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OPEN MEETING AGENDA I

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Tubac, AZ 85646

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January 30, 2005

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WS-01303A-02-0868
WS-01303A-02-0869
WS-01303A-02-0870
W-01303A-02-0908
W-01303A-01-0983

Jeff Hatch-Miller
Arizona Corporation Commission
1200 West Washington St.
Phoenix, AZ 85007

Dear Mr. Miller,

I wrote to you on January 22, 2005 concerning the request for the Arizona Corporation Commission to consider extending the date to start construction of the arsenic treatment facility for Tubac. Enclosed is a research report concerning a new and inexpensive process for removing arsenic from water. In the report, please note the cost estimates as outlined in the last page. This report indicates that there could well be an inexpensive solution to the problem. I repeat, this is a request that the Corporation Commission should act to delay the construction of the arsenic removal facility in Tubac.

Sincerely,

Lyman L Blackwell

Lyman L. Blackwell

(520) 398-9636 H
(520) 398-9289 W

RESEARCH | NEWS

January 21, 2005

Water Filter Could Help Millions of Bangladeshis

Innovative technology could also help California comply with tighter U.S. EPA standards for arsenic in drinking water

Contact: Contact: Dan Krotz, (510) 486-4019, dakrotz@lbl.gov

BERKELEY, CA – Lawrence Berkeley National Laboratory (Berkeley Lab) scientist Ashok Gadgil is developing a cheap and effective way to provide safe drinking water to 60 million Bangladeshis who live under the specter of arsenic poisoning. His idea is to create arsenic filters from coal ash, the fine gray powder that piles up at the bottom of furnaces at all coal-fired power stations, waiting to be discarded.

Ashok Gadgil hopes to decontaminate water with simple filters made of ash coated with a compound that attracts arsenic.

"It's just coal ash, nothing fancy," says Gadgil, a scientist at the U.S. Department of Energy's Berkeley Lab and its Environmental Energy Technologies Division. "But it could save so many lives."

Arsenic poisoning in Bangladesh has been called one of the largest mass poisonings in human history, expected to cause 10 percent of all future adult deaths in the impoverished nation of 130 million. For reasons not entirely understood, the shallow tube wells that people depend on for water have dangerous concentrations of the toxic substance which, if ingested over long periods of time, leads to debilitating lesions, cancer, and death.

Although still in the investigational stage, Gadgil's technique would involve coating the ash with a compound that attracts arsenic, filling teabag-sized pouches with the powder, and distributing the filters throughout the countryside, one per family per day. Water drawn from any one of the millions of contaminated wells that dot Bangladesh could then be poured through the filter and safely consumed.

It's difficult to believe that one person, armed only with a handful of ash and a few promising lab tests, can derail a catastrophe looming on the other side of the globe. But Gadgil is uncommonly driven when it comes to finding affordable ways to provide safe drinking water to thousands of people. In November, he received an award from San Jose's (CA) Tech Museum of Innovation, which honors people who use

technology to help humanity, for developing a water purification system that kills bacteria with ultraviolet light. The system, called UV Waterworks and marketed by WaterHealth International, Inc., is used daily by about 300,000 people in Mexico, the Philippines, and several other countries. Several systems will soon be installed in his native India. And money is currently being raised to install the system in tsunami-stricken regions of Sri Lanka and India.

Now, Bangladesh weighs just as heavily on his mind.

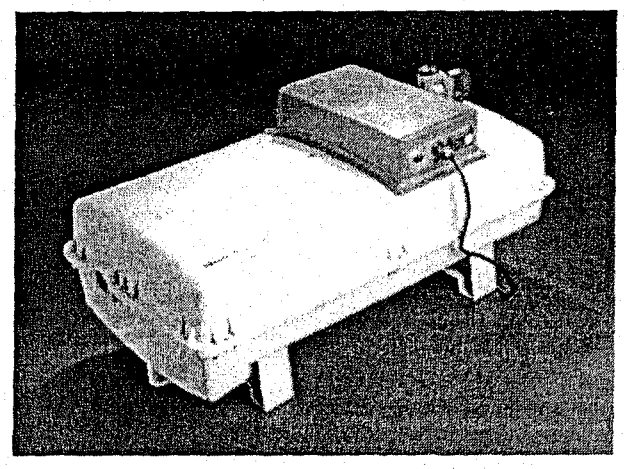
"The magnitude of the problem is overwhelming. We have to develop a solution that is affordable and effective," says Gadgil.

After receiving $5,000 in seed funding from Berkeley Lab's Technology Transfer Department in 2003, Gadgil set out to develop a filter that meets these criteria. His options quickly narrowed. He needed a material that has a high surface-to-volume ratio, is pathogen-free, and is available in large quantities at low cost. Then he remembered coal ash, the leftovers that amass at coal-fired power stations. An additional $20,000 in seed funding from the Blue Planet Run Foundation helped him further advance the work.

Coal ash is composed of particles that measure between one and 10 microns in diameter, much smaller than a 100-micron-diameter human hair. This means that even a small volume of the powder boasts a lot of surface area, maximizing the opportunity for surface reactions to snare arsenic. The ash is also heated to 800 degrees Celsius during the coal burning process, so it's sterile and free of volatile compounds. It's also plentiful. Coal-fired power plants provide most of neighboring India's electricity, and the locally mined coal used is uniquely suited for Gadgil's purposes: it's only 60 percent carbon, meaning 40 percent becomes ash.

After obtaining some ash from India, he assembled Team Arsenic, which includes fellow Berkeley Lab scientists Lara Gundel, Yanbo Pang, Christie Galitsky, Duo Wang, and Anna Blumstein. They developed a way to coat each ash particle with ferric hydroxide, a chemical that reacts with arsenic and forces the element to precipitate onto the particle. Initial tests indicate this specially treated coal ash makes a very powerful filter. After spiking lab water with so much arsenic that its concentration soared to an extremely toxic 2400 parts per billion (ppb), the filter lowered the water's arsenic concentration to 10 ppb. The Bangladeshi standard for safe drinking water is 50 ppb.

Gadgil estimates that five grams of this material could render about three gallons of Bangladeshi well water — with an average arsenic concentration of 400 ppb — safe to drink. Put another way, a filter the size of a teabag could provide drinking water for a family of six for one day. He also estimates the technique will cost about 30 cents per person per year. The next best option is a filter developed by a Bangladeshi engineer, and backed by the nonprofit organization IDE-International, that uses pulverized brick instead of ash. It would cost $9.70 per person per year.



The UV Waterworks system, developed by Gadgil a few years ago, is used around the world to purify drinking water. Photo by Robert Couto, CSO

Closer to home, the California Energy Commission's Public Interest Energy Research program recently awarded Gadgil $250,000 to explore whether a variation of this technique can help the state comply with an Environmental Protection

Agency rule effective in 2006 that tightens the U.S. arsenic drinking water standard from 50 ppb to 10 ppb. Currently, 600,000 California residents consume water with concentrations above 10 ppb. Gadgil will determine whether ash derived from U.S. coal can be developed into a filtration system, and whether such a system can work at small municipal water treatment facilities.

Initial results appear promising. Currently, the cost of arsenic removal at small municipal water systems ranges from $58 to $327 per household per year. Gadgil estimates his method would cost less than $1 per household per year, not including the one-time cost of the reactor for removing the arsenic from water.

Gadgil will also intensify his efforts to help Bangladesh — if he secures more funding. His filter requires many more tests and refinements, and the technology must be licensed for production (it is currently being offered on the Lab's web site at http://www.lbl.gov/Tech-Transfer/techs/lbnl1742.html). But he knows the payoff could be huge.

"If this succeeds, it will be a life-saving and affordable technology for tens of millions of people," he says.

Berkeley Lab is a U.S. Department of Energy national laboratory located in Berkeley, California. It conducts unclassified scientific research and is managed by the University of California. Visit our Website at www.lbl.gov.

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