

Divining Rod

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Testing the Pecan Shell Solution

by Will Keener, WRRRI

Researcher Ranganath Potluri has a simple way to explain his summer's research: he wants to find out if arsenic likes pecan shells. Potluri, a graduate student in the Chemical Engineering Department at New Mexico State University, has completed the design work for his experiments and is poised to begin to measure whether his idea for the conversion of raw pecan shells to activated carbon filters will be an effective way to extract the poisonous element from groundwater.

"In the literature I've reviewed, there are many ways to prepare carbon," says Potluri, who is one of 12 student water research grant awardees from the Water Resources Research Institute for 2009. He has settled on zinc chloride to activate the shells.

First, he will clean and crush the shells and measure the surface area he has created in the process. "The main idea here is that the more surface area you have the more arsenic will adhere to it," he says.

Next, he will rely on a chemical reaction to improve the surface chemistry of the pecan shells to attract arsenic molecules. Many carbon materials, used in systems to extract metals and pollutants from water supplies, rely on an activating chemical that will result in a surface area on the carbon that is negatively charged. A negatively charged surface improves the carbons's ability to attract positively charged metal ions, such as zinc, manganese, copper, nickel, or iron. But arsenic presents the reverse situation, Potluri explains in his lab on the NMSU campus.

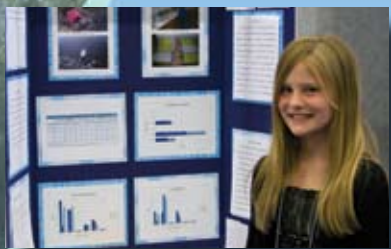
"I need to improve the surface chemistry, which will leave the carbon surface positively charged to attract the arsenic," he says. Arsenic, which is found in groundwater all over the world, typically combines with oxygen and sodium in water to make it more stable. For that combination in solution (AsNaO_2), a positively charged filter will be more effective, he says.



Ranganath Potluri will use this atomic absorption spectroscope in his laboratory to measure the amount of arsenic deposited on the surfaces of the crushed pecan cells.



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Divining-Rod

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Medical researchers have connected the consumption of arsenic-contaminated waters to skin, kidney, and other types of cancer and disease. Arsenic often occurs naturally in rocks and soils and the waters that come into contact with them. Industrial and mining effluents also contribute arsenic to water in some areas.

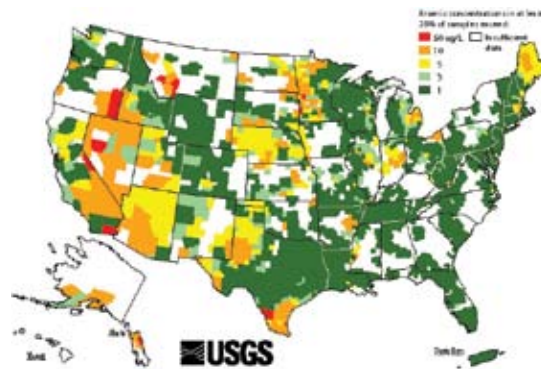
Arsenic contamination is a problem in many places in the world, including Potluri's native India, where contaminated water supplies in the Ganges Delta have caused serious arsenic poisoning to many people. A 2007 study estimated that more than 137 million are likely affected by arsenic poisoning worldwide. In the U.S., the Environmental Protection Agency underscored the problem by lowering the acceptable level of arsenic in groundwater from 5 parts per million to 0.1 parts per million in 2005.

With the change in the standard, many U.S. communities found their treatment systems inadequate to meet the required lower levels. Often located in the western and mid-western parts of the U.S. (see map), some of these communities are struggling with the cost of the new treatment systems they need. This has sent researchers on a quest to find lower-cost treatments.

Among those researchers is NMSU's chemical engineering professor David Rockstraw, Potluri's advisor. Rockstraw has directed his efforts and those of some of his graduate students

toward finding better raw materials for producing effective arsenic trapping materials. Whether these are used in existing systems or new systems under development, it is important to find ways to bring the actual costs of the materials down, he says. Because pecan shells go largely unused at this time, they are an inexpensive source of carbon.

Other candidate materials being considered and investigated are chile pods, cotton-seed husks, peanut shells, and rice husks. Costs associated with the carbon industry are complex. These



This map from the U.S. Geological Survey shows that occurrences of arsenic in groundwater above newly mandated safe levels (red and orange colors) are found principally in the West and Midwest regions.

materials, wood-based (lignocellulosic) carbon raw materials, tend to cost less than lignite-based (coal) carbons, Rockstraw says. "Because the coal does not depend upon a successful harvest, end-users of large quantities of carbon prefer the reliable source of this (coal-based) material. The pecan-shell carbons would essentially be a small niche market if successfully developed," he says.

A Mesilla Valley pecan processor has generously supplied Potluri with pecan shells. After the mechanical processing of the shells, Potluri will measure the surface area created. Then, using controlled amounts of arsenic in the test water, he will measure how much arsenic remains after treatment. Using atomic absorption spectroscopy he can also determine how much arsenic is trapped with the activated pecan filter. 💧

2009 New Mexico Water Research Symposium Call for Abstracts

Abstracts for consideration for presentations and/or posters at the 2009 New Mexico Water Research Symposium will be accepted through July 3, 2009. Abstracts related to any and all water research and management topics will be considered, but abstracts that exhibit multi-disciplinary work are strongly encouraged. Abstracts must not exceed 250 words and must be submitted online via the New Mexico Water Resources Research Institute's homepage (<http://wrri.nmsu.edu>). All accepted abstracts will be made available to participants.

Presenters whose papers are accepted for oral presentations will be limited to a 20-minute talk. All speakers and poster presenters must register for the symposium by August 5, 2009. The registration fee for everyone, including speakers, poster presenters, and other attendees is \$20. The fee will be waived for students presenting an accepted paper or poster. The fee

includes lunch, breaks, and a notebook with abstracts. Registration is online via the WRRI's homepage.

Final symposium agendas will be emailed to poster presenters and speakers in early August and will be posted on the WRRI website.

We encourage you to share this call for abstracts with your colleagues and students. Students are especially welcome to attend and present.



Timetable

Abstract Deadline

July 3, 2009

Notification Acceptance

July 21, 2009

Registration Deadline

August 5, 2009

Symposium Reception

August 10, 2009
5:30-6:30 pm

Symposium

August 11, 2009

Location

Macey Center
New Mexico Tech Campus
Socorro, NM



Technical sessions will be organized around the following topics:

- ◆ Water and wastewater treatment and reuse
- ◆ Erosion and sediment control
- ◆ Reservoir evaporation
- ◆ Economics and policy analysis
- ◆ Watershed assessment, planning, and management
- ◆ Wetlands and riparian issues
- ◆ Agricultural, industrial, and municipal water use
- ◆ Drinking water
- ◆ Atmospheric, surface, and groundwater modeling
- ◆ Impacts of climate variability and change on water resources
- ◆ Ground and surface water
- ◆ Fish and wildlife; endangered species
- ◆ Water supply
- ◆ Water management
- ◆ Impaired water
- ◆ Desalination
- ◆ Pollution prevention
- ◆ Water security
- ◆ Ecosystem services
- ◆ Public health
- ◆ Water quality
- ◆ Hydrogeocology
- ◆ Hydrology



Special Session on Water Management Modeling

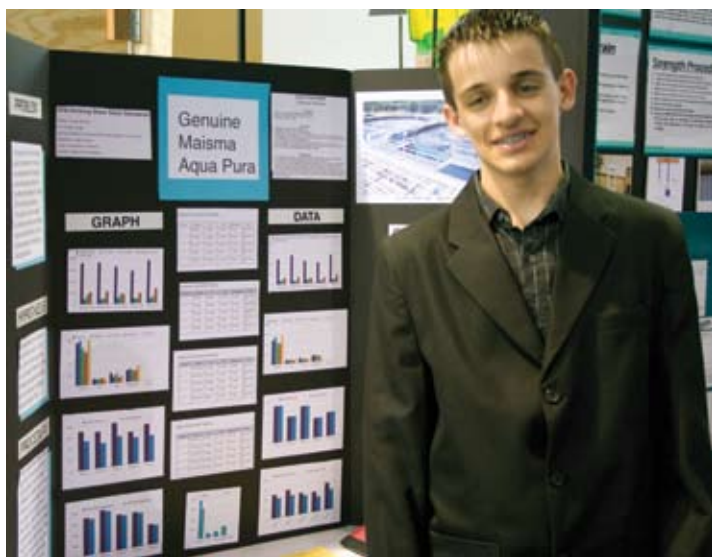
This year's conference includes a special symposium devoted to water resources management modeling for New Mexico. The session will include invited presentations as well as presentations volunteered through the call for abstracts.

Photos by Stephen Nowaczek

WRRRI Awards Students for Water-Related Projects at New Mexico Science Fair

More than 300 middle and high school students from throughout New Mexico earned their way to the 2009 New Mexico Science and Engineering Fair by having their science projects recognized at statewide regional science fairs. The annual state fair held on the New Mexico Tech campus on April 3-4, 2009 rewarded excellence in science, mathematics, and engineering projects. Winners at the state level will compete in the International Science and Engineering Fair in May in Reno, Nevada.

The New Mexico WRRRI presented awards to students in the Senior Division made up of students from grades 9 through 12, and the Junior Division for grades 6 through 8. First place recipients in each division received \$100 and second place received \$50. Several students also received honorable mention certificates from the institute.



Joseph Sarvash, a 9th grade student from Farmington, received the WRRRI's first place award in the Senior Division. His project looked at the water that is extracted along with natural gas and crude oil from Fruitland Coal Natural Gas wells. Joseph studied the possibility and efficiency of filtering the water extracted from the wells to agricultural and drinkable standards.

Joseph indicated this is his first year presenting a science project and will likely continue working on this project for next year's fair. He credited his father for sparking his interest in the subject and his science teacher for helping him develop his project. With a possible future calling in aerospace engineering, Joseph is also interested in a military career.



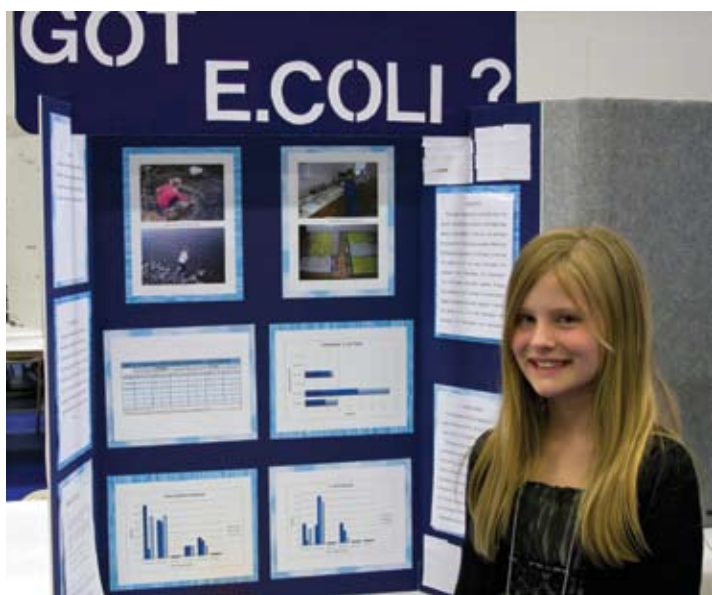
First place in the Junior Division was awarded to Hannah Isbell, a 6th grader at the Isbell Family Homeschool. Her study was entitled *Cool, Clear, Pure ... Clean? Is Our Water Truly Safe?* Hannah collected river samples on the Mississippi, Missouri, and Animas rivers. She used a water analysis kit to test for nitrates and other water quality indicators. She concluded that the Mississippi River sample had the most nitrates at 10 ppm, followed by the Missouri River sample at 5 ppm, and the Animas River with no detectable nitrates in her sample. Hannah expressed relief that the wildlife that she so loves along the Animas River were not being exposed to high levels of nitrates. This was Hannah's first science fair project and she hopes someday to study oceanography or archaeology.

Carlsbad High School junior, Terryl Bell, received second place from WRRI. Terryl said he was assisted by Dr. Newton Hilliard at Eastern New Mexico University who provided resources to complete the project, including the water chemistry analyses laboratory used for bacteria culturing. In his project, *An Analysis of Microbial Diversity and Water Chemistry in Karst Springs: Eddy County, New Mexico and Culberson County, Texas*, Terryl studied hydrogen sulfide emissions occurring in two spring systems. He thought that sulfur oxidizing/reducing bacteria were likely present and sought to determine the sulfur bacteria's ability to improve the water chemistry or increase the quantity of ions in solution, preventing external growth of other bacteria and promoting self-growth. His chemical analyses indicated that bacteria were widespread with a broad spectrum of bacterial types present including sulfur bacteria and *E. coli*.

Terryl has been participating in science fairs since 6th grade. His early years were devoted to microbiology projects and in subsequent years he worked on mathematics and biochemistry projects. Last year he presented the first step in his current project. Terryl is looking at various colleges including Texas A&M University where he plans to study biochemistry and engineering.



Emma Paul, a 6th grader at Heights Middle School in Farmington received second place in the Junior Division for her comparison of *E. coli* and total coliform levels in local river water, tap water, and river water downstream from sewage discharge plants in both Farmington, New Mexico and Durango, Colorado. She indicated that the “experiment took a lot of time and effort.” After Emma’s careful testing of the samples, she found more *E. coli* in Farmington’s river waters than in Durango’s. There was no *E. coli* in either tap waters. Her results also showed that there was more *E. coli* and more total coliform downstream of the sewage plants in Farmington. In Durango, total coliform levels were similar in both samples while more *E. coli* was present upstream. Emma admitted the second trial was marred by a lab accident in which her upstream Durango sample spilled in her refrigerator. She intends to prepare another science fair project next year. Eventually Emma would like to pursue a master’s degree in architecture and then wants to teach.



Can Eco-friendly Turf Varieties Prosper with Graywater Systems?

Story and Photo by Will Keener, WRRJ

Turf scientist Ryan Goss thinks that grass is getting a bad rap and he's doing something about it. Many people removing grasses from residential landscapes to save water are overlooking some positive features of these species, says the researcher and assistant professor with New Mexico State University's College of Agricultural, Consumer and Environmental Sciences. They may be wrong about the water savings, as well.

"A properly maintained lawn can be very eco friendly," says Goss. Installing 1,500 square feet of lawn can reduce air conditioning costs up to 20 percent, provide oxygen in the atmosphere for a family of four, and offer physical benefits. The substantial grass root system traps pollutants and dust. "With turf, we're creating an environment where kids can kick a ball around and still reduce the overall impact on water."

Goss is beginning experiments to evaluate whether reusing graywater from households and businesses to irrigate selected grass species can be more beneficial to the environment. The experiments will be conducted at the Fabian Garcia Research Center west of the New Mexico State campus in Las Cruces. The tests will make use of a unique retrofit system to provide graywater from a residence at the site.

The system from Aquaverde Inc., of San Diego, CA, can be connected to a sewer line to capture graywater without the need for a dual pipe. Many graywater systems at present require two pipe sets to the sewer or septic tank and are feasible only during initial construction of a house or business facility, not as a realistic retrofit solution.



Turf scientist Ryan Goss checks a valve used to control sewage flow as part of an experiment to study the response of ornamental and turf grasses to water treated by a graywater system. About a dozen species will be tested and compared using treated graywater- and community-water irrigated plots at New Mexico State University.

The test system relies on patented sensors, which detect water movement from black water sources inside the residence and open or close valves to direct sewage appropriately. Generally, toilets and kitchen sinks are considered black water sources, while showers, laundry, and other sinks are graywater

sources. In the case of the test site house, sensors are wired to a valve controlling the wastewater separation. The company is developing wireless sensors, which would make a retrofit even easier.

Graywater is diverted to a small tank by a hydraulic valve, which opens in response to information from the sensors. The graywater passes through a particulate filter with 50 or 100 micrometer mesh and then into a smaller UV filter, which kills bacteria in the water. The particulate filters include a self-rinsing mechanism, which cleans the filters when flow-through rates indicate they are clogging. The cleaned water is pumped to another tank, where it can be used for irrigation applications.

"The goal is to be able to come in and plug in some sensors by the wastewater sources in a house and construct the graywater control system in a small shed, where checking batteries and changing filters would be required from time to time," Goss says. Tanks involved could be buried to minimize the visual impact. "It's a retrofit system that is minimally intrusive and makes a lot of sense," the researcher says.

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WRRRI Technical Reports Available Online

The WRRRI publishes peer reviewed technical completion reports resulting from its funded projects. All reports are available in full text online at: <http://wrrri.nmsu.edu/publish/publications.html>. During the past few months, the following reports have been published.

Water Quality and Land Use: Implications for Regulation and Urban Planning

December 2008, Report No. 346

Gwendolyn A. Aldrich, Janie Chermak, and Jennifer A. Thacher, University of New Mexico

Development and Testing of a Semi-Distributed Watershed Model: Case Studies Exploring the Impact of Climate Variability and Change in the Rio Salado

October 2008, Report No. 345

Carlos A. Aragón and Enrique R. Vivoni, New Mexico Tech

Installation of River and Drain Instrumentation Stations to Monitor Flow and Water Quality and Internet Data Sharing

August 2008, Report No. 344

Zhuping Sheng, Texas AgriLife Research, Texas A&M University System; Christopher Brown, New Mexico State University; Bobby Creel, New Mexico Water Resources Research Institute; Raghavan Srinivasan, Spatial Sciences Laboratory, Texas A&M University System; Ari Michelsen, Texas AgriLife Research, Texas A&M University System; Michael P. Fahy, El Paso Water Utilities

Response of Streambanks to Different Intensities and Seasons of Cattle Grazing in Two Montane Riparian Areas in Western New Mexico

November 2008, Miscellaneous Report No. 29

Richard W. Lucas, Terrell T. Baker, M. Karl Wood, Christopher D. Allison, and Dawn M. VanLeeuwen, New Mexico State University

53rd Annual New Mexico Water Conference Proceedings, "Surface Water Opportunities in New Mexico"

April 2009, Report No. 347

Catherine T. Ortega Klett (editor), New Mexico Water Resources Research Institute

A digital copy of the proceedings has been mailed to all participants of the October 2008 annual New Mexico water conference. All presentations from the conference are contained in the proceedings including the 2008 Albert E. Utton Memorial Water Lecture given by John W. Hernandez entitled, "100 Years of New Mexico Water Management — Stories about the People Involved."

Conflict on the Rio Grande: Water and the Law, 1879-1939

Historian Douglas Littlefield has written a book on the politics of water law along the Rio Grande. The University of Oklahoma Press book reveals the transformation of nineteenth- and early twentieth-century law, traces changing attitudes about the role of government, and examines the ways these changes affected the use and eventual protection of natural resources. Rio Grande water policy, Littlefield shows, represents federalism at work – and shows the West, in one locale at least, coming to grips with its unique problems through negotiation and compromise.

Littlefield gave the keynote address at the 44th Annual New Mexico Water Conference in which he traced the history of the Rio Grande Compact.



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Obtained in a partnership with the Water Resources Research Institute, the Aquaverde system would compare to an air conditioner or water heater in terms of homeowner maintenance, Goss suggests. The manufacturer is working to hold system costs below \$3,000 per household, to achieve about a seven-year payback.

The experiments call for testing 10-15 species of ornamental and turf grasses, comparing irrigation by potable water to irrigation from the graywater system. Goss will evaluate plant growth, test the soils for any hazardous microbes, and measure what percentage of the city water going into the residence is treated and made available for irrigation. He expects the system to treat about 100 gallons a day to irrigate the test plots. ♦

Mark Your Calendars

October 15-16, 2009

Isleta Casino and Resort

54th Annual New Mexico Water Conference

Water Planning in a Time of Uncertainty



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