Underwater Seepage Crack Repair Using Polymeric Repair Material – Field Demonstration

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Central Arizona Project- Tucson Aqueduct Reach 2

- Site conditions
  - Ambient Air
    - Low - 33 degrees F
    - High - 52 degrees F
  - Canal Water Temp. - 45 deg. F.
  - Sunny w/ light breeze

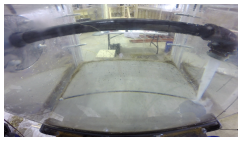
Central Arizona Project- Tucson Aqueduct Reach 2

- Canal Characteristics
  - Canal Depth – 12 ft.
  - Width at the bottom – 14 ft.
  - Slope of Canal Walls – 1 ½ : 1
  - Concrete Lining
    - 3" thick unreinforced
    - 3000 psi @ 28 days Comp. Str.

Goals for the Project

- Seal seepage cracks while in service.
- Determine if premixing the grout with water in an injection nozzle would help to initiate curing reaction.
- Determine if preheating the premix water can reduce set time.

Laboratory Testing



Equipment

- Water heater and generator for heating premix water.

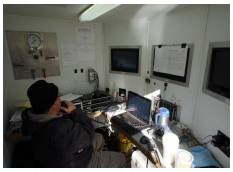
Equipment Cont.

- Airless paint sprayer and hoses for pumping grout and premix water.

Equipment Cont.

- Commercial diver

- Mobile command center

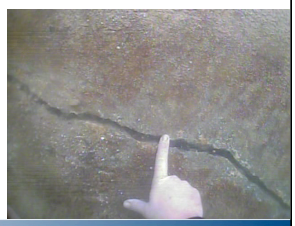


Equipment Cont.

- Injection Assemblies

Method

- Products
  - M#1 – Manufactured product 1
  - M#2 – Manufactured product 2
- Test Sections
  - Approximate 2 ft. sections.
  - Crack width varied from ½" to 1".
  - Some cases had up to ½" of offset in crack.

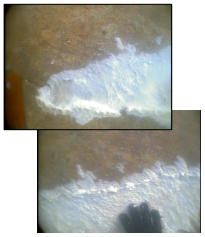


Method Cont.

- M#1 Test Cases
  - Test 1: Single Component Nozzle- no mix water
  - F-assembly with mix water
    - Test 2: 80 degree F. mix water
    - Test 3: 90 degree F. mix water
    - Test 4: 100 degree F. Mix water
    - Test 5: 110 degree F. mix water
    - Test 6: 120 degree F. mix water
    - Test 7: 180 degree F. mix water
- M#2 Test Cases
  - Test 1: Single Component Nozzle- no mix water
  - F-assembly with mix water
    - Test 2: 80 degree F. mix water
    - Test 3: 100 degree F. Mix water
    - Test 4: 120 degree F. mix water
    - Test 5: 180 degree F. mix water

Staking the Location

M#1 Results



Test 1- Single component nozzle- no mix water

- Injection observations-
  - Slow reaction time
  - Product flowed out of the crack before it adhered to the crack
- 24 hour Visual Inspection
  - Little penetration
  - Large amount of product running down face of canal.

M#1 Results Cont.

Test 2 - F-assembly w/ 80 deg. F. mix water

- Injection observations-
  - Quick reaction time
  - Appeared to infiltrate and adhere to the crack
- 24 hour Visual Inspection
  - Good expansion
  - Good adhesion to crack

M#1 Results Cont.

Test 3 - F-assembly w/ 90 deg. F. mix water

- Injection observations-
  - Faster reaction time than 80 deg. F. water.
  - Less product flowed out of the crack.
- 24 hour Visual Inspection
  - Good expansion
  - Good adhesion to crack

M#1 Results Cont.

Test 4 - F-assembly w/ 100 deg. F. mix water

- Injection observations-
  - Faster reaction time than 90 deg. F. water.
  - Less product flowed out of the crack.
- 24 hour Visual Inspection
  - Product appeared gelatinous
  - Little strength and adhesion

M#1 Results Cont.

Test 5 - F-assembly w/ 110 deg. F. mix water

- Injection observations-
  - Flow in the canal began to increase
  - Very little product flowed out of the crack
- 24 hour Visual Inspection
  - Product appeared gelatinous
  - No gaps
  - Good penetration and adhesion
  - Chunks could be easily broken off

M#1 Results Cont.

Test 6 - F-assembly w/ 120 deg. F. mix water

- Injection observations-
  - Product filled crack better than 110 deg. F. test.
  - Diver liked 120 deg. F. water the best.
- 24 hour Visual Inspection
  - Good penetration
  - No gaps
  - Product felt solid and not gelatinous

M#1 Results Cont.

Test 7 - F-assembly w/ 180 deg. F. mix water

- Injection observations-
  - Excessive amount of product flowed out of the cracks
- 24 hour Visual Inspection
  - Poor penetration
  - Product felt gelatinous.

M#1 120°F Mix Water Application

M#1 120°F Mix Water 24 Hr. Review

M#2 Results

Test 1 – Single component nozzle – no mix water

- Injection observations-
  - Little to no runoff of the product
- 24 hour Visual Inspection
  - Good penetration
  - No gaps
  - Good adhesion
  - Final product felt firm but flexible

M#2 Results Cont.

Test 2 – F-assembly 80 deg. F. mix water

- Injection observations-
  - Increase in runoff of product down canal face
  - Product became stringy as it cured
- 24 hour Visual Inspection
  - Good penetration
  - Good adhesion
  - Final product felt firm but flexible

M#2 Results Cont.

Test 3 – F-assembly 100 deg. F. mix water

- Injection observations-
  - Quick reaction time
  - Some runoff down the face of the canal
  - Product became stringy as it cured
- 24 hour Visual Inspection
  - Moderate penetration
  - No gaps
  - Final product had a gooey bond and setup
  - Low adhesion

M#2 Results Cont.

Test 4 – F-assembly 120 deg. F. mix water

- Injection observations-
  - Quick reaction time
  - Similar runoff as test 3
  - Product became stringy as it cured
- 24 hour Visual Inspection
  - Poor penetration
  - Low adhesion

M#2 Results Cont.

Test 5 – F-assembly 180 deg. F. mix water

- Injection observations-
  - Quick reaction time
  - Less penetration than all the other tests
- 24 hour Visual Inspection
  - Poor penetration
  - Good adhesion

M#2 80°F Mix Water Application

M#2 80°F Mix Water 24 Hr. Review

Conclusions

- Both grouts performed better when premixed with water in the injection nozzle prior to injection.
- Premixing with heated water reacted the grout faster.
  - Gave grout sufficient time to Adhere to crack surface.
  - Less product waste.

Conclusions Cont.

- M#1 performed optimally when mixed with water at 120 deg. F.
- M#2 performed optimally when mixed with water at 80 deg. F.

Conclusions Cont.

- 180 degree F. mix water caused near instantaneous particle curing that did not adhere well in the crack for either product.
- The diver preferred M#2 over M#1 because it had better adhesion, penetration, and felt firmer.

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QUESTIONS?