Resistance to Alkali-Silica Reaction of Carbon-Dioxide-Cured Calcium Silicate Cement (CSC) Mortar and Concrete Compared to That Made with Ordinary Portland Cement (OPC)

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Abstract
Concrete made with ordinary portland cement (OPC) with high alkali content and reactive siliceous aggregates, when exposed to moisture, is vulnerable to deterioration due to expansive reaction. The alkali hydroxides produced during the hydration of the OPC reacts with some of the glassy and siliceous components of the aggregates to form alkali silica gel. When this gel imbibes moisture, it results in expansion and generates stresses within the aggregate particles. These particles can then crack. And, when the stresses are high enough within the aggregate, the cracks can propagate from the aggregate particle into the surrounding paste.

A novel calcium silicate cement (CSC) with low calcium content has been developed by Solidia Technologies®, commercially known as Solidia Cement™, which gains strength through a carbonation process, instead of hydration. Under a cooperative agreement with FHWA mortar bars were made using Solidia Cement as well as OPC with reactive fused silica as fine aggregate for ASR testing following ASTM C227. Concrete prisms were also made using reactive New Mexico Placitas coarse aggregate for ASR testing following ASTM C1293. The length change results for the C227 mortar bars with Solidia Cement show negligible expansion whereas specimens with OPC expanded significantly and exceeded the threshold limit of 0.1% within 30 days. The OPC C1293 concrete prisms also expanded significantly, but still within the threshold limit of 0.04% after 185 days of testing, whereas the concrete prisms with Solidia Cement have shown negligible expansion.

Note: The FHWA neither promotes nor endorses a particular technology; the cooperative research work was carried out so that FHWA and the highway community can gain knowledge about new technology and whether it might be applied to highway construction or maintenance.