RESEARCH PROJECT CAPSULE [17-1C]

March 2017

TECHNOLOGY TRANSFER PROGRAM

Effect of Clay Content on Alkali-Carbonate Reactive (ACR) Dolomitic Limestone

JUST THE FACTS:

Start Date:
November 1, 2016

Duration:
36 months

End Date:
October 31, 2019

Funding:
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

Alkali-carbonate reactivity is a type of deterioration that occurs when certain aggregate constituents react with alkali hydroxides in cement, resulting in concrete expansion and cracking. Damage to pavements and bridge structures affected by alkali-carbonate reactive (ACR) aggregate can only be addressed by the complete replacement of the affected pavement.

Pavement containing ACR aggregate has been found in Louisiana on I-20 between Ruston and Monroe as well as near the Mississippi River Bridge. Other paving and structural projects in Louisiana have also been identified as having ACR aggregate. As a result of these investigations, the latest version of the Louisiana Department of Transportation and Development (DOTD) specifications was developed to reduce the risk of using ACR aggregate in concrete applications.

OBJECTIVE

The objective of this research is to investigate the hypothesis that clay content plays an overarching role in expansion and deterioration of concrete containing ACR aggregate. This study will determine the effect of clay content on ACR dolomitic limestone listed in the DOTD Approved Materials List (AML).

METHODOLOGY

After performing a literature review to compile the state-of-knowledge on the alkali-carbonate reactivity phenomenon, samples of each dolomitic limestone aggregate listed in the DOTD AML will be obtained for evaluation using the AASHTO PP65 screening test.

Specimens will be prepared and then analyzed with X-ray fluorescence equipment. Relative amounts of chemical compound constituents (e.g., CaO, MgO, and Al_2O_3) will be determined so that potentially expansive aggregate may be identified. A plot of CaO/MgO ratio vs. Al_2O_3 content (%) can be used for this purpose. Alumina (Al_2O_3) content will be used as an indicator of the amount of clay.

For aggregates identified as potentially expansive, concrete mix designs will be developed and six replicate specimens will be produced for each design. Tests for temperature, slump, and air content will be performed. The specimens will be cured in a moisture-controlled room. Determination of specimen length change will be conducted after the end of months 1, 2, 3, 6, 9 and 12.

The test data will be analyzed as described in the AASHTO PP65 procedures, and an implementation plan will be developed to restrict the use of ACR aggregate in concrete pavement and structures.

IMPLEMENTATION POTENTIAL

The establishment of proper screening procedures for identifying ACR aggregate will allow DOTD to better restrict the use of expansive aggregate in concrete pavement and structures.

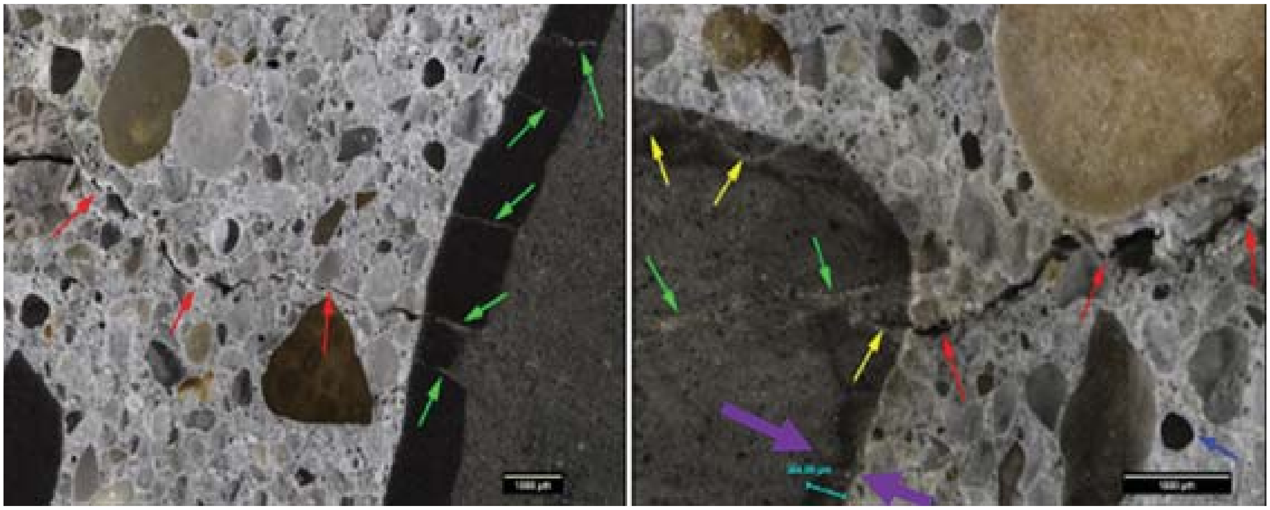

Figure 1
Petrographic examination of a specimen with ACR aggregate, showing cracks originating in the aggregate and extending into the paste

Figure 2
X-ray fluorescence spectrometer

Figure 3
Length comparator