# Sandia designs sensors to detect toxic chemicals in water

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Sandia National Laboratories has developed a new sensor system that can more efficiently detect and monitor toxic chemicals in water supplies.

The system potentially could protect municipal water sources from terrorist chemical threats - although threats to water are more likely to come from biological sources, said Cliff Ho, a Sandia researcher who helped develop the technology.

Biological agents, such as anthrax, are extremely deadly and often kill people in a few days. Toxic agents, such as trichloroethylene, or TCE, a gasoline byproduct, and benzene, take longer and require prolonged exposure before they will kill. Terrorists could use toxic agents as a weapon, but it's not as likely, Ho said.

Several water bodies - especially ground water plumes - in Albuquerque and across the country have been contaminated with toxic elements from fuel and other spills. TCE, benzene and other volatile organic compounds cause cancer at certain levels. Getting accurate readings of those levels and continuously monitoring them, until now, has been difficult and expensive.

The Sandia solution is an array of tiny cylindrical sensor modules - which look kind of like miniflashlights - placed throughout a body of water, that can test in real-time the exact amount of contamination and relay the information instantly to a computer or Web site.

"We developed this to provide long-term monitoring for sites that are already contaminated, particularly Department of Energy complexes with a waste legacy and areas such as gas stations," Ho said. "They could also be used to monitor supplies and make sure they aren't being contaminated by dubious sources."

Other testing methods rely on samples taken annually or semiannually from wells. The samples are removed, placed into vials and transported to a lab for testing, which sometimes takes days.

The problem with these methods is chemicals are exposed to the air and have time to evaporate during storage, which can change their composition and give inaccurate readings, Ho said.

"The standard method is Environmental Protection Agency-approved, and works fairly well," Ho said. "Unfortunately, after watching some of those samples being taken, you can get values that are actually lower than they really are, because of that collection loss during sampling and storage."

The Sandia array is placed in the ground so there is no loss during sampling. The sensors measure a source for contamination continually, so the data are more accurate and more timely, with considerably less effort.

"This could save millions while providing improved monitoring," Ho said. "Take the DOE Savannah River site, for example. It takes up to 40,000 samples per year for soil and groundwater. Each one costs between $100 and $1,000 to test."

The minisensor arrays, on the other hand, cost about $2,000 for an entire array and eliminate the need for repeat sampling.

The researchers are also working on a more advanced version that can detect very low levels of toxins - levels that ordinary testing methods can't ascertain.

"This process isn't EPA approved yet, but this can be used to screen areas, such as the Mixed Waste Landfill in Albuquerque," Ho said. "It would complement approved EPA methods for monitoring and provide increased public comfort. I think that's an important thing."

Residents who live near contaminated areas - and there are dozens around Albuquerque - could use the technology to see changes in their water supplies. The sensors could beam data to a Web site that provides information to the public. And the sensors could sound an alarm and leave cell phone and computer messages for groundwater monitoring personnel if toxic levels become too high, Ho said.

"You could even put these into a water supply beforehand and possibly prevent contamination from happening," Ho said. "By monitoring vapors you could tell if a spill were occurring very early in the process."

Sandia is testing the life span of the sensors in field tests at the Chemical Waste Landfill on Kirtland Air Force Base and at the Nevada Test Site. So far, Ho said, the sensors look like they can last for several years.

## Sensors sniff air above water and send data

The sensor arrays developed by Sandia National Laboratories researchers are composed of minisensors placed inside stainless steel cylinders about an inch thick, called modules.

Each module has a small window covered with Gore-Tex that allows gas to penetrate into the cylinder, but doesn't allow water inside, which could damage the components.

Tiny chemical sensors behind each window basically sniff the air coming inside from the water and can tell the levels of toxic agents that are present. The modules also include wireless transmission components - like very small cell phones - that constantly send the data to a computer for analysis. The modules and computer equipment make up an array.

"The result is we can get real-time monitoring from anywhere in the world - even very remote locations," said Cliff Ho, a Sandia researcher who helped develop the technology.