

Silica

Raw Material



(solid)

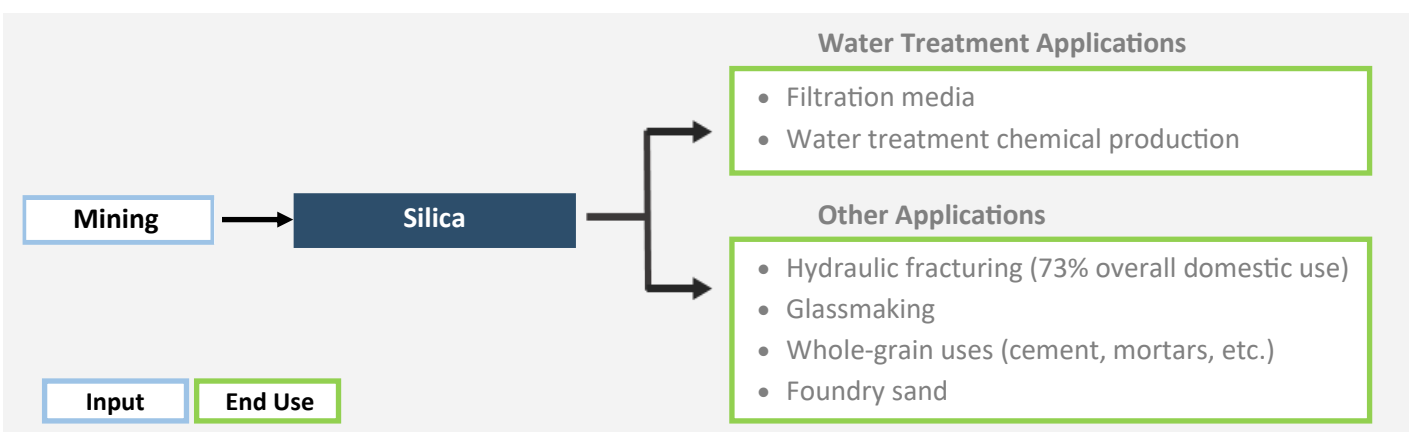


Source of Raw Material: Naturally occurring mineral	% of Total Domestic Consumption Attributed to Water Sector: Less than 3%	Product Family: Silica
Derivative Water Treatment Chemicals: Sodium Silicate	Understanding Chemical Supply Chains	CAS No.: 14808-60-7
		Shelf Life: 60+ Months

RISK OF SUPPLY DISRUPTION (Assessed in 2022)

<p>RISK RATING: Low</p>	<p>RISK DRIVERS</p> <p>Use of silica in hydraulic fracturing is the leading domestic use. Increases or decreases in demand for hydraulic fracturing sand may periodically impact the availability and price of silica, however silica resources are abundant.</p>	<p>RISK PARAMETERS</p> <p>Criticality: High. Essential for water filtration, well construction, and production of corrosion control chemicals.</p> <p>Likelihood: Low. The water sector did not experience silica supply disruptions between 2000 and 2022.</p> <p>Vulnerability: Low. The U.S. is a leading worldwide producer and net exporter of silica. Silica is abundant and production is widely distributed.</p>
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PRODUCTION PROCESS



DOMESTIC PRODUCTION AND CONSUMPTION, AND INTERNATIONAL TRADE

<p>Domestic Production Locations (2019): 308, widely distributed across 35 states.</p>		<p>Domestic Consumption (2019): 102,849 M kg</p> <ul style="list-style-type: none"> ■ Domestic Production (108,000 M kg) ■ Imports for Consumption (389 M kg) ■ Export of Domestic Production (5,540 M kg)
<p>International Trade (2019) Primary Trading Partner (Imports): Canada Primary Trading Partner (Exports): Canada</p>		

Product Description

Silica, also known as silicon dioxide (SiO_2), is an abundant, naturally occurring mineral commonly found in sand. Silica is used directly in water treatment as a filtration media, and also as an input in the manufacturing of liquid silicate solutions for corrosion control. The most common domestic use is in hydraulic fracturing well development.

Use in Water Treatment

Silica sand is used directly in water filtration and as a component of well-packing sand for well construction (USGS, 2021).

Use as a Precursor to Other Water Treatment Chemicals

Silica is used to manufacture liquid silicate solutions, such as sodium silicate, used as corrosion inhibitors in drinking water distribution systems.

Other Applications

Silica has a wide range of applications. The leading domestic use of silica is for hydraulic fracturing well development, packing, and cementing. It is also widely used in glassmaking, foundries, ceramics, chemical manufacturing, roofing, construction, and filtration (USGS, 2020; USGS 2021).

Primary Industrial Consumers

In 2019, approximately 73% of silica consumed in the U.S. was used for hydraulic fracturing well development, packing, and cementing. Additional uses include glassmaking and use as whole-grain silica, each accounting 7% of consumption, use as foundry sand (3%), ceramics and building products (2% each), and recreational sand (1%). Use in water filtration is one of many other applications that accounted for the remaining 3% (USGS, 2020).

Manufacturing, Transport, & Storage

Manufacturing Process

Silica, also called silica sand, industrial sand and gravel or quartz sand, is a sand and gravel with high silica (silicon dioxide) content. There are four common categories of silica: silica sand, quartz crystal (a form of crystalline silica), special silica stone products, and tripoli (USGS, 2021).

Sand and gravel deposits can be found on beaches or in deltas, rivers, and streams. Quartz is one of the most common forms of silica and the second most abundant mineral on the Earth's surface. It is found in rocks such as granite, gneiss, and sandstone. Silica sand deposits are most commonly quarried by surface mining in open pit operations, but dredging and underground mining are also employed. Silica is commonly screened to remove impurities and sorted by grain size. Grain size, shape, color, structure, and refractoriness differ based on deposit location, and will dictate how the mineral is processed and the applications after mining (Minnesota DNR, 2014; USGS, 2021).

Product Transport

Silica is routinely transported from mining operations by many modes of transport including rail, truck, and barge (USGS, 2021).

Storage and Shelf Life

Silica is stable and non-reactive over a wide range of temperatures. When stored properly, silica can have a shelf

life in excess of 60 months (AGSCO, 2017; Northern Filter Media, 2013).

Domestic Production & Consumption

Domestic Production

Production data was collected from USGS, while trade data was collected from the USITC Dataweb, as shown in Table 1. Both production and trade data are specific to silica.

Table 1. Silica Production and Trade Data Sources

Production and Trade Data			
Category	Data Source	Identifier	Description
Domestic Production	U.S. Geological Survey	CAS No.: 14808-60-7	Silica
Imports and Exports	U.S. International Trade Commission	HS Code: 2505.10	Silica

Total U.S. domestic production of silica was approximately 102,849 million kilograms (M kg) in 2019 (USGS, 2020). Domestic commercial production of silica takes place at 308 locations in 35 states within the U.S. Production in 10 states accounted for 85% of domestic sales and use, and Wisconsin, Texas, and Illinois were the top producing states in 2019 (USGS, 2020). In 2018, 93% of total silica production took place at 46% of the production locations. In 2019, the U.S. was the world's leading producer and consumer of silica. The U.S. is a significant exporter due to high quality of silica exports and advanced processing methods that allow producers to meet a variety of specifications (USGS, 2020).

Domestic Consumption

U.S. consumption of silica in 2019 is estimated at 102,849 M kg. This estimate includes production of 108,000 M kg, import of 389 M kg, minus export of 5,540 M kg (USGS, 2020), as shown in Figure 1.

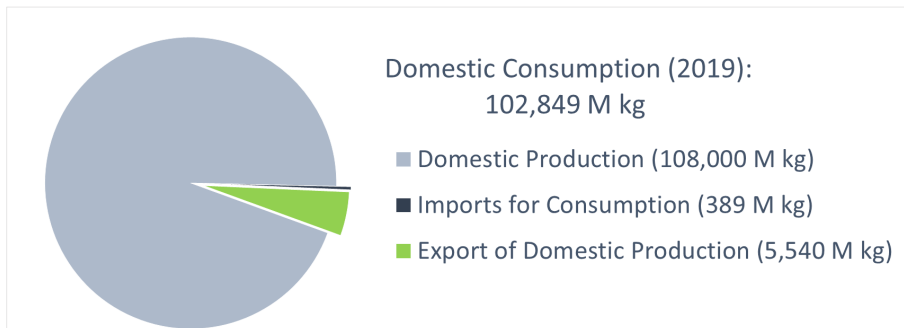


Figure 1. Domestic Production and Consumption of Silica in 2019

Trade & Tariffs

Worldwide Trade

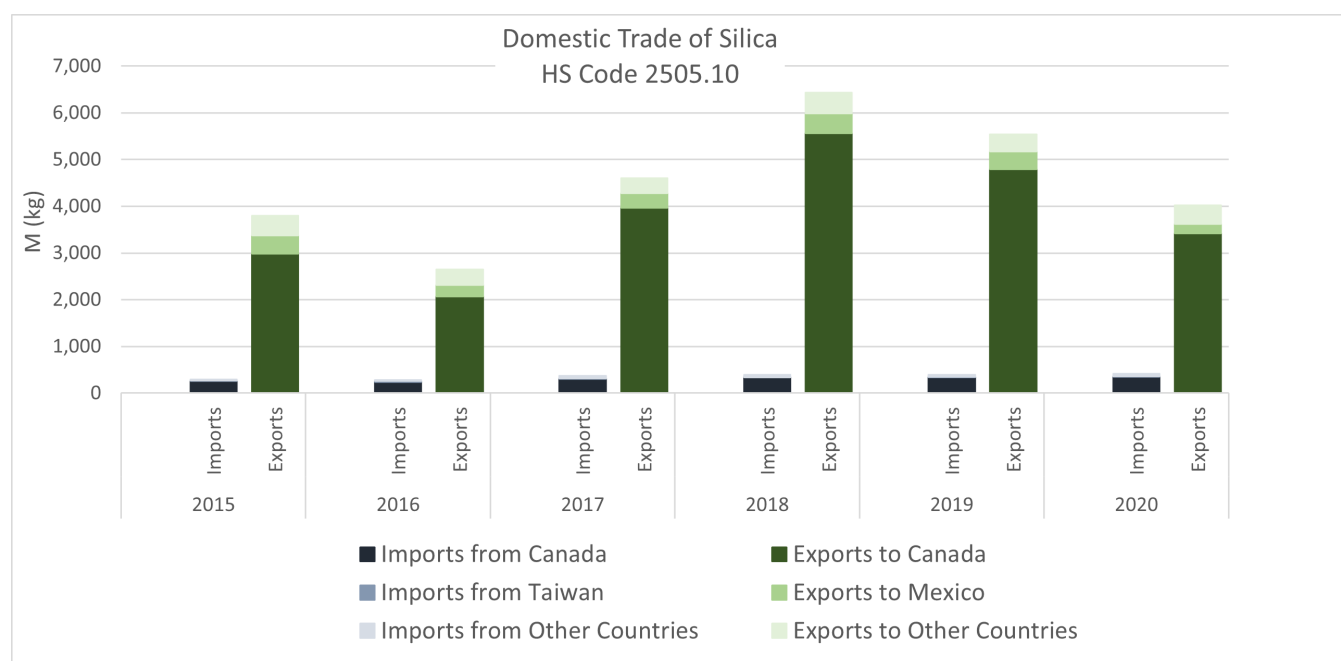
Worldwide import and export data for silica (natural silica and quartz sands) are reported through the World Bank's World Integrated Trade Solutions (WITS) software, as a category specific to silica. In 2021, the U.S. ranked first worldwide in total exports and 24th in total imports of silica. In 2021, Canada ranked first worldwide in total imports (WITS, 2022), as shown in Table 2.

Table 2. WITS Worldwide Export and Import of Silica in 2021

2021 Worldwide Trade Silica (HS Code 2505.10)			
Top 5 Worldwide Exporters		Top 5 Worldwide Importers	
United States	5,356 M kg	Canada	5,129 M kg
Belgium	2,378 M kg	United Arab Emirates	4,515 M kg
Malaysia	1,060 M kg	China	3,455 M kg
Saudi Arabia	861 M kg	Singapore	2,863 M kg
Portugal	701 M kg	Belgium	1,736 M kg

Domestic Imports and Exports

Domestic import and export data are reported by USITC in categories specific to silica. Figure 2 summarizes imports for consumption¹ and domestic exports² of silica between 2015 and 2020. During this period, the overall quantity of exports varied, with the greatest volume of exports occurring in 2018. The volume of imports, considerably smaller than the volume of exports, remained relatively steady. Over this five-year period, Canada was the primary recipient of domestic exports and the primary source of imports (USITC, 2021).

**Figure 2. USITC Domestic Import and Export of Silica between 2015 and 2020**

Tariffs

Imports of silica are primarily supplied from Canada. There is no general duty for import of silica, however there is a 25% additional duty on imports from China (USITC, 2022), as summarized in Table 3.

¹ Imports for consumption are a subset of general imports, representing the total amount cleared through customs and entering consumption channels, not anticipated to be reshipped to foreign points, but may include some reexports.

² Domestic exports are a subset of total exports, representing export of domestic merchandise which are produced or manufactured in the U.S. and commodities of foreign origin which have been changed in the U.S.

Table 3. 2020 Domestic Tariff Schedule for Silica

HS Code	General Duty	Additional Duty – China (Section 301 Tariff List)	Special Duty
2505.10	None	25%	None

Market History & Risk Evaluation

History of Shortages

The most significant current domestic use of silica is hydraulic fracturing well development, packing, and cementing. This application accounts for the consumption of the majority of domestically produced silica. Increases or decreases in demand for hydraulic fracturing sand may periodically impact the availability and price of silica, however silica resources are abundant and there were no identified supply chain disruptions between 2000 and 2022.

Risk Evaluation

The complete risk assessment methodology is described in *Understanding Water Treatment Chemical Supply Chains and the Risk of Disruptions* (EPA, 2022). The risk rating is calculated as the product of the following three risk parameters:

Risk = Criticality x Likelihood x Vulnerability	
Criticality	Measure of the importance of a chemical to the water sector
Likelihood	Measure of the probability that the chemical will experience a supply disruption in the future, which is estimated based on past occurrence of supply disruptions
Vulnerability	Measure of the market dynamics that make a chemical market more or less resilient to supply disruptions

The individual parameter rating is based on evaluation of one or more attributes of the chemical or its supply chain. The ratings and drivers for these three risk parameters are shown below in Table 4.

Table 4. Supply Chain Risk Evaluation for Silica

Risk Parameter Ratings and Drivers					
Criticality	High	Likelihood	Low	Vulnerability	Low
Silica is essential and has widespread application in water filtration and well construction. It is a precursor in the production of silicates used in corrosion control.		The water sector has not experienced silica supply disruptions between 2000 and 2022.		The U.S. is a leading worldwide producer and net exporter of silica. Silica is abundant and production is widely distributed.	
Risk Rating: Low					

References

AGSCO Corp, 2017. Safety Data Sheet for Silica Sand, retrieved from <https://www.agsco.com/silica-sand-safety-data-sheet/>

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World Integrated Trade Solutions (WITS), 2022. Trade Statistics by Product (HS 6-digit), retrieved from <https://wits.worldbank.org/trade/country-byhs6product.aspx?lang=en#void>