MAKING SILICA-FUME CONCRETE IN THE LABORATORY

PROBLEM

The Silica Fume Association is aware of instances in which silica-fume concrete prepared in a laboratory has failed to produce the expected hardened concrete properties, whether the property is compressive strength or low permeability. This problem is particularly common in laboratories having small, and often less efficient, concrete mixers.

BACKGROUND

Silica fume is a very fine powder — the particles are approximately 1/100 the diameter of portland cement grains. When used to produce high-performance concrete, silica fume is typically 4-15% of the cement weight. The exact addition rate depends upon on the specific performance characteristic to be improved. Compared to the other ingredients in concrete, the amount of silica fume used is small. For the silica fume to be effective, there are two issues that must be addressed:

- First, the agglomerations that make up the densified silica fume must be broken down.
- Second, the silica fume must be distributed uniformly throughout the concrete.

When making concrete in the laboratory, the key to both of these issues is batching the silica fume at the appropriate time and then mixing the concrete adequately.

ASTM C192, "Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory," paragraph 7.1.2 recommends: "Mix the concrete, after all ingredients are in the mixer, for 3 min. followed by a 3-min. rest, followed by a 2-min. final mixing." Unfortunately, these recommended mixing times are simply not long enough to break down the agglomerations and to disperse the silica fume.

SUGGESTED REMEDY

The suggested remedy is quite straightforward **(See flow chart on back):**

- Silica fume must always be added with the coarse aggregate and some of the water. Never batch the silica fume alone or first into the mixer. Mix these materials for 1½ minutes.
- Add the portland cement and any other cementitious material such as fly ash or slag cement. Mix for an additional 1½ minutes.
- Add the fine aggregate and use the remaining water to wash in any chemical admixtures added at the end of the batching sequence. Mix for 5 minutes, rest for 3 minutes, and mix for 5 minutes. Your actual mixing time may vary, depending upon the characteristics of your mixer. If you are unsure that full dispersion and efficient mixing has been accomplished, mix longer. You cannot over mix silica-fume concrete.

Following these recommendations will help ensure that the results in your laboratory will closely resemble the results you will see in actual silica-fume concrete production.

WHAT ABOUT PLANT OR TRUCK MIXING?

Our experience is that truck mixers or central plant mixers are much more efficient in breaking down the agglomerations and dispersing silica fume. However, remember to limit batch sizes to the rated mixing capacity of your mixer.

For additional information, please contact your silica fume supplier or the Silica Fume Association.

SFA
THE SILICA FUME ASSOCIATION
38860 Sierra Lane, Lovettsville, VA 20180
Tel: (540) 882-4001 ■ Fax: (540) 882-9388
www.silicafume.org

MAKING SILICA-FUME CONCRETE IN THE LABORATORY

1. Place 75% of water in mixer*
2. Add coarse aggregate
3. Add silica fume slowly into the revolving mixer
4. Mix 1½ minutes

*Follow ASTM C192 for addition of admixtures. Consult admixture manufacturers' recommendations for proper dosage and addition sequence.

5. Add cement and fly ash or slag cement, if being used, slowly into the revolving mixer
6. Mix 1½ minutes

7. Add fine aggregate
8. Wash-in all ingredients using the remaining 25% of water

Finish by mixing as follows:

9. Mix 5 minutes**
10. Rest 3 minutes
11. Mix 5 minutes**

**Time may be extended by user based on equipment and performance results.