

INTERNATIONAL ENVIRONMENTAL DESIGN CONTEST FOR UNIVERSITIES: A REALISTIC HANDS-ON EDUCATIONAL TOOL FOR TECHNOLOGY DEVELOPMENT AND TRANSFER

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ABSTRACT

The Waste-management Education and Research Consortium (WERC) is a consortium of three universities, a community college, and two national laboratories sponsored by the DOE with the mission of generating resources to address issues associated with environmental management.

For the past several years, WERC has implemented an environmental design contest for competition by universities throughout America. This is the only university environmental design contest of its kind in the world. The contest is structured to give university student groups an opportunity to exchange information via a national contest for design, development and testing of an environmental control process. Each year a practical environmental problem is presented to the competing teams. Each team prepares a total plant design for the solution of the environmental problem and demonstrates the solution as a small scale working model. The design stresses not just the technical solution, but also such factors as economics, risk analysis, health, regulations, public policy, and communications. Most participating teams have used the contest problem as part of a capstone design course.

The judging is performed by experts from academia, industry, and government agencies. The awards are based on the written plant design and small-scale demonstration, as well as poster and oral presentations by the competing teams. All the criteria noted above (technical excellence, risk analysis, etc.) are weighed in the judging.

In April 1993, twenty-two teams from throughout North America, including one team from Mexico, competed in the contest which focused on waste remediation and minimization for the printed wiring board (PWB) manufacturing process.

The program has continued to accomplish its objective of providing a design challenge and a medium of exchanging information in the environmental area between various participating teams. Many North American universities have shown an interest in competing in the 1994 contest. In addition to trophies, there will be approximately \$35,000 in cash awards for first through fifth place, as well as other specific categories.

This paper presents the experiences of past competitions and gives information about the 1994 contest which focuses on a soil remediation and land reclamation process.

INTRODUCTION AND PURPOSE

The Waste-management Education and Research Consortium's (WERC) mission is to expand the nation's capability to address issues related to the management of all forms of wastes, via education, technology development and information transfer. More than 2000 students (pre-college, college, and professional) receive these educational benefits, and more than 40 technology development projects are progressing on all aspects of waste management and environmental restoration.

Currently, there are undergraduate and graduate educational programs throughout the world on environmental management and engineering. However, there had never been a vehicle to bring students from various universities together for discussions of and solutions to major environmental issues.

For the first time, in April 1991, a unique and innovative environmental design contest for universities throughout the Americas (including Canada and Mexico) was conducted as part of the Department of Energy (DOE) sponsored Waste-management Education and Research Consortium (WERC). The design contest was co-sponsored by several industrial organizations and the DOE. The contest was structured to give university student groups from all over America an opportunity to exchange information and participate in an international contest for design, development, and testing of an environmental control process. The design problem was described in realistic terms in a simulated letter from company management to an engineer who had recently joined the

company. The young engineer was asked to form a group to design and construct a bench-scale working model and demonstrate the pollution control process.

The expected results include:

- A report that documents the design, economic considerations, health issues, business plan, regulatory implications, & impact on the community.
- A practical bench-scale working model of the process to demonstrate functionality of the process.
- An oral presentation of the design to a group of experts.
- A poster presentation of the waste minimization and remediation process.

The judging, performed by experts from academia, government, and industry, is based on technical, and other criteria (economic, public communications, regulations, etc.) that are important in today's world.

The first year's design was focused on a practical environmental problem, namely clean-up of contaminated liquid. The liquid for this purpose was a specified amount of water containing four contaminants, one from each major toxic category.

For the second year's event, the contest featured a unique and realistic soil contamination problem containing contaminants from five major toxic categories. Nineteen teams from throughout the United States and one team from Mexico competed.

Twenty-two teams competed in the 1993 Third Environmental Design Contest which focused on waste remediation

and waste minimization for a printed wiring board manufacturing plant. For the 1993 contest, top finishing teams received trophies and cash awards totaling \$25,000.

The 1994 contest focuses on a unique and realistic soil remediation process followed by reclamation of the contaminated area. The participating teams will be given 48 hours to demonstrate successful removal of the contaminants from the soil. They also will be required to demonstrate a sealant design for use in water harvesting. The 30 registered teams will be judged on both processes. The cash awards will total approximately \$35,000.

'93 Results and Conclusions

All of the teams reduced all of the contaminants and achieved varied degrees of success. They also provided a number of different ways to eliminate the waste at the onset.

The final standing of the award-winning teams were:

University	Name
1st Place	Purdue University
2nd Place	West Virginia University
3rd Place	Mich. Tech. University
4th Place	Mich. State University
Most Creative Design	New Mexico State University - Las Cruces, NM
Best Paper Design	Clarkson University - Potsdam, NY
Best Oral Presentation	University of Akron - Akron, OH
Best Poster Presentation	University of New Mexico - Albuquerque, NM
Best Bench Scale Model	University of Pennsylvania - Philadelphia, PA
Most Cost Effective Design	Northeastern University - Boston, MA
Outstanding Team Spirit	Texas A&M University - College Station, TX
Best International Design	Universidad de las Americas - Puebla, Mexico
1st Place Community Coll.	New Mexico State University - Carlsbad, NM
2nd Place Community Coll.	Mesa State College - Grand Junction, CO

According to the critique sheets completed by the participants, they not only found the competition challenging, well organized, and worthwhile, but also thought this event to be educational, rewarding, and extremely valuable. Some of the participants thought it would be a good idea to lengthen the time of actual competition in order to be able to attend both the paper presentation and the demonstration events.

The judges felt that the competition was worthwhile for industry, government, and academia. They were impressed with the organization of the event and praised WERC for its leadership in an environmental program such as this.

The winning designs are being examined for possible application to actual field demonstration. If selected, industry will work with the individual schools to work out the contractual arrangements.

1994 ENVIRONMENTAL DESIGN CONTEST

'94 Problem Statement

A large area (hundreds of square miles) in an arid region of the Pacific-Northwest has been contaminated with fallout

from a neighboring manufacturing region. The site is to be both remediated and reclaimed. Remediation will be defined as reducing the concentration of identified contaminants below the threshold values listed below. Reclamation will include the use of a water harvesting system to enhance the growth or natural vegetation or agricultural crops on the site.

Water harvesting is an ancient concept that has been applied to increase biomass production in arid and semi-arid lands. Water harvesting concepts currently applied in arid lands continue to be somewhat primitive technically and small in scale. The desire to improve the technical state of water harvesting by finding, selecting, designing and/or testing sealants for catchment areas and by development equipment that can apply the sealants on very large areas (hundreds of miles) in relatively short times (a few years) in a cost effective manner. These water harvesting catchments (sealed areas) may be tied into no drainage growing strips.

The design team is given the following three tasks:

1. Develop and demonstrate a bench scale process to remove the identified contaminants from a 5kg sample of the soil. Develop a conceptual design of the process applicable to the field scale project.
2. Develop and demonstrate a non-geomembrane, UV resistant, water repellent, erosion resistant, sealant that can be applied to the soil surface as an aid in water harvesting.
3. Develop a conceptual design for a machine capable of applying the sealant developed in task 2, to the surface of the remediated area.

'94 PARTICIPATING TEAMS

- California State University - Northridge
- California Polytechnic State University
- Clarkson University
- Cleveland State University
- Florida International University
- Massachusetts Institute of Technology
- Mesa State College
- Michigan State University
- Michigan Technological University
- Montana College of Mineral Science & Technology
- New Mexico State University
- New Mexico State University - Carlsbad
- Purdue University
- Roane State Community College
- Rose-Hulman Institute of Technology
- Santa Clara University
- South Dakota School of Mines and Technology
- Stanford University
- State University of New York - Buffalo
- Universidad de las Americas - Puebla, Mexico
- University of Akron
- University of Alabama - Huntsville
- University of Idaho
- University of Illinois - Chicago
- University of Maryland
- University of New Mexico
- Wayne State University
- West Virginia University #1 & #2
- Widener University