RESEARCH
PROJECT CAPSULE [20-1C]
November 2019
TECHNOLOGY TRANSFER PROGRAM

Evaluation of the Miniature Concrete Prism Test (MCPT) for use in DOTD

JUST THE FACTS:

Start Date:
October 1, 2019

Duration:
36 months

End Date:
September 30, 2022

Funding:
SPR: TT-Fed/TT-Reg

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used / Implementation Potential

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PROBLEM

Current procedures for testing the alkali-silica reactivity (ASR) of concrete aggregates, such as the concrete prism test (CPT) and the accelerated mortar bar test (AMBT), are either unsuitable for routine evaluation due to testing periods of up to 2 years or unreliable due to the frequency of false-positive or false-negative results, respectively.

Figure 1
Premature deterioration of concrete caused by alkali-silica reaction

Source: Empa (image obtained from the following article: https://www.european-coatings.com/Raw-materials-technologies/Applications/Investigating-reaction-products-formed-by-the-alkali-silica-reaction-in-concrete-structures)

Researchers developed the miniature concrete prism test (MCPT) to shorten the time required to determine the expansion susceptibility of an aggregate due to ASR. It is desirable to have the Louisiana Department of Transportation and Development (DOTD) explore the suitability and feasibility of implementing the MCPT.

OBJECTIVE

The objective of this study is to evaluate the suitability of the MCPT for assessing ASR of concrete aggregates and to determine what additional activity may be needed prior to adopting this test method.

METHODOLOGY

An extensive literature review will be conducted to determine the state-of-practice and any current research endeavors regarding the use and adoption of the MCPT method. A survey will be used to determine the number of states that are currently implementing the MCPT for assessing ASR.

In order to assess the extent of ASR problems in Louisiana, DOTD maintenance engineers and private sector engineers will be surveyed, while construction records, bridge inspection reports, performance management systems, and forensic evaluations are reviewed.

A comprehensive study will be undertaken to compare ASR results from the MCPT (AASHTO T380) and results from the CPT (ASTM C1293) and AMBT (ASTM C1260) tests. The tested aggregates will be from the DOTD approved materials list

and obtained from local sources. AMBT results readily available by the Department will be used for pre-screening and selecting aggregates with a wide range of reactivity to be tested.

Concrete mixtures will be produced based on the requirements set by the MCPT and CPT procedures. Different cementitious systems will be tested, including concrete made from 100% Portland cement and concrete with Portland cement partially replaced with supplementary cementitious materials (SCMs). Samples will be tested immediately after removal from the molds and periodically for at least 12 months for assessment of ASR using the current CPT method. When considering concretes containing SCMs (e.g., fly ash and slag), longer testing periods of up to 2 years will be required. In contrast, the MCPT will only need to be performed up to 8 weeks.

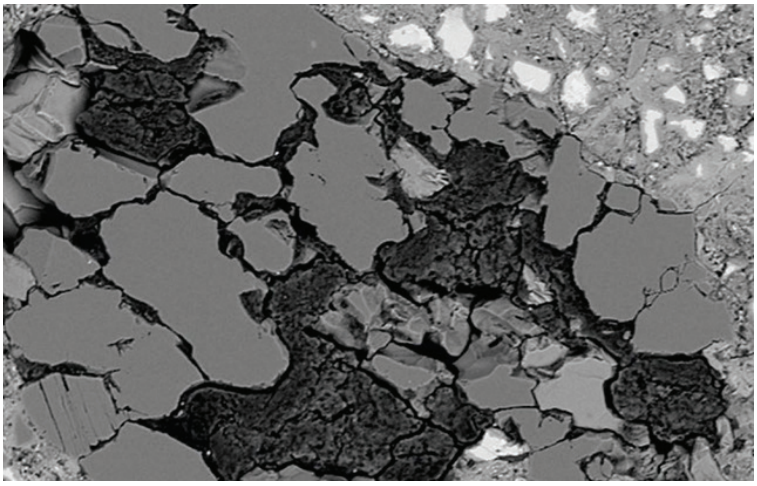

Figure 2
Scanning electron microscope image of alkali-aggregate reaction, where an aggregate containing certain forms of silica will react with the alkali hydroxide ions found in cement in the presence of moisture, causing an unsustainable expansion

Source: https://irl.sika.com/content/ireland/main/en/solutions_products/construction-markets/sika-concrete-technology/concrete-handbook-2013/concrete-types/alkali-silica-reaction-resistant-concrete.html

A total of 192 mixtures will be produced to evaluate the robustness and implementation potential of the MCPT procedure. As such, statistical analyses will be performed to determine if MCPT results correlate or differ significantly from ASR results obtained with the current AMBT and CPT tests.

IMPLEMENTATION POTENTIAL

This research will provide a better tool for ASR characterization, potentially reducing testing time from 1 year to 8 weeks, and will provide guidance for the development of improved specifications for DOTD to address ASR in concrete.

Based on results from this research, future work may involve testing concrete specimens with various additional SCM combinations. If strong correlations exist between the MCPT and current tests, adoption and implementation of the MCPT may be recommended.