PROJECT SUMMARY

Texas Department of Transportation

0-6648: Characterizing Class C Fly Ashes for Alkali Silica Reaction Mitigation Effectiveness

Background

Fly ash is a byproduct material produced from coal-combustion power plants and is one of the most commonly used supplementary cementing materials (SCMs) in the world. Prudent use of fly ash as a replacement for portland cement can have several major technical benefits, including reduced heat of hydration, reduced permeability, and improved resistance to alkali-silica reaction (ASR), sulfate attack, and delayed ettringite formation (DEF). Fly ash also enhances the sustainability of concrete as a building material because for every ton of portland cement replaced by fly ash, CO_2 emissions are reduced by approximately 0.9 tons.

Although fly ash can and typically does impart all of the above benefits to concrete, there are several technical and practical issues that still must be addressed. First, all fly ashes are not created equally. The chemical/mineralogical/physical properties can vary significantly from one source to another, based on differences in fuel sources (coal), combustion conditions, and cooling regimes. Furthermore, the fly ash industry is quite dynamic and is rapidly changing due to recently imposed environmental regulations. As such, fly ash produced from a given power plant may be considerably different than fly ash produced from the same plant just a few years ago. Therefore, it is becoming increasingly important to be able to characterize fly ash in a way that best predicts how it will perform in concrete, and this was the primary focus of this project.

What the Researchers Did

The researchers evaluated over 20 fly ashes from throughout Texas and characterized these ashes using a variety of analytical techniques. The key

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characteristics of the fly ashes were then correlated to a comprehensive database of short- and long-term laboratory and field performance data on these fly ashes, based on previous work performed at the University of Texas. In addition, studies focusing on heat of hydration, sulfate immersion, and alkali-silica reaction were initiated during the course of this project, providing additional data by which to link to the numerous fly ashes included in the study.

What They Found

After performing a comprehensive evaluation of over 20 fly ashes from throughout Texas, the researchers were able to identify the key parameters that most affect the performance of mortar and concrete containing the fly ashes. Primary focus was placed on the effects of fly ash chemistry and mineralogy on external sulfate attack and alkali-silica reaction. Through these efforts the researchers were able to identify test methods that best predict the durability of a given fly ash when used in concrete.

What This Means

By better understanding the characteristics of fly ash, the research team has developed tools and techniques that can be used to estimate or predict concrete performance containing a given fly ash, reducing the need for expensive, long-term testing. It is expected that the overall findings of this study will allow the Texas Department of Transportation to better assess fly ash sources and to ensure that fly ash is used efficiently to improve the durability of our state's transportation infrastructure.

For More Information

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