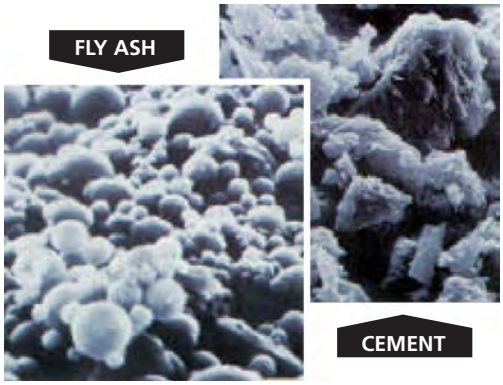
Paneltech

TECHBULLETIN

DEC 2009

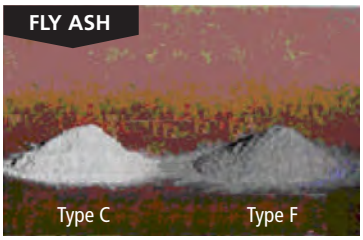
Fly ash in concrete

Concrete forms have been exposed to increasing levels of alkalis in the past few years. This results from higher and higher levels of fly ash now being added to the concrete mix. The reasons for this trend seem compelling and irreversible. To reach this conclusion however, we must first understand the many forces driving the use of fly ash.



Motivation

The use of Portland cement produces a number of environmentally negative consequences. Fly ash can replace as much as 35% of the cement in the concrete mix. Fly ash substitution can reduce energy requirements and CO2 emissions involved in cement manufacturing, as well as making a stronger, more water resistant concrete. The fly ash reacts with the free lime in the concrete mix to increase concrete strength, improve sulfate resistance, reduce permeability, reduce the water required in the mix, and improve workability and pumpability. In addition, fly ash costs less than Portland cement.



What is fly ash?

Fly ash is a fine ash by-product of the combustion of pulverized coal. There are two types of fly ash, Class C or Class F. Class C, from coal sources in the western US, is a lighter color with higher calcium and lower silica content. The added crystalline calcium gives the Class C fly ash more cementitious properties, which allow greater rates of substitution relative to the Class F material. Class F fly ash, from coal sources on the Eastern Seaboard, has lower calcium levels, but may actually reduce alkalinity.

Fly ash is very fine and spherically-shaped. Cement particles, in contrast, are more angular. The rounded shape and small size of the fly ash particles help them act as a lubricant in the mix, helping the mix to flow more easily.

Fly ash can improve the durability of concrete structures considerably. Builders compensate for the naturally slower reaction time of high fly ash concretes by reducing the water content or adding accelerators. To make these flow at the low water levels, builders can add plasticizers, or, in one experimental mix, even higher levels of fly ash with a slightly higher water/cement ratio.

Fly ash is quite similar to the volcanic ash material used in early hydraulic cements in Italy over 2300 years ago. The longevity of many of the ancient Roman structures has been attributed to the use of these materials.

Reduced Form Life

The adverse effects of fly ash on wooden concrete form panels are the result of the slower setting time of the concrete in use. With the slower setting time, the panel surfaces are exposed to the alkaline fluid concrete for a longer time span—up to double. With the added alkalinity in the Class C fly ash, and the increased setting time of both Class C and Class F, the life of the panel can be reduced by 1/2 to 2/3.

In summary, it appears that the reasons to continue using fly ash in concrete mixes are compelling and the trend is likely to increase. Those of us in the business of supplying wood panel forming systems must be sure to consider the effects of fly ash in the design and application of the forming system materials.

Fly ash advantages

- Higher compressive strength
- More durable concrete
- Less permeable concrete
- Less shrinkage, less creep
- Lower heat of hydration
- Better pumpability
- Lower cost
- Lower energy requirements
- Uses otherwist wasted material
- Lower CO_2 emissions

Fly ash disadvantages

- Slower compressive strength gain
- May be more difficult to finish
- Resulting higher alkalinity is rough on concrete forms
- Can cause "skin layer" formation on slabs

2999 John Stevens Way | Hoquiam, WA 98550 | 360.538.1480 | paneltechintl.com