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Research Notes

New Performance Approach to Evaluate ASR in Concrete [TPF-5(521)]

A new performance and prescriptive approach to predict the alkali–silica susceptibility of any concrete mix design.

Pavement

NOVEMBER 2024

Project Title:
New Performance Approach to Evaluate ASR in Concrete [TPF-5(521)]

Task Number: 4396

Start Date: July 24, 2023

Completion Date: December 31, 2028

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WHAT IS THE NEED?

The reaction of the alkalis from the cement with silica in certain aggregates forms ASR gels which. ASR is a distress mechanism in concrete structures. The ASR gels can absorb water and swell causing the concrete to crack. Repairing ASR damage to concrete infrastructure costs billions of dollars in the United States annually. The Turner Fairbank Highway Research Center (TFHRC) Chemistry Laboratory developed a new test method that accurately determines ASR in aggregates and predicts expansion using chemical measurements. The test is called Turner-Fairbank ASR Susceptibility Test (T-FAST) and is completed in 21 days. Although the test can detect ASR reactive sites in aggregates, it cannot determine whether gels will form in the concrete, and it is particularly dependent on the alkali loading of the mix.

The idea of measuring the alkali threshold of aggregates has been discussed over the years although no reliable test has been available. Consequently, a new test, Alkali Threshold Test (ATT), has been developed in the TFHRC. With this method it is possible to determine the ASR formation in concrete. While research at TFHRC supports this concept, Caltrans together with other state highway agencies has partnered in this pooled fund study to address the need in verifying the validity of this technique by evaluating the commonly used aggregates in various concrete mix designs.

WHAT ARE WE DOING?

The Federal Highway Administration (FHWA) is leading this research study. Several participating state agencies will supply samples of concrete mixtures such as aggregates, cements,

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and Supplementary Cementitious Materials (SCMs) along with its corresponding mix designs to TFHRC. The research team will employ the test methods for T-FAST and ATT in the laboratory to evaluate the ASR reactivity and the alkali threshold of the aggregate combination. They will compare the information against the alkali loading of the provided mixtures to ensure that the T-FAST/ATT combination can predict its field performance.

WHAT IS OUR GOAL?

The goal of this study is to evaluate a wide selection of concrete mix designs to validate the use of the new AASHTO TP-144-21 (T-FAST) and alkali threshold test (ATT) methods in conjunction with mix design data, cement mill reports, and SCM properties to determine the likelihood of ASR gel formation in concrete.

WHAT IS THE BENEFIT?

Alkali-silica reaction (ASR) is one of the major degradation causes of concrete. This research will substantiate the method of detecting potential ASR in concrete. The results of this study will be used to design an ASR mitigation test like T-FAST. It is necessary to expand T-FAST capabilities to evaluate ASR mitigation strategies. Guidelines for effective mitigation methods to limit the occurrence of ASR in future concrete are required to protect the long-term investment in California.

WHAT IS THE PROGRESS TO DATE?

Task 1: Selection of Aggregates and characterization using TFHRC toolkit tests

The PTF team progressed on aggregate characterization with 90% completion of T-FAST testing and 62% completion of ATAg measurements under AASHTO standards.

Task 2: Characterization of supplementary cementitious materials (SCM)

Preparations began for measuring combined alkali thresholds (ATMx) in two paving mixes containing Virginia aggregates and 564 lb/yd^3 of binder.

Task 3: Prepare Concrete Samples

The PTF team collected 0-day and 3-month samples from two Pennsylvania mixes, completing initial air void quantification and preparing the rest for microstructural analysis.