

What is silica?

Silica is the name given to a group of minerals composed of silicon and oxygen, the two most abundant elements in the earth's crust. In spite of its simple chemical formula, SiO_2 , silica exists in many different forms. Silica is found commonly in the crystalline state but occurs also in an amorphous state resulting from weathering or plankton fossilisation.

Silica exists in ten different crystalline forms or polymorphs, quartz being by far the most common. Quartz is the second most common mineral on the earth's surface and it is found in almost every type of rock, i.e. igneous, metamorphic and sedimentary. Since it is so abundant, quartz is present in nearly all mining operations. It occurs in the host rock, in the ore being mined, as well as in the soil and surface materials above the bedrock, which are called the overburden.



Industry mainly uses the crystalline forms of silica, i.e. quartz and cristobalite. Both are sold as sand, which is a granular material with particles greater than 0.063 millimetres, or as flours that consist of finer particles.

Silica is hard, chemically inert and has a high melting point because of the strength of the bonds between the atoms. These are prized qualities in various industrial uses.

Quartz is usually colourless or white but is frequently coloured by impurities such as iron. Quartz may be transparent to translucent, hence its use in glassmaking, and has a vitreous lustre. Depending on how the silica sand was formed, quartz grains may be sharp and angular or rounded.

For industrial use, pure deposits of silica capable of yielding products of at least 98% SiO_2 are required. Silica sand may be produced from sandstone, quartzite and loosely cemented or unconsolidated sand deposits.



High grade silica is normally found in unconsolidated deposits below thin layers of overburden. It is also found as 'veins' of quartz within other rocks and these veins can be many metres thick.

Silica sand deposits are normally exploited by quarrying and the material extracted may undergo considerable processing before sale. The objectives of processing are to reduce impurities and increase the grade of silica present and to produce the optimum size distribution of the product depending upon end use.

After processing the sand may be sold in the moist state or it may be dried. Dry grinding in rotary mills, using beach pebbles or alumina balls as grinding media is the most common way to produce silica and cristobalite flour.

Since the natural resources of cristobalite are not sufficient for industrial use, it has to be synthesised by the conversion of quartz in a rotary kiln at high temperature ($>1500^\circ\text{C}$) with the assistance of a catalyst.

Multiple properties – manifold uses

● **Paints and Plastics, Polymer Compounds, Rubber, Sealants and Adhesives:** Crystalline silica, as quartz and cristobalite, in its finest flour form is used as a reinforcing filler. Silica flour provides resistance against abrasive actions and chemical attack. Self-cleaning exterior wall coatings and heavy-duty offshore or marine paints are typical examples. The intrinsic properties of silica flour promote its use in plastics for encapsulating electronic components.



Industrial Minerals

Your world is made of them

- **Ceramics:** Typical everyday products such as tableware, sanitaryware, ornaments and wall and floor tiles but also high tech ceramics contain silica flour that has been ground to fine sizes to form a major constituent of ceramic glazes. Crystalline silica is a main component in the production of refractory bricks, ladle linings and fluxes.
- **Glass:** Silica is the major ingredient in virtually all types of glass. The principal glass products include containers (bottles and jars), flat glass (windows, mirrors, vehicle glass), tableware (drinking glasses, bowls, decanters), lighting glass (light bulbs, fluorescent tubes), TV tubes and screens (including flat screens), decorative glass optical glass, etc. The glass fibres, mainly used for composite reinforcing or in decorative textiles, are made from fine ground silica flour.
- **Foundry Casting:** Crystalline silica has a higher melting point than iron, copper and aluminium. This enables castings to be produced by pouring molten metal into moulds made out of silica sand and a binder. Castings form the basis of the engineering and manufacturing industries. Quartz and cristobalite flours are the main components in investment casting (also called precision casting) for the production of specialist products such as jewellery, dental bridges, aviation turbines and golf clubs.
- **Filtration:** Closely sized silica sand is the principal filtration medium used by the water industry to extract solids from wastewater.
- **Building Applications, Specialities and Commodities:** The construction industry is founded on silica sand and flours. There are a host of specialist applications including cement manufacture, silica and aerated concrete blocks, glues for roof and floor tiles, flooring and rendering compounds, white line markings, roofing felt and cement and resin injection systems.
- **Sports and Leisure:** Silica sand is used for equestrian surfaces, including the production of all weather horse racing tracks. It is also used in the production of root zones and drainage media for high specification football and other sports pitches and for golf courses. It is also used in play sand pits for the construction of sand castles!
- **Oil field application:** Special grades of silica sand that are of coarse size and have spherical particles are pumped down oil wells and into the oil-bearing strata to improve permeability and the flow of oil into the well.



- **Agriculture:** Silica is used in farming, market gardening, horticulture and forestry in applications such as soil conditioner or carrier for fertiliser and animal feed additives.
- **Chemicals:** Cristobalite sand and high purity quartz are used to produce a range of silicon chemicals including sodium silicate, silica gel, silicones, silicon tetrachloride, silanes and pure silicon. Pure silicon is used for silicon chips, the heart of the computer world. Silicon products are used in the production of detergents, pharmaceuticals and cosmetics.
- **Metallurgical Industry:** Quartz is the raw material for the production of silicon metal and ferrosilicon. Silicon metal is used in the production of alloys based on aluminium, copper and nickel. Ferrosilicon is a major alloying ingredient for iron and steel. Metal ores are purified in the furnace by silica sand that is transformed into metal slag.

For more information, please contact:

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