Use of High Volume Fly Ash Mixes in Preventing Corrosion in Concrete

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Abstract

Nationally, use of coal combustion products (CCPs) has increased more than 50 percent in the past decade. In 2000, more than 32 million tons of coal combustion products were recycled for beneficial uses. This is more than seven times the volume of aluminum that is recycled. But even though consumption has increased rapidly, only a third of all CCPs generated in the United States are currently being used in beneficial applications. This leaves more than 76 million tons of CCPs to be disposed of annually.

The United States has recognized that its infrastructure of concrete bridges and highways is facing structural distress due to increased traffic volumes, increased axle loads, and damage due to corrosion. In a landmark study conducted by Battelle Memorial Institute for the National Bureau of Standards, it is estimated that corrosion damage in the United States is 4.2 percent of the Gross National Product (GNP). Projecting this percentage out to recent GNP information, this amounts to about $350 billion of corrosion damage annually. Battelle estimates that over $139 billion (40%) of these costs could be avoided through application with existing technologies and best-known practices.

Corrosion of concrete takes place when carbon dioxide (CO_2) and chlorides penetrate concrete. As the chlorides and CO_2 penetrate concrete, the pH level of the concrete begins to drop from 12-13 to about a value of 9. In concrete construction, the 1.5 to 2 inches of concrete cover over the rebar acts as protective layer from the chlorides/CO_2 reaching the rebar. Once the threshold is reached, the concrete cover is compromised and the pH of the concrete surrounding the rebar allows for corrosion. This weakens the concrete and reduces its service life. This subsequently increases costly maintenance on repair and restoration projects for the damaged concrete structure.

There are several practical methods used to counteract problems caused by corrosion, including 1) Adequate concrete cover 2) Concrete quality (low permeability, no cracks) 3) Epoxy coated rebar 4) Stainless steel reinforcement 5) Cathodic protection
6) Protective coatings and 7) Corrosion inhibitors. Recent research has indicated the benefit of using fly ash in preventing corrosion damage in concrete. Reduced permeability, lower water/cement ratio, decreased drying shrinkage/cracking and increased durability are all benefits of fly ash concrete.

This paper reviews the benefits of high volume fly ash mixes in resisting corrosion damage in concrete. It considers the usefulness of current fly ash concrete technology and prevention techniques, and advances a new approach for making concrete resist the deleterious effects of corrosion.