No. 0003-07-01 July 2008

Project Summary

Technology Transfer Outreach Publication

Using High-Carbon Fly Ash as a Supplementary Cementitous Material in Concrete

Researcher
Dr. David Hand
Professor
Department of Civil and Environmental Engineering

dwhand@mtu.edu
906.487.2777

Sponsor
Michigan Tech University Transportation Center

Project Title
Mitigating the Adsorptive Effects of Carbon in Fly Ash

Project Manager
Elizabeth Hoy
UTC Coordinator

Co-Investigators
Michigan Tech University
Melanie Kueber, P.E.
Ph.D. Candidate

Amanda Hartmann
Civil Engineering Undergraduate Student

Coal fly ash has been be beneficially used as a supplementary cementitous material (SCM) in concrete for decades. However, not all fly ash produced can be used in making concrete. Coal fly ash that has an excessive carbon content will adsorb air entraining admixtures (AEAs) from the fresh concrete mixture, resulting in an inadequate air-void system in the concrete. This results in concrete that is less resistant to cyclic freeze-thaw damage and exhibits a lower workability and reduced durability. Furthermore, power plants that produce coal fly ash have begun adding powdered activated carbon to the flue gas stream of the coal combustion process as a way of removing mercury from emissions. This means that in the future, a larger fraction of the coal fly ash produced will be of the high-carbon variety. A method of eliminating the adsorptive effects of carbon is required if fly ash use is to remain constant or increase. This project will investigate methods to mitigate the detrimental effects of high-carbon fly ash in concrete and ultimately allow use of more fly ash sources in concrete manufacturing.

Research Objective

Determine a method to render high carbon fly ash usable as a supplementary cementitious material.

Approach

To accomplish the research objective, various organic and inorganic substances will be used to pre-treat the fly ash prior to addition to the concrete mixture. The hypothesis is that a material can be identified that will preferentially adsorb on the carbon fraction of the fly ash, thereby negating the adsorptive capacity of the ash and eliminating the negative effects on the concrete caused by the adsorption of AEA. The various substances evaluated will be rated based upon their effectiveness, stability, environmental safety, cost, and availability.

Michigan Tech

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

Project Summary

Technology Transfer Outreach Publication

Anticipated Research Findings

The anticipated research findings include:

- Development of a method of assessing properties of carbon in fly ash.
- Determine which method is the best based on efficiency, cost, and sustainability.

Anticipated Implementation

The technology developed will be implemented at the concrete batch plant where ready mixed concrete is produced, or as a pre-treatment of ash by the vendor, prior to delivery to a batch plant.

Benefits

Success in this research will allow more fly ash sources to be used as a supplementary cementitious material in concrete. This will contribute to the sustainability of the concrete industry in two ways. First, using fly ash as a SCM will reduce the need for the manufacture of traditional cement resulting in the reduction of CO_2 produced and lower energy use. Second, the additional fly ash that can be beneficially used will provide relief from the solid waste burden that unusable fly ash poses.

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.

www.mtu.edu

MiSTI

www.misti.mtu.edu

This publication was produced by the U.S. Department of Transportation University Transportation Center for Materials in Sustainable Transportation Infrastructure (MiSTI) at Michigan Technological University under the program management of the Office of Research and Technology Administration-U.S. Department of Transportation. The contents of this summary reflect the views of the authors, who are responsible for facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation University Transportation Centers program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof. For more information or additional copies, visit the Center's Web site at www.misti.mtu.edu, call 906.487.3154, or write to MiSTI, 301 Dillman Hall, Michigan Technological University, Houghton, MI 49931