



Texas Aggregates and Concrete Association

Position Statement #2

Supplementary Cementitious Materials

Pozzolanic Replacement is the Key to High Performance Concrete

High quality concrete is the goal for every producer to supply to every customer. The goal for every customer is to receive high quality concrete from the supplier. With rising costs for raw materials, and increased costs for installation and repair, using the most durable, cost-effective concrete possible is essential in any project. One method for achieving this goal is by incorporating a pozzolanic replacement material, such as fly ash, into concrete.

Fly ash is a pozzolanic replacement material that is a finely divided residue that results from the combustion of coal. The composition is predominantly non-crystalline (glassy) with minor amounts of crystalline constituents. It is spherical in nature and approximately the same size as a cement particle. Fly ash is typically categorized into two distinct classes: Class F and Class C.

The chemical composition of fly ash is such that it chemically reacts with a by-product of the cement hydration process, calcium hydroxide. These chemical reactions have a two-fold effect on the fresh and hardened concrete. In fresh concrete, the initial reactions help to control the heat of hydration. In most cases, concrete hydration temperatures can be reduced in the presence of fly ash. This is invaluable during hot weather applications.

In hardened concrete the calcium hydroxide (CH) forms additional cementitious compounds in the presence of fly ash. If the fly ash were not present, the CH is a chemically soluble compound that will actually dissolve in the presence of water. The dissolution of CH increases the likelihood of water and chemical infiltration (permeability) into the concrete and substrate. With the use of fly ash, the porosity, which directly affects permeability, is significantly decreased. By decreasing the permeability the durability of the concrete is increased. The fly ash also reacts with the CH to form additional cementitious compounds that result in higher ultimate strengths for the concrete that would not have been obtained with a straight cement mix design.

The fly ash particles work as “micro ball bearings” in the paste increasing the workability. With an increase in workability, placement and pumping operations become drastically easier.

There is no product that does not have potential drawbacks when used incorrectly. An excessive weight replacement, without substantiating and supporting data, can lead to an assortment of problems. There are several well-documented cases in the early to late 80's where the product was abused in this manner. Delays in setting time and strength gain can all result from these abuses and misuses. Using fly ash in concrete demands high quality control standards and an adequate amount of performance data to support it use.

One of the most important elements to remember when using fly ash is that it is not a substitute for quality concrete. Fly ash does not make bad quality concrete good, it makes good quality concrete better. As a pozzolanic replacement, fly ash is typically used as a weight replacement for cement. A 20% weight replacement of fly ash for a 100 lbs. of total cementitious material results in 80 lbs. of cement and 20 lbs. of fly ash. There is no scientific or engineering justification for substitutions greater than 1:1. There are instances where a 1:1.25 substitutions are required, but there are antiquated requirements based on incorrect assumptions and conjecture.

Normal operating ranges for fly ash replacement are between 20% to 35% to achieve the full advantages of the fly ash improvements to the concrete. It is not uncommon to see replacements greater than 35% for high strength concrete. In using fly ash as a pozzolanic replacement for cement, the concrete industry takes full advantage of the technological improvements that fly ash offers to concrete consumers to ultimately design, produce, and construct a better, more durable, and cost effective concrete.

This position statement from the Texas Aggregate and Concrete Association is presented for reader interest by the editors. The opinions expressed are not necessarily those of the “magazine”. Reader comment is invited.

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