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Project Summary

Anaerobic Dehalogenation and Its Environmental Implications

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In an international conference, microbiologists from five countries presented results of research into the anaerobic dehalogenation of compounds of environmental interest being performed at selected universities, government agencies, and private companies. The conference, held from August 30 to September 4, 1992, in Athens, GA, was sponsored by the American Society for Microbiology. This document provides abstracts of the 33 papers presented at the conference in sessions addressing the environmental fate of chlorinated organic chemicals; the anaerobic dechlorination of chlorinated phenols; the dechlorination of polychlorinated biphenyls; the dehalogenation of aliphatic compounds; the abiotic dechlorination of porphryns, corrins, and non-tetrapyrroles; the kinetics of dehalogenations; the microbial physiology of dechlorinating systems; and the hydrolytic dehalogenation of compounds. Research results were provided for a variety of compounds, including polychlorinated biphenyls, pentachlorodibenzodioxin, polychlorinated phenols, 2,4-dichlorophenol, aroclors, 1,2-dichloroethane, tetrachloroethene, methyl chloride, perchloroethylene, 2,4,5-trichlorophenoxyacetic acid and pentachlorodibenzofuran.

This Project Summary was developed by EPA's Environmental Research Laboratory, Athens, GA, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Conference Overview

Chlorinated chemicals continue to make an impact on our daily lives. Many of these impacts are positive. For example, chlorinated chemicals currently are used as solvents, oils, and pesticides. Undesirable consequences, however, also can be associated with these materials. Many of these chemicals as well as their degradation products are considered hazardous and can pose problems to humans and other life forms when the compounds enter the environment. The extent of the impact is dependent on the exposure route and the length of exposure.

Considerable scientific effort continues to be directed toward understanding the chemical and biological processes that affect the fate of chemicals in the environment. The close relationship between the susceptibility of chlorinated chemicals to microbial degradation and their persistence in the environment has led to numerous investigations. These research efforts initially focused on aerobic degradation with anaerobic degradation receiving attention mostly in the last decade. Revealed susceptibility to microbial degradation also led to investigations leading to the use of bioremediation in the cleanup of sites contaminated with chlorinated chemicals.

In an effort to integrate the findings of some of the numerous investigators in laboratories across the United States and other countries who are addressing the many aspects of the environmental fate of chlorinated chemicals and the potental use of bioremediation in contaminated site cleanup, the U.S. Environmental Protection Agency and other organizations supported a conference in the summer of

1992 that was sponsored by the American Society for Microbiology. The supporting organizations—EPA, the Department of Energy, General Electric, the National Science Foundation, and the National Institute of Environmental Health Sciences—join with the American Society for Microbiology in the belief that a common sharing of results will lead to better remedial options, provide a database for developing regulatory options, and focus on critical basic research needs.

Compiled Abstracts

1. *Fate of Chlorinated Aromatic Compounds in a Sediment Area of the Rhine River* (J.E.M. Buerskens, J. deWolf, M. Swart, and C.G.C. Dekker), 2. *Reductive Dechlorination of PCBs and PCDDs by Consortia Isolated from Dutch Sediments* (J.R. Parsons, L.C.M. Commandeur, M. Toussaint, and J.E.M. Buerskens), 3. *Anaerobic Microbial PCB Dechlorination in the Environment* (J.F. Brown), 4. *Anaerobic Dehalogenation of Pesticides in Subsurface Environments* (J.M. Suflita), 5. *Anaerobic Degradation of Chlorinated Aromatic Hydrocarbons Using Acclimated Cultures* (J.E. Rogers, W.J. Jones, D.D. Hale, and D. Wubah).

6. *Sequential Degradation of 2,4-Dichlorophenol and Analogous Compounds* (J. Wiegel), 7. *Different Reducing Conditions and Chlorophenol Metabolism* (L.Y. Young, M.M. Haggblom, J. Kazumi, and M.D. Rivera, 8. *Cross-reactivity of PCP-degrading Organisms* (J. Struijs), 9. *Simulation of Reductive Dechlorination of Arochlor 1260 Contaminant in Anaerobic Slurries of Woods Pond Sediment* (D.L. Bedard, H.M. Van Dort, S.C. Bunnell, J.M. Principe, K.A. DeWeerd, R.J. May, and L.A. Smullen), 10. *Reductive Dechlorination in Different Sediments* (M.M. Haggblom, A.C. Alder, S.R. Oppenheimer, and L.Y. Young.

11. *Factors Affecting in situ PCB Dechlorination and the Expected Toxicity Reduction* (J.F. Quensen), 12. *Hudson River:Laboratory and Environmental Changes* (D.A. Abramowicz), 13. *PCB Dechlorination: Large Scale Efforts and Sequential Anaerobic-Aerobic Treatment* (P.A. Anid, L. Nies, B.P. Ravest-Webster, and T.M. Vogel), 14. *Anaerobic Biotransformation of PCBs and Determining Factors* (G-Y. Rhee and R.C. Sokol), 15. *Effect of Temperature on the Dechlorination of PCBs in Woods Pond Sediment* (J. Wiegel).

16. *Reductive Dechlorination of 1,2-Dichloroethane and Tetrachloroethene Catalyzed by Anaerobic Bacteria* (C. Hollinger), 17. *Complete Anaerobic Dechlorination of Tetrachloroethane in a Bioreactor* (W.P. de Bruin, G. Schraa, and A.R.J. Zehnder), 18. *A CH3CL Utilizing Homoacetogen* (G. Diekert), 19. *Factors Effecting PCE Dechlorination in the Subsurface* (G.W. Sewell, S.A. Gibson, and H.H. Russell), 20. *Simulation of Anaerobic 2,4,5-T Degradation* (S.A. Gibson and J.M. Suflita).

21. *Dehalogenation of Highly Chlorinated PCDDs and PCDFs: Retention of the 2,3,7,8-Sequence* (P. Adriaens and D. Grbic-Galic), 22. *Reductive Dehalogenation by Bacteria: A Competition with Oxygen and Oxidation* (C.E. Castro), 23. *The Use of Porphyrins and Corrins in Detoxification* (T.S. Marks and A. Maule), 24. *Enzymatic and Coenzymatic Reductive Dehalogenation: Mechanisms and Applications* (L. Wackett), 25. *Electrocatalytic Dehalogenations* (J.F. Rusling).

26. *Natural Chemical Attenuation of Halogenated Hydrocarbon Compounds Via Dehalogenation Reactions* (M. Reinhard), 27. *Synthetic Nickel Complexes as Dehalogenation Catalysts* (M. Stiles), 28. *Factors Affecting Dichlorophenol Reduction Kinetics* (D.D. Hale), 29. *Reductive Transformation of Halogenated Aromatic Hydrocarbons in Anaerobic Water-Sediment Systems: Kinetics, Mechanisms, Products and QSARs* (W.G.J.M. Peijnenburg, N.L. Bilthoven, and N.L. Wolfe), 30. *Dechlorination and ATP Formation in Desulfomonile tiedje* (J. Dolfing).

31. *Development and Characterization of an Anaerobic Bacterial Co-culture which Dechlorinates 3-Chlorobenzoate* (B. Sharak Genthner), 32. *From Molecular Biology to Treatment: Activities and Adaptations of Dehalogenases* (D.B. Janssen, M. Pentenga, R. Bos, and F. Pries), and 33. *Dechlorination Enzymology: Halidohydrolases from Pseudomonas spec. Strain CBS3* (S. Fetzer, B. Schneider, F. Loffler, R. Muller, and F. Lingens).

The organizing committee for the conference was composed of Dr. John Rogers, U.S. Environmental Protection Agency, Athens GA; Dr. Daniel Abramowicz, General Electric Research and Development Center, Schenectady NY; Dr. Hugh Russell, U.S. Environmental Protection Agency, Ada OK; Dr. Joseph Suflita, University of Oklahoma, Norman OK; Dr. Lily Young, Rutgers University, New Brunswick NJ; and Dr. Alexander Zehnder, Agricultural University, Wageningen, The Netherlands.

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The complete report, entitled "Anaerobic Dehalogenation and Its Environmental Implications: Abstracts of 1992 American Society for Microbiology Conference," (Order No. PB93-217799AS; Cost: $19.50; subject to change) will be available only from:

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