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Project Summary

Technology Transfer Outreach Publication

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Sponsor
National Cooperative Highway Research Program (NCHRP)

Project Number
NCHRP 18-13

Project Title
Specifications and Protocols for Acceptance Tests of Fly Ash

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A New Approach to Specifying Fly Ash for Use in Paving Concrete

The use of fly ash as a supplementary cementitious material in portland cement concrete (PCC) may increase desirable characteristics of the concrete including increased strength, mitigation of alkali silica reactions, and offer cost savings. The use of fly ash, a secondary market material created through the generation of electricity from coal, offers a more sustainable alternative by potentially reducing the amount of portland cement consumed and processed, thereby reducing CO_2 emissions.

Working Towards Greater Acceptance

Before fly ash utilization can be increased, creating a more sustainable solution for transportation infrastructure, new materials specifications based on the chemical and physical properties of fly ash need to be developed. These attributes influence the constructability, performance, and durability of the pavement and may also contribute to problems such as cracking and alkali-silica reactivity in concrete pavements, bridge decks, and other highway structures.

Research Objectives

The objective of this project is to recommend potential improvements to specifications and test protocols to determine the acceptability of fly ash for use in highway concrete.

Methodology

- Provide a thorough study of the existing specifications and classification schemes for fly ash and recommend changes that provide highway agencies with better criteria for selection of fly ash for a given level of performance
- Investigate new test methods for characterizing the reactivity of fly ash
- Evaluate and apply existing and new test methods for characterizing the properties of residual carbon in fly ash and develop strategies that can be used on a day-to-day basis to ensure that air-entraining admixture dosage can be predicted for any given fly ash
- Conduct a thorough evaluation of how fly ash can be used to mitigate alkali-silica reaction in concrete and to provide highway agencies with specific guidance on how to select fly ash type and dosage to reach a specified level of field performance.

MiSTI U.S. DOT University Transportation Center for Materials in Sustainable Transportation Infrastructure

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University Facts

Total Enrollment	6,550
Graduate Enrollment	916
Number of Faculty	417
Placement Rate	95%

Michigan Tech is located in Houghton, MI on the south shore of Lake Superior. This rural area is known for natural beauty, pleasant summers, abundant snowfall, and numerous all-season outdoor activities. In addition, the University maintains its own downhill and cross-country ski facilities and golf course. There are numerous cultural activities and opportunities on campus and in the community. Michigan Tech has also been rated as one of the safest college campuses in the United States, and the local community provides excellent resources conducive to an outstanding quality of life.

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Anticipated Research Findings

The anticipated research findings will include the following deliverables:

- Development of new specifications and test methods for fly ash used in concrete pavements
- Broader understanding of fly ash characteristics leading to greater acceptance and use

Anticipated Implementation

Implementation of this plan will be accomplished through development of new fly ash specifications that will be presented to the American Association of State Highway and Transportation Officials (AASHTO) for adoption. Michigan Tech and its research partners will work closely with this agency, through the National Cooperative Highway Research Board (NCHRP), to bring these new specifications into the construction process. The tests developed for this research will be summarized in concise guidelines that can be immediately put into practice by Department of Transportation organizations choosing to initiate their own specifications or testing protocols.

Benefits

The development of new specifications and tests will lead to a reduction of materials related problems when fly ash is used in concrete construction for transportation infrastructure. Additionally, sound, rational tests based on documented research will lead to increased fly ash utilization providing a net environmental benefit by reducing the material placed in land fills and reducing the demand for portland cement. The latter can significantly impact the production of green house gases and reduce production of other industrial by-products such as cement kiln dust.

With proper mixture design for concrete using fly ash, durability of concrete structures will increase. The research proposed in this work plan will improve mixture design procedures with regard to levels of cement replacement possible for fly ash without strength loss, air entrainment, and ASR mitigation strategies involving fly ash.

Development of new tests for characteristics of fly ash may make available new material sources that were rejected under older, less rigorous testing regimes. The increase in material availability could result in a decrease in materials cost for construction.

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