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Two Sandia microChemLab technologies soon to search for toxins in nation's water supplies

By Chris Burroughs

Two Sandia technologies, both based on microChemLab, are expected to soon be checking for toxins and harmful bacteria in the nation's water supplies.

The microChemLab, officially called µChemLab, is a hand-held "chemistry laboratory." The liquid prototype was designed and built at Sandia/California, while the µChemLab that takes measurements in the gas phase was developed at Sandia/New Mexico.

The µChemLab, electronics, and sample collector weigh about 25 pounds and fit into a box the size of a small suitcase. The only external parts of the two sensor technologies are water collectors. The units are completely portable.

"Our goal is to place these sensors within utility water systems and use them to quickly determine if the water contains harmful bacteria and toxins," says Wayne Einfeld (6245), who heads the Sensor Development Focus Area within Sandia's Water Initiative (www.sandia.gov/water). "This on-site monitoring approach would replace current utility monitoring systems that require water samples to be sent to laboratories for analysis, which sometimes takes days for results."

The United States has more than 300,000 public supply water wells, 55,000 utilities,

JAY WEST calibrates an instrument as part of a project to determine the steps necessary to identify toxins in drinking water. (Photo by Bud Pelletier)

120,000 transient systems at rest stops or campgrounds, and tens of millions of hydrants. Up until now, real-time, remote water quality monitoring for toxins has been very limited.

The liquid µChemLab is currently being tested at the Contra Costa (Calif.) Water Utility, says Jay West (8324), California principal investigator. Specifically, the team is testing to determine the steps necessary to identify toxins in

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RESEARCHER Curt Mowry (1722) tests typical Sandia tap water for trihalomethanes. (Photo by Bill Doty)

Water research

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drinking water, as well as expanding its capabilities as an autonomous monitor. The device is presently collecting and analyzing a water sample every 30 minutes and reporting results via a real-time data link to researchers at Sandia.

CRADA partners have long experience

Sandia's cooperative research and development agreement (CRADA) partners in the California endeavor are CH2M Hill, a leading US engineering firm, and Tenix, an Australian engineering services company. CH2M Hill is a global engineering and construction management firm with particular expertise in sewer and wastewater treatment design. Tenix is an engineering services and technology company with more than 30 years' experience in water supply, sewerage and drainage infrastrucure, and defense.

The California µChemLab identifies proteins by separating samples into distinct bands in seconds to minutes. Separations occur in channels as narrow as a human hair coiled onto a glass chip about the size of a nickel.

Curt Mowry (1764), principal investigator for the New Mexico project, says his team is seeking to develop a device that detects trihalomethanes, undesirable byproducts of the chlorination process used to control the bacterial content of water. Trihalomethanes, which form naturally when surface water is treated with chlorine, are highly carcinogenic and can have adverse liver and kidney effects. The New Mexico project is funded through Laboratory Directed Research and Development (LDRD) resources allocated through Sandia's Water Initiative.

"The EPA has regulations for water utilities to monitor for trihalomethanes on a regular schedule," Curt says. "Currently they have to collect samples and send them to labs for analysis. They get numbers back a few days later. This is a scary thing for us as consumers. The way it's done now, chemists might have measured high levels and there is chance someone has already consumed the water before the results return. Using the µChemLab will provide a way to bring the labs to the site and get results in a more timely manner."

The µChemLab system is expected to help water utilities control the formation of trihalomethanes by functioning as a component of a process control loop.

New Mexico's portable unit analyzes a sample of water by bubbling air through it and collecting trihalomethanes from that air. The collector is heated, sending the trihalomethanes through a separation channel and then over a surface acoustic wave (SAW) detector.

"The collector and the separation phase can be purchased off the shelf, but the SAW detector is at the heart of the microChemLab," Curt says. "The goal by the end of summer is to replace the commercial separation column with a Sandia microfabricated column made using MEMS fabrication technology to reduce the power needed and increase performance."

Commercial collectors are about four to five inches in diameter. Microfabricated collectors will be half a square inch. They are in development and need further tuning for trihalomethanes.

The Sandia/New Mexico microChemLab uses similar concepts to the California one — collect, separate, and detect. The main difference is at the "front end" of the device, where different capabilities are needed to be able to extract gases such as trihalomethanes from the water.

"Both systems will speed the analytical process and give the utility operator better information in a shorter time period," Wayne says. "In addition to routine water quality monitoring, both are expected to be part of early warning systems that can alert utility operators to intentional contamination events that might occur at vulnerable locations downstream from treatment plans."

And finally, he says, "In both of these projects Sandia has successfully leveraged MEMS-based core technologies nurtured by various DOE programs into the water security applications area."

DSO turns your classified into scrap

Department 6146 offers a service that destroys excess classified material, up to and including Secret Restricted Data (SRD). Dwight Stockham (manager, 6146, and a Derivative Classifier) says Disassembly & Sanitization Operations (DSO) has been functional since February. The service was begun as a result of the need to destroy classified material removed from the Classified Waste Landfill — part of the Environmental Restoration Project.

DSO is a one-of-a-kind operation currently offered only to Sandia organizations, but the service may be expanded to include other DOE facilities outside of Sandia that need to destroy classified items. Dwight foresees this service will someday be upgraded to handle all levels of classified material.

If the item is accepted for DSO, it will be documented and locked in one of two Vault Type Rooms until the DSO process can begin. It will be tracked until the process is completed. Disassembly and sanitization is achieved by a variety of operations, which can include the use of a shredder, a ring mill, a band saw, and hand tools, until the item is no longer classified. Material that is generated is disposed of according to Sandia policy.

To schedule the service, contact Dwight (844-5493 or djstock@sandia.gov). He will need information detailing what the item is, its classification, quantity, size, and location. If the item is accepted by DSO, arrangements can be made to pick it up, or it can be dropped off at Tech Area 2, the site of DSO. A Project/Task is required to cover the cost associated with the service. — *Jan Kohler (6147)*