

## *Silica Fume In Fresh Concrete*

### Increased Cohesion

Fresh concrete made with silica fume is more cohesive and therefore less prone to segregation than concrete without silica fume. To offset this increased cohesion when placing, silica-fume concrete is typically placed at 40 to 50 mm greater slump than concrete without silica fume in the same placement

The main benefit from increased cohesion can be seen in shotcrete, whether it is for new construction, repair of existing structures, or ground support in tunneling operations. Using silica fume in shotcrete allows for greater thickness of shotcrete layers, particularly when shooting overhead, and a significant reduction in rebound. Silica-fume shotcrete frequently includes steel fibers to provide increased flexural strength. Silica fume is compatible with all of the accelerators that are commonly used in shotcrete. Once the shotcrete is in place, all of the expected benefits of silica fume in hardened concrete come into play. An additional benefit is the increased bond strength of the silica-fume shotcrete to the underlying material and between lifts of layers in multi-pass applications.

### Reduced Bleeding

Because of the very high surface area of the silica fume and the usually very low water content of silica-fume concrete, there will be very little, if any bleeding. Once a silica fume content of about five percent is reached, there will be no bleeding in most concretes.

Concrete bleeds as the heavier components (cement and aggregates) settle under the influence of gravity before the concrete stiffens. As the heavier components settle, the lighter water is forced upward. Some of the water is trapped under aggregate particles or reinforcing steel and some of it reaches the surface of the concrete. This movement of water takes place in what are called capillary channels. Once the water evaporates, these channels serve as shortcuts for aggressive agents such as chloride ions from deicing salts or sea water to get back into the concrete. Therefore, the reduction or elimination of these channels improves the durability of the concrete.

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In addition to the improvements in durability, the lack of bleeding allows a more efficient finishing process to be used with silica-fume concrete flatwork. For conventional concrete, it is critical not to conduct finishing operations until all bleeding has stopped and all bleed water has evaporated from the surface. Thus, there is usually a several hour waiting period after the initial placing and finishing operations. Once bleed water has disappeared and the concrete has gained sufficient strength, final finishing is started.

With silica-fume concrete showing no bleeding, the finishing operation can be continuous from placement to texturing and curing. This approach is called “one-pass” or “fast-track” finishing and is particularly advantageous in structures where silica fume is likely to be specified for durability such as bridge decks or parking structures. Unless a special finish is required, it is not unusual for finishing of silica-fume concrete to be completed within a half hour of concrete arriving on the deck.

### **REFERENCES**

Information provided by US DEPARTMENT OF TRANSPORTATION – Federal Highway Administration – Silca Fume Association - April 2005