UA Professor, Startup Work To Cleanse the World's Water

NIST provides $100K grant for carbon-iron formula to remove contaminants

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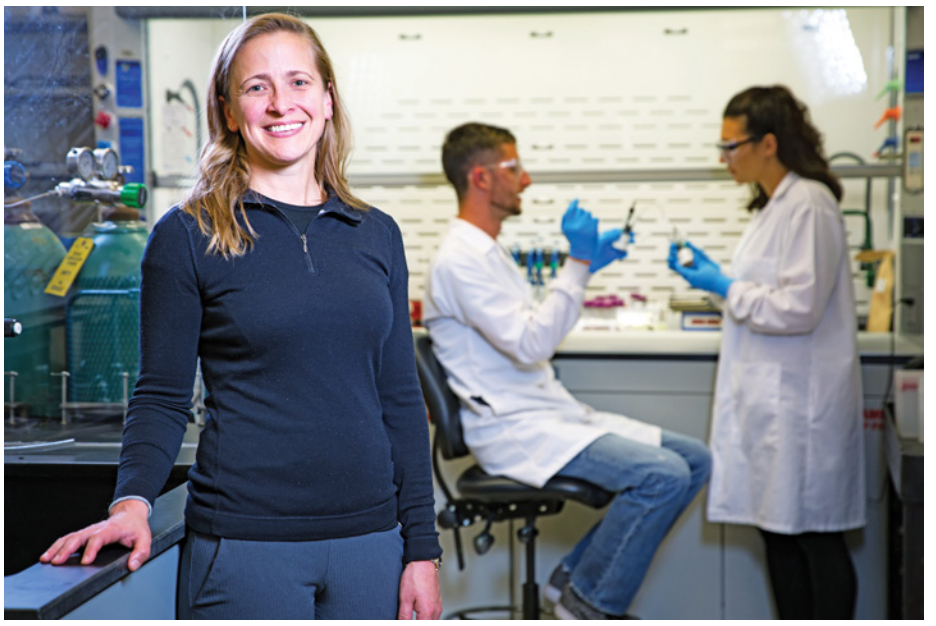

UA Professor Lauren Greenlee has devised a method using a carbon-iron formula to clean up toxic trichloroethylene in groundwater. If tests go well, it could be a moneymaker. [PHOTO PROVIDED]

Life comes down to water, and Lauren Greenlee is working on a project she hopes will one day make the world's water supply much cleaner.

Greenlee is an assistant professor in the Chemical Engineering Department at the University of Arkansas at Fayetteville, a position she has held since 2015. When she joined the faculty, she had been working as a scientist at the National Institute of Standards & Technology in Boulder, Colorado, where her research dealt with using nanoparticles for water treatment.

Greenlee, 39, has continued that work at the UA, where she has teamed with a startup company, AxNano LLC, a subsidiary of Triad Growth Partners of Greensboro, North Carolina. Greenlee and AxNano believe that her carbon-iron formula will more effectively remove contaminants from groundwater, and NIST gave the group a nearly $100,000 grant in 2016 to try to develop the process for commercial use.

The first main focus for the project is a contaminant called trichloroethylene, which was commonly used in manufacturing as a solvent. TCE has been classified as a carcinogen by the Environmental Protection Agency, and its improper disposal or storage has contaminated groundwater and facilities nationwide.

"It is one of the most common groundwater contaminants and it is carcinogenic," Greenlee said. "We actually degrade it. We degrade it so it is not toxic anymore. It is super common. It is no longer produced industrially, but it was used throughout the 20th century as a solvent or a degreaser.

"It was actually one of the main components in dry-cleaning facilities for a really long time. It doesn't really degrade naturally."

The degrading agent that Greenlee has created — she did her initial work while at NIST after earning her doctorate in chemical engineering from the University of Texas at Austin in 2009 — combines carbon and iron nanoparticles and other components to create a material that is injected into the ground to interact with contaminated groundwater.

The material, which rolls off the tongue as bimetallic zero valent iron-carbon composites, then attaches to the trichloroethylene in groundwater and renders it nontoxic. AxNano markets the substance as RemRx CSI.

Cheaper, Better

Similar compounds are already being used to decontaminate TCE in groundwater, but Greenlee believes her formula can be more effective.

She thinks her formula will be more viscous underground — seeping through more area to cleanse more groundwater — while being more effective with any TCE it comes into contact with. A more effective treatment protocol will mean lower costs, since current treatments often have to be repeated many times at any given contaminated site.

"What makes it expensive with current options is the number of treatments required," Greenlee said. "The treatment has a short life. You have to reapply, reapply, reapply. If you don't have good movement of the material in the ground, it is way less effective."

Greenlee's team consists of two postdoctoral students, 10 graduate students and a varying number of undergraduate students. They have made her formula into what she calls a "slurry" material so it can seep and ooze through underground strata and interact with as much contaminant as it can.

"What we have found through our customer engagement and discovery is our potential customers have tried the other products on the market, and they are either not reactive enough, or they are reactive but they get stuck," Greenlee said. "They pump them into the ground and nothing really happens. If you think about pumping a mixture into the ground, you want it to move a little bit so it can take care of a big enough area. I would say the biggest challenge is enabling that slurry to move a little bit in the subsurface."

Greenlee said she hears concerns about her procedure because she is pumping a carbon-and-iron slurry into underground water sources. She said that the mixture is benign, especially compared to the TCE it will effectively eliminate.

"Some people balk at that, 'Why would you be putting something into the ground?'" Greenlee said. "What is in the ground is much more dangerous and toxic than anything that we would put into the ground. We have very tight parameters around how we can design our material because we don't want to put anything super toxic into the ground.

"It really is a compromise. Nothing is going to be perfect. We would rather remove the contaminant that is actually carcinogenic and really toxic to humans and have something reactive in the ground that is really not that toxic."

Business of Science

Cleansing a contaminated site can costs hundreds of thousands of dollars, which makes any successful creation a potential moneymaker.

Greenlee said her mixture has shown good results in lab tests and she hopes to begin field trials within the next year. In those trials, Greenlee said, her mixture will be used at volunteered sites and then the results tested to determine the effectiveness.

A better-working cleanup procedure is a desire of many developers and consultants, Greenlee said. Imagine wanting to put a commercial building on a site, or refurbish an existing vacant one, only to discover the site is contaminated and has to be cleaned up, expensively, before any development can be done.

"That's the main financial driver," Greenlee said. "Our customer would likely be consulting companies. Say you're a site owner and your site is contaminated; you don't know how to treat it. A consulting company is contracted to come in and clean it up, and that consulting company is looking for technologies that they can use to clean up whatever mess they are trying to clean up."

If the product turns into a successful business, it will fall in line with the university's recent dedication to increase funding for more research and development and the creation of more businesses from that R&D. Greenlee said, as an engineer, it is helpful to have an application goal for her research.

"It is an interesting question when it comes to fundamental research: Should it be application-focused, or should there always be a space where people can investigate questions for the benefit of science and knowledge and learning?" Greenlee said. "I am of the opinion we need to have both. I love having an application in mind. I think it drives what we do. I would love to see it work." ■

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