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Project News

Remote-Monitoring Protects Water Facilities at Two Army Bases

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The corrosion of water systems is a widespread problem that is often overlooked in favor of protecting higher profile facilities that transport and contain dangerous, polluting chemicals and gases. However, the direct costs associated with water and wastewater system failure and maintenance are huge—$36 billion annually in the U.S. alone, according to the 2002 U.S. Federal Highway Administration study, "Corrosion Costs and Preventive Strategies in the United States."

The Army is especially concerned with maintaining water storage and piping systems at its many installations to avoid costly failures and provide personnel with safe, high-quality, and reliable water sources. In addition, water must be available and maintained at the appropriate pressure for such firefighting needs as aircraft deluge systems, building fire suppression systems, and fire hydrants.

The Army's Engineer Research and Development Center's Construction Engineering Research Laboratory (CERL) is using cutting-edge technologies to address the problem of water system corrosion at two of its installations as part of an Office of the Secretary of Defense (OSD)-funded initiative. A project at North Carolina's Fort Bragg involves using new pipeline water sensors to monitor water quality and corrosion, while the project at Fort Drum in New York focuses on ice-free cathodic protection (CP) of tanks. Both systems interface with a computerized Supervisory Control and Data Acquisition (SCADA) system to log and track the data in real time.

Pipe Corrosion Sensors at Fort Bragg

The water distribution piping at Fort Bragg runs underground for hundreds of miles, supporting fire suppression, troop deployment to arid regions, and soldier welfare. Some of the pipelines are more than 50 years old and can fail catastrophically if corrosion problems are not detected and corrected. The CERL project at Fort Bragg is focused on determining if corrosion problems exist in the pipelines, finding their locations, and characterizing their nature and severity. Once this is done, decisions can be made on whether to correct the problem by installing a lining, using a system-wide or localized water treatment program, or replacing the pipe.


Researchers are testing commercially available sensors in Fort Bragg's water distribution systems to find and correct corrosion problems.

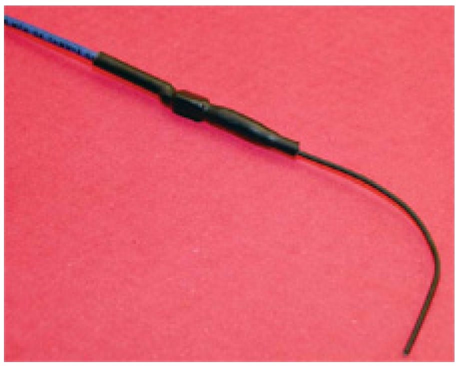
The first step in the project was to install new, commercially available sensors in critical areas of the water distribution system to measure the water's corrosivity and the corrosion rate at given locations. The water quality and corrosivity sensor measures pH, conductivity, turbidity, dissolved oxygen, oxidation-reduction potential, pressure, and temperature. Designed for long-term field use, the sensor is watertight and resists debris. The other sensor measures linear polarization resistance, which allows the actual corrosion rate to be calculated.

"The sensors are already helping us because they allow us to quantify the benefits of our water treatment program," said Brenda Audette, Water Treatment Plant Supervisor at Fort Bragg.

Both sensors continuously provide data to the SCADA system, which transfers the information to the water treatment plant and alerts the plant operator if there is a water quality or corrosion problem. It stores and displays data in a logical, organized manner so that public works personnel can easily observe trends and patterns over time and can fine-tune the water treatment process to address any problems that are detected.

Ice-Free Protection for Storage Tanks at Fort Drum

The CERL team is also involved in a water facility corrosion project at an Army installation where extreme cold provides particular challenges. Elevated steel potable water storage tanks and associated piping at Fort Drum, which should have a service life of 50 to 75 years, have failed in as little as 20 years because of high corrosion rates. The tanks have traditionally been equipped with CP, a technique that reduces the corrosion of a metal surface by making that surface the cathode of an electrochemical cell. However, when surface ice forms in the tank in cold weather, traditionally designed CP systems comprising anodes suspended from the roof of the tank are often prematurely damaged or destroyed.



Ceramic-coated wire anodes are being used in Fort Drum's water storage tanks as part of an impressed-current, cathodic protection system that prevents corrosion, even in icy conditions.

"The CP system in one of our potable water storage tanks was completely destroyed in 2000 because of ice damage after only a few years of service," said Tom Ferguson, Operations & Maintenance Division Chief at Fort Drum. "When a CP system fails, the inside of a tank may remain unprotected for months or even years until funds can be obtained to replace it."

The researchers have installed an innovative, ice-free, impressed-current CP (ICCP) system in two of Fort Drum's elevated water tanks. In an ICCP system, a rectifier is connected to anodes that discharge direct current through the water and onto the protected structure, stopping the natural process of corrosion. In this case, ceramic-coated wire anodes are hooked to an umbrella-like flotation and support system that keeps them submerged in water underneath surface ice, regardless of the water level. Because the anodes and their supports are kept away from the ice, they are not susceptible to ice damage.

The anode in this ice-free CP system is in the form of a ceramic-coated wire instead of the more traditional segmented rod shape. The wire is then wrapped around a polyester rope hoop that is held in place by several polyvinyl chloride floating "arms" that extend radially outward from the dry access tube at the center of the tank. The "arms" are hinged at the point of attachment to the dry access tube so that the hoop can move up and down as the water level changes.

"One major benefit of the CP system is that it allows us to extend the life of the water tank's interior coating," said Ferguson. "Recoating is expensive and requires the tank to be taken out of service for several weeks."

Fort Drum's existing SCADA system is used to monitor the performance of the ICCP, recording rectifier outputs, "on" potentials, and "instant off" potentials. The SCADA system also monitors key parameters in the installation's water and sewage systems and helps control the operation of pumps, valves, and other equipment.

"From our experience on these projects at Fort Bragg and Fort Drum, we highly recommend that the SCADA programmers, the sensor manufacturers, and the ultimate users of the system all be involved as early in the process as possible," said Vicki Van Blaricum, associate manager of the CERL projects. "It is critical to the success of these projects that the SCADA programmers have a detailed understanding of how the sensors work and exactly what output signals they produce. They also need to know how the users wish to see and use the data."

Once testing has been completed and the results tabulated at the two installations, CERL will prepare guidance and procurement specifications that can be used to fight water system corrosion in many other locations.

"The next step is to be able to automatically feed live sensor data directly into dynamic hydraulic and water quality simulations," said Van Blaricum. "Interfacing the corrosion sensors with simulations, SCADA systems, and water treatment systems will provide an automated and integrated corrosion-control solution for water distribution systems. That is what we are proposing to do in fiscal year 2007."