RECLAMATION

Managing Water in the West

Aqualastic® Repair to Encapsulate Degraded RCC Lining in Canals

Research and Development Office
Science and Technology Program
Final Report ST-2015-786-1

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Mission Statements

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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Peer Reviewer: I have reviewed the assigned items/sections(s) noted for the above document and believe them to be in accordance with the project requirements, standards of the profession, and Reclamation policy.

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(Signature)

Executive Summary

- What the problem was – the Roller Compacted Concrete (RCC) liner in the invert of the North Unit Main Canal is deteriorating. Heavy equipment track marks left in the concrete after construction are rough and provide a start to cavitation and erosion. Current repair methods are to patch with more concrete which moves the rough spot to a different location and reduces channel capacity over time.

- What the research did – In 2013, nine test sections were repaired with Aqualastic® to compare surface preparation methods on typical problem areas and to see if channel velocities made a difference in how well the product holds up. The problem areas include dozer tracks, the feathered edge where the side slope meets the invert, and rough repair patches. Surface preparation was either sandblast to white or mechanical brushing to remove loose material. Test sections were chosen in areas with wider and narrower cross sections with relatively slower and faster flow velocities. The test sections are photo monitored for wear, bubbling, alligator cracking and delamination of the leading edge.

- What the results were – After two years of service, all test sections are performing well. One test section (Test Section 3) has developed a small pocket on the leading edge. This test section is over the feathered edge of the side slope to invert transition and the surface preparation was brushed.

- What are the recommended next steps? Continue to monitor test sections for long term durability.

Contents

Introduction

Background

Reclamation has many concrete and shotcrete lined canals that are in various stages of dis-repair. Finding a material that is economical, results in a smooth surface, is relatively easy to apply, doesn't reduce channel capacity, and that will last for many irrigation seasons is critical for repairing Reclamation's and our irrigation district partners' infrastructure.

The standard way to repair concrete lined canals is to patch with more concrete. This process is labor intensive and costly. Shotcrete repairs vary between 2 to 4 inches of material over the existing shotcrete. This fills the channel with concrete rather than with water, reducing the channel capacity. It can also make the channel rougher, further reducing flows and channel capacity. To avoid this, the old shotcrete and/or concrete would need to be removed, but this increases the cost of repairs substantially. Reclamation needs cost effective ways to repair and maintain these canals.

Goals for the project

The main goal of the project was to field test Aqualastic® as a sealant (repair material) for concrete lined canals. Ancillary goals were to test various surface preparation techniques and to determine long term durability.

Test Sections and Material

North Unit Main Canal

The North Unit Irrigation District in Bend Oregon partnered to provide a test area in the North Unit Main Canal. North Unit installed Roller Compacted Concrete (RCC) as a liner in the invert of the canal in 1998 for a distance of 12 miles and shotcrete on the side slopes in 1999 for a distance of 7 miles. Areas where the RCC had dozer track marks left from construction had the most erosion damage. North Unit Irrigation District has been patching these areas with ready mix concrete and then spreading with a loader bucket. The canal width varies widely from over 100 feet to less than 30 feet, so there are a wide variety of flow velocities. The irrigation season typically is from mid-April to mid-October each year. The canal is dewatered every winter and is subject to freeze-thaw on a daily basis through the winter months.

Test Sections

Test Section 1 is a dozer track mark in a relatively wide section of the canal. The surface preparation is brushed.

Photo 1 Test Section 1 Brush surface preparation.

Test Section 2 is a track mark in a relatively wide section of the canal. The surface preparation is sandblast to white.

Photo 2 Test Section 2 Sandblast to white surface preparation.

Test Section 3 is the feathered edge between the RCC invert and the shotcrete side slope in a wide section of the canal. The surface preparation is brushed.

Photo 3 Test Section 3 Brushed surface preparation. Starting the Aqualastic application.

Test Section 4 is the feathered edge between the RCC invert and the shotcrete side slope in a wide section of the canal. The surface preparation is sandblast to white.

Photo 4 Test Section 4 in the background. Sandblast to white surface preparation.

Test Section 5 is a general patch near the center of the canal. The surface preparation is brushed.

Photo 5 Test Section 5 Brushed surface preparation.

Test Section 6 is a general patch near the center of the canal. The surface preparation is sandblast to white.

Photo 6 Test Section 6 Sandblast to white surface preparation.

Test Section 7 is a track mark in a relatively narrow section of the canal. The surface preparation is sandblast to white.

Photo 7 Test Section 7 Sandblast to white surface preparation.

Test section 8 is a strip across the canal in a relatively narrow section. The strip covers a track mark, a repair patch, and feathered edges. The surface preparation is sandblast to white.

Photo 8 Test Section 8 Sandblast to white surface preparation.

Test Section 9 is a large side by side patch in a narrow section of the canal. The left side is sandblast to white. The right side is brushed.

Photo 9 Test Section 9 Sandblast to white surface preparation on the left, brushed surface preparation on the right. This is a narrow deep section of the canal that has higher velocities.

Material

Aqualastic® is a polyurea elastomeric coating that is sprayed onto a prepared surface. This product is similar to spray-on bedliners commonly used in pickup trucks. Aqualastic® is typically applied to concrete canal lining as a crack sealer.

The Test

The Operation and Maintenance crew from Yakima Field Office did the surface preparation and applied the Aqualastic® with their sandblast and spray equipment. They rented a small front end loader with a brush attachment to prepare the brushed test sections. The application happened in March of 2013 just before irrigation season.

The test sections are photo monitored and checked for adhesion at the leading edge twice per year, just before and just after irrigation season.

The Results

The test sections have gone through two irrigation seasons and two winter seasons to date.

Test Section 1 is a track mark in a relatively wide section of the canal. The surface preparation is brushed. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC.

Photo 10 Test Section 1 Spring 2015

Test Section 2 is a track mark in a relatively wide section of the canal. The surface preparation is sandblast to white. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC.

Photo 11 Test Section 2 Spring 2015

Test Section 3 is the feathered edge between the RCC invert and the shotcrete side slope in a wide section of the canal. The surface preparation is brushed. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC. The leading edge has a small pocket that has formed where some loose material washed out.

Photo 12 Test Section 3 Spring 2015 a small pocket has formed right at the edge of the RCC and side slope shotcrete.

Test Section 4 is the feathered edge between the RCC invert and the shotcrete side slope in a wide section of the canal. The surface preparation is sandblast to white. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC.

Photo 13 Test Section 4 Spring 2015

Test Section 5 is a general patch near the center of the canal. The surface preparation is brushed. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC.

Photo 14 Test Section 5 Spring 2015

Test Section 6 is a general patch near the center of the canal. The surface preparation is sandblast to white. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC.

Photo 15 Test Section 6 Spring 2015

Test Section 7 is a track mark in a relatively narrow section of the canal. The surface preparation is sandblast to white. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC.

Photo 16 Test Section 7 Spring 2015

Test section 8 is a strip across the canal in a relatively narrow section. The strip covers a track mark, a repair patch, and feathered edges. The surface preparation is sandblast to white. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC.

Photo 17 Test Section 8 Spring 2015 Right side leading edge

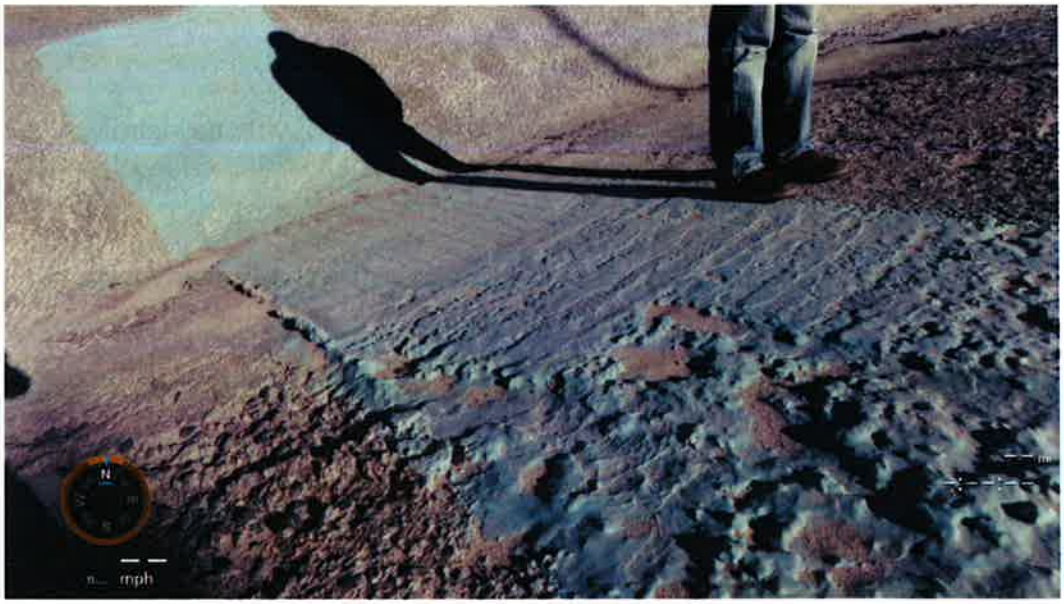

Photo 18 Test Section 8 Spring 2015 Left side leading edge

Test Section 9 is a large side by side patch in a narrow section of the canal. The left side is sandblast to white. The right side is brushed. No alligator cracking and/or bubbling found. The Aqualastic ® is still strongly bonded to the RCC.

Photo 19 Test Section 9 Spring 2014

Conclusion

After two years, all of the test sections are performing well with no significant differences observed between surface preparations (sandblasting vs. mechanical brushing) or flow velocities.

This project and future projects will check the test sections on a yearly basis to see how well the polyurea holds up over time.

Aqualastic® appears to be a cost effective repair method that can reduce seepage without reducing channel capacity.