

## Research Update

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### Bottom Line

This research project tested several polyurethane grouts to determine if they are suitable to use underwater to seal seepage cracks.

### Better, Faster, Cheaper

Sealing seepage cracks often requires either dewatering the structures or using a rigid underwater epoxy that could cause the surrounding concrete to crack if the foundation moves. Polyurethane grouts are flexible materials that use water to cure, eliminating the need for dewatering.

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## Using Polyurethane Grouts to Seal Seepage Cracks Underwater

*Testing polyurethane grouts in a laboratory to determine their value in sealing seepage cracks*

### Problem

Reclamation must repair and maintain its concrete structures, yet many of them are too important or critical to remove from service for repairs. As a result, it is vital to make repairs underwater so Reclamation can maintain water and power deliveries.

Water seepage from cracks in aging concrete canals has been an issue for Reclamation and the infrastructure it manages for decades. In addition, dewatering canals can be costly and lead to long service delays during installation of repair materials. Repairs must also be compatible with base materials, such as concrete, to mitigate or prevent additional damage or deterioration. Epoxies can be rigid, which may lead to cracking adjacent concrete.

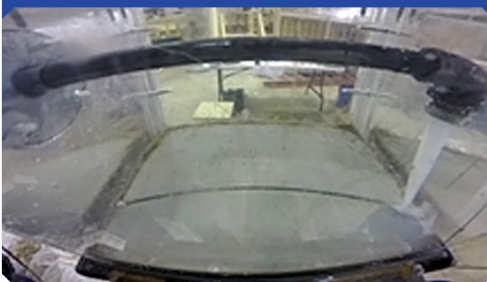
### Solution

Polyurethane grouts are a solution because they use water to cure, thus eliminating the need to dewater the canal or other infrastructure for repairs. Polyurethane grouts are also excellent for repairing and sealing seepage cracks due to their flexibility, which permits minor foundation movement without disturbing the seal.

This Reclamation Science and Technology Program research project evaluated the effectiveness of polyurethane grouts. The Hydraulic Investigations and Laboratory Services Group in Reclamation's Technical Service Center (TSC), in building 56 of the Denver Federal Center, conducted research and designed a pressurized tank specifically for use during the project. To simulate a crack at the bottom of a 12 foot canal, a 5-pound-per-square-inch pressure head was applied to a laboratory model. The following four polyurethane grouts were injected underwater into these identical cracks using a single part pump and an injection nozzle:

1. ST-504 Hydrophilic Vari-Gel Injection Resin distributed by Strata-Tech, Inc.
2. ST-524/ST-525 Hydrophobic Poly-Foam Injection Resin distributed by Strata-Tech, Inc.
3. AV-330 SAFEGUARD Hydrophilic Polyurethane Foam distributed by Avanti International
4. AV-248/249 FLEXSEAL Hydrophobic Polyurethane Foam distributed by Avanti International

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Injection of polyurethane grout in test tank.



Bottom view of concrete specimens after underwater grout injection (from left to right: 330, 248/249, 524/525, and 504).

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The four grouts were rated based on the:

- Effectiveness of the grout to seal the crack
- Ability to view the repair being made (visibility)
- Ease of injection

## Application and Results

Results indicated that only one of the four polyurethane grouts would be a likely candidate for use as an underwater installation and cure repair material for sealing cracks in concrete canals. The table below provides a summary of the results.

Product Name	Crack Sealed	Visibility	Workability	Recommended
ST-504	Pass	Poor	Good	No
ST-524/ST-525	Fail <sup>1</sup>	Good	Poor	No
AV-330 Pass	Pass	Good	Good	Yes
AV-248-/AV-249	Fail	Good	Poor	No

<sup>1</sup>Test was terminated because the nozzle failed.

The Avanti International AV-330 showed great promise by scoring a “Pass” or “Good” rating on all three parameters.

Reclamation’s TSC embarked on a separate effort, using some epoxies to repair a canal underwater in the Central Arizona Project (CAP). Results showed that the two hydrophilic grouts (ST-524/ST-525 and AV-248/AV-249) were the best at sealing, but the two hydrophobic grouts (ST-504 and AV-330) had the best visibility.



Test tank after AV-330 was used to seal crack.

## Future Plans

Future research is needed to determine the most effective grout system for sealing cracks underwater in Reclamation’s infrastructure. Research could include:

- Mixing a hydrophobic grout with a hydrophilic grout to discover a product that exhibits the best qualities of both grouts.
- Premixing water with the grouts prior to injection to decrease set time and determine if this would increase workability and seal potential.
- Investigating the long-term performance of the grout seal.
- Examining potential performance in deeper canals by using pressure applications to mimic deeper canals in a laboratory setting.
- Investigating remote injection to determine if the grout can be installed without a diver.

***“This technology appears to be promising in providing a material to effectively repair cracked concrete underwater, thus effectively eliminating the need to dewater a canal for repairs.”***

Chris Duke  
Manager,  
Water Conveyance Group  
Reclamation’s Technical  
Service Center

***“This project demonstrated that polyurethane grouts can seal cracked concrete canal linings without dewatering or using divers.”***

Janet White  
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## Collaborators

Reclamation’s TSC:

- Concrete, Geotechnical, and Structural Laboratory
- Hydraulic Investigations and Laboratory Services Group
- Water Conveyance Group

## More Information

<http://www.usbr.gov/research/projects/detail.cfm?id=2398>