



Environmental, Health and Safety News

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We're Proud of Our Work



Something to Think About

There are no secrets to success. It is the result of preparation, hard work, and learning from failure.

-- Colin Powell

Silica Fume—High Strength Concrete Additive

From time to time our customers, or their designers, specify silica fume as an additive to ready mixed concrete. Almost without exception, questions arise about the safe practices of adding the product to our mixes. The concerns surface when bags of silica fume must be added by hand directly to our mixer trucks. Fortunately we do not do a lot of this, but for everyone's edification let's review what the product is and what the safe handling procedures should be so we are better prepared for the next time.

What is Silica Fume

(information from the Silica Fume Association)

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial uses for silica fume is in concrete. Because of its chemical and physical properties, it is a very reactive pozzolan (a pozzolan is basically anything added to the concrete mixture that modifies the Portland Cement). Concrete containing silica fume can have very high strength and can be very durable.

Silicon metal and alloys are produced in electric furnaces. The raw materials are quartz, coal, and woodchips. The smoke that results from the furnace operation is collected and sold as silica fume. Again, the most important use of this material is as a mineral admixture in concrete. If not for its pozzolan qualities it would most likely be placed in a landfill.

Silica fume consists primarily of amorphous (non-crystalline) silicon dioxide (SiO₂). The individual particles are extremely small, approximately 1/100th the size of an average cement particle. Because of its fine particles, large surface area, and the high SiO₂ content, silica fume is a very reactive pozzolan when used in concrete. The quality of silica fume is specified by ASTM C 1240 and AASHTO M 307.

High-strength concrete is a very economical material for carrying vertical loads in high-rise structures. Until a few years ago, 6,000 psi concrete was considered to be high strength. Today, using silica fume, concrete with compressive strength in excess of 15,000 psi can be readily produced.

The greatest cause of concrete deterioration in the US today is corrosion induced by deicing or marine salts. Silica-fume concrete with a low water/cement ratio is highly resistant to penetration by chloride ions. More and more transportation agencies are using silica fume in their concrete for construction of new bridges or rehabilitation of existing structures.

Adding Silica Fume to the Mix

Silica fume can come in a variety of forms. It can be either wet or dry as a concrete additive. I am not aware that we have had any product in a wet form. When dry it can either come bagged or in bulk form. Economics plays a role in the decision of which silica fume to use. While handling the silica fume in bulk form is certainly the preferred method of adding the product to our ready mixed concrete, for most small jobs the quantity of silica fume used dictates bagged product.

Over the years intermittent use of bagged silica fume has produced different results in the final product. The package (the bag) of the bagged silica fume is considered biodegradable. While instructions that come with the product say to throw unopened bags directly into the plastic mix, our experience with the product over the years has shown this practice to not always result in the best final product. The size and angularity of the coarse aggregate affects the results when the bag is placed in the mixer. When the mix design contains larger crushed limestone, disintegration of the package is more easily accomplished as com-

It's 2011 and during this year.....
"BE SAFE AND STAY HEALTHY!" is our cheer!



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**Safety is never an accident: it is
always the result of high inten-
tion, sincere effort, intelligent di-
rection and skilled execution! It
represents the wise choice of
many alternatives!!**

pared with gravel course aggregate. And it seems logical that sharper aggregate would do a better job of shredding the bag.

My conversations with several of our own people who have experience with bagged silica fume indicates that the best practice for adding silica fume when bulk product is not available is to slice the bags open and then slide the silica fume and bag into the mix. **We should never dump the contents from the bag!**

Safe Handling of Silica Fume

Using the MSDS as a guide, caution is recommended to protect against eye, skin and respiratory irritation. Precautionary measures include avoiding contact with eyes, skin and clothing; avoiding creating and inhaling airborne dust or particles; and practicing good personal hygiene to avoid ingestion. This can be accomplished by wearing long sleeves and pants along with gloves, and respiratory protection when needed. **A method of adding bagged silica fume must be adopted that minimizes the creation of dust.**

The greatest percentage of silica fume is amorphous Silicon Dioxide (more than 85%) which is not a form of silica that is generally considered a carcinogen. Less than 0.5% is crystalline Silicon Dioxide, a form of silica that is associated with lung disease and ultimately lung cancer. The primary health concern here is from total dust. Any finely ground substance is a concern if it enters the body through the lungs. Therefore if any dust is creating during handling it is a best practice to wear some form of respiratory protection. Our own air sampling results during han-

Location: _____

Supervisor: _____

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dling of bagged silica fume have not found any major health concerns. Our sampling showed exposure levels below those recommended by government agencies. But that does not mean that we shouldn't try to protect ourselves. We do not currently have any requirements for respiratory protection for any activity that we normally perform, but disposable respiratory protection is readily available and is encouraged when dusty conditions exist. (A formal respiratory protection program is a topic for another EHS Newsletter).

In Summary

Silica fume is not considered an extremely hazardous substance. It can cause irritation of eyes, skin and lungs with over exposure. Every situation where we are required to handle silica fume is a little different. Most times the EHS department may not even know that silica fume is a part of a particular job. Each employee should be aware of the potential concerns in handling bagged silica fume and should feel free to discuss proper handling techniques with their supervisor. Early contact with the EHS group to review safe handling procedures is encouraged. It is difficult for us to have input into special handling requirements when we are not brought into the conversation until the event has come and gone. **There is nothing that we do that is worth someone being injured over! Always take the safe route!**

