What’s New with ASR?

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What is ASR?

Figure from: FHWA-RD-03-047, Folliard et al., 2003

Alkali-Silica Reactivity

Occurrences of ASR in the United States (From 1994 FHWA Showcase Workshop on ASR)

SAFETEA-LU Legislation

- Sec. 5203. (e) Demonstration Projects and Studies
  - (3) Alkali Silica Reactivity. Of the funds made available by 5101(a)(1) of this Act, $2,450,000 shall be made available by the Secretary for each of fiscal years 2006 through 2009 for further development and deployment of techniques to prevent and mitigate alkali silica reactivity.

Before FHWA Started a New Program

ASR Benchmarking Workshop

Stakeholders and customers provide input and identify potential program elements toward development of a comprehensive program of development and deployment activities addressing techniques to prevent and mitigate alkali silica reactivity.
Main Points from the Workshop

- Develop protocols/framework/decision tree for ASR prevention and mitigation using existing techniques and guide specifications
- Field trials, field trials, and more field trials
- Develop a framework for inventorying and prioritizing structures through existing Pavement Management and Bridge Management systems
- Provide technology transfer through delivery of information and training/education

ASR Program Goals

- Increase durability, performance, and reduce life cycle costs
- More effectively deploy current technologies
- Develop new technologies, develop rapid lab methods, and develop NDE techniques to assess ASR in the field

FHWA’s ASR Development and Deployment Program

(1.) Understanding the ASR Mechanism Process for Prevention

(2.) Develop Testing and Evaluation Protocols

(3.) Selection, Implementation, and Maintenance of Field Application and Demonstration Projects

(4.) Assist States in Inventorying Existing Structures for ASR

(5.) Deployment and Technology Transfer

Establishment of a Technical Working Group (TWG) to monitor the Program

(1.) Understanding the ASR Mechanism

Task Goal:
- Obtain a better understanding of the ASR mechanism

Applied Research Strategies:
- Quantify various chemical reactions and rates between constituents
- Identification of formed products
- Consideration of environmental effects such as deicers

Applied Research Products:
- Development of prescriptive methodology to produce durable concrete mix designs

(2.) Develop Testing and Evaluation Protocols

Task Goal:
- Develop a reasonable, effective, and clear decision-making process for methods and techniques to prevent and mitigate ASR

Deployment Strategies:
- Develop protocols for rapid testing and evaluation for ASR prevention in new construction, ASR mitigation in existing concrete, and determination of future deterioration
(2.) Develop Testing and Evaluation Protocols

- Deployment Products:
  - Guidance on evaluation of aggregates and mixtures appropriate to prevent against ASR
  - Guidance on the determination of existence and extent of ASR
  - Guidance on mitigation measures to reduce the severity of ASR

- Applied Research Strategies:
  - Identify the most viable rapid test methods to accurately predict field performance of ASR

- Applied Research Products:
  - Modifications to existing test procedures or recommendation for the development of a new test procedure

Determining Aggregate Reactivity and Selecting Measures to Prevent ASR

- Guidance on using results from
  - ASTM C 1293 Concrete Prism Test
  - ASTM C 1260 Accelerated Mortar Bar Test

Diagnosis and Prognosis of ASR

Guidance on how to use results from the Cracking Index and the Petrographic Examination to determine next steps in ASR diagnosis

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Comments and Action</th>
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<tbody>
<tr>
<td>“Cracking” &gt; criteria and Low probability of AAR (from petrography)</td>
<td>Significant cracking is affecting the element investigated. On the other hand, there is no conclusive evidence of ASR in the concrete (based on petrography). Action: initiate further investigations for other mechanisms of deterioration, if required.</td>
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Selection of Mitigation Measures

- Treat the Cause
  - Chemical Treatment/Injection
    - CO₂
    - Lithium Compounds
  - Drying
    - Seals
    - Cladding
    - Improved Drainage
- Treat the Symptom
  - Crack Filling
    - Aesthetics
    - Protection (e.g. from Chloride ingress)
  - Restraint
    - Prevent Expansion
    - Strengthen/Stabilize
  - Relieve Stress
    - Sawcutting/Slot Cutting

(3.) Field Trials

- Task Goal:
  - Gather long-term data on the effectiveness and service life of methods and techniques to prevent ASR in new concrete and mitigate ASR in existing concrete

- Deployment Strategies:
  - Implementation of existing techniques to prevent and mitigate ASR
  - Explore new methods and techniques to prevent and mitigate ASR
(3.) Field Trials

- Deployment Products:
  - Implementation and monitoring of field trials
  - Analysis of the best methods and techniques to prevent and mitigate ASR

(3.) Field Trials

- Applied Research Strategies:
  - Controlled laboratory experiments coordinated with field trials

- Applied Research Products:
  - Cost effective methods for ASR mitigation

(4.) Assist States with Inventorying Existing Structures for ASR

- Task Goal:
  - “Assist States in inventorying existing structures for ASR” per SAFETEA-LU legislation

- Deployment Strategies:
  - Provide tools for States to successfully track and monitor ASR affected structures

(4.) Assist States with Inventorying Existing Structures for ASR

- Deployment Products:
  - Track ASR affected structures utilizing States Pavement Management and Bridge Management Systems
    - Development of a severity rating system
    - Training

(4.) Assist States with Inventorying Existing Structures for ASR

- Applied Research Strategies:
  - Distinguish ASR and subsequent damage from other deterioration mechanisms to make decisions regarding mitigation, rehabilitation, and reconstruction

- Applied Research Products:
  - Development of a simple reliable non-destructive field test for the determination of ASR

(5.) Deployment and Technology Transfer

- Task Goals:
  - Provide tools, assistance, and efficient and effective technology transfer to educate and train

- Deployment Strategies:
  - ASR Data Center
  - Technology Transfer
(5.) Deployment and Technology Transfer

- Deployment Products:
  - Data center that serves as a clearing house for information
  - Training (presentations, workshops, etc.)
  - ASR Newsletter – *Reactive Solutions*

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**ASR Technical Working Group**

- States ★ Academia ★ Industry ★ Federal Agencies

- Information Sharing
- Technical Input on the Program
- Monitor Program Implementation

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**What’s Next**

- Looking for ASR field trials
  - Prevention of ASR in new concrete
  - Mitigation of ASR in existing concrete

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**What’s Next**

- *Reactive Solutions*
  - Looking for interesting stories, photos, questions, YOUR INVOLVEMENT & INTEREST

- Survey State Structures
  - States to pilot the system developed
For Questions or Information Regarding FHWA’s ASR Program:

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