Reactive Solutions

An FHWA Alkali-Silica Reactivity News Publication

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Mitigating ASR in Maine Bridge Structures *Treatment marks second implementation project under FHWA's ASR Program*	1
Editor's Corner	2
This Issue's Ask.Send. Receive	2
ASTM Holds Workshop on Alkali-Aggregate Specifications	3
New AASHTO Recommended Practice on Alkali-Silica Reactivity	3
Schedule of Events	4
This Issue's Photos	4

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Mitigating ASR in Maine Bridge Structures

Treatment marks second implementation project under FHWA's ASR Program

A series of concrete structures afflicted by alkali-silica reaction (ASR) in Bangor, Maine are undergoing mitigative measures using various treatment methods. A total of five bridge structures along Interstate 395 were selected to undergo treatment using three different sealer products, a carbon fiber reinforcement polymer (CFRP) wrap, and an electrochemical treatment with lithium nitrate.

After a petrographic analysis confirmed ASR in seven different bridge structures, the team coordinated with Maine Department of Transportation (DOT) and FHWA to determine the course of treatment for the bridges. Ultimately, five bridges were selected for the following treatments (listed in the table below):

Bridge Structure	Elements Selected for Treatment	Type of Treatment
I-395 over Main Street	Eastbound abutments and wing walls	A 100% and 40% silane product, respectively
I-395 over Penobscot River	Three columns	A 100% and 40% silane product, respectively, and an elastomeric coating
5th Parkway over I-395	Eastbound and westbound abutments and wing walls	A 100% and 40% silane product, respectively, and an elastomeric coating
South Parkway over I-395	Three columns	CFRP, electrochemical treatment with lithium nitrate, and 100% silane product, respectively
Green Point Road over I-395	Eastbound and westbound abutments and wing walls	A 100% and 40% silane product, respectively, and an elastomeric coating

Table 1. Selected bridge structures and accompanying treatment.

Figure 1. Instrumentation panel with embedded steel pins and marked grid. Orange cases enclose humidity probes at various depths.

To evaluate the efficacy of the treatments, the research team instrumented the bridge structures in late May to monitor the expansion of the structure, progression of cracking, and internal humidity. Steel pins were embedded in the structure to measure expansion and a grid was drawn on the surface of each instrumentation site to monitor the progression of surface cracking (see Figure 1). In addition, holes were drilled at 1, 2, and 3-inch depths in order to measure the internal humidity of the structure with humidity probes inserted at these various depths (see Figure 1).

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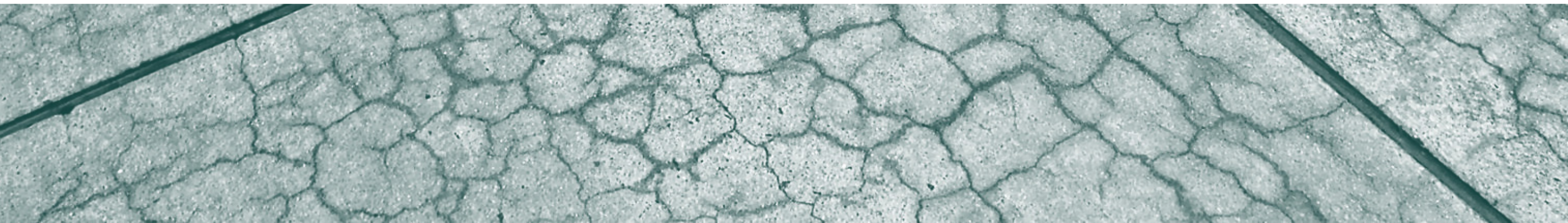


Editor's Corner

Dr. Michael Thomas, University of New Brunswick

Dear Readers,

This quarter saw the start of a second implementation field trial under the FHWA ASR Development and Deployment Program. A series of bridge structures in Bangor, Maine were selected for treatment with various sealers, electrochemical, and structural wrap applications. This marks the first implementation field trial under this program with more than one treatment regime, and the treatment schedule is set to be completed by the end of the summer. In other news, the American Society for Testing and Materials Committee C09 held a workshop in St. Louis this June to discuss developments in alkali-aggregate reactivity (AAR). In addition, the workshop also served as a platform to discuss on-going work and recent developments in the field of AAR. Furthermore, the American Association for State Highway Transportation Officials (AASHTO) Recommended Practice on ASR (which was adopted in 2009) will be published in the 2010 AASHTO publication "Standards and Specifications for Transportation Materials and Methods for Sampling and Testing". If you have any questions or comments for us, please email us at asrnewsletter@transtec.us.

Mitigating ASR in Maine Bridge Structures (cont.)

Figure 2. Application of titanium mesh for electrochemical treatment with lithium nitrate.

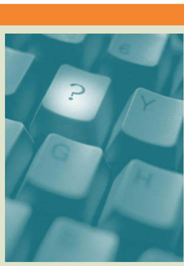
During the first week of June, the electrochemical treatment of one column (located on South Parkway over I-395) was initiated (see Figure 2). This treatment extends over a period of five weeks where a voltage is continuously applied between the concrete surface and the reinforcement in the structure to draw the lithium solution into the concrete.

In addition, once the electrochemical set-up was completed, the contractor proceeded to wrap a second column with CFRP (see Figure 3). CFRP is a very light, yet strong composite material that has become more notable in the past two decades for structural engineering purposes. The most popular use of CFRP is retrofitting, where the load capacity of structures, is increased through CFRP wraps. The use of CFRP wraps on ASR-affected structures has been evaluated in the past, and its evaluation under this program will provide more knowledge of its capacity as a rehabilitation option. The topical applications of the two silane and elastomeric products will be conducted this summer.

To determine the effectiveness of the treatments selected, it was essential for the team to select a section or structure from each bridge to serve as a control.

Once all treatments are completed, the team will commence monitoring activities for the duration of the program by the research team and Maine DOT. For more information about this field implementation project, please contact Gina Ahlstrom at Gina.Ahlstrom@dot.gov.

Figure 3. Application of CFRP wrap.



A.sk
S.end
R.eceive

This Issue's Question:

Has your state recently updated your current ASR specification?

Submit your answers to: asrnewsletter@transtec.us

ASTM Holds Workshop on Alkali-Aggregate Specifications

The American Society for Testing and Materials (ASTM) Committee C09 on Concrete and Concrete Aggregates and Committee C01 on Cement held a workshop on June 6, 2010, in St. Louis, Missouri in conjunction with the semi-annual meetings of those committees. Close to 100 people attended the workshop, in which 7 speakers presented an overview of the current state-of-the-practice on alkali-silica reactivity (ASR).

The workshop was kicked off with a presentation on current ASTM specifications, noting that different concrete materials specifications use different criteria for addressing ASR resistance. A presentation by the Federal Highway Administration (FHWA) research team reviewed the American Association of State Highway and Transportation Officials (AASHTO) *Recommended Practice*, which is anticipated to be published this summer. Presentations also included an overview of extensive updates on ASR in the American Concrete Institute (ACI) 201.2R, *Guide to Durable Concrete,* and a review of Canadian Standards Association provisions for dealing with ASR, which served as a model for the AASHTO Recommended Practice. ASR requirements in project specifications were also discussed, emphasizing the need for a national reference standard. Also discussed were suggestions for improvements to specifications dealing with ASR, based on forensic analysis of results of test methods, which in many cases provide contradictory indications and actual in-service performance. Recent research findings and on-going research questions were also presented by comparing expansion and cracking of test blocks in a field exposure site with various mitigating options to minimize ASR. In closing remarks, members noted the challenging task ahead for the newly formed ASTM subcommittee C09.50, and its objective to develop specification guidance on ASR.

New AASHTO Recommended Practice on Alkali-Silica Reactivity

A new Recommended Practice for designing concrete mixtures resistant to alkali-silica reactivity (ASR) was adopted in 2009. The "Recommended Practice for Determining the Reactivity of Concrete Aggregates and Selecting Appropriate Measures for Preventing Deleterious Expansion in New Concrete Construction" will be included in the 2010 publication of the American Association for State Highway Transportation Officials (AASHTO) "Standards and Specifications for Transportation Materials and Methods for Sampling and Testing".

A process for determining the reactivity of an aggregate is provided in the Recommended Practice. Test limits for the Concrete Prism Test (ASTM C 1293) and the Accelerate Mortar Bar Test (AASHTO T 3030) are included. States are encouraged to gain a history of their aggregate supply using the Concrete Prism Test. Although the test is lengthy, (the test duration is one year to evaluate aggregate reactivity) a valuable database of test results can be gathered. Recommendations are provided for using the Accelerated Mortar Bar Test (AASHTO T 303) if results from the Concrete Prism Test (AASTM C 1293) are not available.

The Recommended Practice presents two approaches for designing concrete mixtures free of ASR. The first is a performance based approach. In this approach the Concrete Prism Test (ASTM C 1293) and the Accelerated Mortar Bar Test for evaluating supplementary cementitious materials (SCMs) and blended cements (AASHTO T 15670) are used to determine the appropriate prevention techniques. A method is also presented for modifying the Accelerated Mortar Bar Test (AASHTO T 303) to determine the appropriate dosage of lithium nitrate needed to suppress ASR.

The second approach is prescriptive based. Concrete mixtures are designed considering the class, size, and exposure condition of the structure, degree of aggregate reactivity, and the level of alkalis from the portland cement.

For more information on the Recommended Practice, contact Gina Ahlstrom at Gina.Ahlstrom@dot.gov.

Schedule of Events

August

4-6
2nd International Conference on Transport Infrastructures
São Paulo, Brazil

8-13
AASHTO Subcommittee on Materials Meeting
Madison, Wisconsin

28-September 1
SASHTO 2010 Conference
Little Rock, Arkansas

September

15-17
International Conference on Sustainable Concrete Pavements
Sacramento, California

October

13-15
11th International Symposium on Concrete Roads
Seville, Spain

28-November 2
2010 AASHTO Annual Meeting
Biloxi, Mississippi

This Issue's Photos

This picture illustrates the effect of moisture on cracking in an ASR-affected concrete in Quebec City, Canada. Prior to the demolition of the bridge, the wing walls were excavated, thus leaving the zones above and below ground apparent. The section of the element above the ground level shows densely-developed map cracking typical of ASR (with associated white gel exudations). Cracking in the below-ground portion of the wing wall is also apparent when under close examination but has a more widely-spaced pattern of cracking.

Have a picture you'd like to send us of an ASR-affected structure in your state? Send us what you like - a bridge, a core, a snapshot of your lab, etc. - our editorial committee will select one picture and post it here for all to see.
Email your pictures to asrnewsletter@transtec.us