



# LAFARGE

### Company Profile

Lafarge in North America is part of the Lafarge Group. The world leader in building materials, active on five continents, the Lafarge Group holds top-ranking positions in cement, aggregates, concrete and gypsum.

By focusing on the development and improvement of building materials, Lafarge puts the customer at the core of its strategy and offers the construction industry and the general public innovative solutions that will bring more safety, comfort and beauty to our everyday lives.

Please contact your Lafarge Office for specific product information, availability and ordering.

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Calgary, Alberta  
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### Lafarge North America Cement Operating Areas



### Limited Warranty

Lafarge warrants that Lafarge fly ash meets applicable ASTM and CSA requirements. Lafarge makes no other warranty, whether of merchantability or fitness for a particular purpose with respect to these products. Having no control over their use, Lafarge will not guarantee finished work in which these products are used.



CEMENT

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## LAFARGE Fly Ash in Concrete Applications



# LAFARGE FLY ASH IN CONCRETE APPLICATIONS

## What is Fly Ash?

Fly ash is an extremely fine powder consisting of spherical particles less than 50 microns in size. Fly ash is one of the construction industry's most commonly used pozzolans. Pozzolans are siliceous or siliceous/alumino materials possessing the ability to form cementitious compounds when mixed with lime (calcium hydroxide or CaOH) and water.

The word "pozzolan" is named after the small Italian town of Pozzuoli where some of the first hydraulic cements were created over 2000 years ago. The ancient Romans used volcanic ash as a pozzolan in their structures, some of which still stand today.

In North America over 26 million tons of pozzolans are consumed each year in concrete, concrete products, and geotechnical applications.

## Where Does Fly Ash Come From?

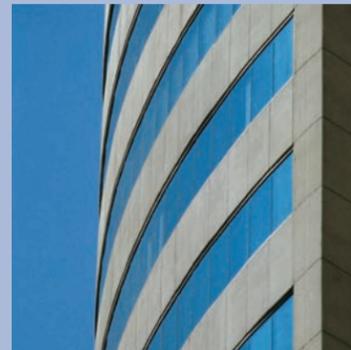
Fly ash is produced by coal-fired power plants during the combustion of coal. Fly ash consists mainly of inorganic glassy particles formed from the mineral matter in the coal. During combustion, these minerals are heated to a molten state and chemically combined and solidified while suspended in the exhaust gas. They are then collected by electrostatic precipitators or bag houses.

Fly ash is classified based on the chemical and physical composition of the ash.

According to ASTM, Class F fly ash is normally produced from burning anthracite or bituminous coal that meets the applicable requirements for this class. This class of fly ash has pozzolanic properties. Class C fly ash is normally produced from lignite or subbituminous coal that meets the applicable requirements. This class of fly ash, in addition to having pozzolanic properties, also has some cementitious properties.

According to CSA, Type F fly ash has a calcium oxide content of less than 8%, Type CI fly ash has a calcium oxide content from 8% to 20%, and Type CH fly ash has a calcium oxide content above 20%.

Reference ACI 211.1 to evaluate the performance of a given fly ash in concrete and to establish proper mix proportions for a specific application. Trial batch adjustments should also be considered.



## Consistent Performance

Fly ash performance in concrete is affected by such variables as coal composition, combustion conditions, and ash collection systems. Power plants operating under stable load conditions tend to produce more uniform fly ash than when operating under variable load. Lafarge North America's fly ash quality control and assurance program ensures construction industry standards are met.

## Fly Ash and the Environment

As a coal combustion product (CCP), use of fly ash in concrete offers advantages that go beyond performance. Using fly ash reduces the amount of by-product material electric utilities landfill and enables manufacturers to minimize mining and processing virgin materials, thereby reducing the emission of carbon dioxide.

Concrete containing fly ash can qualify for the LEED Material and Resources credit MR-4, Recycled Content.



## Fly Ash in Portland Cement Concrete

When portland cement is mixed with water, most of the cement forms insoluble cementitious compounds. Calcium hydroxide (CaOH) is formed as part of this reaction. When fly ash is introduced into concrete, it reacts with the CaOH to form additional cementitious compounds.

According to ACI 232.2R-9, "the shape, size, particle-size distribution, and density of fly ash particles influence the properties of freshly mixed, unhardened concrete, and the strength development and other properties of hardened concrete. This is due in part to the influence of particle characteristics on the water demand in the concrete mixture."

Factors that influence the effectiveness of fly ash include:

- chemical and physical composition
- alkali-hydroxide concentration
- morphology of fly ash particles
- fineness
- initial hydration process
- reduction in mixing water requirements

In a properly proportioned mix, fly ash can improve many of the properties of concrete, including:

- improved workability and consolidation
- increased flexural and compressive strengths
- improved pumpability
- reduced drying shrinkage
- reduced bleeding and segregation
- decreased permeability
- increased resistance to ASR and sulfate attack
- improved economics
- reduced water requirements

## Fly Ash – A Solid Idea Lafarge – A Solid Supplier!

"Meet customer needs." It's such a business basic, yet so necessary for success. This is why Lafarge is a reliable source of supply. We've developed a company-wide sourcing system that transports product from areas with surpluses to those in need. Lafarge has invested in over 225,000 tons of ash storage, hundreds of rail cars, and dozens of pneumatic truck trailers.

In addition to reliable product supply, our customers need reliable product performance. To meet this need, Lafarge has established a rigorous quality assurance program, rigid product standards, and an on-going research and development program that provides continuous research studies and product tests at Lafarge laboratories in the U.S., Canada and Europe.

