LOW-COST, HIGH-PERFORMANCE MATERIALS USING ILLINOIS COAL COMBUSTION BY-PRODUCTS

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Reference: CBU-1997-12

ABSTRACT

This project was carried out to establish high-volume use technologies for manufacture of cement-based products using Illinois coal ashes. The entire project work was completed in two phases (Phase I, year 1; and Phase II, year 2). Phase I work was primarily directed toward optimizing mixture proportions and production technologies for concretes and masonry products containing Illinois coal ash through lab investigation during the year 1994-1995. In Phase I, a number of candidate mixtures for concretes, bricks, blocks, and paving stones were established based on strength and durability performance data. In Phase II (September 1, 1996 thru August 31, 1997), mixtures selected from Phase I were field tested and evaluated to establish optimum mixture proportions and production technologies for commercial applications.

A total of 15 concrete mixtures consisting of five non-air entrained, five non-air entrained with a high range water reducing admixture (HRWRA), and five air entrained concrete mixtures were manufactured at the facilities of United Ready Mix, Inc., Peoria, IL. Two of each type of concrete mixtures were control mixtures without fly ash and the remaining contained fly ash up to a maximum of 60% of total cementitious materials. Concrete mixtures were tested for strength and durability related properties such as compressive strength, splitting tensile strength, flexural strength, drying shrinkage, abrasion resistance, deicer-salt scaling resistance, freezing and thawing resistance, and chloride-ion penetration as a function of age. A total of 15 cast-concrete product mixtures consisting of five brick mixtures, six hollow-core block mixtures, and four paving stone mixtures were manufactured at the facilities of Best Block Co. in Racine, WI, near the Illinois state border. Brick and block mixtures contained up to a maximum of 56% fly ash while paving stone mixtures contained up to a maximum of 30% fly ash of total cementitious materials. The brick and block mixtures were tested and evaluated for compressive strength, absorption, density, and shrinkage as a function of age. Block mixtures were also tested for freezing and thawing durability. Paving stone mixtures were tested and evaluated for compressive strength, absorption, density, abrasion resistance, and freezing and thawing resistance. Based on strength and durability performance data, as well as economic considerations, optimum mixtures for concrete and masonry products were established for commercial production in Illinois.