DEVELOPMENT AND DEMONSTRATION OF HIGH-CARBON CCPs AND FGD BY-PRODUCTS IN PERMEABLE ROADWAY BASE CONSTRUCTION

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ABSTRACT

This investigation was conducted to develop and demonstrate permeable base course materials using coal combustion products (CCPs) for highways, roadways, and airfield pavements. Three types of CCPs—two high-carbon, high-sulfate flue-gas desulfurization (FGD) by-products and a variable-carbon fly ash—were evaluated for no-fines or low-fines concrete as a permeable base material. This report summarizes the work completed for this two-year project.

A total of 56 mixtures were proportioned and manufactured in the laboratory in this research. Mixture proportions for the base course materials were developed using a two-step experimental optimization process. The first step involved developing mixture proportions for permeable base course materials containing no CCPs. A total of 26 mixtures were produced in the first step. The optimum mixtures developed from the first step of the experimental process were used as candidate mixture proportions for the second step of the optimization process. The second step of the mixture optimization included various combinations of the three CCPs for developing mixtures for base course materials. Specimens from each mixture were made using roller-compacted concrete (RCC) technology in accordance with ASTM C 1435. Three different series of ten base course mixtures were developed and tested based on the structure of the base course: dense-graded, intermediate-graded, and open-graded. Each mixture was evaluated for both strength and durability properties. The strength properties that were evaluated consisted of compressive strength (ASTM C 39), flexural strength (ASTM C 78), and splitting tensile strength (ASTM C 496). Durability properties consisted of drying shrinkage (ASTM C 157), resistance to sulfate exposure (modified ASTM C 1012), and resistance to rapid freezing and thawing (modified ASTM C 666).

Based on the mixture proportions established in the laboratory, four prototype open-graded base course mixtures containing one source of CCP were manufactured at a commercial ready-mixed concrete plant.

A full-scale base course mixture was produced for a construction demonstration, which was held in conjunction with a technology transfer educational workshop conducted in Green Bay, Wisconsin, in September 2002. The base course mixture was open-graded to maximize drainage capability. The base course mixture was made by replacing approximately 50 % of the cement with one of the sources of CCP evaluated for this project. Adequate compressive and flexural strength were achieved from the mixture used for the demonstration.