

2.7 SILICA FUME

Workability: With the addition of silica fume, the slump loss with time is directly proportional to increase in the silica fume content due to the introduction of large surface area in the concrete mix by its addition. Although the slump decreases, the mix remains highly cohesive.

Segregation and bleeding: Silica fume reduces bleeding significantly because the free water is consumed in wetting of the large surface area of the silica fume and hence the free water left in the mix for bleeding also decreases. Silica fume also blocks the pores in the fresh concrete so water within the concrete is not allowed to come to the surface.

Silica fume is a light to dark grey or pink or white cementing material composed of atleast 85% ultra-fine, amorphous non-crystalline spherical silicon dioxide particles give silica fume the super pozzolanic properties.

- Silica fume, also referred to as micro silica or condensed silica fume, is another material that is used as an artificial pozzolanic admixture.
- Silica fume rises as an oxidised vapour. It cools, condenses and is collected in cloth bags.
- Silica fume is a very fine amorphous (non - crystalline) silica produced in electric arc furnaces as a by-product of the production of elemental silicon or alloys containing silicon.
- At least 85% SiO_2 content
- Mean particle size between 0.1 and 0.2 micron
- Minimum specific surface area is $15,000 \text{ m}^2/\text{kg}$
- Spherical particle shape

Properties of Silica Fume

- Specific gravity : 2.2

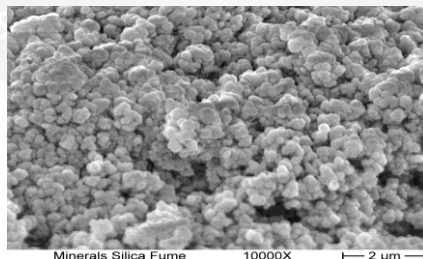
- Typical fineness : 15000 m²/kg (average particle size ~ 0.1 – 0.5 µm)
- Bulk density : As - produced - 130 to 430 kg/m³, slurry - 1320 to 1440 kg/m³, densified - 480 to 720 kg/m³
- Colour : light grey to dark grey (lighter implies purer)
- Cost : almost 10 times as much as Cement
- Typically used at 5 – 15% replacement level

Working of Silica Fume in Concrete

The second function silica fume performs in cementitious compounds is a physical one. Because silica fume is 100 to 150 times smaller than a cement particle it can fill the voids created by free water in the matrix. This function, called particle packing.

Applications of Silica Fume

- Conserve cement
- Produce ultra-high strength concrete of the order of 70 to 120 Mpa.
- Increase early strength of fly concrete.
- Control alkali - aggregate reaction.
- Reduce sulphate attack & chloride associated corrosion.



Effects of Silica Fume

On fresh concrete:

- The increase in water demand of concrete.
- Lead to lower slump but more cohesive mix.
- Make the fresh concrete sticky in nature and hard to handle.

- Large reduction in bleeding and concrete with micro silica could be handled and transported without segregation.
- Plastic shrinkage cracking and, therefore, sheet or mat curing should be considered.
- Produces more heat of hydration at the initial stage of hydration.
- The total generation of heat will be less than that of reference concrete.

On harden concrete:

- Modulus of elasticity of silica fume concrete is less.
- Improvement in durability of concrete
- Resistance against frost damage.
- Addition of silica fume in small quantities actually increases the expansion.

Forms of Silica Fume

