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CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

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# Research Notes

# Further Development and Piloting of Supplementary Cementitious Materials in Concrete

Evaluating local sources for supplementary cementitious materials in concrete.

**Pavement**

**NOVEMBER 2024**

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

**Task Number:** 4258

**Start Date:** November 14, 2023

**Completion Date:** September 30, 2026

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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 elsewhere.

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- 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 task is thirty five percent complete. Activities conducted are as follows: (1) collecting additional new samples from select suppliers; (2) performing screening testing for pozzolanic reactivity on the new samples and continuing ASR testing on all samples including batching and concrete testing on more than 10 pozzolans and over 5 wood ashes; and (3) holding an initial internal planning meeting to develop the rough layouts of the test sections. Additional locations at UC Davis were considered, and testing requirements for SCMs were incorporated.

The following are expected next quarter: (1) securing samples from new suppliers; (2) continuing reactivity and ASR tests and initiating concrete testing; (3) developing cost estimates for the test tracks and organize funding for materials; and (4) collaborating with METS on testing requirements and thresholds for natural pozzolans and other SCMs.