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CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Notes

Further Development and Piloting of Supplementary Cementitious Materials in Concrete

Evaluating local sources for supplementary cementitious materials in concrete.

Pavement

MAY 2024

Project Title:
Partnered Pavement Research Center (PPRC) 23: Recycling

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WHAT IS THE NEED?

Secondary cementitious materials (SCMs) from industrial by-products can partially replace high-carbon portland cement and improve the durability of concrete. SCMs consume calcium hydroxide and produce secondary calcium-silicate-hydrates that refine the pore system and reduce the permeability of concrete. However, supplies of fly ash, the most used SCM, are declining due to regulatory restrictions on coal-fired power plants. Another accepted SCM is ground granulated blast furnace slag from steel making, but its insufficient supply does not support the US and global demand. Therefore, there have been efforts to find alternative SCMs such as calcined clay, volcanic ashes, and ash from waste biomass. However, these materials vary in chemical composition depending on their location and source. In addition, some of these materials are local to certain areas and thus are expensive or unavailable.

In an ongoing study, likely SCMs are identified in California and other regions for mainstream use in concrete pavements. A parallel study will be looking at historic deposits and recycled glass as alternative source. A follow-on study to review the calcined clay, and volcanic and biomass ashes are required. This study aims to advance the likely SCMs' readiness through testing and characterization for mainstream implementation in concrete pavements, culverts, pipes, curbs and gutters, and flatwork associated with vehicle and active transportation.

WHAT ARE WE DOING?

The following items are to be conducted throughout this task:

- Acquiring likely SCMs identified from the current conceptual study such as the one from California and other regions

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elsewhere.
- Performing complete laboratory characterization to identify replacement rates and develop highly durable performance-engineered paving mixtures using the likely SCMs.
- Building trial slabs, instrumenting them, obtaining material properties for pavement design and other flatwork applications, drainage features, and developing methods and information needed for their consideration in design methods.
- Updating preliminary life cycle cost analysis and life cycle assessment from the current project to compare cost and environmental impacts with current materials.
- Providing recommendations for pilot projects.

WHAT IS OUR GOAL?

The goal of this study is to develop the guidance and specification for the use of alternative supplementary cementitious materials in concrete pavements.

WHAT IS THE BENEFIT?

One of the benefits of this study is to identify sources of SCMs in California for concrete pavement construction in lieu of diminishing supply of fly ash and slag materials. This also ensures the continued progress towards sustainable concrete production practices by reducing clinker content in the concrete.

WHAT IS THE PROGRESS TO DATE?

The Research Team started to collect new samples from some suppliers; perform screening tests for pozzolanic reactivity on the new samples; conduct alkali silica reactivity(ASR) testing on all samples; conduct initial internal planning meeting to develop the rough layout of the test sections and their potential location; and exchange information with Caltrans METS on incorporating additional testing requirements for SCMs. Work on the above activities is expected to continue to the next quarter.