

# HazTech

T R A N S F E R

Great Plains/Rocky Mountain Hazardous Substance Research Center

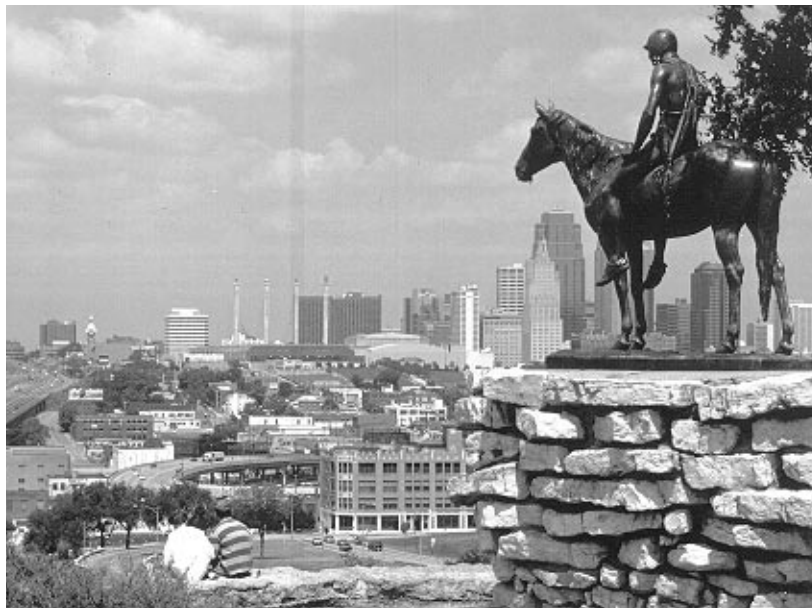
## Kansas City conference plans finalized

"Goin' to Kansas City, Kansas City here I come," will be the tune of nearly 300 participants expected to attend the 12th annual Conference on Hazardous Waste Research in Kansas City, Mo., May 20-22. The three-day event will take place at the Kansas City Airport Hilton and will also feature four workshops before and after the principal focus of the conference.

This year's theme, "Building Partnerships for Innovative Technologies," will be carried out in a three-track program Tuesday morning through Thursday noon featuring sessions on such topics as partnerships and technology innovation, commercialization of innovative technologies, bioremediation, munitions-contaminated soils, biofilms, mine waste remediation, and minority environmental programs.

Plenary speakers on the opening day of the conference will be Thomas M. Houlihan, liaison from the White House Office of Science and Technology Policy to the Interagency Environmental Technologies Office, and Louis A. Licht, of Ecolotree®, Inc. Their topics, respectively, will be "The National Environmental Technology Strategy: The Future and the Role of Research," and "Environmental Innovation — The Meter Is Running: Fast-Tracked Conceptual Design to Permitted Installation." Lt. Col. Stan Hunt, Air Force Center for Environmental Excellence, will speak on "Innovative Technologies, Partnerships, and AFCEE" at the noon luncheon on Tuesday. Guest speaker for the luncheon on Wednesday will be Ricardo Jacquez, Waste-management Education and Research Consortium (WERC), addressing the topic, "Technology Development and Commercialization."

Pre-conference opening activities include a special evening technical session on Monday, May 19, "Mining, Mine Lands, and the Environment — Research and Infrastructure Needs." Panelists from research, government, industry, and trade organizations will present their views on this topic, followed by an interactive session among the panelists and audience. Tuesday evening will be highlighted by a poster and exhibitor session, and on Wednesday evening attendees may choose to attend a pub crawl in the River Market area of downtown Kansas City to sample some of the area's famous barbecue cuisine and jazz clubs.



**This skyline of Kansas City, Mo., will greet guests of the 12th annual Conference on Hazardous Waste Research May 20-22.**

Workshops surrounding the conference include "Acid Mine Drainage Short Course" and "8-Hour HAZWOPER Refresher Course" on Monday, May 19, and "Selection of Chelating Agents for Removal of Heavy Metals from Soils" and "Prepared Bed Bioremediation of Contaminated Soils" on Thursday, May 22.

Conference brochures with registration details are in the mail to those associated with HSRC and other affiliated conference sponsors. Information on the conference is also available on the World Wide Web at:  
<http://www.engg.ksu.edu/HSRC/home.html>

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## ***Eight years of research have saved dollars***

This February 1997, the Great Plains/Rocky Mountain Hazardous Substance Research Center completed eight years of research and technology transfer activities.

Much has happened in those years to improve the science and engineering of remediation of contaminated soil. Cost of remediation has been reduced substantially through developments in bioremediation, phytoremediation, chemical oxidation technologies, and other processes.

In some cases innovative technologies have reduced the cost by more than 50 percent, compared to conventional treatments.

Estimates of the economic value of the research and technology transfer carried out through the center indicate that for each dollar invested, more than \$10 has been saved in cleanup costs, compared to conventional technologies. Significant additional savings are projected as these technologies continue to be applied.

To illustrate the value of the research conducted through the center, I will use the work of Richard Valentine at the University of Iowa who investigated hydrogen peroxide decomposition and organic contaminant oxidation in the presence of iron oxide.

Several papers on the application of Fenton chemistry by Valentine and his former student, Chris Miller, are the basis for expanded use of this technology in field applications.

Recently, I was asked to provide information on the dates of presentation and publication of their early work at our annual conference because of a patent that had been issued to another party based on work that had been done at a later date. At least three companies are now using this technology in field applications.

A renewal proposal for the center was submitted in December 1996 and is being reviewed and evaluated. The need for additional research and technology transfer is great, and we have a strong consortium with an excellent record of publications and service to society.

I want to thank all who have contributed to the advances that we have made these past eight years. I hope that we will be able to continue to work together for several more years.

**Larry Erickson**  
**Center Director**

## ***PPI training materials available from NU***

New program materials, "Pollution Prevention for Farms, Acreages and Households," are available from the University of Nebraska, intended for use by professional educators working in the environmental area with adults, businesses, farms, households, science classes, natural resource districts, departments of environmental quality, health departments, and others.

The package, available for \$39.95, includes educators' guides, transparencies, participant content, media guides, impact evaluation forms, videos, and activities. To order, contact the University of Nebraska at 1-800-755-7765.

The materials were created by engineering faculty and Extension personnel at the University of Nebraska, with funding assistance from the Great Plains/Rocky Mountain Hazardous Substance Research Center and the U.S. EPA Region VII, and the University of Nebraska Cooperative Extension Services.

### **Hot Links**

## ***BIO web site provides useful links***

The Biotechnology Industry Organization (BIO), a trade organization serving the biotechnology industry in the U.S. and elsewhere, provides a Web site with many useful links at <http://www.bio.org>.

Although environmental topics are not a main focus of these pages, there is some environmental material. Pages are easy to navigate, allowing the user to find desired material quickly. An extensive library is included. Most items in the library are not yet active, but its Journals and Periodicals section contains many active links.

This Web site also includes links to research and academic sites (including biotechnology centers), databases, member companies, and other sites.

# Curriculum production team assists HSRC

By Stephen M. Hoffman

The Curriculum Production Team, under administrative direction of the Technical Assistance Center, Kansas State University-Salina, was organized in 1995 under a Department of Defense grant to disseminate a two-year environmental technology program to community colleges. Under the original grant, the team would package and publish teaching modules developed by K-State faculty with expertise in pollution prevention, pollution remediation, and resource conservation. These modules would be passed on to community colleges near military bases which were slated to close with the idea that some of the former military employees would turn to local colleges for new skills, and begin to form the core of a wave of environmental technologists.

The DOD project ended in March 1997 but received strong enough reviews to earn the team other contracts. The National Science Foundation is funding a project similar to the DOD's, this one to develop curriculum building blocks around the combined uses of satellite positioning technology and mapping databases.

Western Resources has engaged the team to produce training materials for its field technicians. Modules are written by KSU engineers working with specialists at Western Resources who cover academic territory as wide as Kansas: engineering, economics, gas and electricity distribution, surveying, and basic math.

The U.S. Department of Agriculture, working through K-State Extension, engaged the Salina team to produce CD-ROMs that can be used to train youth coun-

selors at 147 Army bases around the globe. The first CD was reviewed enthusiastically by Extension and military officials who have ordered more of the training modules.

K-State's Hazardous Substance Research Center asked the team to help update its 1997 Annual Report, both in print and in digital form available on the Internet.

Dennis Franz heads up the Curriculum Production Team. With commercial broadcast and college teaching experience, Dennis is a liaison between the team and its several clients. Steve Hoffman and Bryan Ackley are the other full-time team members. Brian and Steve have journalism degrees from K-State. For the most part their experiences are with print and editorial issues, but Bryan has moved almost entirely into Web publishing and several other facets of new media development. He designed and maintains the team's Website, which in the future will hold DOD and NSF curriculum materials for downloading. Bryan has been working with HSRC's Pat McDonald to put the 1997 Annual Report on line. Steve handles mostly print editing chores, working with modules written by K-State instructors. He also does some publication design and layout.

Jack Koehn, history teacher at Canton-Galva High School, works part-time for the team as a multimedia developer and did the actual programming that resulted in the training CD-ROMs for the Army.

In addition to working with CD-ROMs and printed materials, the team has experimented with Adobe System's Acrobat soft-

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## Consortium Directory

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

Key personnel at each university are:

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*HazTech Transfer* is published quarterly by the Great Plains/Rocky Mountain Hazardous Substance Research Center, Regions 7 & 8, at Kansas State University, Manhattan, KS 66506, to serve as a means of communication and a forum for members of the center's consortium partners and researchers and the public. The Office of Research and Development, USEPA, under agreement R-819653, provides 70 percent of the funding for this program and this publication. The content of this publication does not necessarily represent the views of that agency.

Although the projects described in this article have been funded in part by the U.S. Environmental Protection Agency under assistance agreement R-819653, 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.

# Gamma rays may reveal subsoil mysteries

By J. Patrick McDonald

Physical and chemical characterization of the subsurface at abandoned hazardous waste facilities is a costly but necessary activity. Two researchers at KSU are working on one possible solution: prompt gamma ray neutron activation analysis (PGNAA). Using this technique, fast neutrons are directed into the soil from a fixed source above the surface and a radiation detector measures the gamma photons released by elements that capture the neutrons.

In practice, this technique is commonly used to collect physical data from soils, most commonly to construct well boring logs. Dr. R.E. Faw and Dr. J.K. Shultis have developed analytical techniques that allow this method to estimate actual contaminant concentration profiles up to a depth of one-half meter. Since the photons released by each individual element produce a unique spectrum, it is possible to identify specific contaminant species.

Application of this technology presents two specific challenges. The first difficulty is that an accurate representation of the neutron field vs. depth must be known in order to properly calibrate the analysis. Without an accurate understanding of the absorption rate of neutrons, the resulting spectra are useless.

The second difficulty is that the analysis of the data requires a solution to an ill-posed mathematical problem (the analysis relies on the solution of an underdetermined set of equations).

## Research findings

Work on solving the neutron absorption rate has produced empirical expressions for flux that solve the problem of identifying the baseline signal. Results of this effort are shown in Figure 1 as a normalized thermal neutron fluence in various soil types.

The second part of the analysis is proving a bit more challenging. However, four sound ways of solving the ill-posed problem have been identified and tested and are returning reliable results. Each of the four analytical techniques was tested against simulated data. The results of two such inversions are shown in Figure 2. While signal noise remains a significant problem, several techniques are being employed to solve this problem.

Future work will incorporate the Bayesian Method to further limit statistical noise. This technique works by combining data from previous measurements to clarify the results of subsequent measurements.

## Potential development

This research has significant applications in site characterization. Specifically, it could be very useful in the specific application of surface and subsurface clearance of sites where unexploded ordnance (UXO) is present.

Another application involves introduction of the source at various depths (by driving the source into the soil). While this technique is invasive, it does provide additional information that can be used to reduce the problem of noise and produce a more accurate profile.

The advantage of these techniques of course is the speed with which an analysis can be completed. Properly configured, a reading can be taken in anywhere from a few seconds to a few minutes, depending upon the accuracy needed. Thus PGNAA may be quite useful as a screening tool at a variety of hazardous waste sites.

The combined speed and potential accuracy of the method could allow for a quick method of generating a three-dimensional model of subsurface contamination.

## Principal investigators

R.E. Faw, Professor of Nuclear Engineering, Ward Hall, Kansas State University, Manhattan, KS 66502.

J.K. Shultis, Professor of Nuclear Engineering, Ward Hall, Kansas State University, Manhattan, KS 66502.

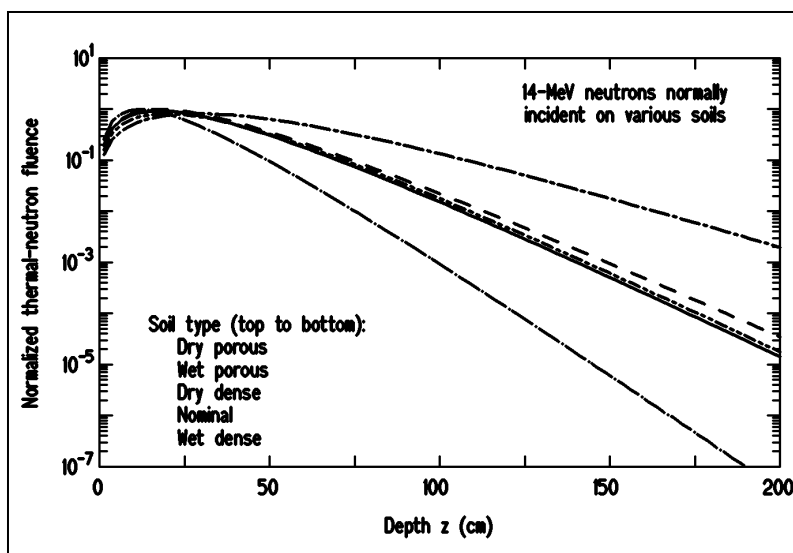


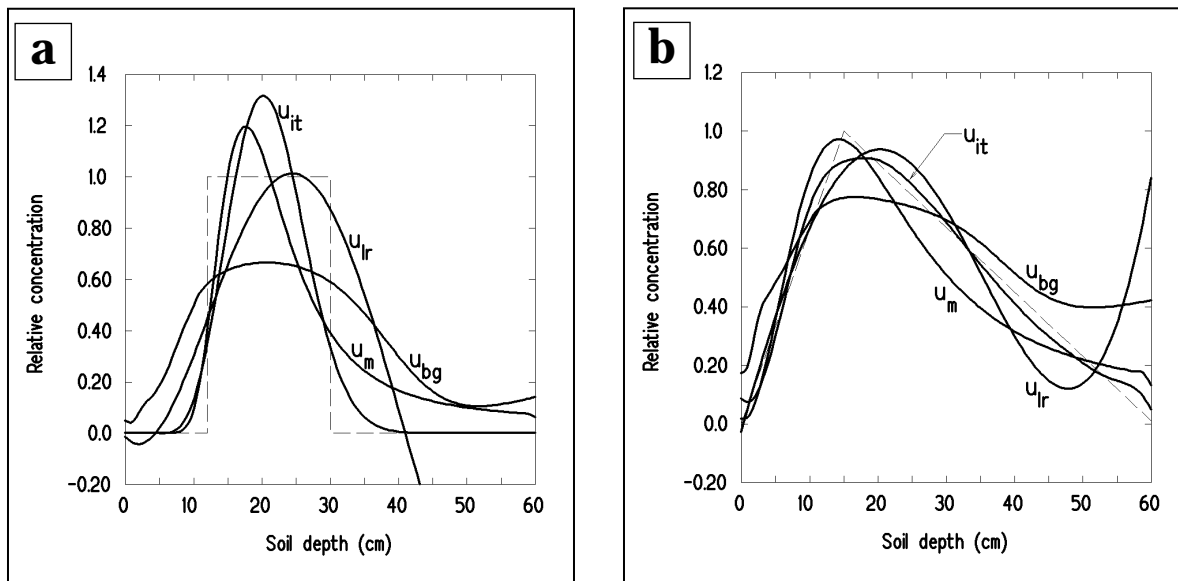
Figure 1. Normalized thermal neutron fluence in irradiated soil.

**Publications**

Shultis, J.K., R.E. Faw, and F.A Khan, "Methods for Determining Soil Contaminant Profiles from Prompt Neutron Gamma Activation Data," Proceedings of the HSRC/WERC Joint Conference on the Environment, Albuquerque, NM, pp. 615-631, May

21-23, 1996.

Shue, S. L., R.E. Faw, and J.K. Shultis, "Fast Neutron Thermalization and Capture Gamma-Ray Generation in Soils," Proceedings of the HSRC/WERC Joint Conference on the Environment, Albuquerque, NM, pp. 596-614, May 21-23, 1996.



**Figure 2. Inversion of a step profile (a) and a bilinear profile (b) for an idealized chromium contaminant using four different inversion methods: ulr linear regularization; uit linear regularization with positivity iteration constraints; ubg The Backus-Gilbert method; and um the maximum entropy method.**

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

## HERS hosts 'Introduction to Air Quality Management' training

Haskell Indian Nations University and the Haskell Environmental Research Studies Center hosted an "Introduction to Air Quality Management" workshop Feb. 4-7, 1997, in Lawrence, Kan. The workshop was a cooperative effort between the Institute for Tribal Environmental Professionals at Northern Arizona University at Flagstaff and the U.S. Environmental Protection Agency American Indian Air Quality Training Program.

Twenty people from tribal environmental offices and natural resources programs attended to gain an understanding of the importance of clean air, protection of the environment and human health, and need for air quality management. Material was presented with sensitivity to Native American cultural values.

The workshop used multiple approaches including lectures, laboratory work, group presentations, small group discussions, and problem-solving exercises. It was geared for entry level personnel who

do not have strong science and air quality backgrounds. Topics covered were concepts of pH, sources of pollutants and their effects, National Ambient Air Quality Standards, use of a PM10 air sampler, and major provisions of the Clean Air Act and its application to tribes and components of tribal air quality programs.

## 'All Things Are Connected' seminar series films second program

"All Things Are Connected—Our Connection to the Land" was filmed at the Haskell Indian Nations University (HINU) television studio Feb. 28, 1997. Panel members were Kim Tallbear, Environmental Policy Analyst for the Council Energy Resource Tribes, Denver, Colo.; Jim Grijalva, director of the Tribal Environmental Law Project, University of North Dakota; and Bill Welton, professor of Natural Resources, HINU. The program was moderated by Aietah Stephens, HINU alumna and a graduate student in broadcast journalism at Northeastern State

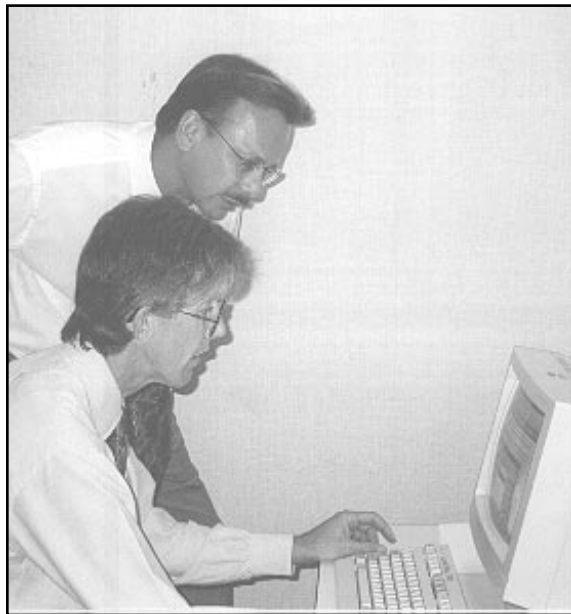
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## ***Flechas brings expertise to SAC***

**By Mary Rankin**

Stating that his participation is focused on "being able to develop science and technology which is practical and economical," Felix Flechas, senior environmental engineer with the Region 8 office the U.S. Environmental Protection Agency in Denver, has been a member of the Great Plains/Rocky Mountain Hazardous Substance Research Center's Science Advisory Committee (SAC) since 1989.

In his regulatory development work, Flechas said he "became aware of the limitations which existing science and technology face in being able to address environmental issues at complicated hazardous waste sites." Representing the interests of EPA Region 8 while serving on SAC, he is able to



***Felix Flechas, standing, discusses a briefing with EPA coworker, David Schaller.***

review research proposals and research progress aimed at dealing with this issue. He had also been a member of the Technology Transfer and Training Committee for the GP/RM HSRC prior to his position on SAC.

Flechas began his career with EPA in 1979, serving four years in the Safe Drinking Water Program. In 1983 he started working in the regional hazardous waste program writing hazardous waste permits and enforcing hazardous waste laws. His recent work has focused on cleanup of hazardous waste sites and providing the region with technical assistance on the remediation of such sites.

Active in the development of new regulations, Flechas has taught hazardous waste courses and provided waste management assistance to foreign governments for EPA. "The most interesting part of my profession," he said, "is communicating information in a manner which teaches people new ideas or concepts, enabling them to perform more efficiently or make progress in problem areas." In 1995 his accomplishments were recognized as he was named EPA's Federal Engineer of the Year.

With an aptitude for engineering and an interest in environmental matters sparked by having grown up in the '60s and '70s, Flechas said, "Environmental engineering afforded me the opportunity to combine aptitude and interest in a unique way." His undergraduate degree in engineering is from Walla Walla College, and he received his master's in that discipline from the University of Colorado.

Acknowledging that "work seems to consume most of my free time," Flechas did add that landscape work around his new home, snow skiing, and biking were favorite leisure time activities. He and his wife Debbie are expecting their first child in late April. With an international assistance trip to Malaysia planned for the second half of March, Flechas said, "Hopefully, the baby will not decide to arrive early."

## ***"All Things . . ." series films second program***

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University, Tahlequah, Okla.

Panelists agreed that there is a need for Native American environmental engineers, scientists, and geologists who understand cultural sensitivity issues regarding nature. They stressed that in order for tribes to assert their sovereign authority on environmental activities in their territory effectively, they need qualified Native Americans working in

tribal environmental offices.

The third program, "The Water — Going Beneath the Surface of an Issue," will be recorded at the HINU TV studio March 20, 1997, and distributed to seminar series participants. The fourth program, "Air—Ensuring Quality for the Future," will be available via satellite April 22, 1997. This program will be broadcast on both C-Band at Galaxy 6, transponder 2, and KU-Band at SBS 6, transponder 14.

## Repository documents available through HSRC

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# 1166.** Cunningham, A. B. Final Project Report: Engineering Scale-up of in situ Bioremediation Processes: a Workshop on Biotreatability. Bozeman, MT: Montana State University, 1996. 32 pp.

**Rec# 1167.** Strategic Plan for the Office of Research and Development. Washington, DC: Environmental Protection Agency, Office of Research and Development, May 1996. 60 pp.

**Rec# 1168.** Environmental Legacy for Our Grandchildren: Live Teleconference. Lawrence, KS: Haskell Indian Nations University, 1996. VHS Tape.

**Rec# 1169.** Comparison of Native American and European Worldviews: A Roundtable Discussion, Part 2. Lawrence, KS: Haskell Indian Nations University, 1995. VHS Tape.

**Rec# 1170.** Comparison of Native American and European Worldviews: A Roundtable Discussion. Lawrence, KS: Haskell Indian Nations University, 1995. VHS Tape.

**Rec# 1171.** Office of Scientific and Technical Information, Office of Environmental Management Technical Reports: A Bibliography. Oak Ridge, TN: U.S. Department of Energy, 1996.

**Rec# 1172.** Staack, Bill. Implementation of SB 509. California Department of Health Services, Toxic Substance Control Division, 1987.

**Rec# 1173.** IGT Symposium on Gas, Oil, Coal, and Environmental Biotechnology. Institute of Gas Technology.

**Rec# 1174.** Smith, John R.; Nakles, David V.; Cushey, Mark A.; Morgan, David J. Application of Biodegradation Screening Protocol to Contaminated Soils from Manufactured Gas Plant Sites. Pittsburgh, PA: Remediation Technologies, Inc.

**Rec# 1175.** Regulation of Ethylene Glycol Wastes in California: A Regulatory Interpretation. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division, Waste Evaluation Unit, September 1991.

**Rec# 1176.** Hazardous Waste Management in California 1986-1988. California Department of Health Services, Toxic Substances Control Program Biennial Report.

**Rec# 1177.** Appendices to the Guidance Manual for the

Hazardous Waste Source Reduction and Management Review Act of 1989. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division.

**Rec# 1178.** Guidance Manual for the Hazardous Waste Source Reduction and Management Review Act of 1989. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division.

**Rec# 1179.** Land Disposal Restriction Newsletter. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. 1988.

**Rec# 1180.** Waste Minimization for the Pesticide Formulating Industry. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet, February 1991.

**Rec# 1181.** Asbestos Handling, Transport and Disposal. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet, July 1990.

**Rec# 1182.** Hazardous Waste and the Environmental Industry. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet.

**Rec# 1183.** Selected Technology Demonstrations. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet.

**Rec# 1184.** Waste Reduction for Paint Formulators. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet, December 1989.

**Rec# 1185.** Handling and Transport of Spent Lead-Acid Storage Batteries for Recycling. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet, April 1991.

**Rec# 1186.** Waste Reduction in the Aerospace Industry. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet, April 1990.

**Rec# 1187.** Vacuum Deposition: Source Technology. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet.

**Rec# 1188.** Treatment Standards for Non-RCRA Hazardous Wastes. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Section. Fact Sheet, June 1989.

**Rec# 1189.** Printed Circuit Board Manufacturers. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet, February 1991.

**Rec# 1190.** Waste Minimization for Metal Finishers. California Department of Health Services, Toxic Substances Control Program, Alternative Technology Division. Fact Sheet, February 1991.

## Curriculum production team assists HSRC

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ware to create an interactive teaching text called ActiveDOC®. This is a textbook with links to audio and video files. Readers are treated to sound, animation, slide shows, or brief video clips that reinforce lessons

in the printed text. When linked to the user's Web-browsing software, ActiveDOC® will also let readers send e-mail to the text's author, making it easier than ever for students to send questions or comments.

The Curriculum Production

Team can be contacted through Dennis Franz at: TAC Bldg., Kansas State University-Salina, 2409 Scanlan Ave., Salina, KS 67401-8196. Phone: 913-826-2659. E-mail: dlfranz@gmail.sal.ksu.edu.

## Calendar

**April 22-24** — WERC/HSRC Joint Conference on the Environment, Albuquerque, NM; co-sponsored by the Waste-management Education and Research Consortium and the South/Southwest Hazardous Substance Research Center; contact WERC at 800-523-5996.

**April 24** — Certified Hazardous Materials Manager Review by interactive television begins at several locations and continues each Thursday evening for six weeks (exam June 21); Univ. of Mo.-Columbia, Virginia Nettleton, 573-882-8880.

**April 25** — HAZWOPER Refresher, Kansas City, KS; Univ. of Kansas Center for Environmental Education and Training, Shirley Welhoelter, 913-897-8527.

**April 28** — Lead Abatement Training for Supervisors and Contractors, Mid-States Rocky Mountain Regional Lead Training Center, Barbara Miles, 913-897-8528.

**April 29-30** — Risk-Based Corrective Action: The Standard for Petroleum Release Sites ASTM Standard E 1739, St. Louis, MO; Univ. of Mo.-Columbia, Virginia Nettleton, 573-882-8880.

**April 30** — Project Designer Refresher, Kansas City, KS; National Asbestos Training Center, Barbara Miles, 913-897-8528.

**May 13-14** — ISO 14000 for Auditors, Kansas

City, MO; Univ. of Mo.-Columbia, Virginia Nettleton, 573-882-8880.

**May 13-15** — Certified Hazardous Materials Manager Review, Wichita, KS; Univ. of Kansas Center for Environmental Education and Training, Shirley Welhoelter, 913-897-8527.

**May 16** — Certified Hazardous Materials Manager Exam, Univ. of Kansas Center for Environmental Education and Training, Shirley Welhoelter, 913-897-8527.

**May 19-21** — Lead Inspector Training, Kansas City, KS; Mid-States Rocky Mountain Regional Lead Training Center, Barbara Miles, 913-897-8528.

**May 20** — HAZWOPER Refresher, Columbia, MO; Univ. of Mo.-Columbia, Virginia Nettleton, 573-882-8880.

**May 20-22** — **12th Annual Conference on Hazardous Waste Research, Kansas City, MO; Great Plains/Rocky Mountain HSRC, Carla Wolfe, 913-532-7464.**

**May 22** — ISO 9000 training begins, Omaha, NE; Univ. of Mo.-Columbia, Virginia Nettleton, 573-882-8880.

**May 22-23** — Lead-Based Paint Risk Assessment, Kansas City, KS; Mid-States Rocky Mountain Regional Lead Training Center, Barbara

Miles, 913-897-8528.

**May 29** — Contractor/Supervisor Refresher, Kansas City, KS; National Asbestos Training Center, Barbara Miles, 913-897-8528.

**May 30** — Inspector/Management Planner Refresher, Kansas City, KS; National Asbestos Training Center, Barbara Miles, 913-897-8528.

**June 3-5** — EPA Region 7 Pollution Prevention Conference, Kansas City, MO; Kansas State Univ. Engineering Extension, Gene Meyer, 913-532-6026.

**June 10-13** — Transport and Fate of Organic Chemicals in Soil and Ground Water (short course), Golden, CO; Colorado School of Mines; Helen Dawson, 303-273-3402.

**June 18** — Lead Inspector Refresher Training, Kansas City, KS; Mid-States Rocky Mountain Regional Lead Training Center, Barbara Miles, 913-897-8528.

**June 19** — Lead Supervisor/Contractor Refresher Training, Kansas City, KS; Mid-States/Rocky Mountain Regional Lead Training Center, Barbara Miles, 913-897-8528.

**June 20** — HAZWOPER Refresher, Kansas City, KS; Univ. of Kansas Center for Environmental Education and Training, Shirley Welhoelter, 913-897-8527.



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