Silica Fume

This document is a high-level summary intended to provide the general public with an overview of product safety for this substance. It is not intended to replace the Safety Data Sheet or legally required safety information, which is available from Dow Corning and should be referred to for full details of recommended safety procedures for each type of use. Where there is any inconsistency in the information provided herein and the Safety Data Sheet/legally required information, the latter shall prevail.

1. Substance Name and Chemical Identity

   Chemical Name: Silica Fume
   CAS Number: 69012-64-2
   Molecular formula: SiO₂

2. Uses and Applications

   Silica fume, which is also known as microsilica, is an amorphous (non-crystalline) polymorph of silicon dioxide (SiO₂), silica.

   Silica fume consists of spherical particles with primary silica particles in the size range of 0.02 - 1.0 μm (average particle size 0.15 μm) and a specific surface area of typically 17 to 30 m²/g. The chemical and physical properties of this inorganic product are different as compared to other amorphous and crystalline silica, and it should not be confused with fumed silica (also known as pyrogenic silica, CAS number 112945-52-2).

   Silica fume is an ultrafine powder collected as a by-product from the volatilization and vaporization of furnace feed materials in the manufacture of ferrosilicon alloys and silicon. It is produced by the carbothermic reduction of high-purity quartz with carbonaceous materials like coal, coke, wood-chips, in electric arc furnaces. In the process, quartz mineral is reduced to silicon, and silicon monoxide gas (SiO) is formed as a by-product. This, in contact with oxygen, oxidizes to silicon dioxide (SiO₂) which condenses forming ultra-fine spherical particles referred to as silica fume.

   The purity of commercial silica fume is typically > 80%, and will contain small amounts of impurities, mainly carbon, silicon carbide, diiron trioxide, calcium oxide, magnesium oxide and sodium oxide (up to 5%). Silica fume may also contain traces of crystalline silicon dioxide in the form of quartz or cristobalite. These impurities originate mainly from carry-over of the off-gas from the production process. The concentration of quartz in silica fume is usually below 1.5 wt%, and < 0.1wt% in its respirable form.

   During collection, cooling and bagging, the primary particles tend to form larger agglomerates. The solubility of silicon dioxide in water is low.

   Silica fume is used in a variety of cementitious (concrete, grouts and mortars), refractory, elastomer and polymer applications but the main field of application is as pozzolanic material for high performance concrete. Because of its chemical and physical properties (fine particles, large surface area, and the high SiO₂ content), concrete containing silica fume can have very high...
strength and can be very durable. Silica fume prevents reinforcing steel corrosion in concrete, due to its extremely low permeability to chloride-ion intrusion and high electrical resistivity. 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 achieved. The greatest cause of concrete deterioration in the US today is corrosion induced by deicing or marine salts. Silica-fume concrete with low water content is highly resistant to penetration by chloride ions.

Silica fume is available in its as-produced, dry undensified form, but also in a dry densified form, with twice the bulk density to provide dustless, uniform and smooth bulk handling during concrete production. The quality of silica fume is specified by ASTM C 1240 and AASHTO M307.

In refractory and ceramic applications silica fume is used for its’ ability to modified flow characteristics and for its unique particle packing ability.

3. Physical/chemical properties

Silica fume has not been classified for hazardous physicochemical properties under the Globally Harmonised System (GHS).

- Not classified as flammable solid under GHS
- No classification for health and environment hazards

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>Solid - Amorphous sub-micron powder</td>
</tr>
<tr>
<td>Colour</td>
<td>white, gray or black</td>
</tr>
<tr>
<td>Odour</td>
<td>No odour</td>
</tr>
<tr>
<td>Molecular weight range</td>
<td>ca. 60.0843</td>
</tr>
<tr>
<td>Melting/freezing point</td>
<td>&gt;1500 °C at 101.3 kPa</td>
</tr>
<tr>
<td>Relative density</td>
<td>2.2 - 2.3 g/cm³</td>
</tr>
<tr>
<td>Water solubility</td>
<td>OECD T/D screening test: ≤ 0.25 mg/l at pH 6 (21.5 °C); 0.37 ≤ 0.72 mg/l at pH 8 (21.5 °C)</td>
</tr>
<tr>
<td></td>
<td>OECD 105: 1.3 ≤ 5.3 mg/l at pH 5.9-7.6 (20 °C)</td>
</tr>
<tr>
<td></td>
<td>silica fume particles; diameter &lt; 1 mm</td>
</tr>
<tr>
<td>Flammability</td>
<td>Non combustible</td>
</tr>
<tr>
<td>Flash point</td>
<td>N/A</td>
</tr>
<tr>
<td>Self-ignition temperature</td>
<td>N/A</td>
</tr>
<tr>
<td>Explosive properties</td>
<td>No danger of explosion</td>
</tr>
<tr>
<td>Particle size</td>
<td>Approx. 0.1 to 1.0 μm (average particle size 0.15 μm). Tendency for particles to form agglomerates. The proportion of respirable particles of the total inhalable silica fume is in the range. 1 - 3 wt%.</td>
</tr>
</tbody>
</table>
4. Health information

Silica fume does not meet the criteria for classification in any hazard class according to REACH and to Regulation (EC) N01272/2008 (CLP).

It is possible for Silica Fume to contain trace amounts (<0.1%) of respirable crystalline silica, which has been shown to cause silicosis, and has been identified by IARC and NTP as a possible human carcinogen but this does not trigger any hazard classification. Silica Fume is generally considered a nuisance dust of low toxicity, and consequently it is considered to pose minimal risk of pulmonary fibrosis (silicosis).

Heating Silica Fume at temperatures above 500ºC (930ºF) for prolonged time periods will convert amorphous silica to the crystalline phases cristobalite and tridymite that may cause silicosis.

A derived no-effect limit DNEL of 4 mg/m3 (inhaleable fraction) and 0.3 mg/m3 (respirable fraction) is recommended for commercial silica fume in occupational exposure.

5. Environmental information

Silica fume is an inorganic substance which is not biodegradable. Silica fume is not regarded as a hazardous or bioaccumulative contaminant. The product is not characterised as dangerous for the environment, and is not classified for environmental hazards under the Globally Harmonised System (GHS).

6. Exposure potential

**Consumer exposure:** As mentioned Silica fume is used as a key ingredient to make high strength concrete, and as such can be found in hardware store. There is no residual silica fume in end-products manufactured using the substance.

**Workplace exposure:** This refers to the potential for worker exposure at manufacturing sites or industrial workplaces, and laboratories (including academic). Silica fume is not acutely toxic via the oral, inhalation or dermal route. Silica fume is not a skin or eye irritant, and for the respiratory system. Naturally, like any other dust, the dust from silica fume may cause non-specific mechanical irritation to the eyes and respiratory tract.

**Environmental releases:** Manufacturing occurs under controlled conditions, with only very small releases to air and waste water. Environmental exposure is minimised by applying air and waste water abatement technologies to remove dust, unreacted substance and reaction products. The use of appropriate measures to manage environmental release is described in the Safety Data Sheet and CES Guidance Document on safe handling.

7. Risk management recommendations

**Consumer and professional risk management:** For both consumer and professional usage, the use and handling of Silica Fume does not represent a health risk when normal safety rules are observed, and instructions on safety data sheets are followed. Avoid prolonged exposure to silica fume dust concentrations above the recommended exposure limits unless protective equipment is used.

**Industrial risk management:** For more detailed information please refer to the safety data sheet for information on protecting workers and limiting environmental exposure at industrial sites. There must be adequate ventilation to avoid dust built up, and suitable respiratory protection must be worn if the product is handled in large quantities in confined spaces or above the permissible
exposure limits. Protective clothing, gloves, safety glasses or other suitable eye protection must be worn. Keep containers tightly closed, and store in a dry and cool place.

8. Conclusions

Silica fume is manufactured only under highly-controlled conditions at industrial sites. The manufacturing and use of silica fume does not pose a risk to humans or the environment if instructions in the Safety Data Sheet are followed.

9. Contact Information

For further information on this substance or product safety summaries in general, please contact:

Dow Corning EH&S Team

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