Transportation Consortium of South Central States

Use of Rice Husk Ash (RHA) in Flowable Fill Concrete Mix Material

Key Points

Project Number:
18CASU03

Start Date:
03/15/2018

End Date:
09/15/2019

Principal Investigator(s):
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Lead Institution:
Arkansas State University

Funds Requested to UTC:
$39,500

Funding Source(s):
Tran-SET
Arkansas State University
NEAR Ready Mix Concrete

Total Project Cost:
$79,010

Brief Project Description

The main goal of the proposed study is to assess the feasibility of the use local RHA in producing flowable fill concrete (FFC). Flowable fill concrete is defined by the American Concrete Institute (ACI) as a self-compacting cementitious material that is in a flowable state at placement and has a compressive strength of 8.3 MPa (1,200 psi) or less at 28 days.

Problem Statement

Rice hull (RH) is one of the main agricultural residues obtained from the outer covering of rice grains during the milling process. RH constitutes 20% of about 700 million tons of paddy produced in the world. When burnt, 20% of RH is transformed into rice husk ash (RHA). RHA is a cementitious material, and locally produced RHA in Arkansas contains about 75% silica in an amorphous form and has an extremely high surface area. RHA is also economically beneficial in producing concrete, but its performance as a construction material has been investigated very little. Based on the preliminary data of the research team of this project, locally produced RHA is not capable of producing “regular” concrete of compressive strength of greater than 20 MPa (3000 psi). Rather, low strength concrete such as Flowable Fill Concrete (FFC) can be produced using the “as is” RHA. FFC is typically used as structural fill or back fill in sewer and utility trenches, bridge abutments, pile excavation, road cuts etc. However, the usage, test protocols and procedures of FFC are different from “regular” concrete. Thus, the research team will evaluate the performance of the RHA-modified FFC. Arkansas Department of Transportation (ARDOT) has ranked this problem statement in its Top 10 Problems for possible solution in 2018-2019.

Objectives

The objective of this project is to assess the use of rice husk ash modified concrete as an alternative of compacted granular fill. The specific objectives of this study are to: (i) prepare FFC and determine their workability and flow behavior, (ii) evaluate the effect of curing time and environmental conditions on strength properties and durability of RHA-modified FFC, and (iii) evaluate the optimum dosages of RHA as pozzolan in preparing FFC.

Intended Implementation of Research

Education

The educational goals of this project will be achieved through training of graduate, undergraduate and high school students in STEM research. The research activities will be presented to undergraduate students and their volunteer participation will be encouraged. The outcomes of this research study will also be presented at the A-State Chapter of the ASCE meetings. A-State faculty members and students will be encouraged to conduct Senior Design project related to this topic. A field trip to NEAR Concrete production plant will be organized for students (maximum size 20) enrolled in CE Materials class so that they can get some hands-on training on stockpiling and processing of aggregates and admixture, and mixing, testing and producing concrete in a batch plant. NEAR Concrete has committed to provide necessary support to conduct these trainings.

The PI will also blend this research into undergraduate and graduate curricula. Students enrolled in Civil Engineering Materials and Advanced Civil Engineering will be introduced with the use of RHA as a construction material.

Workforce Development

Manuscripts will be prepared for possible publication in Transportation Research Board (TRB) and/or other pertinent peer reviewed journals. The findings of the project will also be presented in ARDOT Technical Research Council (TRC) annual conference in Little Rock and in national/international conferences having significance to this topic. Periodic meetings and discussions will be held with the Trans-SET personnel and interested parties to discuss the direction and outcomes of the study. Findings will also be presented at Tran-SET organized/sponsored conferences and meetings.

Anticipated Impacts/Benefits of Implementation

The outcome of the proposed study is expected to be important in setting the direction of the sustainable use RHA in producing flowable fill concrete and be significant cost saving for construction and utility companies. This project will also help local farmers to be economically sustainable as they are striving to find new markets for RHA. Students will be trained in STEM research, and they are expected to be future transportation workforce.

Weblinks:

- Tran-SET's website (http://transet.lsu.edu/research-in-progress/)
- TRB's Research in Progress (RIP) database (https://rip.trb.org/View/1505430)