CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

5-6717-01: Implementation: Investigation of Alternative Supplementary Cementing Materials (SCMs)

Background

Supplementary cementitious materials (SCMs) provide many benefits to concrete mixtures in terms of cost, long-term strength, and durability. Class F fly ash is the most widely used SCM in Texas, but its availability is dwindling while demand is increasing. Given the importance of Class F fly ash as a means to improve concrete durability, it is necessary to find alternative materials that can maintain the high quality and durability of concrete in Texas.

TxDOT project 0-6717: Investigation of Alternative Supplementary Cementing Materials (SCMs), completed in August 2014, identified sources of Class F fly ash alternatives that can be used in Texas concrete and developed best practices for testing these materials. Lower cost sources of materials have been identified since the completion of that project and may present better opportunities for Class F fly ash replacement than those initially tested. These materials include natural mineral byproducts of other industries, reclaimed fly ashes, and remediated fly ashes. The natural mineral byproducts tested were a pumicite that was quarry overburden and fines from grinding minerals for a commercial product. Reclaimed fly ashes are those that are retrieved from disposal sites. Remediated (or beneficiated) fly ashes are those that require chemical or physical treatment to meet specifications for use in concrete

What the Researchers Did

The experimental protocols developed in project 0-6717 were performed on these new sources of materials to determine their suitability for use in Texas concrete. The materials were chemically and physically characterized, and their performance in cement paste, mortar, and concrete mixtures was tested. The focus of the testing was on characterizing the pozzolanic reactivity of the materials and determining the effects of the materials on key properties of cementitious mixtures, such as workability, setting time, compressive strength, permeability, and mitigation of alkali silica reaction and sulfate attack. Further, the potential of the SCMs to interfere with the use of chemical admixtures, specifically water reducing admixtures (WRAs) and air-entraining admixtures, was investigated.

What They Found

It was determined that all of the byproduct fines from grinding natural minerals were inert; hence, these materials are not recommended for use in concrete as SCMs. The properties of cementitious mixtures containing these minerals were comparable to those containing an inert ground quartz filler.

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The natural pumicite quarry overburden, on the other hand, performed well and could likely be procured at a relatively low cost. This overburden pumicite, however, did not perform well in sulfate resistance testing and merits further investigation. It is possible that the overburden pumicite would perform better if used at a higher replacement level of cement.

The reclaimed and remediated fly ashes performed very well in most tests, proving their ability to be used as substitutes for Class F fly ash. However, some of the fly ashes performed poorly in sulfate attack testing, which requires further investigation if the ashes are used in applications where this would be a concern. Some of the fly ashes increased water demand in cementitious mixtures, which could be remedied through the use of WRAs. One fly ash delayed setting time, which could be managed through the use of an accelerating admixture. Prior to using chemical admixtures, testing should be performed to determine the appropriate admixture type and dosage and to verify that no problems occur with mixture stiffening and strength gain.

What This Means

The testing protocols developed to evaluate SCMs for use as Class F fly ash replacements were able to distinguish between inert and reactive materials. The test methods were also able to identify problems with specific SCMs that would need attention before use in the field. Therefore, implementation of these test methods in this project was successful. Several sources of low cost SCMs were identified that can be used to replace Class F fly ash. In some cases, TxDOT specifications may need modification to accommodate the use of the alternative SCMs.

For More Information

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