



Silica

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What it is:

- Silica, or silicon dioxide (SiO_2), is the most abundant mineral in the Earth's crust. Found in nature as glassy sand or quartz, and in rocks/minerals. Also naturally in tissues of living organisms.
- In freshwater sources, silica is found in concentrations ranging from 1 to about 100 milligrams per liter (mg/L), with groundwater concentrations typically in the higher end of that range.
- Constituent element silicon is used in many products, from metal alloys to lubricants to semiconductors. Pure sand is a chemically stable, low-cost water filtration media. Salts of silica (silicates) are used as pipe corrosion inhibitors and to sequester soluble iron and manganese in water.

Health effects:

- Inert and harmless in water; passes through the body without effect; has no nutritional value.
- Occupational disease silicosis is contracted by breathing air containing silica dust, which lodges in and irritates the lungs.

Water chemistry/effects:

- Complex and unpredictable. In water, the term silica can include all reactive (dissolved) and inert (nonreactive, undissolved or colloidal) forms of SiO_2 .
- Only slightly soluble, but counted as part of TDS. Dissolved silica is in the form of hydrated, dissolved silicic acid, or $\text{Si}(\text{OH})_4$.
 - *Below pH 9.0:* If silicic acid's solubility is exceeded, silica and silicates will precipitate out of solution. At low pH, silica can condense to form uncharged particles of colloidal silica, some as small as 0.02 micron.
 - *When pH exceeds 8.0:* Silicic acid turns into silicate anions and silica's solubility increases. However, if cations such as calcium, magnesium or iron are present in high-enough concentrations at these higher pH levels, they will combine with the silicate anions and precipitate out as insoluble silicate salts.
- *Why treat?* Silica precipitation and colloidal silica can foul reverse osmosis (RO) membranes under some conditions. Can cause undesirable scale formation in boilers, cooling towers. Silica can clog pores of adsorption media. It can contribute to the formation of colloidal iron and colloidal manganese.

Regulation:

- Silica is not on the US Environmental Protection Agency's Primary or Secondary drinking water contaminant lists.

Water treatment:

- Ion exchange with strong base anion resin (for dissolved silica).
- Coagulation (such as with alum)/filtration.
- RO (if silica solubility is not exceeded in the reject stream).
- Ultrafiltration (of colloidal silica).
- Lime softening/precipitation (in large flows).

Sources: Water Quality Association, Mineral Information Institute, Severn Trent Services, APEC Water Systems, Aqua Pure Water Filters, Finishing.com, ASTM International.