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Research Results

Alternative Supplementary Cementitious Materials

Exploring alternative supplementary cementitious materials (ASCMs) to address shortages, reduce emissions, and support California's infrastructure needs.

Pavement

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Project Title:
Partnered Pavement Research Center (PPRC) 17: Sustainability

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WHAT WAS THE NEED?

Cement production is a significant contributor to environmental challenges due to its greenhouse gas emissions. Traditional supplementary cementitious materials (SCMs), such as fly ash and slag, are becoming increasingly scarce due to changes in industrial operations like the transition away from coal-fired power plants and blast furnace steel production. California, as a leading consumer of cement, faces the dual challenge of maintaining its infrastructure needs while adhering to environmental mandates such as decarbonization goals. Identifying alternative SCMs is critical to addressing these challenges, reducing emissions, and ensuring the availability of sustainable materials for construction.

WHAT WAS OUR GOAL?

The goal was to identify and evaluate alternative supplementary cementitious materials (ASCMs) that can reduce Portland cement use, lower greenhouse gas emissions, and recycle waste materials. These materials should meet California's infrastructure standards while addressing SCM shortages.

WHAT DID WE DO?

The research involved a comprehensive review of potential ASCMs, including natural pozzolans (volcanic and sedimentary materials), biomass ashes, and recycled construction and demolition waste materials. The evaluation considered chemical, physical, and mechanical properties

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to assess their suitability for use in concrete. Environmental and economic impacts, such as production emissions and cost feasibility, were also analyzed. Collaboration with universities and industry stakeholders helped gather data on supply availability, processing methods, and technology readiness levels. The study systematically classified these materials based on their potential for implementation in the construction industry, identifying key strengths and limitations of each alternative.

WHAT WAS THE OUTCOME?

The study identified several promising ASCMs, including biomass ashes and natural pozzolans, which show potential to supplement or replace traditional SCMs. However, most of these materials are at an early stage of readiness, requiring additional processing and research to meet performance and regulatory standards. The research highlighted practical challenges such as the variability in material properties, the need for a reliable supply chain, and regional limitations in material availability. The study also provided recommendations for further research and development to advance the industrial adoption of these alternatives.

WHAT IS THE BENEFIT?

The research offers multiple benefits. It supports environmental sustainability by reducing reliance on traditional high-emission materials in cement production. Additionally, it promotes the recycling of industrial and agricultural waste, reducing landfill use and contributing to a sustainable economy. The identified SCMs also have the potential to improve the durability and performance of concrete, thereby extending the lifespan of infrastructure projects. By aligning with California's decarbonization goals, this research ensures that the state remains a leader in sustainable construction practices.

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Research Final Report:

https://escholarship.org/uc/item/14r6b3x8