ARMCON

Fly Ash – What is it?

– An Overview

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Overview

Fly ash is a by product of power stations – it is the ash produced by burning tons of coal.

It is used as a replacement to cement in the concrete. The principal ingredients of concrete are gravel, sand, water, and cement.

Although the cement only comprises 10-15% of concrete by weight, its production is responsible for most of concrete's environmental impacts. The cement, composed of lime and silica (sourced from limestone, clay, and sand), is fired in a rotary kiln at 2700°F, consuming enormous quantities of fossil fuels and thereby producing high amounts of CO_2. In addition, the chemical reaction that creates Portland cement produces CO_2 as a by-product. By displacing a large percentage of the cement in concrete, fly ash significantly reduces the associated environmental impacts of CO_2 production and air pollution.

Having said this, concerns have been raised regarding the health and safety of using fly ash in concrete, because of the way it is produced (burning coal) some impurities can be found inside the coal such as heavy metals.

On the other side trapping the fly ash in concrete is one way of encasing any harmful products.

Below are some benefits of Fly ash in comparison to using some standard cements.

High Volume Fly Ash Concrete	**Conventional Concrete**
Less energy intensive manufacture	Energy intensive manufacture
Higher ultimate strength	Weaker ultimate strength
More durable	Less durable
Requires less water	Requires more water
Uses a waste by-product	Uses (in most cases) virgin materials only
Creates fewer global warming gases	Creates more global warming gases

When looking at fly ash through a microscope, you would notice that the grains that make up the fly ash are rounded. This helps your concrete move in a more flowable way, and acts almost like a plasticiser.

Some of the problems of fly ash can be a slower strength gain, so the strength takes a lot longer to come into effect

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Most fly ash is pozzolanic, which means it's a siliceous or siliceous-and-aluminous material that reacts with calcium hydroxide to form a type of cement. When Portland cement reacts with water, it produces a hydrated calcium silicate (CSH) and lime. The hydrated silicate develops strength and the lime fills the voids. Properly selected fly ash reacts with the lime to form CSH–the same cementing product as in Portland cement. This reaction of fly ash with lime in concrete improves strength. Typically, fly ash is added to structural concrete at 15-35 percent by weight of the cement, but up to 70 percent is added for mass concrete used in dams, roller-compacted concrete pavements, and parking areas. Special care must be taken in selecting fly ash to ensure improved properties in concrete.

The main problem with fly ash is that the quality of the material can vary greatly, meaning your concrete quality can be affected greatly.
Precasters should try to obtain fly ash with as high a silica content as possible. Silica reacts with lime from cement to produce strength and reduce permeability (class F fly ash should have 50 percent silica content; class C should have 35 percent silica content).

Ask that the water requirement be less than the control, that the color, density and fineness have a minimum variation (<5 percent) and that the strength activity index at 3, 7 and 28 days be 90 percent of the control. If protection from the alkali aggregate reaction is needed, then the fly ash should be tested in ASTM C 441 with 25 percent of the cement replaced with the fly ash. Some class C fly ash will not protect against the alkali-aggregate reaction.

Lastly, it is important for the precast concrete producer to test the mix design continually, because fly ash is a group of materials that comes from burning coal.

As with any concrete material, cube tests are advisable.