, K.L., L.W. Barnthouse, C.L. Brierley, E.H. Clark and C.H. Ward "Superfund and Mining Megasites." *Environmental Science and Technology* (2006).(In Press)

Presentations**Invited Talks**

"The Journals of SETAC: Environmental Science Reaching the World." 1st Annual Desert Southwest Society of Environmental Toxicology and Chemistry Meeting, University of Texas at El Paso, El Paso, TX. (June 25-26, 2004)

"Bioremediation of DNAPL Source Zones." Regenesys, Orlando, Florida. (June 2, 2003)

"Project of the Year Awards." Partners in Environmental Technology Technical Symposium & Workshop, Washington, D.C. (December 2-4, 2003)

"How to Read the Newspaper on Environmental Issues." Women's Faculty Club, Rice University. (Feb. 12, 2003)

Lectures

"Superfund Regulations and Remediation." UNIV 113, Rice University. (March 6, 2003)

Other

"Bioremediation/Natural Attenuation." US EPA/TIO GWRTAC Advances in Innovative Ground-Water REMediation Technologies Conference, Boston MA. (June 6-7, 2000)

"Plenary Address: Enhanced Bioattenuation for Subsurface Remediation." In-Situ and On-Site Bioremediation, Fifth International Battelle Symposium, San Diego CA. (April 19, 1999)

"Session B2: Enhanced Bioremediation of DNAPL Source Zones." 7th International In Situ and On-Site Bioremediation Symposium, Orlando, Florida. (June 2-5, 2003)

"The Urban Challenge: Thinking Outside the Box." Rice Old Men Eating Out (ROMEO), Houston, TX. (January 12, 2001)

"Keynote Address: Future Needs for Enhanced Bioattenuation of Subsurface Contaminants." Partners in Environmental Technology Symposium, US Department of Defense, Washington DC. (November 30, 1999)

"R&D Needs for Chlorinated Solvent Site Cleanup." Partners in Environmental Technology Symposium, SERDP/ESTCP, Washington, D.C.. (November 27-29, 2001) With Hans Stroo and Michael Kavanaugh.

"The Cutting Edge Technology Report on Hazardous Waste." Information Television Network (ITV), CNBC. (April 2000)

"Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." Association of Environmental Engineering and Science Professors (AEESP) Year 2000 Distinguished Lecture Tour, University of Nevada--Las Vegas. (March 2-3, 2000)

"Invited Seminar: Contaminated Ground Water Resources: Current Approaches for Assessment and Remediation." Clemson University. (February 22, 1999)

"Overview on In-Situ Treatment Technologies." NATO Advanced Study Institute on Innovative Approaches to the On-Site Assessment and Remediation of Contaminated Sites, Prague, Czech Republic. (May 24 - June 2, 2001)

"Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." AEESP Year 2000 Distinguished Lecture Tour, University of Missouri--Columbia. (March 7-8, 2000)

"Keynote Address." Dedication of the Environmental Chemistry Center and expanded facilities of the Hazardous Waste Research Center, US Corps of Engineers, Waterways Experiment Station, Vicksburg MS. (June 25, 1999)

"Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." AEESP Year 2000 Distinguished Lecture Tour, Tennessee Technological University. (March 21-22, 2000)

"Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." AEESP Year 2000 National Distinguished Lecture Tour, North Carolina State University. (April 5-6, 2000)

"Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." AEESP Year 2000 National Distinguished Lecture Tour, University of Cincinnati. (April 6-7, 2000)

"Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." AEESP Year 2000 National Distinguished Lecture Tour, University of Toronto. (April 11, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges." AEESP Year 2000 National Distinguished Lecture Tour, University of Delaware. (March 13, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges." AEESP Year 2000 National Distinguished Lecture Tour, University of Pittsburgh. (March 16-17, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges." AEESP Year 2000 National Distinguished Lecture Tour, University of Florida--Gainesville. (March 23-24, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges." AEESP Year 2000 National Distinguished Lecture Tour, Johns Hopkins University. (March 30-31, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges." AEESP Year 2000 National Distinguished Lecture Tour, Michigan Technological University. (April 13, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges." AEESP Year 2000 National Distinguished Lecture Tour, University of Alabama at Birmingham. (April 18, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges" AND "Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." AEESP Year 2000 National Distinguished Lecture Tour, Clemson University. (April 20, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges" AND "Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." AEESP Year 2000 National Distinguished Lecture Tour, UCLA & California Technological Institute. (May 2-3, 2000)

"Environmental Remediation Technology Development: National Needs, Opportunities, and Challenges" AND "Bioattenuation of Contaminants in the Subsurface: Strategies for Engineering Control." AEESP Year 2000 National Distinguished Lecture Tour, Utah State University. (May 4-5, 2000)

Session Chair

"Panel Discussion on DNAPL Source Zone Treatment: Lessons learned and implications for future applications." Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California. (May 22, 2006)

Editorial Positions

Other, Environmental Toxicology and Chemistry. SETAC Press. (1981-).

Editorial Board, *Bioremediation Journal*. (1997-).

International Advisory Board, *Enzyme and Microbial Technology*. (1997-).

Other, *Environmental Toxicology and Chemistry*. Society for Environmental Toxicology & Chemistry. (1999-1999).

Editorial Board, *Bioremediation Journal*. (1999-1999).

International Advisory Board, *Enzyme and Microbial Technology*. (1999-1999).

Other, *Environmental Toxicology and Chemistry*. SETAC Press. (1981-).

Editorial Board, *Bioremediation Journal*. (1998-).

International Advisory Board, *Enzyme and Microbial Technology*. (1996-).

Editor in Chief, *Environmental Toxicology and Chemistry*. (1981-).

Member of the Editorial Board, *Bioremediation Journal*. (1997-).

Editor in Chief, *Environmental Toxicology and Chemistry*. (1981-).

Editor, SERDP/ESTCP monographs on chlorinated solvent and perchlorate remediation. (2006-).

Theses

Rebecca Daprato, Masters. "Interpretation and Modeling of Slurry Reactor Performance to Provide Monitoring Strategies for the Aerobic Bioremediation of Dinitrotoluene Contaminated Soils." (2001).

C. Nelson Neale, "No Title."

Honors, Awards and Fellowships

Chair, Committee on Subsurface Contaminants, Committee on Environmental Management Technologies (CEMT). (1999).

Chair, Peer Review Committee, Committee on Environmental Management Technologies (CEMT). (1999).

Peer Review Board, Small Business Innovative Research (SBIR) Program, US EPA, Office of Research & Development. (1999).

Retrospective Study Committee, US EPA, Science Advisory Board. (1999).

Environmental Engineering Committee, US EPA, Science Advisory Board. (1999).

Chair, Scientific Advisory Board, US DoD, Strategic Environmental Research and Development Program (SERDP). (1999).

Technical Advisory Committee, Explosives Thrust Area, Federal Integrated Biotreatment Research Consortium (FIBRC), US, DoD, Strategic Environmental Research and Development Program (SERDP). (1999).

Chair, Review Board, National Environmental Technology Test Sites (NETTS), US DoD, Strategic Environmental Research and Development Program (SERDP). (1999).

Founders Award, Society for Environmental Toxicology and Chemistry. (1999).

Chair, Science and Technological Advancement Awards Board, US EPA, Science Advisory Committee. (1999).

Herb Ward Distinguished Service Award (New Named Award), Society for Environmental Toxicology and Chemistry. (1999).

Chair, Scientific Advisory Board, Strategic Environmental Research and Development Program (SERDP). (1998-Present).

National Environmental Technology Test Sites (NETTS) Demonstration Program Review Panel, Strategic Environmental Research and Development Program (SERDP). (1994-Present).

Technical Advisory Committee (TAC), Explosives Thrust Area, Federal Integrated Biotreatment Research Consortium (FIBRC), Strategic Environmental Research and Development Program (SERDP). (1997-Present).

Co-Director, Hazardous Substance Research Center/South & Southwest. (2000).

University Representative, Gulf Coast Hazardous Substance Research Center. (2000).

Chair, Scientific Advisory Board, Strategic Environmental Research and Development Program (SERDP). (1998 - present).

Chair, Science Working Group, SERDP/ESTCP Chlorinated Solvents Expert Panel Workshop. (2001).

Chair, Science and Technological Achievement Awards Committee, U.S. Environmental Protection Agency. (1998-2001).

Review Panel, National Environmental Technology Test Sites (NETTS) Demonstration Program. (1994-present).

Chair, Environmental Science and Technology Advisory Committee, Los Alamos National Laboratory. (2001).

Chair, External Advisory Board, Institute of Environmental Toxicology, Clemson University. (1998 - present).

Diplomate Environmental Engineer (DEE), American Academy of Environmental Engineering. (11/04).

Frederick George Pohland Medal for Outstanding Contributions to Bridging Research, Education and Practice, American Academy of Environmental Engineers and the Association of Environmental Engineering and Science Professors. (October 2006).

Brown and Caldwell Lifetime Achievement Award for Environmental Remediation, Battelle Conference.

(May 2006).

Positions Held

Member of NRC Committee on the Superfund Site Assessment and Remediation in Coeur d'Alene River Basis, National Research Council. (Dec. 2003 - July 2005).

Chair of Scientific Advisory Board, Strategic Environmental Research and Development Program (SERDP). (Nov. 1998 - Oct. 2004).

Chair of Science and Technology Advisory Committee, US. Department of Energy, Los Alamos National Laboratory. (2002 -).

Chair, US. Department of Energy, Los Alamos National Laboratory, Division Review Committee, Risk Reduction and Environmental Stewardship Division. (2002 -).

Senior Consultant, EPA Science Advisory Board. (1995 -).

Member, EPA Board of Scientific Counselors, Review of National Center for Environmental Research. (2003 -).

Chair, Clemson University External Advisory Committee in Environmental Toxicology and Chemistry. (2000 -).

Chair, Science Advisory Board, Regenesys, Inc. (1993 -).

Member, Strategic Advisory Committee, ReTec Group. (2001 -).

University Contact, Gulf Coast Hazardous Substance Research Center. (1993 -).

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