WERC
A CONSORTIUM FOR ENVIRONMENTAL EDUCATION AND TECHNOLOGY DEVELOPMENT

Annual Report

Highlights 2005 - 2006

NM STATE College of Engineering

Photo courtesy of Tom A. Freelove

ABOUT WERC

WERC: A Consortium for Environmental Education and Technology Development is comprised of New Mexico State University (administered through the College of Engineering), University of New Mexico, New Mexico Institute of Mining and Technology, Diné College (The Higher Education Institute of the Navajo Nation), Sandia National Laboratories and Los Alamos National Laboratory.

Established in 1990, WERC's mission is to develop human resources and technologies to address environmental and human-health related issues focusing on the following:

1. Education—creating opportunities for students to pursue environment-related degrees ~
2. Public outreach—teaching school, community and business leaders how to increase energy efficiency and reduce pollution ~
3. Technology development and deployment—supporting research that furthers a clean environment ~

One of WERC's primary goals is to conserve natural resources and provide economic benefits to the public. WERC accomplishes these goals through a strategic alliance among educational institutions, national laboratories, industry and the U. S. Department of Energy. WERC programs include the following:

- Pollution Prevention
- Energy and Environmental Sustainability
- Water Quality and Conservation
- Nuclear Waste Management
- Bio-Medical Waste Management
- Food Contamination Safety
- Peer Review

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Photo courtesy of Tom A. Freelove

FROM THE EXECUTIVE DIRECTOR

It is my esteemed pleasure to share with you this documented report of the WERC Highlights for 2005-2006. Featured are WERC's activities and achievements of this, the 16th year of our cooperative partnership with the U.S. Department of Energy.

Since 1990, WERC has diligently focused its mission on the development of human resources and technologies to help government, industry and academia address environmental challenges and related human health issues. Through education, outreach and technology development, WERC has enjoyed continued success in this effort. This success is due in large part to the dedicated efforts of our staff and the on-going support and commitment of federal, state, local and other key stakeholders.

While we take this opportunity to look back on our triumphs, we are mindful of the many environmental challenges that still face our nation, our state, our communities and our population. It is only through continued tenacity and focused efforts that we will make our environment cleaner and healthier for generations to come. Access to clean water, air and affordable energy are vital for continued development and quality of life.

Regards,

Abbas Ghassemi

Photo courtesy of NMSU Communications

STUDENTS DEVELOP ARSENIC REMOVAL SYSTEMS

With the new standards for arsenic levels in drinking water effective in 2006, arsenic removal from water has become a prominent issue for communities throughout the nation. University students who developed innovative solutions to the problem at the 2005 WERC Environmental Design Contest, held this past spring in Las Cruces, NM, have been selected to further develop their technologies.

The new Environmental Protection Agency (EPA) regulations lowered the maximum contaminant level for arsenic from 50 parts-per billion (ppb) to 10 ppb, as long-term exposure to the metal poses a variety of environmental and health risks. More than 2,000 public water systems across the nation, including an estimated 100 systems in New Mexico, must implement new processes in order to comply with the new regulations.

In response to arsenic removal as a growing issue, New Mexico Senator Pete Domenici requested the U.S. Department of Energy (DOE) form a partnership among WERC, Sandia National Laboratories and the American Water Works Research Foundation (AwwaRF). The Arsenic Water Technology Partnership is charged with providing domestic and municipal water utilities, particularly those serving small and rural communities, with cost-effective solutions for complying with the EPA standards.

"It has been a well-coordinated effort between the three members of the partnership and the EPA to find new, innovative technologies for arsenic removal," AwwaRF's Arsenic Program Manager Albert Ilges said.

The Arsenic Water Technology Partnership sponsored a task featured in WERC's annual Environmental Design Contest that challenged students to develop a treatment technology to remove arsenic and nitrates from drinking water in rural, isolated communities. Solutions needed to be cost-effective and energy-efficient, with the capacity to function appropriately in the presence of other competing ions such as silica and phosphate.

"This task was more difficult," Ilges said. "There were some innovative ideas ranging from ways to modify existing technologies to new ideas to potentially remove other contaminants from water."

Teams from 11 universities tackled the problem. All teams had to develop a working bench-scale model and prepare an oral presentation, a poster outlining the details of the project and a written report. Representatives from each of the partners in the Arsenic Water Technology Partnership reviewed proposals submitted by the teams and invited two teams to further develop their technologies.

A team from Lafayette College, in Easton, PA, returned to the NMSU campus to demonstrate and verify the technology they presented at the design contest. The team devised a system using iron-enhanced activated alumina and a nitrate resin. Arsenic is removed by the alumina and the nitrate resin removes nitrate efficiently. Not only is this system efficient and low-cost, it creates non-hazardous waste and can easily be implemented into an existing water system.

"WERC's design contest was a unique opportunity to implement and use our engineering classes in a real-world problem," Lafayette team member Katie Herchenroder said.

A team from NMSU, spear-headed by the NMSU Chemical Engineering Department, was also invited to demonstrate and verify the technology they presented at the contest.

The NMSU team developed a method using activated alumina as a filter medium. The team discovered by using activated alumina during adsorption, a process by which particles adhere to a surface without any chemical reaction, both the arsenic and the nitrates could be removed in one step.

"The series of technologies proposed by the contestants at the contest will have long-term significant impact in assisting small communities throughout the country meet the newly promulgated arsenic rule," WERC Executive Director Abbas Ghassemi said. "We're excited about some of the innovations offered at the contest. These efforts will augment the efforts of the partnership to develop and field test new technologies and provide an effective cost-decision tool to help communities."

2005 - 2006 Summary

WERC RESEARCH

Robert S. Bowman, NM Tech
Removal of Perchlorate from Contaminated Waters Using Surfactant-Modified Zeolite/ZeroValent Iron Pellets

T. David Burleigh, NM Tech
Process to Anodize Steel for Corrosion Protection

Shuguang Deng, NMSU
Membrane Distillation for Brackish Water Desalination

Joe Ellington, NMSU
Demonstration of Precision Agricultural Technology to Increase Profit, Reduce Environmental Damage, Production Costs and Water Use: A Case Study - Cotton in the Mesilla Valley, New Mexico

Majid Ghassemi, NM Tech
Research and Development of a Low Cost, Environmentally Friendly, Energy Efficient, Non-isotropic Building Panel Utilizing Sustainable Construction Material

Thomas L. Kieft, NM Tech
Immuno-PCR Detection of Biological Food Contamination

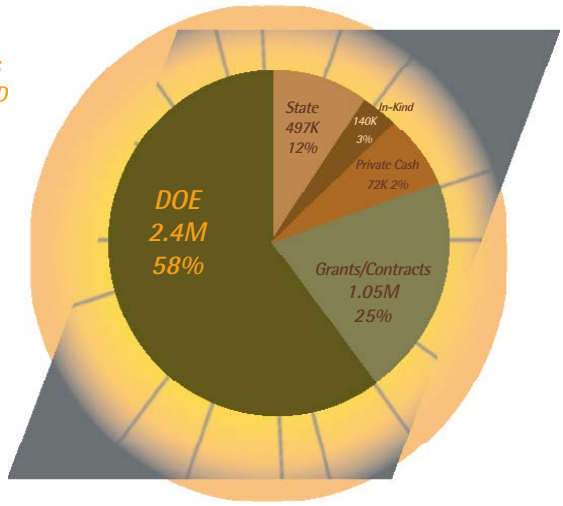
Navid Mojtabai, NM Tech
Evaluation of Selected Dust Control Reagents for Surface Mining Operation

Rebecca A. Reiss, NM Tech
Environmental Proteomics: Isolation of Enzymes Responsible for Dihaloethane Biodegradation

Bruce Thomson, UNM
Investigation of Long Term Stability of Residuals from Drinking Water Arsenic Treatment

Hai Xiao, NM Tech
Development of Zeolite-coated Optical Fiber Sensors for In-Situ Monitoring of Dissolved Organics in Water

TOTAL FY 2005-2006 WERC FUND 4.1M



TECHNOLOGY DEVELOPMENT

	TECH. DEV. GRANTS	SEED GRANTS
Total Projects Funded	10	1
Students Employed	28	1
Faculty Supported	19	1
Partners Involved	5	0
Formal Presentations & Papers Published	20	0
Patent Applications Submitted	2	0
Total Research Awards	$559,000	$4,792

TECHNOLOGY DEVELOPMENT 1990 - 2006
Approximately 160 Technology Development Projects
Deployment of 16 Technologies Nationally
More than 203 Faculty Involved
More than 376 Students Employed

EDUCATION PROGRAM

Number of Students Fall 2005	98
Number of Students Spring 2006	98
Number of Students Earning Minor	10
Number of Students Earning Certificate	5
Number of Fellowships Awarded	81
Total Fellowships Awarded	$39,500
Minority Students	55%
Traditional Courses Presented	9
Distance Education Courses Presented	4

PROFESSIONAL and K - 12 DEVELOPMENT

Pollution Prevention
- Pollution Prevention Training Guidelines
- Partnership on Carbon Sequestration
- Arsenic Water Technology Partnership
- Distributed Energy Resources

Southwestern Regional Interactive Training Workshops & On-Site Industry Audits: 20
Participants Educated 215

National, Award-Winning, Multi-Disciplinary Environmental Programs For Educators & Students

- Summer Environment Academy
- Water Stewardship Education Program
- Small-Scale Chemistry
- Pre-Freshman Engineering Program
- Project WET
- Art & Essay Contest-Recycling & the Environment
- Radiation Education
- Southwestern NM Regional Science & Engineering Fair

Facilitators & Other Educators: 277
U.S. Teachers, Elementary, Middle and High School Students: 4,752

EDUCATION PROGRAM 1990 - 2006

Students Participating	1,965
Students Hired by DOE/National Labs (estimated)	600+
Students Earning Minor	499
Students Earning Minor	25%

Photo by Tom A. Freelove

GROUND TIRES TESTED TO SAFEGUARD ABANDONED MINES

In an effort to safeguard abandoned mines, WERC: A Consortium for Environmental Education and Technology Development is developing a slurry mixture composed of ground-up old tires and cement to fill dangerous underground passages.

WERC has received two grants from the Bureau of Land Management (BLM) to investigate innovative methods utilizing waste materials to safeguard abandoned mine land in the Boston Hill area of Silver City, NM.

Boston Hill is an abandoned mine property purchased by Silver City in 1999 as an open-space preserve to be developed as a hiking and bike trail. Silver and manganese-iron ore were mined in the Boston Hill area beginning in the late 1800s and are a significant part of the area's history. Four different parcels of land in Boston Hill remain the property of the BLM, three of which have abandoned mine land hazards, including various types of underground passages and surface openings.

WERC has been tasked with researching methods to safeguard physical safety hazards and identify methods of controlling surface water run on and run off. The methods must also allow for the protection of the habitats of bat species residing in the Boston Hill area and preserve mining heritage for educational purposes.

The project began in summer 2003 with a physical investigation of the abandoned mines. Research was then conducted to identify current methods and innovative technologies utilizing waste materials as a method to safeguard abandoned mines. As a result of this research, WERC proposes to experiment with slurry made from ground-up old tires and cement as a material to fill some of the abandoned mines.

Four interconnected mine passages, totaling 4,000 cubic feet, were identified as a site to pilot the proposed method. Biologists have determined that the site is not a bat habitat.

WERC Program Manager Jim Loya formed a steering committee this past spring comprised of representatives of state agencies, the BLM, public interest groups, the town of Silver City and New Mexico State University to develop parameters for laboratory and field testing of new concepts and materials as well as conditions for long-term monitoring of the remediated mine site.

"Initial literature research shows that the material could be used successfully as a fill for abandoned mines," Loya said, "This research also indicates that studies conducted on similar substances did not yield environmental problems, such as leaching from the material."

Laboratory research is needed to find the right combinations of materials and to develop mixing methods. Variables such as strength and shrinkage will also be tested. Once a promising mixture is developed, it will be tested to determine how successfully it can be pumped before actual use in the field.

Laboratory work at NMSU's civil engineering laboratory and remediation of the site began in early 2006. Once the formula for the slurry mixture is perfected it will be made available for use at other BLM sites. "It's an innovative way to address two environmental problems," Loya said.

Photo by Therese Shakra

WERC 16TH ANNUAL ENVIRONMENTAL DESIGN CONTEST

Sponsors for the 2006 Environmental Design Contest included the following:

- American Water Works Association Research Foundation
- Intel Corporation
- Los Alamos National Laboratory
- Malcolm Pirnie, Inc.
- Oak Ridge Associated Universities
- U.S. Department of Agriculture
- U.S. Department of Energy, Office of Fossil Energy
- U.S. Department of Energy, Waste Isolation Pilot Plant
- U.S. Department of Energy, National Nuclear Security Administration
- U.S. Food and Drug Administration

Design Tasks for the 2006 Environmental Design Contest included the following:

Task 1 - Arsenic Treatment for Water in Rural, Isolated Communities
Task 2 - Low Energy Use Desalination System
Task 3 -Cleaning of a Water Distribution System
Task 4 -Food Facility Decontamination
Task 5 - Removal of Tetramethlammonium Hydroxide (TMAH) from a Liquid-Waste Collective System
Task 6 -Eliminate Black Smoke from Diesel Operations
Task 7 -Carbon Sequestration
Task 8 -Underwater Pond Liner Repair System

2006			
University Participants	171	High School Participants	47
University Teams	28	High School Teams	14
Universities	20	High Schools	6

Environmental Design Contest 1990-2006

- 3,718 Students Participating
- 72 U.S. Universities
- 10 International Universities
- 28 High Schools

Photo courtesy of Tom A. Freelove

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