Tech Brief

National Concrete Pavement Technology Center

Tech Center

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T-FAST

A NEW TEST METHOD TO ASSESS ALKALI-SILICA REACTION SUSCEPTIBILITY IN AGGREGATES

WHAT IS ALKALI–SILICA REACTION?

Alkali-silica reaction (ASR) is a degradation mechanism that affects concrete infrastructure worldwide. ASR occurs in a concrete mixture when certain siliceous mineral phases within the aggregates react with the alkalis typically supplied by the cementitious materials. Certain products of this reaction, known as ASR gels, can absorb moisture and swell. This swelling, when ASR gels accumulate in sufficient quantities, can cause the concrete to crack, which reduces its service life. ASR is a complex reaction that generally takes 5 to 25 years to manifest in the field.

HOW DO PRACTITIONERS ASSESS RISK OF ASR IN NEW CONSTRUCTION?

Traditionally, the concrete community has relied heavily on accelerated expansion testing to detect the ASR susceptibility of aggregates used in concrete. Practitioners use the information conveyed by various standard test methods, described below, to determine the risk of ASR for a given aggregate.

COMMONLY USED ASR EXPANSION TEST METHODS AND THEIR LIMITATIONS

The most common expansion-based accelerated standard tests for assessing aggregate reactivity in the United States are the concrete prism test (CPT) described in ASTM C1293, the accelerated mortar bar test (AMBT) described in ASTM C1260 and its counterpart AASHTO T 303, and, to a lesser extent, the miniature concrete prism test (MCPT) described in AASHTO T 380. Unfortunately, factors such as the low sensitivity to some specific alkali-silica reactive phases (false negatives) in the AMBT, the nature of the “nonreactive” counterpart aggregate used in the CPT, and the influence of cement chemistry on the outcomes of all of these tests affect the reliability of these standards. As a result of these limitations, different laboratories may report different ASR classifications for the same aggregate, thus increasing the risk that inadequate mitigation strategies will be implemented when the tested aggregate is used in the field or that acceptable aggregates are rejected.

T-FAST: A NEW CHEMICAL-BASED STANDARD

Provisional standard AASHTO TP 144 describes the Turner-Fairbank ASR Aggregate Susceptibility Test (T-FAST), a new testing protocol used to determine whether an aggregate contains alkali-silica reactive phases. T-FAST is a chemical test in which the aggregate (crushed in the case of coarse aggregate) is exposed to the main factors controlling ASR (alkalis, water, calcium, and temperature). Changes in the measured concentration of certain ions (calcium, aluminum, and silicon) in the test solution are used as indicators to predict the formation of ASR gel products. This test moves away from the need to physically mix, cast, and measure the expansion of concrete prisms and mortar bars, as shown in Figure 1.

T-FAST has been designed to be a detection tool for even trace amounts of reactive phases in aggregates but should not be used by itself to predict the field performance of concrete. Interested to know how to assess ASR field performance of a mixture? Read more in a related tech brief on alkali threshold testing.

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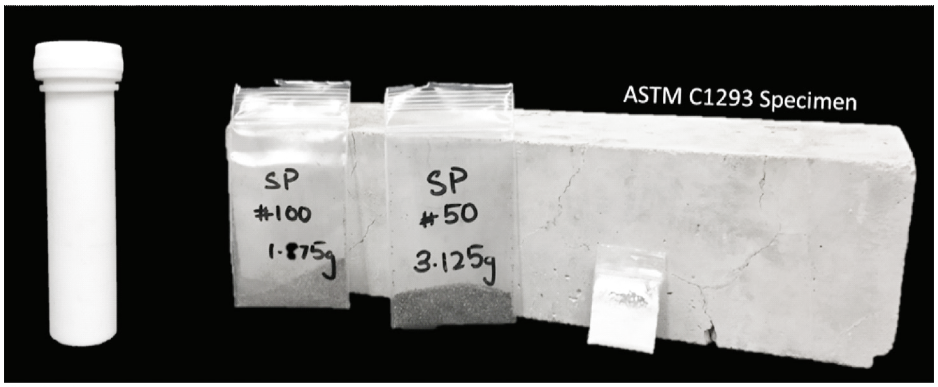

SP = Spratt aggregate

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Figure 1. Comparison between the T-FAST test tube setup and a typical concrete prism specified in ASTM C1293

WHY T-FAST?

T-FAST more accurately detects the presence of alkali-silica reactive phases in aggregates than the current ASR expansion tests. Its results are not influenced by the typical challenges associated with these tests. Because of its high sensitivity, T-FAST eliminates the risk of false negatives that affect the AMBT results. Unlike CPT, T-FAST evaluates the aggregate independently, eliminating the influence of nonreactive aggregates in the results. These advantages enable a safe assessment of aggregate reactivity. Additionally, T-FAST is efficient, with results achieved within 21 days. Given its high sensitivity and efficiency, T-FAST can be used as a powerful quality assurance tool.

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