Research in Progress

Evaluation & Mitigation Methods for the Prevention of Cement Concrete Deterioration due to Pyrrhotite: Part 2

Research Need

Sulfide-bearing minerals, particularly pyrrhotite, when present in aggregates used in portland cement concrete, can oxidize and trigger premature deterioration. There is a critical need to investigate concrete mixture design parameters and treatment strategies that can mitigate these reactions and reduce the risk and progression of premature concrete distress.

Goals/Objectives

The primary objective of this project is to evaluate how concrete mixture design strategies and selected treatments can mitigate degradation mechanisms and slow the rate of damage in concrete affected by oxidation of pyrrhotite-bearing aggregates.

Three project tasks are currently underway:
Task 1: Mixture Design Effects – Assess how key parameters (w/c ratio and supplementary cementitious materials) influence deterioration mechanisms, reaction products, and damage evolution.
Task 2: Admixture/Treatment Effects – Evaluate pre- and post-casting mitigation approaches (colloidal silica sealers, hydrophobic agents, corrosion inhibitors) to reduce moisture ingress, slow oxidation-driven reactions, and limit damage progression.
Task 3: Final Report – Synthesize results and conclusions into actionable, practice-oriented guidance for mitigating premature deterioration in pyrrhotite-affected concrete.

Project Information

This project is being conducted as part of the Massachusetts Department of Transportation (MassDOT) Research Program with funding from Federal Highway Administration (FHWA) State Planning and Research (SPR) funds.

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Performing Organization:
University of Connecticut

Project Champion:
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Project Start Date:
12/12/2025

Expected Project Completion Date:
12/31/2026

Methodology

The project will evaluate mitigation strategies using an electrochemical accelerated testing approach that induces chloride ingress under an applied voltage while tracking specimen response over time (e.g., electrical resistivity changes, visible cracking, and deterioration). Damage progression will be quantified through (i) periodic high-resolution imaging with image stitching and crack-length analysis and (ii) resonance frequency testing (ASTM C215) at regular intervals to estimate changes in dynamic modulus, supported by targeted microstructural/phase characterization before and after acceleration. Promising mixture designs and admixture/treatment combinations will be selected iteratively based on results and coordinated through regular collaboration with MassDOT.

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