SCIENCE NEWS

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Rust Could Be the Key to Arsenic-Free Water

Rust, or at least one of its constituents, could bring relief to the 60 million people in Bangladesh. They reportedly face the risk of delirium, stomach pains, hyperkeratosis and death as a result of arsenic in their drinking water, which comes from wells in the Ganges River basin. People once thought that cleaning the water would demand an extensive and expensive process involving pumps and a lot of electricity. Researchers at Rice University have now developed a small-scale, cheap and energy-free process to clean well water, which they report in tomorrow's issue of *Science*.

Image: ©REUTERS/CORBIS

CHILDREN WAIT for drinking water in Bangladesh, where a high amount of arsenic has been found in the drinking supply.

The new method for water purification takes advantage of nanoparticles of magnetite, an iron oxide with well-known magnetic properties. Compared with processes such as filtration, separations involving magnetism are often more efficient and less expensive, although a strong magnetic field is typically needed when directing 16-nanometer-wide magnetite particles in solution. When the Rice team attempted to remove uniform iron oxide nanoparticles that were mixed in water, however, they discovered that they could move the nanoparticles with handheld magnets instead of electromagnets. "It turns out that the nanoparticles actually exert forces on each other," says physicist Doug Natelson, a co-author of the paper. "Once the handheld magnets start gently pulling on a few nanoparticles and get things going, the nanoparticles effectively work together to pull themselves out of the water."

The nanoparticles behaved similarly to iron filings when a magnet is placed above them, essentially responding in a clumping fashion to the force pulling them. This clumping avoids a huge problem that is endemic to using these tiny entities. "Small particles are great--high surface area, high contact, short diffusional times between particles to suck up things. The problem is How do I get these things out?" explains Paul E Laibinis, a chemical engineer at Vanderbilt University. Typically, nonmagnetic particles call for expensive processes such as centrifugation. These processes become easier when magnetic particles are involved. "By getting these particles to cluster," Laibinis says, " this magnetic field that you would need to filter these things out becomes reasonable."

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Knowing that arsenic binds strongly to iron oxides, the Rice team, led by Vicki Colvin, turned their attention to arsenic-contaminated water. Using magnetite particles just 12 nanometers wide--smaller than a virus--the group cleaned a two-liter arsenic solution that had 50 times the arsenic allowed in drinking water to within a small fraction more than the Environmental Protection Agency's maximum contaminant level. They are now trying to scale the process up--replacing the expensive magnetite with iron oxide nanoparticles that can be obtained from rust and olive oil so that it's useful in the developing world. "We think the technology could adapt up to 50- to 100-liter batch modes," Colvin says, "about the size of a water cooler." For the magnets, she explains that the process will likely require something "stronger than fridge magnets, but in the range for hard disk magnets."

Given the batch nature of this process, it is unlikely that homes in the developing world can be outfitted with filters placed directly on taps, but getting poison-free water by the tank load is still a step in the right direction. --*Nikhil Swaminathan*

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