Florida Department of Transportation
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BLENDING OF CLASS F FLY ASHES

PROBLEM STATEMENT

In recent years, many coal fired electric generating plants have made operational changes to conform to more stringent air emission requirements. These changes have had negative effects on the volume of low loss on ignition (LOI) (<6.0%) fly ashes available. Many of these changes have resulted in fly ash with an increase in LOI content, often exceeding 6.0%. In accordance with current Florida Department of Transportation (FDOT) specifications, an upper limit for carbon content has been set at an LOI of 6%.

OBJECTIVES

Due to shortage and limited supply of low LOI Class F fly ashes in Florida, this investigation was initiated to address the effects of blending high and low LOI class F fly ashes, and to study the impact that the blending of fly ashes has on fresh and hardened concrete properties.

Three Class F fly ashes were used in this investigation with AASHTO Type II cement. From the three as-received ashes, several blends were generated at different weight percentages to obtain variable LOI values for fly ash content. The as-received materials were subjected to a battery of tests, including chemical analyses, particle size distribution, particle morphology, and mineralogical analysis using x-ray diffraction. Concrete and mortar specimens were prepared in two separate regimes. In the first, which simulates ready mix concrete batching, the aggregates were not proportioned, and the air entraining admixture dosage was varied to maintain a constant air content. The slump was maintained at 4 inches. In the second regime, the air entraining admixture dosage was maintained constant and batches were prepared for a constant slump of 4 inches.

The concrete mix in both cases was a Class II FDOT mix. In the first regime 10 mixes including the control were prepared, while in the second regime 14 mixes were prepared. The effect of blending fly ashes on concrete durability was examined through length change measurements on concrete and mortar prisms and rapid chloride permeability tests.

FINDINGS AND CONCLUSIONS

The findings of this investigation indicated that blending fly ashes passing FDOT specifications with rejected ashes can possibly yield a blend of lower strength than that of the normally acceptable fly ash. In addition, producing a fly ash to meet specification requirements through the blending of different ashes from the same sources or different sources can have potential durability problems. Monitoring strength gain over a period of 735 days showed profiles that are dependent on particle fineness, LOI, and fly ash sources.

In general, monitoring expansion for a period of one year in the case of mortar or two years in the

case of concrete showed that concrete durability is a function of fly ash LOI. An increase in LOI indicated an accelerated concrete deterioration. Blended fly ash with an LOI content of 3.3% (well within the current FDOT specifications) had poor durability performance when compared to unblended fly ashes with an LOI content of less than 6% (0.1% and 4.8 %). The results also indicated that durability performance of the blended ash is dependent on the quality of the source ash.

The findings and conclusions may be summarized as follows:

1. Blending two fly ashes of different sources or the same source, with one passing the current FDOT specifications, generated blends that had a strength behavior controlled by the quality of the original ashes.
2. Blending two fly ashes from different sources or the same source, with only one passing the current FDOT specifications, generated blends whose durability (as assessed by mortar expansion) will be of unequal performance to that attained by current ashes that pass FDOT specifications.
3. Material parameters that were found to be affected by blending of ashes include particle size distribution, morphology, and LOI.

Although it is critical to study the original sources of the ashes to be able to determine if there is a blend, particle size distribution of the ashes up to 1000 microns was found to be a promising tool that needs to be further studied for its use as a possible indicated criteria for accepting/rejecting blended Class F ashes.

Based on the findings of this investigation, it is recommended that (1) since current FDOT specifications do not necessarily regulate blending of Class F fly ashes, a study should be initiated whereby the critical indicators established by this study can be verified on a larger number of blended fly ashes with LOI ranges up to 6%; and (2) based on the first recommendation, the current FDOT specifications could be amended.

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