

Evaluation of Alternative Sources of Supplementary Cementitious Materials (SCMs) for Engineered Cementitious Composites in Transportation Infrastructure

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22CLSU17

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Lead Institution:

Louisiana State University

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Tran-SET

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\$ 58,868

Evaluating alternative SCMs for ECCs in transportation infrastructure

Due to their superior ductility and mechanical strength, Engineered Cementitious Composites (ECCs) have been proposed as a promising material alternative to extend the durability and infrastructure service life. Compared with normal concrete, ECC uses more cement due to the absence of coarse aggregate in the mixture design. High cement content usually introduces higher hydration heat, autogenous shrinkage, and increased cost. Moreover, the associated increase in primary energy and emission of carbon dioxide may cause negative environmental impacts. A plausible solution would be to replace a large portion of cement in ECC with SCMs (e.g., fly ash), without sacrificing its mechanical properties, in general, and tensile ductility, in particular. As such, fly ash has become a key ingredient in the production of ECC materials. In the U.S., fly ash is the most utilized SCM in the cement and concrete industry and has become an integral part of concrete mixtures. However, the decline in coal-fired power generation is affecting its wide availability. Consequently, there is an urgent need to find alternative sources of SCMs that are high-quality, cost-effective, and readily available, which can provide a portfolio of alternatives to conventional fly ash. As a response to the expected shortage of fly ash, the objective of this project is to evaluate the much-needed alternative sources of SCMs, including unconventional sources of fly ash, to provide high-quality and cost-effective SCM alternatives for the future of ECC production in Region 6. The unconventional fly ash sources to be investigated in this study are ground bottom ash, reclaimed fly ash, ground glass, and cement kiln dust (CKD).

sacrificing its mechanical properties, in general, and tensile ductility, in particular. As such, fly ash has become a key ingredient in the production of ECC materials. In the U.S., fly ash is by far the most utilized SCM in the cement and concrete industry and has become an integral part of concrete mixtures. However, the decline in coal-fired power generation will jeopardize its wide availability. Consequently, there is an urgent need to find alternative sources of SCMs that are high-quality, cost-effective, and readily available, which can provide a portfolio of alternatives to conventional fly ash. As a response to the expected shortage of fly ash, the objective of this project is to evaluate the much-needed alternative sources of SCMs, including unconventional sources of fly ash, to provide high-quality and cost-effective SCM alternatives for the future of ECC production in Region 6. The unconventional sources of fly ash to be investigated in this study are ground bottom ash, reclaimed fly ash, ground glass, and cement kiln dust (CKD).

Objectives

The objective of this project is to evaluate the much-needed alternative sources of SCMs for the manufacture of ECC for transportation infrastructure in Region 6, including unconventional sources of SCMs (i.e., ground bottom ash, reclaimed fly ash, ground glass, and cement kiln dust (CKD)) to provide with high quality and cost-effective SCM alternatives for the future of ECC production.

Problem Statement

Compared with normal concrete, ECC uses more cement due to the absence of coarse aggregate in the mixture design. High cement content usually introduces higher hydration heat, autogenous shrinkage, and increased cost. Moreover, the associated increase in primary energy and emission of carbon dioxide may create negative environmental impacts. A plausible solution would be to replace a large portion of cement in ECC with SCMs, for example, fly ash, without



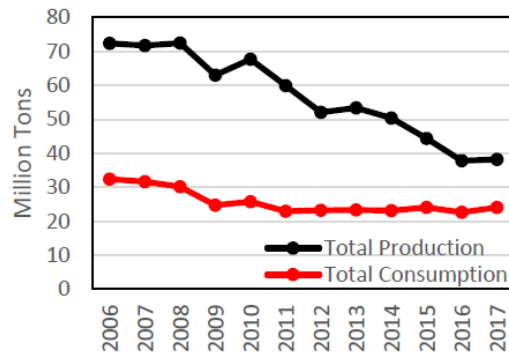


Figure 1. Total Fly Ash Production and Consumption

Intended Implementation of Research

Workforce Development, Education, and Outreach: This research project will provide funding to a graduate student at Louisiana State University (LSU). This will help recruit and train future leaders in the Transportation Sector specializing in materials for the transportation infrastructure. The research team will also prepare educational materials on alternative SCMs to be incorporated in ECC at LSU and share it with other universities in the consortium. The educational materials will also be summarized and disseminated to government entities and the industry. The results of this work will also be disseminated at national conferences such as TRB and ASCE. This project will offer internships for undergraduate students to introduce them to research in materials for the transportation infrastructure. Moreover, the developed educational materials prepared in this project will be shared with our partner community colleges to be used to recruit students to the transportation field.

Anticipated Impacts/Benefits of Implementation

The outcome of this research project will be several successful ECC mix designs with different alternative SCMs that will be readily available for implementation in the transportation infrastructure as well as for further evaluation in future research projects. The outcomes of this study will help extend the life of the existing transportation infrastructure and promote sustainability and resiliency of the transportation infrastructure renewal and upgrade.



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.