Rustlike Crystals Found to Cleanse Water of Arsenic Cheaply

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A common mineral similar to rust fashioned into a powder of tiny crystals could provide a simple, inexpensive method for removing hazardous levels of arsenic from drinking water, researchers at Rice University in Houston are reporting today.

That would help reduce the risk of cancer for tens of millions of impoverished villagers in China and Southeast Asia, where high levels of arsenic occur naturally in many water supplies, the researchers said in telephone interviews.

Arsenic contamination is also a threat to water supplies in parts of Latin America, Africa and the United States, where the Environmental Protection Agency this year reduced allowable arsenic levels in municipal water systems to 10 parts per billion, down from 50 parts per billion.

The research, being reported in the journal Science, is the latest of numerous investigations into the environmental uses of nanotechnology, the manipulation of materials so tiny they are measured in nanometers, or billionths of a meter. At such small scales, common materials often begin to exhibit novel behaviors.

In this case, the researchers made crystals of the rustlike mineral, magnetite. They found that when the crystals were smaller than 40 nanometers wide, they were much more sensitive to low-strength magnetic fields than would have been expected based on the behavior of larger particles.

At 12 nanometers wide, the researchers found, the magnetite particles could bind up to 100 times as much arsenic as the larger iron particles currently used in filters, yet still be extracted from test liquids with inexpensive magnets widely used as computer components.

While the particles' performance has been tested only in laboratories, the researchers said it seemed likely that removing arsenic could be as simple as pouring a small amount of magnetite powder into a pot of well water and waiting briefly while bound arsenic was pulled to the bottom by a simple magnet.

"This should come out costing one to two cents a day for a family of four in the developing world," said Mason B. Tomson, a professor of engineering at Rice who was a co-author of the report.

Mr. Tomson added that the process would leave a small amount of arsenic-laced residue, enough to fill a cooking bowl in a year, that villagers would have to collect and dispose of, probably in landfills.

Communities with centralized water systems might use filters rather than magnets to collect the particles because such technology is already in place to collect contaminants, said Vicki L. Colvin, a chemistry and chemical engineering professor who is director of the Center for Biological and Environmental Nanotechnology at Rice.

The researchers said further research was needed to determine whether the magnetite would be an improvement on other nanoscale minerals already used in such systems, including zirconium, aluminum, iron and manganese compounds.

Even if Mr. Tomson's cost estimates are correct, researchers still have to demonstrate that the technology can be used safely. For example, no one knows the risks of the arsenic residues' being consumed by accident or of their leaching from landfills back into water supplies. The first field tests of the material are being planned for Brownsville, Tex., next year, as is a study in India, the researchers said.

Competing technologies, including the use of plants to draw arsenic from the ground and specialized clay filters, are also being explored.

Experts in arsenic contamination who were not involved in the Rice research said it sounded intriguing.

"All of the arsenic removal systems so far require filtration of some sort," said Alexander van Geen, a senior research scientist at the Lamont-Doherty Earth Observatory at Columbia University.

Such systems perform poorly if not properly maintained and may become infected with bacteria and other microbes, Mr. van Geen and others said.

But Mr. van Geen said a simple solution was to drill wells into deeper water supplies that are free of arsenic. He has estimated that most villages in Bangladesh, the country with the most wide-ranging problems, could be supplied with clean water through a $50 million investment in deeper wells.