

Alkali-Silica Reaction Mitigation using Alternative Supplementary Cementitious Materials

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22CNMSU19

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Lead Institution:

New Mexico State University

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Tran-SET

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\$ 106,000

Mitigating Alkali-Silica reaction using alternative SCMs

New Mexico contains several aggregate sources that are extremely susceptible to alkalisilica reaction (ASR). To mediate ASR, the New Mexico Department of Transportation (NMDOT) requires a minimum of 20% class F fly ash (by mass of cement) in nearly all concrete produced for their projects. Since class F fly ash has become difficult to procure and future availability is uncertain, NMDOT is considering alternative supplementary cementitious materials (SCMs) that could be used in place of class F fly ash. This project will assess two SCMs being considered for widespread acceptance by NMDOT and builds on work performed during a Year 3 Tran-SET project to investigate a natural pozzolan mined near Espanola, NM for use with extremely reactive fine aggregates. This new project will focus on utilizing the natural pozzolan (pumicite) as well as a metakaolin product with a broad range of reactive aggregates. NMDOT has limited data for mixture proportions and durability properties (such as ASR mitigation) of concrete produced with these SCMs. Therefore, they are unable to confidently accept the materials for use in concrete produced for NMDOT projects, even if class F fly ash is not available. The specific focus of this project is to assess ASR mitigation capabilities of the alternative SCMs when used in combinations with several crushed coarse aggregate sources so that general guidelines that can be developed to minimize the use of the SCMs (based on aggregate reactivity) to prolong availability of SCM sources and improve sustainability.

been produced by generating stations that burn coal to produce electricity. Because it has been widely available, inexpensive, and effectively mitigates ASR, it has been used in large quantities in NMDOT concrete mixtures. However, the last two decades have seen dramatic increases in renewable energy investments by the power industry as well as the federal government’s classification of fly ash as a hazardous material. These factors have reduced availability of fly ash while economic growth and increased construction spending have driven demand for fly ash. Consequently, NMDOT wants to develop the ability to use alternative SCMs to prepare for the possibility that fly ash becomes unavailable. One potential SCM being considered for widespread adoption by NMDOT (to replace class F fly ash) is a tan pumicite (natural pozzolan) from a deposit in Northern New Mexico near Espanola. The deposit covers more than 600 acres (2.43 km²) with a depth of more than 30 feet (9.14 m) and contains an estimated 10,000,000 tons (9,071,000 metric tons) of material. Another potential SCM being considered for adoption by NMDOT is metakaolin, which is the anhydrous form of the calcined clay mineral kaolinite.

Objectives

The purpose of this research project is to assess SCMs being considered for widespread acceptance by NMDOT and builds on work performed during a Year 3 Tran-SET project to investigate a natural pozzolan mined from a pumicite deposit near Espanola, NM for use with extremely reactive fine aggregates. Research for this new project will focus on utilizing the natural pozzolan (pumicite) as well as a metakaolin product.

Problem Statement

SCMs can provide pozzolanic or hydraulic activity to a concrete mixture when added as partial replacement of cement. Utilizing SCMs as a partial replacement of portland cement is usually cost effective, because many SCMs are waste products or naturally occurring materials, and also environmentally friendly, because their use reduces portland cement production. The most common SCMs used in the concrete industry are fly ash, ground blast furnace slag, silica fume, and natural pozzolans. In New Mexico, fly ash has been commonly available for decades because it has



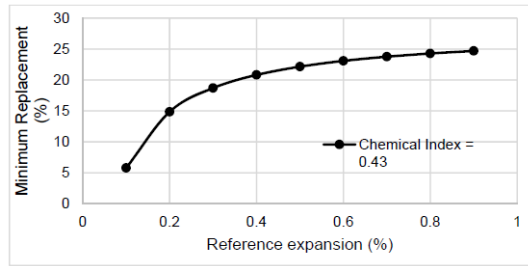


Figure 1. Minimum natural pozzolan replacement to mitigate ASR expansion as a function of reference expansion for specimens produced with only cement (no SCM).

Intended Implementation of Research

Workforce Development, Education, and Outreach: The goal of the research team is to ensure that results of this project are published in archival form to provide lasting impact on the transportation industry. NMSU's research team intends to disseminate the research results to the research community, state DOTs, and other transportation related organizations.

Anticipated Impacts/Benefits of Implementation

This project is expected to produce meaningful contributions by: a) Broadening the class of SCMs that can be used in concrete mixtures for state DOT projects. The alternative SCMs have the potential to improve durability of concrete that might need to be produced without class F fly ash. The primary durability concern in New Mexico is ASR, which is also a concern in other states throughout the region; b) Improving sustainability of concrete produced with SCMs. Since fly ash is produced by burning fossil fuels and has been classified as a hazardous material, the alternative SCMs investigated in this work would be more environmentally friendly.

Web links

- Tran-SET's website <https://transet.lsu.edu/research-in-progress/>

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit [our website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.

