Water: Getting the salt out

Researchers develop a simple way to remove salt and some other dissolved substances from polluted water

By
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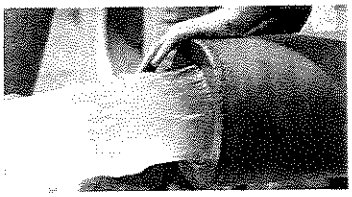
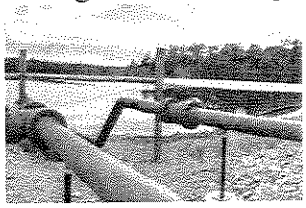

Researchers have developed a new way to remove salt and some other dissolved substances from water. This could help purify tainted groundwater or desalinate seawater.

Walter Galloway/istockphoto

The world's population is ever rising. And the more people there are, the more need there is for clean drinking water. Now, researchers have come up with a new way to remove many pollutants from water, including salt: They zap it.

The oceans hold about 97 percent of Earth's water. Its salt content makes it undrinkable. Other water that is pumped from underground often has minerals dissolved in it. So this water, too, can be undrinkable (or at least not tasty). Scientists have developed many methods to remove impurities from water. But those methods often take lots of energy. And that makes them costly.

But Martin Bazant and his teammates have come up with a new method that could lower the cost. Bazant works at the Massachusetts Institute of Technology in Cambridge. And as a chemical engineer, he uses chemistry to solve problems related to the production of food, fuel and other products. Many of the methods now used to separate fresh water from salty use some sort of barrier, such as a filter. Those barriers often are designed to let water pass through, but block larger atoms, such as sodium and chlorine. (Those two elements are what make up table- and sea salts.)

Bazant's group instead made a system that doesn't use physical barriers. It takes advantage of the fact that sodium and chlorine particles have an electrical charge. Charged particles are called *ions*. And the new system uses electricity to steer the ions dissolved in water in a particular direction. This separates them from a stream of fresh (unsalty) water. Bazant's team published its results November 3 in *Environmental Science and Technology Letters*.

Here's how it works

The MIT team pushes the water they're trying to purify through a porous material. That means it contains many tiny holes. (For its tests, the team built a system small enough to sit on a bench in a laboratory. They used a material made of tiny glass particles. Those tiny bits were fused together to make a solid object that looked somewhat like a sponge.) Then, they place that material between a positive and a negative *electrode* and send an electric current through it. That current separates the water flowing through the material into two different

zones. One part of the stream contains sodium and chlorine ions. So this water becomes exceptionally salty. The other part of the stream contains fresh water. On the downstream side of the porous material, a simple divider channels the fresh water into a separate area.

Large amounts of waste water left behind by hydraulic fracturing (or "fracking") operations are stored in this collection pond. A new way to remove the salts could help engineers purify that fracking waste water.
MIT
The new system can work nonstop, says Bazant. And its materials are cheap, so making larger versions should be easy and quite affordable. That makes the system practical, he says. One added benefit: Electricity passing through the water might kill bacteria even in the zone that remains polluted, Bazant says.

The system only steers charged particles. So it won't remove pollutants that have no electric charge. And the now extra-salty (or polluted) portion of the water will need to be treated as a waste.

Particularly due to its inexpensive materials, the new system "opens up a whole range of possibilities," says Maarten Biesheuvel. He's an environmental engineer at the European Center of Excellence for Sustainable Water Technology. That's a research institute in Leeuwarden, The Netherlands. There, scientists and engineers study how to develop water-cleanup methods that are (among other things) easier on the environment.

Biesheuvel suspects the system could be used to pull salt out of seawater. It might also help remove salts from groundwater. He says it even might be used to remove the dissolved salts from the fluids left over from the *hydraulic fracturing* (fracking) of rocks to extract gas and oil.

Plus, Biesheuvel adds, the new study will likely lead to even more research. For example, scientists and engineers will want to figure out how to make the systems larger and more efficient. "I expect that this discovery will be a big 'hit' in the academic field," he says.

desalination - The removal of salt from some substance. This process is often used to generate fresh water.

prototype - A first or early model of some device, system or product that still needs to be perfected.

sodium - A soft, silvery metallic element that will interact explosively when added to water. It is also a basic building block of table salt (a molecule of which consists of one atom of sodium and one atom of chlorine: NaCl).

hydraulic fracturing, or fracking - The cracking open of underground rocks by introducing liquid at high pressure, especially to extract natural gas. Those cracks are then held open by sand that had been added to the fracking fluid.

Original Journal Source: S. Schlumpberger et al. Scalable and continuous water deionization by shock electrodialysis. *Environmental Science & Technology Letters*. Published early online November 3, 2015. doi: 10.1021/acs.estlett.5b00303.

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