

Concrete Craftsmanship Series

Mineral Admixtures why and how....

Mineral Admixtures

During the last few decades, the use of mineral admixtures sometimes known as pozzolans have been on the rise. In our area the two most common mineral admixtures used in concrete are fly ash and silica fume.

Fly Ash is the result of coal burning power plants or industrial boilers. Due to clean air sanctions by the Environmental Protection Agency (EPA) methods for capturing these fine particles as opposed to letting these escapes were developed. Depending on the type of coal burned the result is either a Class C* or Class F* ash. Class C ash commonly used in concrete in Arkansas not only has pozzolanic properties as well. In fresh concrete an important quality of fly ash is its spherical shape. Because of these small spherical particles the workability or flowability of the concrete is improved this can mean a reduction in water content which would also reduce the amount of bleeding and drying shrinkage in fresh concrete. Also due to reduced heat of hydration fly ash concrete is very suitable for mass concrete structures.

In hardened concrete fly ash contributes in two ways. Through pozzolanic activity it helps strengthen the concrete although the initial strengths may be lower than straight cement mixes the ultimate strengths may be greater at a later age. A 1982 study reported 50% increase in strengths in 1 year in fly ash concrete versus 30% increase in concrete without fly ash. The other contribution fly ash makes is through densification, this means less water and gas permeability, therefore greater corrosion resistance.

- Pozzolan – A finely divided siliceous or siliceous and aluminous material that in presence of moisture chemically reacts with calcium hydroxide to form compounds possessing cementitious properties.
- Class F Fly Ash – A by product of anthracite or bituminous coals – less than 5% calcium oxide content has pozzolanic properties only.
- Class C Fly Ash – A by product of lignite or sub-bituminous coals – may have lime contents in excess of 10% has pozzolanic and cementitious properties.
- Silica Fume - Is a by product of the silicon metal and ferro-silicon alloy industries. Again, until the 1950's this material escaped from smoke stacks with the flu gasses. Although silica fume is classified as highly pozzolanic its availability is considerably less than fly ash hence more expensive.

Silica fume comes in 3 forms:

- Powder –Particles finer than those in cigarette smoke
- Condensed – A method to make larger particles of the powder
- Slurry – The powders are premixed with liquid chemical admixtures.

In fresh concrete, due to the fineness of silica fume two things must be taken into consideration during its use. These are reduced workability or flowability and the difficulty of entraining air. Both of these can be overcome by the use of superplasticizers (high range water reducers) and increasing the dosage rate of the air entrainment agent. Fog sheet or mat curing should be considered when placing silica fume concrete due to its vulnerability to plastic shrinkage cracking.

In hardened concrete silica fume can show greatly increased compressive strengths. This is largely due to an increase in density. The benefits can be smaller load bearing structure able to support like size loads and the reduction in the permeability of chlorides and corrosion of reinforcement.

**For additional information contact
your local Ready Mix Producer**

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