INL scientist removes arsenic from drinking water

by Daniel Mower

You probably wouldn't think Terry Todd is a chemical engineer if you saw him. When Todd makes his daily 6 a.m. drive to work along the farm-dotted country roads near Springfield, Idaho, he isn't typically thinking about saving lives. Usually, he's sipping a steamy cup of coffee and mentally mapping out an excursion in his Maule--the hardy little bushplane that transforms Idaho's extensive backcountry into Todd's back yard.

Nevertheless, the Montana native holds a bachelor's and a master's degree from Montana State University, plus a doctorate from Khlopin Radium Institute in St. Petersburg, Russia. And he's got 12 patents under his belt--eight in the U.S. and four in Russia.

Photo: Todd with plane

Todd with his Maule bushplane.

Most recently, a new technology Todd and a team of INL scientists developed emerged as one of R&D Magazine's top 100 significant scientific developments of the year. It's called Nano-Composite Arsenic Sorbent (N-CAS). N-CAS is a compound that can remove arsenic contamination from drinking water over eight times more effectively than any other method to date, for a fraction of the cost.

Arsenic is a highly poisonous, naturally occurring element that can seep from soil into groundwater supplies. Drinking contaminated water leads to disfiguring skin diseases and skin and organ cancers in humans.

Arsenic poisoning isn't by any means a national emergency in the U.S., Todd says. But the Environmental Protection Agency recently changed the allowable limit of arsenic in drinking water from 50 parts per billion (ppb) to 10 ppb, leaving at least 4,000 American communities and potentially millions of private well users struggling to pay for water treatment upgrades. For them, the cost-effectiveness of N-CAS could help alleviate strained resources and budgets.

In other parts of the world, it could prove to be a saving grace.

Arsenic poisoning is a national emergency in Bangladesh, where contaminated wells have poisoned millions of the population. Todd hopes N-CAS will eventually be able to offer relief in those poorer countries. "Other solutions being proposed there aren't effective or affordable," he said.

What makes N-CAS such a breakthrough? It's all in the design. N-CAS mixes a special polymer (plastic) with an iron oxide adept at trapping arsenic compounds. N-CAS pellets are tiny sponge-like spheres less than a millimeter across. Each sphere is highly porous; so porous, in fact, that a gram of N-CAS (less than one teaspoon) has more than 3,200 square feet of surface area--more than most Americans' homes--on which to trap arsenic.

As successful as it has been, N-CAS research isn't even part of Todd's job assignment--it's more of a team-effort side project. His main role is a project leader for nuclear fuel separations under the Global Nuclear Energy Partnership (GNEP), which is an initiative to pave the way for safe, environmentally friendly energy for the future, easing dependence on foreign energy sources.

Even as a side project, N-CAS has been highly rewarding. "In the 20-some years I've been working, this is probably the best opportunity for anything I've done to impact people's lives," Todd said.

If work continues to progress on N-CAS, it could be on the market within the next year. But the transition from a laboratory experiment to commercial product to a water filter in Bangladesh, or even Oregon, is a long, uncertain road. "We really can't control whether or not this is actually used," Todd said. "All we can do is make the technology the best we can."

That's the attitude he adopts about life: make it the best you can, and don't worry about the rest.

Things have come a long way for Todd since his childhood in tiny Denton, Mont., population 400. He's seen the world, built a successful career and raised a family. But in some ways, it hasn't changed much at all. He still loves the outdoors, the country and basketball--even though his boys now occasionally school him in half-court.

"My wife, Jan, and I, we just don't like a real fast lifestyle," Todd says. "We're busy, but we like a nice quiet place to relax where there aren't a lot of people--where we can sit out on our deck, looking out over the American Falls Reservoir, and watch ducks, geese and pheasant."

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Photo: The radioisotope thermal generator

The pores are made up of a complex matrix of plastic and iron particles seen in this 3,200X magnification.

Photo: The radioisotope thermal generator

At 25,000X magnification, the iron oxide particles responsible for trapping arsenic appear as small buds embedded in a polymer web.