HazTecH

T R A N S F E R

Great Plains/Rocky Mountain Hazardous Substance Research Center

Plans set for workshops, special sessions

Plans and details continue to move forward for the Great Plains/Rocky Mountain Hazardous Substance Research Center (HSRC)/Waste-management Education & Research Consortium (WERC) Joint Conference on the Environment, "Creating a New Path on the Santa Fe Trail," set for May 21-23 in Albuquerque, N.M. The conference will be held at the Holiday Inn Pyramid and will feature five workshops before and after the main three-day event.

Before the conference officially opens on Tuesday, May 21, an eight-hour workshop on phytoremediation is scheduled for Monday, May 20. Workshops will begin again Thursday afternoon, May 23, after the conference ends at noon, and run through Friday morning. Topics covered in these include an eight-hour HAZWOPER refresher course, an eight-hour session on remediation technologies, and a four-hour meeting focused on munitions and explosives contaminations.

Blase Leven, national coordinator for the R2D2 (Research and Re-education for the Department of Defense) Program, is planning a student technical session/seminar in conjunction with the conference involving research and professional development topics.

On Wednesday evening of the conference, Navajo Dryland Environments Laboratory will host a poster and demonstration session on environmental education and research projects conducted by WERC and HSRC affiliates in Native American communities. Tuesday evening has been left open so that conference participants can take advantage of the culture and history opportunities of the region in activities of their own choosing.

Advisory committee ranks proposals

The HSRC Science and Training/Technology Transfer Advisory Committees met in Kansas City November 1 through 3 and recommended a total of 26 proposals for possible funding. As monetary resources for new (FY96) projects are unknown, the committees simply ranked proposals for support as funds become available. The consideration process included general discussion on each proposal, followed by a ranking session.

The Science Advisory Committee ranked 17 new proposals, as follows:

95-29 Plant-Enzyme Systems for the Phytoremediation of Chlorinated Aliphatics in Contaminated Soils: J. L. Schnoor and L. J. Kurimski, University of Iowa.

95-32 Simultaneous Transformation of Atrazine and Nitrate in Contaminated Water, Sediment, and Soil by Zero-Valent Iron-Promoted Processes: T. C. Zhang, G. B. Keefer, P. J. Shea, S. D. Comfort, University of Nebraska.

95-10 Fate of Trichloroethylene (TCE) in Plant/Soil Systems: Evaluating Phytoremediation: W. J. Doucette, B. Bugbee, D. K. Stevens, Utah State University.

95-04a Nanoscale Metal and Metal Oxide Particles as Reagents for Destruction and Immobilization of Hazardous Substances in Air, Water, and/or as an Alternative to Incineration: K. J. Klabunde, W. Walawender, Kansas State University.

95-30 In-Situ Vibrorecovery of LNAPL Contaminants from the Subsurface: L. N. Reddi, Kansas

continued on page 3

Deadline for abstracts for HSRC/WERC Joint Conference on the Environment:

February 1, 1996

Submit to:
HSRC/WERC Joint Conference
HSRC
Kansas State University
101 Ward Hall
Manhattan, KS 66502-2502
Contact: Carla Wolfe, 913-532-7464

On page...

Director's memo

This is a time of great change in government, in the private sector, and in our universities. Computers and new ways of doing business have improved the efficiency and effectiveness of industry; competition has eliminated some firms that have not kept pace with modern developments. Even in environmental decision making, there is a growing emphasis on relevance, risk assessment, and cost effectiveness.

Responsible parties and environmental leaders want to see research funds used for innovative projects which have the potential to greatly reduce environmental restoration costs. Cost of cleanup has already been reduced substantially because of the excellent research carried out through the five Hazardous Substance Research Centers, the EPA National Laboratories, and other laboratories and educational institutions. Recent studies show that more than $10 in cleanup costs are saved for each dollar spent on EPA-funded research.

Some government leaders want to combine, coordinate, and integrate environmental cleanup activities so that contaminated sites under control of the Department of Defense, Department of Energy, Department of Interior, and the Environmental Protection Agency would all be the responsibility of one federal entity. Research to develop innovative technologies, and technology transfer to implement these new processes at field sites would be coordinated so that the most cost-effective technologies are selected and utilized. Many cooperative research and demonstration projects are already underway and important results are being presented at professional meetings and in publications. With the Internet, fax machines, and teleconferencing, such cooperation can be very successful and fruitful. Research funding for remediation and restoration should be appropriated such that coordination and cooperation are encouraged and expected.

On large cleanup projects of more than $2,000,000, it may be beneficial for a team of experts to be part of the site technical committee in order to identify optimal, site specific, technical solutions which are in the best interests of society. When innovative technologies are selected for a field site, one or more of those who have helped to develop or advance the technology could then help with field implementation until contractors have received sufficient training and instruction to design and implement it themselves.

As we move forward with research and development activities for our many sites with unsolved problems, adapting our strategies and practices to address the needs of our changing economic climate is a challenge we must face.

Larry Erickson
Director

Haskell hosts varied events, activities

Workshop session

The Haskell Environmental Research Studies (HERS) Center hosted a two-week environmental technology workshop in July at Haskell Indian Nations University (HINU), "Technologies in Cleanup and Compliance," which was a test program for a two-year environmental technology curriculum being developed by Kansas State University for use in community colleges.

Modules tested in the workshop included compliance with environmental regulations and cleanup of hazardous wastes.

Workshop participants also received training in hazardous waste operations and emergency response procedures. Thirty-six people, ages 16-24, successfully completed this program.

Seminar series

In September, "A Round Table Discussion," third in a seminar series of Comparison of Native American and European World Views, featured HINU faculty members Venida Chenault-White, Robert T. Dixon, and Dan Wildcat from the department of natural and social sciences, and Jim Sherow, KSU professor of environmental history.

A follow-up seminar is tentatively planned for January 1996 that will include faculty members from HINU and KU.

Board activities

The HERS Advisory Board convened for the third time Oct. 11-13 at HINU. The opening evening's presentation by Kim Klausen and Emma Featherman-Sam, Oglala Lakota Nation's Natural Resources Regulatory Agency, "The Badlands Bombing Range Project," was filmed and will be distributed as part of the NAOMI Seminar Program.

The board meeting included two other campuswide presentations. Merv Tano, environmental programs director for the Council of Energy Resource Tribes, spoke on the impact of federal funding on tribal environmental programs. Wes Martel, Wind River Association president, addressed the importance of protecting reservation environments and the role of education in enhancing this protection.

Proposals ranked

continued from page 1

State University.

95-07 Bioremediation of Explosives by Plants: W. F. Mueller, New Mexico State University.

95-02 Iron-Enhanced Phytoremediation of TNT-Contaminated Soils: W. L. Powers, G. L. Horst, University of Nebraska.

95-19 Remediation of Chlorinated VOCs: Performance Models and Economic Analysis: B. I. Dvorak, University of Nebraska; R. L. Segar, University of Missouri-Columbia.

95-14 Phytoremediation of Metal-Contaminated Soils: J. E. McLean, R. C. Sims, P. R. Grossl, W. Scouten, Utah State University.

95-06 Immobilization of Contaminants in Soils with In-Situ Calcite Precipitation: K. J. Reddy, K. T. Carron, G. F. Vance, R. Zhang, University of Wyoming.

95-08 Mine-Shaft Water Phytoremediation Using Constructed Wetlands: S. K. Banerji, R. K. Bajpai, C. J. Gantzer, J. R. Brown, R. M. Bricka, University of Missouri.

95-11 Laboratory and Field Assessments of New Technologies for Remediation of Soils Contaminated with Cd, Pb and Zn: G. Vance, S. Sharmasarkar, L. Stillings, J. Drever, University of Wyoming.

95-09 Winter Cover Crops for Reducing Herbicide Mobility in the Corn Belt: S. H. Anderson, C. J. Gantzer, R. L. Peyton, R. N. Lerch, G. A. Buyanovsky, University of Missouri-Columbia.

95-16 The Use of Wetlands for Storage of Biogenic Metal Sulfides as a Strategy to Remediate AMD: G. Southam, Northern Arizona State University; D. Dollhopf, Montana State University.

95-33 Bacterial/Plant-Root Association to Enhance Revegetation and Bioremediation of PCP-Contaminated Soil: W. F. Pfender, Kansas State University.

95-18 Rhizofiltration of Metals from Mine-Shaft Drainage and Liquid Waste of Soil-Washing Process: R. Bajpai, S. Banerji, S. Pueppke, University of Missouri; R. J. Bricka, U.S. Army Corps of Engineers.

95-31 Remediating Munitions-Contaminated Soil by Fenton Oxidation and Metal Reduction: Pilot-Scale Demonstrations: S. D. Comfort, P. J. Shea, T. C. Zhang, University of Nebraska.

The Training and Technology Transfer Advisory Committee ranked new proposals as follows:

TR95-10 Virtual Library: Transferring HSRC Research Results Through the Internet: L. E. Erickson, J. P. McDonald, D. L. Tillison, Kansas State University.

TR95-11 Environmental Data Technology Transfer Project: L. N. Reddi, S. C. Grant, Kansas State University.

TR95-5 In-Situ Vibrorecovery of LNAPL Contaminants—A Technology Transfer Project: L. N. Reddi, Kansas State University.

TR95-9 Pesticide Training Program for Farm Families and Urban Homeowner Families: B. C. Kross, University of Iowa.

TR95-3 Phytoremediation and Technology Transfer to a Large Municipality: J. L. Schnoor, University of Iowa, and G. D. Hill, Texas Southern University.

TR95-6 Engineering Foundation Conference on Bioremediation of Surface and Subsurface Contamination: R. K. Bajpai, University of Missouri-Columbia.

TR95-4 Understanding Behavior of Nonaqueous Phase Organic Waste Chemicals in Aquifers and Problem Solutions: T. H. Illangasekare, University of Colorado.

The T³AC conceptually recommended partial funding of the following projects as a joint project with TR95-10:

TR95-8 Phytoremediation Technology Transfer Project: R. H. Potter and R. L. Peyton, University of Missouri-Columbia.

TR95-1 Technology Transfer for Hazardous Waste Management: A Worldwide Web Multi-Media Approach: D. W. Zachmann and S. N. Afifi, Colorado State University.

Consortium Directory

Our World Wide Web address is:
http://www.engg.ksu.edu/HSRC/home.html

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Researcher studies field scale bioremediation

By J. Patrick McDonald

Bioremediation has been a buzzword in the environmental cleanup field for several years. Dr. Ronald Sims at Utah State is evaluating this technology in the field at the Champion International superfund site in Libby, Mont. The site, a former wood treating facility, has soils that are contaminated with polycyclic aromatic hydrocarbons (PAHs) and pentachlorophenol (PCP).

Soils at this site are being treated in the field using a prepared bed bioremediation technique. The scheme involves applying "lifts"—six to 12-inch layers—of contaminated soils onto a prepared bed, and promoting mineralization through application of nutrients, tillage, etc. When the contaminant concentration drops below acceptable levels, a new lift of contaminated soil is applied over the treated soil.

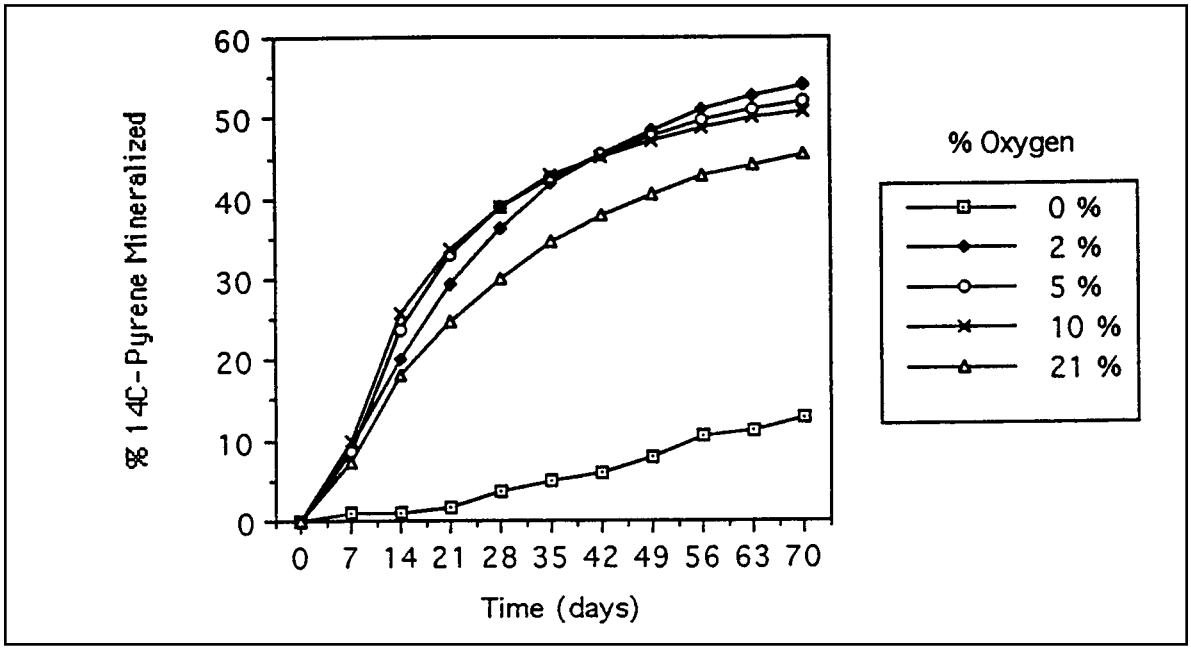
The primary difficulty in such schemes is keeping the soil gas in the unsaturated soil rich in oxygen. Oxygen is often the limiting factor in biodegradation of PAHs. Dr. Sims has studied the effects of oxygen concentration in the soil gas on the biodegradation rates.

Research findings

Sims used radio-labeled pyrene as an indicator PAH to study the effects of soil gas oxygen concentration on the biodegradation rate. Results of laboratory microcosm studies of soils taken from the site have been encouraging. As expected, loss of the indicator PAH in both sterilized and oxygen-deficient microcosms was insignificant. Once oxygen was available at a concentration from 2 to 5 percent in the soil gas, however, significant mineralization occurred. Enriching the soil gas with oxygen did not produce significant increases in mineralization rates. This indicates that while oxygenation of buried lifts is required for successful land treatment, only minimal pumping would be required.

Chemical mass balance results for radio-labeled pyrene were completed for the microcosm study with a minimum of 85 percent recovery. Mineralized C^{14} indicated by $C^{14}O_2$ measurement accounted for 45 to 53 percent of the initial C^{14} from the pyrene in the microcosms with 2 percent or more oxygen concentration in the soil gas. $C^{14}O_2$ production in the sterile microcosms was minimal (< 0.1 percent). In the live microcosm with low oxygen soil gas mineralization was limited to 13 percent.

Volatilization accounted for less than 1 percent of spiked pyrene in all microcosms. Soil extractable and soil bound fractions comprised 82 percent and 10 percent of the sterile microcosms. In the biologically active microcosms, soil extractable C^{14} dropped to 70 percent under oxygen limited conditions and to 20-25 percent with



2 percent or greater oxygen in the soil gas. The bound soil fraction increased to around 15 percent in the non-sterile microcosms when mineralization became the primary fate mechanism.

The microcosm experiments were repeated using non-radio-labeled pyrene, benzo(a)-anthracene and chrysene with similar results.

Potential development

This research will assist engineers designing prepared bed treatment units for PAH contaminated soil. By maintaining a minimal supply of oxygen in buried lifts, it will be possible to apply a new lift more quickly. Rather than waiting for target soil concentrations to be reached for the first lift, supplied oxygen will maintain mineralization while the subsequent lift is applied. Such engineered systems will significantly reduce the time required to complete remediation in prepared bed treatment systems.

Principal investigator

Ronald C. Sims
Professor and Head
Division of Environmental Engineering
Utah State University
Utah Water Research Laboratory
Logan, UT 84322-4110

Publications

R.C. Sims, J.L. Sims, D.L. Sorensen, and J.E. McLean, "Champion International Superfund Site, Libby, Mont.: Bioremediation Field Performance Evaluation of the Prepared Bed Land Treatment System," 1995, U.S. EPA (in press; Mr. Scott Huling, Robert S. Kerr Environmental Research Laboratory, Ada, OK, U.S. EPA Project Officer).

C.J. Hurst, R.C. Sims, J.L. Sims, D.L. Sorensen, J.E. McLean, and S. Huling, "Polycyclic Aromatic Hydrocarbon Biodegradation as a Function of Oxygen Tension in Contaminated Soil," Proceedings of the 10th Annual Conference on Hazardous Waste Research, Manhattan, Kansas, May 23-24, 1995.

Although the projects described in this article have been funded in part by the U.S. Environmental Protection Agency under assistance agreement R-819563, through the Great Plains-Rocky Mountain Hazardous Substance Research Center, it has not been subjected to the agency's peer and administrative review and, therefore, may not reflect the views of the agency. No official endorsement should be inferred.

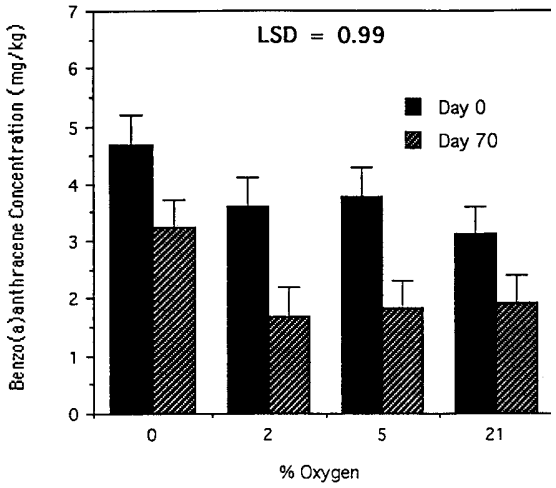


Fig. 3. This chart shows the benzo(a)-anthracene concentrations in microcosms at zero and 70 days as a function of soil gas oxygen concentration.

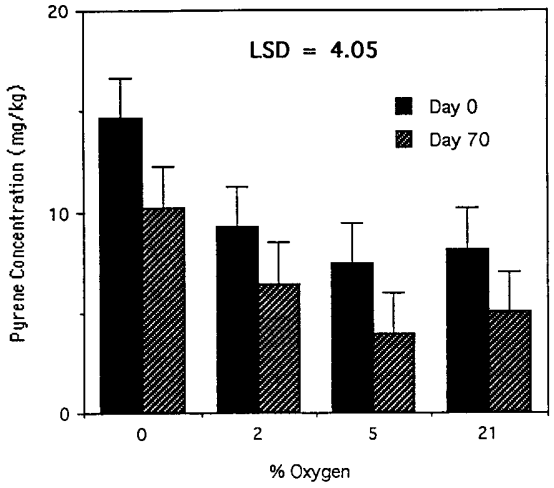


Fig. 2. This chart shows the pyrene concentrations in microcosms at zero and 70 days as a function of soil gas oxygen concentration.

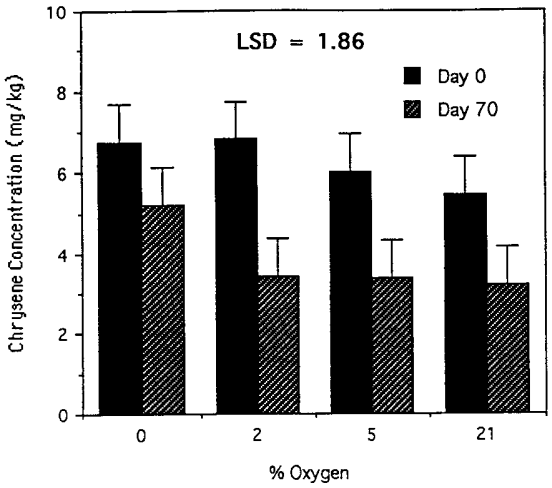


Fig. 4. This chart shows the chrysene concentrations in microcosms at zero and 70 days as a function of soil gas oxygen concentration.

Parkin likes challenge of environmental engineering

By Mary Rankin

"I very much like teaching and research, because both involve learning which is really my favorite activity," said Gene Parkin, professor of civil and environmental engineering at the University of Iowa. "Many like to separate teaching and research, but research is also teaching. That is, teaching yourself and your students, as well as the profession, about new "things" is research!"

> "Many like to separate teaching and research, but research is also teaching . . . teaching yourself and your students about new 'things' is research ..."

And part of Parkin's current research endeavors include two HSRC-funded projects. The first, "The Role of Iron in the Biotransformation of Chlorinated Xenobiotics," is believed to be the only research activity presently pursuing fundamental studies of metal chemistry in combination with methanogenic bacteria. Specific objectives include the following: determining abiotic and microbial phenomena that contribute to the transformation of carbon tetrachloride (CT) under methanogenic conditions in the presence of metallic iron; determining the fate of CT under the above conditions in the presence of metallic iron; determining reaction stoichiometry and kinetics; and applying reaction kinetics to numerically simulate response of a plug flow with dispersion column reactor packed with steel wool as a support for biomass.

Co-PI's on this project are Lenly Weathers, Jerry Schnoor, and Pedro Alvarez. According to Parkin, initial studies demonstrate significant promise with the iron-methanogen process for treating chlorinated organic compounds.

The second project, "Application of Anaerobic and Multiple-Electron-Acceptor Bioremediation to Chlorinated Aliphatic Subsurface Contamination," involves assessing the potential for bioremediating chlorinated solvents perchloroethylene (PCE), 1,1,1-trichloroethane (TCA), and carbon tetrachloride (CT) when using sequential anaerobic-aerobic, in situ bioremediation.

To better understand the potential of anaerobic biodegradation of chlorinated aliphatics, Parkin said this research focuses on assessing the effects of mixtures of PCE, TCA, and CT on transformation rates of individual compounds; investigating potential for sequential anaerobic-aerobic bioremediation of PCE, TCA, and CT; and to the extent possible, identifying organisms capable of converting chlorinated aliphatics to non-objectionable products and determining their growth requirements.

Parkin received both his B.S. and master's degrees in civil engineering from the University of Iowa, and completed his Ph.D. at Stanford University. He said his interest in engineering began in fifth grade when he discovered that engineers were the people who surpervised construction of roads, bridges and buildings. A high school counselor directed him towards the study of civil engineering at the University of Iowa, and in his senior year there, Parkin said, "I took my first class in environmental engineering and the first Earth Day was that semester. Solving environmental problems using engineering tools looked challenging, interesting, and rewarding. It still does!"

Two people Parkin noted as having significant impact on his career are Richard Dague, currently at Iowa State University, who taught that first environmental engineering course that sparked Parkin's enthusiasm for the field; and Perry McCarty, his Ph.D. advisor at Stanford. "I am most fortunate to have worked with him," he said. "His contributions to the field are many and varied. He is an invaluable mentor, colleague, and friend."

> "Solving envrionmental problems using engineering tools looked challenging, interesting and rewarding. It still does!"

Along with his teaching and research duties, Parkin is also the director of the Center for Health Effects of Environmental Contamination at the university. He is a member of several professional societies, and in his spare time likes to read, golf, and play softball.

He and his wife Annette, who is working to become a florist, have two sons, Kyle, 12, and Eric, 9. Both boys are active in sports and Parkin gets involved with coaching in this area. His sons, he said, "provide perspective on what is truly important in life."

As part of a continuing series on the holdings of the Hazardous Substance Research Center repository, following is a partial list of holdings available for checkout or interlibrary loan from Farrell Library at Kansas State University (KSU). This list is of some of the most recent acquisitions.

Floppy disk copies of the entire list of holdings are also available. To request a disk copy of the list, write to Repository List, HSRC, Kansas State University, 101 Ward Hall, Manhattan, KS 66506-2502, 913-532-6519, FAX 913-532-5985.

Rec# 1091. NAOMI Program and HERS: New Opportunities in Environmental Research. VHS tape. 1994.

Rec# 1092. Comparison of Native American and European World Views: A Native American Viewpoint. VHS tape. 1994.

Rec# 1093. Pollution Prevention for Small Manufacturers. VHS tape. 1994.

Rec# 1094. Beneficial Effects of Vegetation in Contaminated Soils: Part 1, Biodegradation Characteristics of Soil Microflora in the Root Zone. VHS tape. 1995.

Rec# 1095. Beneficial Effects of Vegetation in Contaminated Soils: Part 2, Plant Uptake, Translocation, Metabolism and Vaporization of Hazardous Chemicals. VHS tape. 1995.

Rec# 1096. Beneficial Effects of Vegetation in Contaminated Soils: Part 3, Effects of Organic Contaminants on Vegetation and Fate of Organic Contaminants in a Vegetated Chamber. VHS tape. 1995.

Rec# 1097. Beneficial Effects of Vegetation in Contaminated Soils: Part 4a, Modeling Ground Water Flow and Uptake in the Root Zone; Part 4b, Modeling the Fate of Contaminants in the Root Zone. VHS tape. 1995.

Rec# 1098. Beneficial Effects of Vegetation in Contaminated Soils: Part 5a, Results from Laboratory and Field Studies; Part 5b, Phytoremediation at Permitted Wastewater Treatment, Landfill and Chemical Spill Sites. VHS tape. 1995.

Rec# 1099. Comparison of Native American and European World Views: A European Viewpoint. VHS tape. 1995.

Rec# 1100. Environmental Impacts of Gold Mining Operations near the Fort Belknap Reservation. VHS tape. 1995.

Rec# 1102. Bioremediation of Munitions-contaminated Soil: Part 1a, Composting of TNT and Related Compounds; Part 1b, Anaerobic Biodegradation of Munitions Compounds. VHS tape. 1995.

Rec# 1103. Bioremediation of Munitions-contaminated Soil: Part 2a, Aerobic Bioslurry Processes for Degradation of TNT; Part 2b, Isolation, Identification and Utilization of the Nitroreductase Enzyme for TNT-contaminated Soils and Sediments. VHS tape. 1995.

Rec# 1104. Bioremediation of Munitions-contaminated Soil: Part 3a, In Situ Phytobioremediation of TNT-contaminated Soils; Part 3b, Beneficial Effects of Vegetation in the Remediation of Munitions-contaminated Soil. VHS tape. 1995.

Rec# 1105. Bioremediation of Munitions-contaminated Soil: Part 4a, Integrated Approaches to Remediation of Munitions-contaminated Soil; Part 4b, Regulatory Considerations and Requirements for Munitions-contaminated Soil; Part 4c, Field Site for Demonstration of Remediation Technologies for Munitions- contaminated Soil and Ground Water. VHS tape. 1995.

Rec# 1106. Bioremediation of Munitions-contaminated Soil: Part 5a, Army National Test Site Program; Part 5b, Western Governors' Association Military Munitions Waste Working Group Plan for Field Demonstrations with Stakeholder Participation. VHS tape.

HSRC *Update* on center activities .....

R2D2 program moves into an uncertain future

Approximately 10 students will join the R2D2 program in the spring 1996 school term, bringing the GP/RM total to approximately 26. However, the efforts to reduce the number serving in the military is ending and future funding for this program is uncertain. Because of this, priority will be given to completing existing projects and job placement activities. Efforts are underway to identify new funding within and outside DoD sources to make up shortfalls and enable the program to continue serving society and veterans.

A significant number of prospective R2D2 students are interested in work on approximately nine DoD-related projects (proposed by GP/RM area researchers), if new funds are identified.

TOSC receives funding for third year

The Technical Outreach Services for Communities pilot program received $125,000 for third year funding, and will continue to help communities understand the science and technical issues involved in local hazardous substance management. Two new communities have been identified for assistance. The Restoration Advisory Board for the Black Hills Army Depot, Igloo, S.D., has requested and is receiving assistance from TOSC. TOSC will also assist with the cleanup of the bombing range on the Pine Ridge Reservation in South Dakota.

Videotape available

"Poplar Buffers...I Can Do That" is the title of a 10-minute videotape highlighting the research efforts of Louis Licht and Jerry Schnoor, University of Iowa, using vegetation to remediate soil and water. Their work is funded in part by EPA and the Great Plains/Rocky Mountain HSRC.

Produced with the nonscientific audience in mind, the tape features various uses for poplar trees in cleaning up soil and water in agricultural settings and landfills, and explores their potential use at EPA Superfund sites.

The tape is available for purchase through the HSRC Office at Kansas State University for $10 per copy or available for loan through the HSRC repository. Make checks payable to KSU, and send with requests to: Carla Wolfe, Videotape Offer, HSRC, Kansas State University, 101 Ward Hall, Manhattan, KS 66506-2502. For more details or answers to questions, contact Wolfe at 913-532-7464.

Calendar

Feb. 8—HAZWOPER Refresher, Overland Park, KS; Center for Environmental Education and Training, Shirley Welhoelter, 913-897-8527.

Feb. 8—Advanced Hazardous Waste Management Course, Kansas City, MO; University of Missouri Columbia, John Atkinson, 314-882-8880.

Feb. 9—Annual Hazardous Materials Update (8-Hr. Refresher), Television Simulcast, Kansas City, St. Louis, Columbia and Rolla, MO; University of Missouri Columbia, John Atkinson, 314-882-8880.

Feb. 12-16—Lead Abatement Training for Supervisors and Contractors, Overland Park, KS; Mid-States Rocky Mountain Regional Lead Training Center, Stacy Milliman, 913-897-8524.

Feb. 15—Annual HM181-126F, Interactive Television Simulcast, Kansas City, St. Louis, Columbia and Rolla, MO; University of Missouri Columbia, John Atkinson, 314-882-8880.

Feb. 20-21—Risk-Based Correction Action for Petroleum Sites, Dallas-Fort Worth, TX; ASTM, John Atkinson, 314-882-8880.

Mar. 3-4—HazMat HM-126F and HM-181, Overland Park, KS; Center for Environmental Education and Training, Shirley Welhoelter, 913-897-8527.

Mar. 5-6—Real Estate Site Assessment, Phase I, Kansas City, MO; University of Missouri Columbia, John Atkinson, 213-882-8880.

Mar. 7—Lead Inspector Refresher, Overland Park, KS; Mid-States Rocky Mountain Regional Lead Training Center, Stacy Milliman, 913-897-8524.

Mar. 8—Lead Supervisor Refresher, Overland Park, KS; Mid-States Rocky Mountain Regional Lead Training Center, Stacy Milliman, 913-897-8524.

Mar. 17-23—Billings Reclamation Symposium, Billings, MT; Montana State University, Frank Munshower, 406-994-4821.

Mar. 18-22—HAZWOPER 40-Hour Course, Lakewood CO; OSHA Training Institute, 800-933-8394.

Mar. 19-20—Real Estate Site Assessment, Phase I, Omaha, NE; University of Missouri Columbia, John Atkinson, 314-882-8880.

Mar. 25-27—Lead Inspector Training, Overland Park, KS; Mid-States Rocky Mountain Regional Lead Training Center, Stacy Milliman, 913-897-8524.

Mar. 28-29—Advanced Water Treatment, Columbia, MO; University of Missouri Columbia, John Atkinson, 314-882-8880.

April 8-12—Hazardous Waste Site Operations Training, Overland Park, KS; Center for Environmental Education and Training, Shirley Welhoelter, 913-897-8527.

April 12—Environmental Risk Management, Overland Park, KS; National Asbestos Training Center, Barbara Miles, 913-897-8549.

April 21-25—'96 Environmental Design Contest, Las Cruces, NM; Waste-management Education & Research Consortium (WERC), Kay Perkins, 505-646-7707.

April 25—Solvent Alternative Expo, Salina, KS; Kansas State University, Tim Piero, 913-532-4995.

April 25—HAZWOPER Refresher, Overland Park, KS; Center for Environmental Education and Training, Shirley Welhoelter, 913-897-8527.

April 26—Contractor/Supervisor Refresher, Lawrence, KS; National Asbestos Training Center, Barbara Miles, 913-897-8549.

May 20-24, 1996—HSRC/WERC Joint Conference on the Environment, Albuquerque, NM; deadline for abstracts 2-1-96; Great Plains/Rocky Mountain HSRC, Carla Wolfe, 913-532-7464.

May 27-31—Unexploded Ordnance Detection and Range Remediation Conference, Albuquerque, NM; deadline for abstracts 1-15-96; Yuma Proving Ground and the Army Environmental Center, Dr. Shyam Gurbaxani, 505-846-4604.

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