RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Research Update

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Bottom Line

This research project applied laboratory research from 2015 by injecting chemical grout underwater to seal a 1-inch crack in a concrete canal lining.

Better, Faster, Cheaper

Traditional methods of chemical grout injection require dewatering the concrete canal and drilling injection ports into the concrete that intersect the crack in the liner. This research eliminates the need to do either.

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Injecting Chemical Grout Underwater

A field demonstration of underwater chemical grout injection on inactive cracks in a Central Arizona Project canal

Problem

Seepage from concrete canals continues to be a problem for Reclamation. Dewatering a canal to perform routine sealing of seepage cracks can be costly, especially for projects like the Central Arizona Project (CAP) where the canals deliver an average of 1.5 million acre-feet of water per year to approximately 80 percent of the state's population.

The CAP has been using underwater applications consisting of epoxy products to seal seepage cracks in the concrete lining, but many of these products are rigid repair materials that either crack adjacent concrete or can crack at the repair material if there is movement in the panel.

Polyurethane grouts (i.e., chemical grouts) are an excellent repair material solution for sealing seepage cracks because they are flexible and can allow for some minor movement in the cracks. Until now, research on injecting chemical grout underwater without drilling injection ports has not been widely documented.

Application

The Concrete, Geotechnical, and Structural Laboratory in Reclamation's Technical Service Center conducted a laboratory research study in the summer of 2015 to determine if chemical grout could be injected underwater without having to drill portholes into the concrete. The success of this research piqued the interest of the Phoenix Area Office and CAP personnel in Reclamation's Lower Colorado Region, which led to the performance of a field demonstration of the injection process.

This Reclamation Science and Technology Program research project was performed on inactive cracks in a CAP canal. The canal was located in Pool 33 near Casa Grande, Arizona. The test section spanned two panels, approximately 20 feet. The canal was full, but the flows were brought down to a minimum so that the products had a better chance adhering and penetrating the cracks. High and low ambient air temperatures were about 33 to 52 degrees Fahrenheit (°F). The canal water temperature was about 45 °F.

With the support of the Arizona Commercial Diving Services, Reclamation was able to inject the chemical grout and optimize the procedure. A special grout premixing assembly was used to allow for premixing of the grout with controlled temperature water. Two hydrophilic grouts

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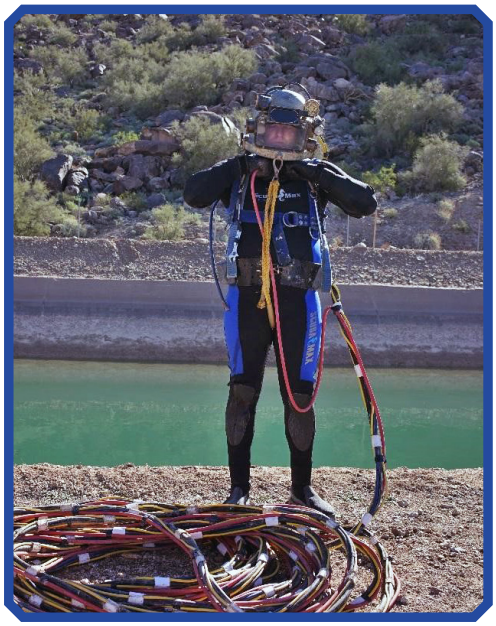

A diver prepares for injecting chemical grout underwater.

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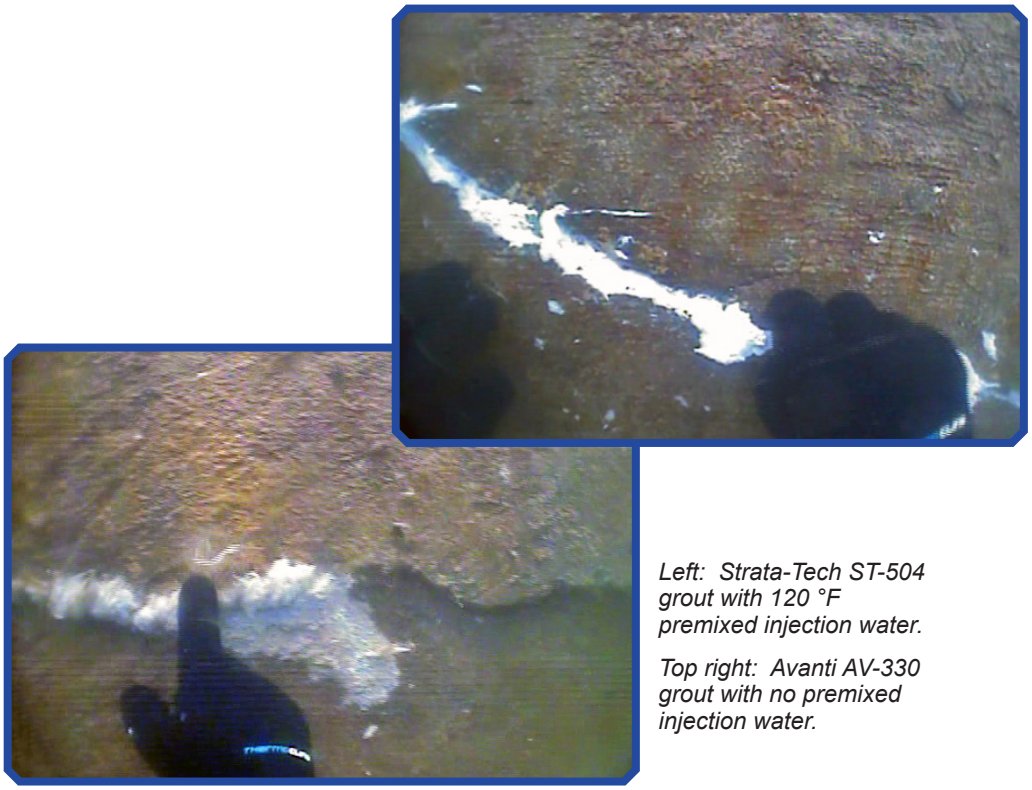
from two different manufacturers were used—Strata-Tech ST-504 and Avanti AV-330. These grouts were identified by the previous laboratory research and featured a National Sanitation Foundation (NSF 61) potable water rating for safe usage in drinking water supplies.

Several tests were directed by Reclamation to evaluate the effect of the mix water temperature on the curing time and grout properties. A total of six tests with Strata-Tech ST-504 grout and four tests with Avanti AV-330 grout were performed. The temperatures ranged from 80 to 180 °F with the Strata-Tech ST-504 grout and 80 to 120 °F with the Avanti AV-330 grout. The premix water temperature was measured at the pump and flowed through about 100 feet of line before mixing with the grout at the nozzle.

Results

Both products could be injected in the underwater demonstration. It appeared that each product performed better when mixed with warm water to speed up the curing process. However, each product had a different optimal premix temperature and material properties. The Strata-Tech ST-504 grout performed the best when the water that was mixed with it was at 120 °F. The Avanti AV-330 grout performed the best during high flows in the canal when the water was at 80 °F. In addition, the Strata-Tech ST-504 grout was more rigid than the Avanti AV-330 grout. At its optimal mix temperature, the Avanti AV-330 grout also seemed to have less waste. The photographs below show the final products 24 hours after injection.



Left: Strata-Tech ST-504 grout with 120 °F premixed injection water.

Top right: Avanti AV-330 grout with no premixed injection water.

Future Plans

The 24-hour inspection of the final products included only a visual inspection. However, future studies should include taking core samples through the sealed cracks so that a quantitative analysis can be performed on the adhesion and penetration of the grouts in the cracks. Also, the mix water temperatures should be measured at the nozzle and grout temperatures recorded. In addition, performing the same demonstration on active cracks is something the principal investigators would like to attempt.

"Using a combination of this technology and delivery method/ equipment offers a very inexpensive and effective way to perform these leak repairs while the canal is in service."

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Collaborators

Reclamation:

- **Technical Service Center**
- **Phoenix Area Office in Lower Colorado Region**
- **Central Arizona Project in Lower Colorado Region**

More Information

www.usbr.gov/research/projects/detail.cfm?id=2398

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