Summary Report ICAR-301-1S

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FROM 12 MONTHS TO 3 MONTHS: ICAR STUDY YIELDS NEW TEST FOR ALKALI-SILICA REACTION THAT REDUCES TIME REQUIRED

"The research on alkali-silica reaction (ASR) in concrete completed by the International Center for Aggregates Research (ICAR) assures long-term, viable solutions for concrete durability and maintains concrete as a competitive material in the construction markets. The research on modifications to ASTM C 1260 and C 1293 recognizes the use of project materials, mitigation alternatives and reduces the time for material testing to support customer needs. Solutions to ASR developed through the leadership of ICAR represent a beneficial, positive, and enormous return on the investments made in this research project."

(Norman Nelson, Lyman-Richey Corporation; Chair, ICAR Task Force on Alkali-Silica/Alkali-Carbonate Reaction in Portland Cement Concrete)

ICAR PROJECT 301, "Alkali-Silica Reaction in Portland Cement Concrete," headed by Dr. David W. Fowler at The University of Texas at Austin, succeeded in modifying ASTM C 1293 to yield comparable findings in thirteen weeks that previously required twelve months or more. Furthermore, the second stage of the project identified several economical mitigation alternatives for aggregates that did prove reactive.

The project considered fourteen US aggregate sources and used cement with an average alkali content of 1.14%. Mitigation methods included admixtures of Class F and C flyashes, silica fume, granulated slag, calcined clay, lithium nitrate (LiNO), one high-range water reducer, and one air-entraining agent.

The study of ASTM C 1260 and its modifications for predicting the reactivity of aggregates led to the following conclusions:

1. ASTM C 1260 proved ultra-conservative for identifying reactive aggregates based on their 14-day expansion.

2. ASTM C 1260 is too severe for some aggregates, indicating that they are reactive although they pass C 1293 as well as have good field performance. With other aggregates, C 1260 overestimated the reactivity as "highly reactive" whereas C 1293 characterized them as "slowly reactive." Therefore, ASTM C 1260 should not be used for rejection of an aggregate.

3. Increasing the testing time of C 1260 from 14 days to 56 days with expansion limits of 0.33% at 28 days and 0.48% at 56 days proved ineffective in predicting the correct reactivity of aggregates. "Slowly reactive" aggregates did not pass these limits, and "Category E" aggregates (those with good field performance that tested as reactive) were still erroneously identified as reactive.

The study of ASTM C 1293 and its modifications for predicting the reactivity of the aggregates found the following conclusions:

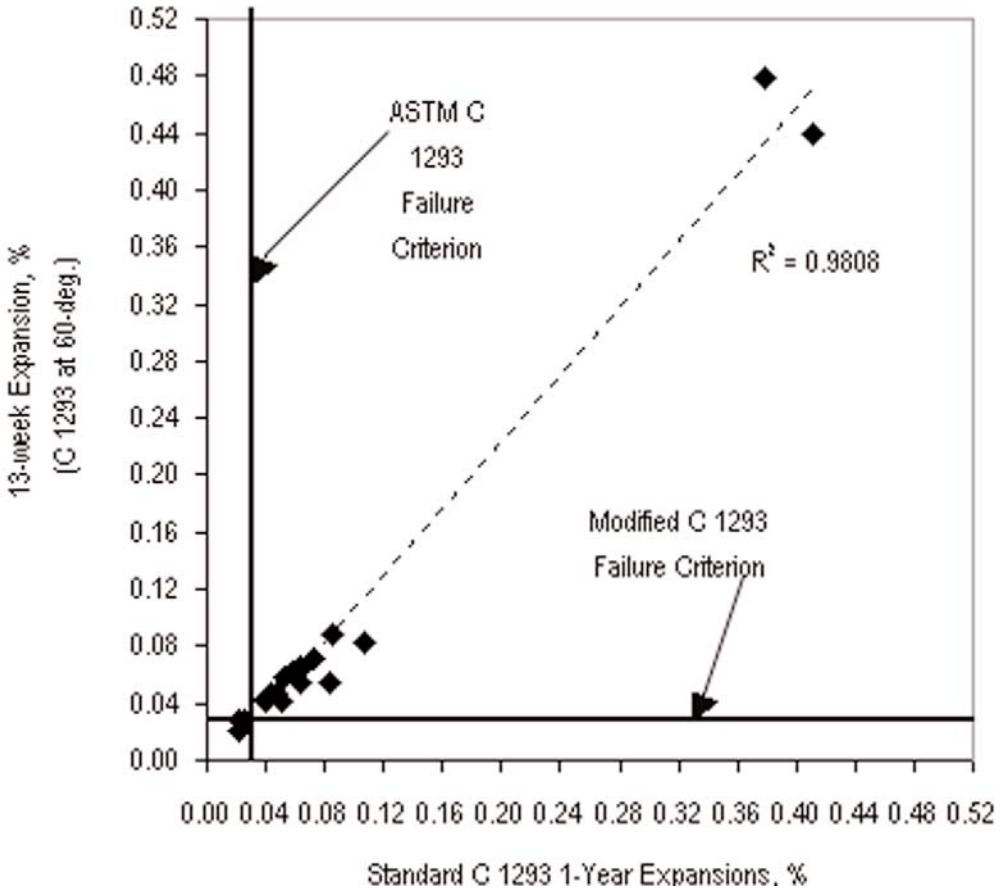
1. The one-year expansion rates accurately determined the aggregates as "innocuous" (less than 0.040%), "slowly reactive" (ranging from 0.040% - 0.070%), and "highly reactive" (more than 0.070%).

2. Storing concrete prisms in a 1N NaOH solution at 80 degrees C was too severe for some aggregates. However, by lowering the temperature to 38 degrees C, the test correctly characterized the reactivity of "innocuous," "slowly reactive," and "highly reactive" aggregates, using a 26-week expansion limit of 0.040%.

3. Storing concrete prisms over water at 100% RH, in sealed containers with wicks at 60 degrees C, resulted in almost identical results as the standard C 1293 but in a much shorter, 3-month, period of time. An expansion limit of 0.040% after three months of testing was effective for all aggregates in generating results similar to the standard C 1293. The correlation between the two procedures is shown below.

The information in this summary is detailed in ICAR Report 301-1F, Alkali-Silica Reaction in Portland Cement Concrete: Testing Methods and Mitigation Alternatives, *by Wissam E. Touma, David W. Fowler, and Ramon L. Carrasquillo.*

The contents of this summary do not necessarily reflect the official views of AFTRE or ICAR.



Comparison Between the Standard C 1293 Procedures and Modified C 1293 at 60^{0}C