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

Determining the parameters for encapsulated bacteria in concrete to grow in a simulated environment

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LTRC

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NEAR Concrete

Randolph County

Total Project Cost:

$433,527

Concrete materials are in virtually all types of transportation infrastructure including roads, bridges, and airports. As such, concrete is essential to transportation infrastructure. Supplementary cementitious materials (SCMs) are a key ingredient of modern concrete. SCMs improves the durability (e.g., decreases permeability and helps mitigate delrimental reactions) and mechanical properties of concrete and drastically reduces its carbon footprint by lessening the use of clinker. In recent years, the decline in coal-fired power generation in the US jeopardizes the wide availability of fly ash for concrete production. Since fly ash is the most utilized SCM in the US, there is a dire need to find alternative sources of SCMs. As a response to the expected shortage of fly ash, the objective of this research project is to evaluate the much-needed alternative sources of SCMs including unconventional sources (i.e., landfilled and impounded fly ash), natural pozzolans, and calcined clays to provide high-quality, economical, and available SCM alternatives for future concrete production in Region 6.

Problem Statement

Supplementary cementitious materials (SCMs) are extensively used in concrete to partly replace clinker in cement (i.e., blended cements) or to partially replace cement in concrete (at the ready-mixed concrete plant). Since the clinkering process is energy intensive, using of SCMs considerably reduces CO_2 emissions associated with concrete production by reducing the amount of clinker utilized. SCMs can exhibit hydraulic (i.e., cementitious) and pozzolanic characteristics based on their composition. SCMs with hydraulic properties (e.g., ground granulated blast furnace slag and class C fly ash) can set and harden with water via hydration reactions; yet its hydraulic activity is rather low compared to Portland cement. Conversely, pozzolanic SCMs (e.g., natural pozzolans, silica fume and class F fly ash) are siliceous or siliceous and aluminous materials when admixed with water exhibit negligible cementitious activity; yet, in the presence of water and calcium hydroxide form compounds with cementitious properties.

Objectives

The goal of this study is to evaluate the urgently-needed alternative sources of supplementary cementitious materials (SCMs) for the manufacture of concrete for transportation infrastructure in Region 6 which can include unconventional sources of fly ash (i.e., landfilled and impounded fly ash), natural pozzolans, and calcined clays to provide with high-quality, cost-effective, and readily-available SCM alternatives for the future of concrete production in Region 6.

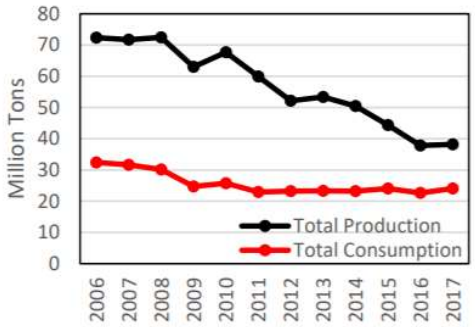

Figure 1: Total Fly Ash Production and Consumption

Intended Implementation of Research

Education and Workforce Development: This research project will provide funding to graduate students at Louisiana State University (LSU), Arkansas State University (ASU), and Texas A&M University (TAMU). This will aid in recruiting and training future leaders in the Transportation Sector specializing in materials for transportation infrastructure. The research team will also prepare educational material on alternative SCMs to be incorporated in courses at LSU, ASU, and TAMU, and share it with other universities. The

educational material will also be summarized and disseminated to government entities and the industry. Results of this work will be also disseminated through national conferences such as TRB and ASCE.

Outreach: This project will extend internships for undergraduate students to introduce them to research in materials for transportation infrastructure. Furthermore, the developed educational material prepared will be shared with partnering community colleges student recruitment for Transportation. Additionally, educational information explaining findings of the project will be offered to research institutes and companies interested in emerging innovative technologies for the Transportation Sector in collaboration with the highway agencies in Region 6.

Anticipated Impacts/Benefits of Implementation

The goal of this research project will be several characterized SCM materials that will be readily available for use in local infrastructure as well as for future research projects. The outcomes of this study will help prolong the life of the existing transportation infrastructure and promote sustainability and resiliency of the transportation infrastructure renewal and upgrade.

The main deliverables from this study are: (1) a final report to include the description of the problem, approach, methodology, findings, conclusions, and recommendations (2) analyzed data that will be presented at national conferences (TRB and ASCE).

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

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.