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- Home
- Current Issue
- ChemJobs
- RSS Feed
- Email Alerts
- Multimedia
- Archive
-

Search Go
Advanced

Home » Latest News » Cleaning Water With 'Nanorust'

Latest News

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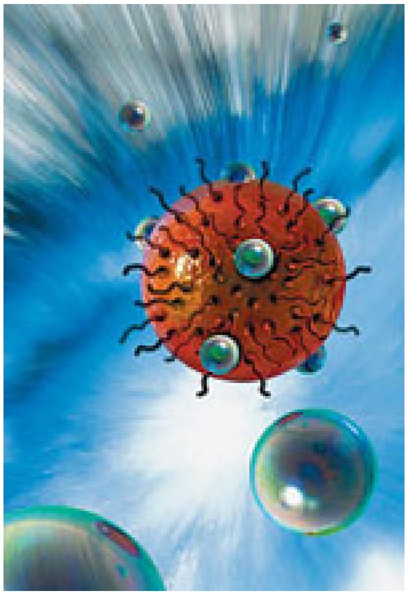
Magnetic Separation

Cleaning Water With 'Nanorust'

Magnetite nanoparticles effectively remove arsenic from water

Bethany Halford

Rust, olive oil, and a handheld magnet could someday be all that's needed to remove arsenic from drinking water, according to researchers at Rice University. The low-tech solution to a serious problem for developing countries stems from basic research on the magnetic behavior of magnetite (Fe_3O_4) nanoparticles (*Science* **2006,** *314,* 964).



Courtesy of Rice University

Oleic acid-coated Fe_3O_4 nanoparticle (orange) binds arsenic (gray spheres).

On the basis of extrapolations from the bulk material, an impractically large magnetic field would be needed to draw Fe_3O_4 nanoparticles out of solution. But how materials behave in bulk isn't always a good predictor of how they'll act at the nanometer scale.

Having just figured out how to make Fe_3O_4 nanoparticles in various sizes and keep them from clumping by coating them with oleic acid, chemistry professor Vicki L. Colvin and colleagues decided to see how strong a magnet would be needed to pull their new nanoparticles out of solution. "We were surprised to find that we didn't need large electromagnets to move our nanoparticles, and in some cases, handheld magnets could do the trick," she says.

"In this instance, it turns out that the nanoparticles actually exert forces on each other," explains Douglas Natelson, a Rice physics professor who participated in the study. "So, once the handheld magnets start gently pulling on a few nanoparticles and getting things going, the nanoparticles effectively work together to pull themselves out of the water."

Iron oxides are known to bind arsenic, so Colvin's team decided to see if size, and therefore surface area, made a difference in arsenic remediation. They found that Fe_3O_4 particles 12 nm in diameter removed nearly all the arsenic from solution, but the same mass of 300-nm Fe_3O_4 particles eliminated less than 30% of the poison.

"This is interesting work," comments Troy J. Tranter, who is working on arsenic remediation at the Department of Energy's Idaho National Laboratory. "From a practical perspective, it would be interesting to see how this material would be used in an engineered system."

Colvin is trying to tackle that issue. "Although the nanoparticles used in the publication are expensive, we are working on new approaches to their production that use rust and olive oil and require no more facilities than a kitchen with a gas cooktop," she says.

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