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2019 Minerals Yearbook

SILICA [ADVANCE RELEASE]

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Silica

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Four silica categories are covered in this report—industrial sand and gravel, quartz crystal (a form of crystalline silica), special silica stone products, and tripoli. Most of the stone covered in the special silica stone products section is novaculite. The section on tripoli includes other fine-grained, porous silica materials, such as rottenstone, that have all similar properties and end uses. Certain silica and silicate materials, such as diatomite and pumice, are covered in other chapters of the U.S. Geological Survey (USGS) Minerals Yearbook, volume I, Metals and Minerals. Trade data in this report are from the U.S. Census Bureau. All percentages were calculated using unrounded data.

Industrial Sand and Gravel

Total industrial sand and gravel production in the United States decreased to 114 million metric tons (Mt) in 2019 from the revised 123 Mt in 2018 (table 1). Industrial sand production decreased by 8%, and industrial gravel production decreased by 7% compared with those in 2018. The value of industrial sand and gravel production in 2019 was $5.38 billion—a 23% decrease compared with the revised $6.94 billion in 2018. Estimated world production of industrial sand and gravel in 2019 was 325 Mt, a 3% decrease compared with 2018 production (table 10).

The most important driving force in the industrial sand and gravel industry continued to be the production and sale of hydraulic fracturing sand (frac sand). The consumption of frac sand had increased over the past several years as production of natural gas and petroleum extracted from shale deposits increased in the United States. However, frac sand production decreased by 7% to 81.5 Mt in 2019 compared with that in 2018 (table 6). In 2019, frac sand production decreased primarily as a result of decreased oil-and-gas-drilling activity in North America.

Industrial sand and gravel, often called silica, silica sand, and (or) quartz sand, includes sands and gravels with high silicon dioxide (SiO_2) content. End-use examples include abrasives, filtration, foundry, glassmaking, hydraulic fracturing, and silicon metal applications. The specifications for each use differ, but silica resources for most uses are abundant. In almost all cases, silica mining used open pit or dredging methods with standard mining equipment. Following extraction, the silica sand was processed to make the sand free of contaminants and separated by grain size, regardless of the eventual end use.

Legislation and Government Programs.—One of the most important issues affecting the industrial minerals industry has been the potential effect of crystalline silica on human health. The understanding of the regulations, the implementation of the measurements and actions taken to mitigate exposure to crystalline silica, and the appreciation of the effect of such exposure on the future of many industries remain central to an ongoing debate. On March 25, 2016, the Occupational Safety and Health Administration (OSHA) issued a final ruling on permissible occupational exposure limits to respirable crystalline silica. By issuing the ruling, OSHA amended its existing standards for occupational exposure to respirable crystalline silica. The final rule established a new permissible exposure limit of 50 micrograms of respirable crystalline silica per cubic meter of air as an 8-hour time-weighted average in all industries covered by the rule. The final rule was made effective on June 23, 2016. Phased implementation of the regulations was scheduled to take effect through 2021 (Occupational Safety and Health Administration, 2016, p. 16286, 16288). In July 2019, OSHA augmented an existing website containing frequently asked questions on OSHA's standard for respirable crystalline silica with guidance regarding standards for general industry. Additionally, the website contains information on topics such as the health effects of respirable crystalline silica, guidance for OSHA regulations for the construction and maritime industries, and sampling and analysis guidelines (Occupational Safety and Health Administration, 2019).

Production.—Domestic production data for industrial sand and gravel were developed by the USGS from a voluntary survey of U.S. producers. The USGS canvassed 180 active producers with 311 operations known to produce industrial sand and gravel. Of the 311 surveyed operations, 277 (89%) were active and 34 were idle or closed. The USGS received responses from 58 operations, and their combined production represented 29% of the U.S. total tonnage. Production data for the nonrespondents were estimated primarily based on previously reported information, which were supplemented with worker-hour reports from the Mine Safety and Health Administration (MSHA), information from State agencies, preliminary survey data, and company reports.

Of the 114 Mt of industrial sand and gravel produced in the United States in 2019, the South (South Atlantic, East South Central, and West South Central U.S. Census Bureau geographic divisions) led the Nation, accounting for 48%. This was followed by the Midwest (East North Central and West North Central geographic divisions) with 47%, the West (Pacific and Mountain geographic divisions) with 3%, and the Northeast (New England and Middle Atlantic geographic divisions) with 2% (table 2).

The leading producing States were, in descending order, Texas, Wisconsin, Illinois, Oklahoma, Missouri, Minnesota, Mississippi, North Carolina, Louisiana, and Iowa (table 3). The combined production of these States accounted for 86% of the national total.

[1]Deceased.

Of the total industrial sand and gravel produced, 92% was produced at 122 operations, each with production of 200,000 metric tons per year or more (table 4). The 10 leading producers of industrial sand and gravel were, in descending order, Covia Holdings LLC; U.S. Silica Holdings, Inc.; Hi-Crush Inc.; SP Silica Corporate, LLC; Badger Mining Corp.; Shale Support Holdings, LLC; Superior Silica Sands, LLC; Vista Proppants and Logistics, LLC; SmartSand, Inc.; and Capital Sand Proppants, LLC. Their combined production represented 66% of the U.S. total.

On July 15, 2019, Emerge Energy Services LP and its affiliates and subsidiaries, including the company's frac sand producer, Superior Silica Sands, filed for bankruptcy. Despite the bankruptcy filing, the company continued to operate throughout the year. On December 18, 2019, the United States Bankruptcy Court for the District of Delaware, approved the company's reorganization plan (Market Exclusive, 2019).

Consumption.—Industrial sand and gravel production, reported by producers to the USGS, was material used by the producing companies or sold to their customers. Stockpiled material was not reported until consumed or sold. Of the 114 Mt of industrial sand and gravel sold or used, 73% was consumed as frac sand and sand for well packing and cementing, 8% as glassmaking sand, and 7% as other whole-grain silica (table 6). Other common uses were, in decreasing quantity of use, foundry sand, ceramics, whole-grain fillers for building products, other ground silica, and recreational sand, which accounted for 10% combined. Abrasives, chemicals, fillers, filtration sand, metallurgical flux, roofing granules, silica gravel, and traction sand, combined, accounted for the remainder of industrial sand and gravel end uses. Consumption of silica sand as frac sand decreased by 7% in 2019 compared with that in 2018. Increased consumption was noted for many end uses, including abrasives, glassmaking sand, other whole grain silica, recreational sand, and roofing granules and fillers. Consumption of silica sand for the remaining end uses in 2019 declined compared with that in 2018, except for swimming pool filtration sand, which remained unchanged. Overall, silica gravel consumption decreased by 7%, but silica gravel used for silicon and ferrosilicon metal production and filtration end uses increased substantially (table 6).

In some cases, consuming industries were intentionally located near a silica resource. For example, the automotive industry was originally located in the Midwest near clay, coal, iron, and silica resources. For that reason, foundry sands have been widely produced in Illinois, Indiana, Michigan, Ohio, and other Midwestern States. In 2019, 78% of foundry sand was produced in the Midwest (table 6).

In 2019, 51% of frac sand was produced in the Midwest. The principal sources of "Northern White" or "Ottawa" sand in the upper Midwest were the Middle and Upper Ordovician St. Peter Sandstone, the Lower Ordovician and Upper Cambrian Jordan Formation, and the Upper Cambrian Wonewoc and Mount Simon Formations. Mined in five States, frac sand from the St. Peter Sandstone was within reasonable transport distance to numerous underground shale formations producing natural gas. Additional frac sand sources to the south included the Upper Cambrian Hickory Sandstone Member of the Riley Formation in Texas, which is referred to informally as "Brown" or "Brady" sand, and the Middle Ordovician Oil Creek Formation in Oklahoma—both sources were increasingly used as proppant owing to lower costs and closer proximity to drilling activity in local basins (Benson and Wilson, 2015, p. 8–22).

The share of silica sold for all types of glassmaking increased slightly compared with that in 2018. Sales of sand for container glass production increased by 3% in 2019, sales for flat glass decreased by 7%, and sales to specialty glass manufacturers increased slightly compared with those in 2018 (table 6). The amount of unground silica sand consumed for fiberglass production increased by 27% and ground silica sand consumed for fiberglass production increased by 15% compared with those in 2018. Silica sand was the most-used mineral by tonnage in glassmaking and accounted for more than 70% of total batch composition (Industrial Minerals, 2017).

The demand for foundry sand was dependent mainly on automobile and light truck production. Sales of foundry sand decreased by 11% compared with those in 2018.

Whole-grain silica was used regularly in filler-type and building applications. In 2019, consumption of whole-grain fillers for building products was 2.05 Mt, a 13% decrease compared with that in 2018.

In 2019, silica sand sales for chemical production were 509,000 t, a decrease of 38% compared with those in 2018. Total sales of silica gravel for silicon and ferrosilicon production, filtration, and other uses decreased by 7% in 2019 compared with those in 2018. The main uses for silicon metal were in the manufacture of silanes, silicones, and semiconductor-grade silicon and in the production of aluminum alloys.

Producers of industrial sand and gravel were asked to provide statistics on the destination of silica produced at their operations. The producers were asked to list only the quantity of shipments (no value data were collected in this section of the questionnaire) and the State or other location to which the material was shipped for consumption. For producers that did not provide this information, their data were estimated or assigned to the "Destination unknown" category. In 2019, 72% of industrial sand and gravel shipped by producers was assigned to the "Destination unknown" category. All 50 States received industrial sand and gravel. Of the quantity of shipments reported, the States that received the most industrial sand and gravel were, in descending order, Texas, North Dakota, Oklahoma, Ohio, Pennsylvania, North Carolina, California, Louisiana, New Jersey, and Minnesota. Producers reported exporting 279,000 metric tons (t) of silica to Mexico (table 7).

Transportation.—According to the USGS voluntary survey of U.S. producers, of all industrial sand and gravel produced in 2019, 39% was transported by truck from the plant to the site of first sale or use, 23% was transported by rail, 2% was transported by waterway, and 36% was transported by unspecified modes of transport. In any given year, most industrial sand and gravel, including frac sand, was transported by rail and truck to sites of first use, but because some producers did not provide transportation information, some transportation data were assigned to the "unspecified modes of transport" category.

Prices.—The average unit value, free on board plant, of U.S. industrial sand and gravel decreased to $47.30 per metric

ton in 2019, a 16% decrease compared with the average value of $56.36 per metric ton in 2018 (table 1). The average unit values for industrial sand and industrial gravel were $47.41 per metric ton and $21.05 per metric ton, respectively. The average unit value for sand ranged from $22.53 per metric ton for ground sand for molding and core to $80.75 per metric ton for swimming pool filtration. For gravel, unit values ranged from $17.21 per metric ton for silicon and ferrosilicon production to $24.43 per metric ton for filtration uses. Nationally, sand for swimming pool filtration had the highest value ($80.75 per metric ton), followed by well packing and cementing sand ($64.92 per metric ton), ground sand for fillers ($64.33 per metric ton), ground and unground sand for chemicals ($64.02 per metric ton), ground sand for fiberglass ($63.39 per metric ton), foundry sand for refractory ($60.30 per metric ton), and sand for container glass ($59.71 per metric ton) (table 6). In addition to decreased demand for frac sand, sand for certain other industrial end uses experienced fluctuating to decreasing demand resulting in lower prices in 2019.

In any given year, producer prices reported to the USGS for silica commonly ranged from several dollars per metric ton to hundreds of dollars per metric ton. Prices for certain high-purity quartz products for specialized end uses, not covered in this chapter, can reach thousands of dollars per metric ton. These specialized end uses include fused quartz crucibles (for the manufacture of silicon metal ingots that are later processed into silicon wafers for the photovoltaic cell and semiconductor markets), solar power cells, high-temperature lamp tubing, and telecommunications uses (Industrial Minerals, 2013).

By geographic division, the average unit value of industrial sand and gravel was highest in the Northeast ($62.28 per metric ton), followed by the Midwest ($49.32 per metric ton), the South ($45.66 per metric ton), and the West ($33.33 per metric ton) (table 6). Prices can vary greatly for similar grades of silica at various locations in the United States, owing to limited supplies and higher production costs in certain regions of the country. For example, the average unit value of container glass sand varied from $81.03 per metric ton in the Northeast to $39.04 per metric ton in the West (table 6).

Foreign Trade.—Exports of industrial sand and gravel in 2019 decreased by 14% compared with the quantity exported in 2018, and the associated value decreased by 16% (table 8). Canada was the leading recipient of United States exports, receiving 85% of total industrial sand and gravel exports; Mexico received 7%, and Japan received 4%. The remainder went to many other countries. The average unit value of exports decreased to $87.63 per metric ton in 2019 from $89.67 per metric ton in 2018. In 2019, export unit values varied widely by region, indicating that only small quantities of higher value material were shipped longer distances.

Imports for consumption of industrial sand decreased slightly to 389,000 t, compared with those in 2018 (table 9). The total value of imports was $20.7 million, with an average unit value of $53.32 per metric ton. Canada supplied 87% of the silica imports and these imports averaged $14.72 per metric ton; this included cost, insurance, and freight to the United States ports of entry. Higher priced imports came from Australia, Belgium, Brazil, Chile, China, Germany, Japan, the Netherlands, and Taiwan.

World Review.—Based on information provided mainly by foreign Governments, world production of industrial sand and gravel was estimated to be 325 Mt (table 10). Of the countries listed, the United States was the leading global producer with 35% of world production, followed, in descending order, by the Netherlands, Spain, Italy, India, Malaysia, France, Turkey, Bulgaria, Germany, and Indonesia. Most countries had some production and consumption of industrial sand and gravel, which are essential to the glass and foundry industries. Because of the great variation in reporting standards, however, obtaining reliable information was sometimes difficult. In addition to the countries listed, many other countries were thought to have had some type of silica production and consumption. Based on estimates of glass production, China was thought to be the world's leading producer of industrial sand.

Outlook.—In December 2019, an outbreak of a novel coronavirus (COVID-19) was first identified in China. The World Health Organization declared that COVID-19 was a global pandemic on March 11, 2020. Measures instituted to mitigate the spread of the COVID-19 pandemic, such as closures of nonessential businesses, are likely to cause disruptions in the mining industry across the United States and around the world. The duration and the outcome of the COVID-19 pandemic remains uncertain, but it is expected that the economies of the United States and the world as a whole will likely be negatively affected, which could influence the performance of the industrial sand and gravel industry.

The United States is the leading producer, major consumer, and net exporter of silica sand and is self-sufficient in this mined mineral commodity. Domestic production is expected to continue to satisfy 97% to 98% of U.S. consumption well beyond 2019. By yearend 2019 and continuing into 2020, declining oil and gas prices and the resultant decreased oilfield activity would lead to slackened demand for frac sand and sand for well packing and cementing. Reduced demand and (or) oversupply conditions could result in reduced production and consumption of frac sand and sand for well packing and cementing.

Because the unit price for most silica sand is relatively low, the proximity of a silica sand deposit to market location will continue to be an important factor in determining the economic feasibility of developing a deposit. Consequently, a significant number of relatively small operations will supply local markets with a limited number of products.

Increased efforts to reduce waste and to increase recycling would likely lower demand for mined glass sand. Glass cullet is an industry term for furnace-ready scrap glass, an important material used in glass manufacturing. Recycling of glass cullet has increased in most industrialized nations, and recycling has accounted for 25% to 70% of the raw material needed for the glass container industry in many countries. It has been estimated that for every 10% of recycled glass cullet used in the melting process for glass container manufacture, energy use decreases by 2% to 3%. According to the U.S. Environmental Protection Agency, in 2018, 39.6% of beer and soft drink glass bottles were recovered for recycling in the United States. An additional 39.8% of wine and liquor glass bottles and 15.0% of other glass bottles and jars were recycled. In total, about 33.1% of all

glass containers were recycled (U.S. Environmental Protection Agency, 2020).

Health concerns about the use of silica sand and stricter legislative and regulatory measures concerning crystalline silica exposure could reduce demand in some silica markets. The use of silica sand in the abrasive blast industry was being evaluated as a health hazard, and marketers of competing materials, which include garnet, olivine, and slags, encouraged the use of their "safer" media. In addition, owing to health concerns and compliance with stricter legislative and regulatory measures, the use of ceramic molding media in the foundry industry was being evaluated as a competing material with silica sand.

Quartz Crystal

Natural quartz crystal was used in many electronic and optical applications until 1971, when it was replaced by cultured quartz crystal. Cultured quartz is not a mined mineral commodity; rather, it is synthetically produced from natural feedstock quartz, termed "lascas," which is mined. Cultured quartz crystal that has been rejected owing to crystallographic imperfections is used by certain companies as feedstock for growing cultured quartz crystal. Mining of lascas in the United States ceased in 1997 owing to competition from less expensive imported lascas, predominantly from mines in Brazil and Madagascar.

The use of natural quartz crystal for carvings and other gemstone applications has continued; more information can be found in the "Gemstones" chapter of the USGS Minerals Yearbook, volume I, Metals and Minerals.

Legislation and Government Programs.—The strategic value of quartz crystal was demonstrated during World War II when it gained widespread use as an essential component of military communication systems. After the war, natural electronic-grade quartz crystal was designated as a strategic and critical material for stockpiling by the Federal Government. Cultured quartz crystal, which eventually supplanted natural crystal in nearly all applications, was not commercially available when acquisition of natural quartz crystal for a national stockpile began.

As of December 31, 2019, the National Defense Stockpile (NDS) contained 7,148 kilograms (kg) of natural quartz crystal. The stockpile has 11 weight classes for natural quartz crystal that range from 0.2 kg to more than 10 kg. The stockpiled crystals are primarily in the larger weight classes. The larger pieces are individual crystals in the NDS inventory that weigh 10 kg or more and are suitable as seed crystals, which are very thin crystals cut to exact dimensions, to produce cultured quartz crystal. In addition, many of the stockpiled crystals could be of interest to the specimen and gemstone industry. Little, if any, of the stockpiled material is likely to be used in the same applications as cultured quartz crystal. Brazil traditionally has been the source of such large natural crystals, but changes in mining operations have reduced output.

Natural quartz crystal was not sold from the NDS in 2019, and the Federal Government did not intend to dispose of or sell any of the remaining material.

Quartz crystal is affected by the regulation of crystalline silica as discussed in the "Legislation and Government Programs" portion of the "Industrial Sand and Gravel" section of this chapter.

Production.—The USGS collects production data for quartz crystal through a survey of the domestic industry. Anecdotal evidence indicated that two companies produced cultured quartz crystal in the United States. In 2019, one of the companies reported the production of cultured quartz crystal, but production data were withheld to avoid disclosing company proprietary data. At least one of these companies used cultured quartz crystal that had been rejected as feedstock for growing cultured quartz crystal owing to crystallographic imperfections. More cultured quartz crystal was produced overseas than in the United States, primarily in Asia and Europe.

Consumption.—In 2019, the USGS collected domestic consumption data for quartz crystal through a survey of 12 U.S. operations that fabricate quartz crystal devices in seven States. Of the 12 operations, 6 responded to the survey. Total U.S. consumption of quartz crystal in 2019, including that by nonrespondents, was estimated to be in the range of 3,000 to 6,000 kg; consumption of quartz crystal may be larger.

Electronic-grade quartz crystal, also known as cultured quartz crystal, is single-crystal silica with properties uniquely suited for accurate filters, frequency controls, and timers used in electronic circuits. These devices were used for a variety of electronic applications in aerospace hardware, commercial and military navigational instruments, communications equipment, computers, and consumer goods (for example, clocks, games, television receivers, and toys). Such uses generate most demand for electronic-grade quartz crystal. A small amount of optical-grade quartz crystal was used for lenses and windows in specialized devices, including some lasers.

Prices.—The price of as-grown cultured quartz was estimated to be $200 per kilogram in 2019, but in any given year prices can vary depending on the producer. Lumbered quartz, which is as-grown cultured quartz that has been processed by sawing and grinding, was estimated to be $500 per kilogram in 2019, but prices have ranged from $20 per kilogram to more than $1,500 per kilogram, depending on the application.

Foreign Trade.—The U.S. Census Bureau, which is the major Government source of U.S. trade data, does not provide specific import or export statistics on lascas, but does collect export and import statistics on electronic- and optical-grade quartz crystal. Cultured quartz crystal exports decreased by 6% to 40,900 kg in 2019 from 43,400 kg in 2018. Cultured quartz crystal imports (Harmonized Tariff Schedule of the United States code 7104.10.0000) more than tripled to 54,700 kg in 2019 from 16,100 kg in 2018. The top five sources of imported cultured quartz crystal to the United States in 2019 were China, Japan, Denmark, Russia, and Taiwan.

World Review.—Cultured quartz crystal production was concentrated in China, Japan, and Russia; several companies produced crystal in each country. Belgium, Brazil, Bulgaria, France, Germany, Italy, Romania, South Africa, Taiwan, and the United Kingdom also produced cultured quartz crystal. Details concerning quartz operations in China, Eastern Europe, and most nations of the Commonwealth of Independent States were unavailable. Operations in Russia, however, have significant capacity to produce synthetic quartz.

Outlook.—Increasing imports of piezoelectric quartz in the past several years were likely the result of increased demand

for vibration sensors such as accelerometers, which are used in aerospace and automotive applications. Demand for cultured quartz crystal for frequency-control oscillators and frequency filters in a variety of electronic devices is expected to remain stable. Growth of the consumer electronics market (for example, personal computers, electronic games, and tablet computers) is likely to sustain global production of cultured quartz crystal.

Special Silica Stone Products

In 2019, crude production of special silica stone was estimated to be unchanged compared with that in 2018 (table 1). The value of crude production in 2019 was $76,000, unchanged compared with that in 2018. Silica stone (another type of crystalline silica) products are materials for abrasive tools, such as deburring media, grinding pebbles, grindstones, hones, oilstones, stone files, tube-mill liners, and whetstones. These products were manufactured from novaculite, quartzite, and other microcrystalline quartz rock. This chapter, however, excludes products that are fabricated from such materials by artificial bonding of the abrasive grains (information on other manufactured and natural abrasives may be found in other chapters of the USGS Minerals Yearbook, volume I, Metals and Minerals).

Special silica stone is also affected by the regulation of crystalline silica as discussed in the "Legislation and Government Programs" part of the "Industrial Sand and Gravel" section of this chapter.

Production.—None of the four domestic firms thought to produce special silica stone in 2019 responded to the USGS production survey. In recent years, Arkansas accounted for most of the value and quantity of reported production. Plants in Arkansas manufactured files, deburring-tumbling media, oilstones, and whetstones.

The industry produced and marketed four main grades of Arkansas whetstone in recent years. The grades ranged from the high-quality black, hard Arkansas stone to Washita stone, a soft, coarse stone. In general, the black, hard Arkansas stone has a porosity of 0.07% and a waxy luster, and Washita stone has a porosity of 16% and resembles unglazed porcelain.

Consumption.—The domestic consumption of special silica stone products consisted of a combination of craft, household, industrial, and leisure uses. The leading household use was for sharpening knives and other cutlery, lawn and garden tools, scissors, and shears. Major industrial uses included deburring metal and plastic castings, polishing metal surfaces, and sharpening and honing cutting surfaces. The major recreational use was in sharpening arrowheads, fishhooks, spear points, and sports knives. The leading craft application was sharpening tools for engraving, jewelry making, and woodcarving. Silica stone files also were used in the manufacture, modification, and repair of firearms.

Prices.—In 2019, the average value of crude material suitable for cutting into finished products was estimated to be $239 per metric ton.

Foreign Trade.—In 2019, silica stone product exports had a value of $13.4 million, a decrease of 18% from that in 2018. These exports were categorized as "hand sharpening or polishing stones" by the U.S. Census Bureau. This category accounted for most or all the silica stone products exported in 2019.

In 2019, the value of imported silica stone products was $13.8 million, a decrease of 27% from that in 2018. These imports were hand sharpening or polishing stones, which accounted for most or all the imported silica stone products in 2019. A portion of the finished products that were imported may have been made from crude novaculite originally produced from mines in the United States and exported for processing.

Outlook.—Consumption patterns for special silica stone are not expected to change significantly during the next several years. Most of the existing markets are well defined, and there is a low probability of new uses being created.

Tripoli

Tripoli, broadly defined, includes extremely fine-grained crystalline silica in various stages of aggregation. Grain sizes usually range from 1 to 10 micrometers (μm), but particles as small as 0.1 to 0.2 μm are common. Commercial tripoli contains 98% to 99% silica and minor quantities of alumina (as clay) and iron oxide. Tripoli may be white or some shade of brown, red, or yellow, depending on the percentage of iron oxide.

Tripoli is affected by the regulation of crystalline silica as discussed in the "Legislation and Government Programs" part of the "Industrial Sand and Gravel" section of this chapter.

Production.—In 2019, three U.S. companies were known to produce and process tripoli. American Tripoli, Inc. operated a mine and produced finished material in Newton County, MO. Malvern Minerals Co. in Garland County, AR, produced crude and finished material from novaculite. Covia Specialty Minerals Inc. in Alexander County, IL, produced crude and finished material. Of the three U.S. firms, one responded to the USGS survey. Production for the nonrespondents was estimated based on reports from previous years and supplemented with worker-hour reports from MSHA.

Consumption.—Sales of processed tripoli in 2019 increased by an estimated 19% to 106,000 t with a value of $18.9 million (table 1). The increase in tripoli sales was owing to increased demand for its use as a functional filler and extender in adhesives, plastics, rubber, and sealants. In 2019, about 96% of tripoli was used as a filler and extender in caulking compounds, concrete admixture, enamel, linings, paint, plastic, rubber, and other products. Most of the filler-grade tripoli was used in the relatively low cost concrete admixture end use. Less than 1% of the tripoli was used in brake friction products and refractories. The end-use pattern for tripoli has changed significantly since 1970 when nearly 70% of processed tripoli was used as an abrasive. In 2019, about 4% of tripoli output was used as an abrasive.

Prices.—The average unit value as reported by domestic producers of all tripoli sold or used in the United States was estimated to be $178 per metric ton in 2019. The average unit value of abrasive-grade tripoli sold or used in the United States during 2019 was estimated to be $315 per metric ton, and the average unit value of filler-grade tripoli sold or used domestically was estimated to be $175 per metric ton.

Outlook.—Consumption patterns for tripoli are not expected to change significantly during the next several years. Most of the existing markets are well defined, and the probability of new uses being created is low.

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GENERAL SOURCES OF INFORMATION

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TABLE 1
SALIENT U.S. SILICA STATISTICS[1]

(Thousand metric tons and thousand dollars unless otherwise specified)

		2015	2016	2017	2018	2019
Industrial sand and gravel:[2]						
Sold or used:						
Quantity:						
Sand		101,000	78,800	102,000	123,000 r	113,000
Gravel		962	574	513	531	492
Total		102,000	79,400	103,000	123,000 r	114,000
Value:						
Sand		4,820,000	2,800,000	5,330,000	6,930,000 r	5,370,000
Gravel		16,100	9,850	11,300	12,400	10,400
Total		4,840,000	2,810,000	5,340,000	6,940,000 r	5,380,000
Exports:						
Quantity		3,910	2,780	4,680	6,550 r	5,620
Value		382,000	316,000	462,000	588,000	493,000
Imports for consumption:						
Quantity		289	281	366	392	389
Value		16,400	15,400	18,600	19,500	20,700
Processed tripoli:[3]						
Quantity	metric tons	91,300 r	76,500 r	99,000 r	89,400 r	106,000
Value		19,600 r	17,400 r	19,100 r	18,900 r	18,900
Special silica stone:						
Crude production:						
Quantity	metric tons	205	300 e	318 e	318 e	318 e
Value		49	72 e	76 e	76 e	76 e
Sold or used:[e]						
Quantity	metric tons	465	400	418	418	418
Value		765	700	732	732	732

[e]Estimated. [r]Revised.
[1]Table includes data available through September 22, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Excludes Puerto Rico.
[3]Includes amorphous silica and Pennsylvania rottenstone.

TABLE 2
INDUSTRIAL SAND AND GRAVEL SOLD OR USED IN THE UNITED STATES, BY GEOGRAPHIC DIVISION[1]

	2018				2019			
Geographic region[2]	Quantity (thousand metric tons)	Percent of total quantity	Value (thousands)	Percent of total value	Quantity (thousand metric tons)	Percent of total quantity	Value (thousands)	Percent of total value
Northeast:								
New England	127	(3)	$4,200	(3)	128	(3)	$4,230	(3)
Middle Atlantic	2,200	2	102,000	1	1,860	2	120,000	2
Midwest:								
East North Central	51,400	42	3,030,000	44	39,200	35	1,870,000	35
West North Central	17,300	14	1,060,000	16	14,500	13	778,000	14
South:								
South Atlantic	6,080	5	178,000	3	6,170	5	258,000	5
East South Central	7,650	6	399,000	6	6,730	6	255,000	5
West South Central	34,100 r	28 r	2,030,000 r	28	41,500	37	1,970,000	37
West:								
Mountain	2,200	2	61,000	1	1,660	1	42,200	1
Pacific	2,060	2	75,000	1	1,870	2	75,400	1
Total	123,000 r	100	6,940,000 r	100	114,000	100	5,380,000	100

[r]Revised.
[1]Table includes data available through September 22, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Sales region equivalent to U.S. Census Bureau Geographic Division as follows: New England (CT, MA, ME, NH, RI, VT); Middle Atlantic (NJ, NY, PA); East North Central (IL, IN, MI, OH, WI); West North Central (IA, KS, MN, MO, ND, NE, SD); South Atlantic (DC, DE, FL, GA, MD, NC, SC, VA, WV); East South Central (AL, KY, MS, TN); West South Central (AR, LA, OK, TX); Mountain (AZ, CO, ID, MT, NM, NV, UT, WY); Pacific (AK, CA, HI, OR, WA).
[3]Less than ½ unit.

TABLE 3
INDUSTRIAL SAND AND GRAVEL SOLD OR USED IN
THE UNITED STATES, BY STATE[1]

(Thousand metric tons and thousand dollars)

State	2018		2019	
	Quantity	Value	Quantity	Value
Alabama	1,600	44,200	1,990	71,400
Arizona	W	W	W	W
Arkansas	2,040	134,000	1,610	82,700
California	1,760	60,500	1,580	62,100
Colorado	W	W	W	W
Florida	291	9,610	352	10,200
Georgia	W	W	W	W
Idaho	W	W	W	W
Illinois	15,300	994,000	14,400	628,000
Indiana	W	W	--	--
Iowa	2,860	178,000	2,320	119,000
Kentucky	W	W	W	W
Louisiana	2,500	160,000	2,680	150,000
Michigan	669	33,200	666	27,300
Minnesota	5,200	315,000	4,970	267,000
Mississippi	4,450	290,000	3,130	116,000
Missouri	8,330	514,000	6,680	366,000
Nebraska	W	W	W	W
Nevada	W	W	W	W
New Jersey	1,220	69,600	1,030	49,700
New York	W	W	W	W
North Carolina	3,140	43,800	2,970	76,300
North Dakota	W	W	--	--
Ohio	1,010	48,000	903	49,300
Oklahoma	6,000 r	281,000 r	6,990	318,000
Oregon	--	--	W	W
Pennsylvania	W	W	W	W
Rhode Island	W	W	W	W
South Carolina	532	26,000	546	34,400
South Dakota	W	W	W	W
Tennessee	1,490	59,400	1,490	62,300
Texas	23,600 r	1,450,000 r	30,200	1,420,000
Virginia	W	W	W	W
Washington	W	W	W	W
West Virginia	543	33,100	356	30,600
Wisconsin	34,400 r	1,950,000	23,300	1,170,000
Other	6,210	243,000	5,500	268,000
Total	123,000 r	6,940,000 r	114,000	5,380,000

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other." -- Zero.
[1]Table includes data available through September 22, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 4
INDUSTRIAL SAND AND GRAVEL PRODUCTION IN THE UNITED STATES IN 2019, BY SIZE OF OPERATION[1]

Capacity (metric tons per year)	Number of operations	Percent of total operations	Quantity (thousand metric tons)	Percent of total quantity
Less than 25,000	53	19	442	(2)
25,000 to 49,999	31	11	1,020	1
50,000 to 99,999	29	10	1,930	2
100,000 to 199,999	42	15	5,170	5
200,000 to 299,999	18	6	4,170	4
300,000 to 399,999	18	6	5,650	5
400,000 to 499,999	14	5	5,690	5
500,000 to 599,999	16	6	7,920	7
600,000 to 699,999	3	1	1,680	1
700,000 and more	53	21	80,000	70
Total	277	100	114,000	100

[1]Table includes data available through September 22, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than ½ unit.

TABLE 5
NUMBER OF INDUSTRIAL SAND AND GRAVEL OPERATIONS AND PROCESSING PLANTS IN THE UNITED STATES IN 2019, BY GEOGRAPHIC DIVISION[1]

	Mining operations on land			Total active operations
Geographic region[2]	Stationary	Stationary and portable	Dredging operations	
Northeast:				
New England	1	--	--	1
Middle Atlantic	3	1	3	7
Midwest:				
East North Central	71	8	5	84
West North Central	11	11	8	30
South:				
South Atlantic	21	8	5	34
East South Central	14	1	4	19
West South Central	63	2	14	79
West:				
Mountain	5	--	--	5
Pacific	16	2	--	18
Total	205	33	39	277

-- Zero.
[1]Table includes data available through September 22, 2020.
[2]Sales region equivalent to U.S. Census Bureau Geographic Division as follows: New England (CT, MA, ME, NH, RI, VT); Middle Atlantic (NJ, NY, PA); East North Central (IL, IN, MI, OH, WI); West North Central (IA, KS, MN, MO, ND, NE, SD); South Atlantic (DC, DE, FL, GA, MD, NC, SC, VA, WV); East South Central (AL, KY, MS, TN); West South Central (AR, LA, OK, TX); Mountain (AZ, CO, ID, MT, NM, NV, UT, WY); and Pacific (AK, CA, HI, OR, WA).

TABLE 6
INDUSTRIAL SAND AND GRAVEL SOLD OR USED BY U.S. PRODUCERS IN 2019, BY MAJOR END USE[1]

Major use	Northeast			Midwest			South			West			U.S. total		
	Quantity (thousand metric tons)	Value (thousands)	Unit value[2] (dollars per ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value[2] (dollars per ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value[2] (dollars per ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value[2] (dollars per ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value[2] (dollars per ton)
Sand:															
Glassmaking:															
Containers	W	W	$81.03	1,600	$84,600	$52.98	W	W	$59.75	433	$16,900	$39.04	4,860	$290,000	$59.71
Flat, plate and window	--	--	--	877	51,500	58.69	W	W	51.94	W	W	37.00	2,620	136,000	51.81
Specialty	W	W	57.32	W	W	63.59	181	$7,100	39.24	W	W	64.00	531	29,300	55.22
Fiberglass, unground	W	W	33.02	W	W	62.39	W	W	52.57	--	--	--	333	17,700	53.05
Fiberglass, ground	--	--	--	5	274	54.80	W	W	63.45	W	W	64.57	429	27,200	63.39
Foundry:															
Molding and core, unground	W	W	33.06	2,630	118,000	45.03	427	22,800	53.41	W	W	33.19	3,150	144,000	45.83
Molding and core, ground	--	--	--	W	W	22.36	W	W	85.98	--	--	--	186	4,190	22.53
Refractory	--	--	--	W	W	52.22	W	W	65.76	--	--	--	93	5,610	60.30
Metallurgical, flux for metal smelting	--	--	--	W	W	82.13	W	W	57.68	W	W	18.20	18	802	44.56
Abrasives, blasting	W	W	32.90	W	W	60.08	413	15,800	38.36	W	W	106.90	568	21,400	37.70
Chemicals, ground and unground	--	--	--	224	11,400	50.93	285	21,200	74.30	--	--	--	509	32,600	64.02
Fillers, ground, rubber, paints, putty, etc.	--	--	--	252	15,700	62.32	W	W	74.07	W	W	60.19	311	20,000	64.33
Whole-grain fillers/building products	159	$8,220	51.68	427	25,300	59.36	556	29,600	53.20	903	21,500	23.78	2,050	84,600	41.36
Ceramic, ground, pottery, brick, tile, etc.	--	--	--	W	W	57.39	86	6,080	70.70	W	W	82.10	2,410	139,000	57.88
Filtration:															
Water, municipal, county, local	W	W	32.59	189	8,530	45.15	67	5,210	77.82	W	W	33.07	386	18,100	46.77
Swimming pool, other	6	187	31.17	9	729	81.00	W	W	75.47	W	W	129.56	76	6,140	80.75
Petroleum industry:															
Hydraulic fracturing	W	W	57.25	41,900	2,080,000	49.52	38,700	1,890,000	48.91	W	W	38.58	81,500	4,010,000	49.21
Well packing and cementing	--	--	--	298	22,300	74.83	649	38,200	58.87	10	1,620	162.20	957	62,100	64.92
Recreational:															
Golf course, greens and traps	W	W	41.52	176	9,220	52.41	1,010	31,800	31.48	W	W	35.23	1,320	46,100	35.00
Baseball, volleyball, play sand, beaches	W	W	45.19	43	2,380	55.40	367	15,800	43.01	W	W	47.22	494	22,000	44.62
Traction, engine	5	154	30.80	W	W	55.87	26	1,050	40.50	W	W	67.26	60	2,920	48.58
Roofing granules and fillers	58	1,950	33.64	W	W	40.49	W	W	61.05	W	W	49.28	441	24,500	55.60
Other, ground	W	W	28.55	W	W	35.77	971	32,100	33.09	W	W	33.20	1,710	57,400	33.64
Other, whole grain	39	1,930	49.59	1,620	39,900	24.69	5,980	135,000	22.50	543	18,500	34.12	8,180	195,000	23.84
Total or average	1,970	123,000	62.68	53,600	2,650,000	49.37	54,200	2,480,000	45.76	3,420	116,000	34.03	113,000	5,370,000	47.41
Gravel:															
Silicon, ferrosilicon	--	--	--	W	W	33.07	W	W	64.64	W	W	8.82	117	2,010	17.21
Filtration	W	W	28.83	W	W	21.56	W	W	27.56	--	--	--	98	2,390	24.43
Other uses, specified	W	W	33.07	W	W	15.78	231	4,960	21.47	W	W	33.07	277	5,950	21.48
Total or average	24	718	29.92	90	1,820	20.27	274	6,710	24.48	105	1,110	10.56	492	10,400	21.05
Grand total or average	1,990	124,000	62.28	53,700	2,650,000	49.32	54,400	2,480,000	45.66	3,530	118,000	33.33	114,000	5,380,000	47.30

W Withheld to avoid disclosing company proprietary data; included in "Total or average" and "Grand total or average." -- Zero.

[1]Table includes data available through September 22, 2020. Data are rounded to no more than three significant digits, except for unit values; may not add to totals shown.

[2]Calculated using unrounded data.

TABLE 7
INDUSTRIAL SAND AND GRAVEL SOLD OR USED, BY DESTINATION[1]

(Thousand metric tons)

Destination	2018	2019	Destination	2018	2019
State:			State—Continued:		
Alabama	172	176	New Jersey	489	569
Alaska	W	W	New Mexico	W	W
Arizona	17	16	New York	W	W
Arkansas	13	4	North Carolina	1,330	1,130
California	914	1,060	North Dakota	2,150	2,570
Colorado	W	W	Ohio	1,700	1,970
Connecticut	W	W	Oklahoma	1,840	2,340
Delaware	W	W	Oregon	W	W
Florida	24	24	Pennsylvania	1,990	1,870
Georgia	W	W	Rhode Island	W	W
Hawaii	W	W	South Carolina	205	218
Idaho	W	W	South Dakota	23	21
Illinois	255	146	Tennessee	555	549
Indiana	W	W	Texas	10,800	11,600
Iowa	W	W	Utah	W	W
Kansas	17	52	Vermont	W	W
Kentucky	W	W	Virginia	W	W
Louisiana	934	930	Washington	W	W
Maine	W	W	West Virginia	W	W
Maryland	W	W	Wisconsin	2,970 r	502
Massachusetts	W	W	Wyoming	W	W
Michigan	26	16	Country:		
Minnesota	634	558	Canada	W	W
Mississippi	W	W	Mexico	266	279
Missouri	438	509	Other	W	W
Montana	237	85	Other:		
Nebraska	W	W	Puerto Rico	W	W
Nevada	W	W	U.S. possessions and territories	--	--
New Hampshire	W	W	Destination unknown	87,800 r	81,800
			Total	123,000 r	114,000

[r]Revised. W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.
[1]Table includes data available through September 22, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 8
U.S. EXPORTS OF INDUSTRIAL SAND AND GRAVEL, BY REGION AND COUNTRY OR LOCALITY[1]

(Thousand metric tons and thousand dollars)

Destination	2018		2019	
	Quantity	Value[2]	Quantity	Value[2]
Africa and the Middle East:				
Israel	(3)	299	(3)	377
Saudi Arabia	(3)	45	(3)	316
United Arab Emirates	(3)	179	(3)	107
Other	1	297	(3)	312
Total	1	820	1	1,110
Asia:				
China	25	60,000	26	65,800
Hong Kong	(3)	43	(3)	129
India	2	2,250	2	2,930
Japan	272	47,900	207	43,400
Korea, Republic of	1	1,390	1	1,230
Singapore	1	479	1	437
Taiwan	1	919	1	639
Thailand	1	880	1	662
Other	2 r	1,260	2	1,550
Total	304	115,000	241	117,000
Europe:				
Belgium	1	672	1	679
France	26	6,230	18	6,380
Germany	17	28,400	12	25,600
Italy	(3)	59 r	1	261
Netherlands	15	7,950	3	3,190
Norway	16	12,000	21	14,700
Russia	(3)	126	(3)	42
United Kingdom	2	1,450	3	2,270
Other	7 r	3,220	6	3,190
Total	84	60,100	66	56,400
North America:				
Bahamas, The	2	343	1	293
Canada	5,580	304,000	4,800	243,000
Costa Rica	1	288	1	276
Dominican Republic	3	1,050	2	706
Jamaica	4	702	4	907
Mexico	472	51,800	414	41,400
Trinidad and Tobago	1	244	(3)	181
Other	4	1,130	9	1,790
Total	6,060 r	360,000	5,230	288,000
Oceania:				
Australia	14	26,800	3	5,570
Marshall Islands	(3)	117	(3)	21
New Zealand	(3)	516	(3)	341
Total	15 r	27,400	3	5,930
South America:				
Argentina	54	16,100	53	16,100
Brazil	11	2,190	12	2,380
Chile	(3)	186	6	1,680
Colombia	4	785	1	533
Peru	17	4,840	12	3,760
Venezuela	(3)	8	--	--
Other	1	143	1	217
Total	87 r	24,200	85	24,700
Grand total	6,550 r	588,000	5,630	493,000

rRevised. -- Zero.

[1]Table includes data available through July 15, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Free alongside ship value of material at U.S. port of export. Based on transaction price; includes all charges incurred in placing material alongside ship.

[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 9
U.S. IMPORTS FOR CONSUMPTION OF INDUSTRIAL SAND, BY COUNTRY OR LOCALITY[1]

(Thousand metric tons and thousand dollars)

	2018		2019	
Country or locality	Quantity	Value[2]	Quantity	Value[2]
Australia	3	2,820	5	4,550
Belgium	10	2,480	1	453
Brazil	3	2,670	4	2,390
Canada	336	6,340	337	4,960
Chile	(3)	76	1	134
China	2	365	(3)	95
Germany	(3)	176	1	197
Japan	(3)	26	(3)	14
Mexico	--	--	1	218
Netherlands	(3)	13 r	(3)	10
Taiwan	4	895	9	1,610
Other	32 r	3,680	29	6,110
Total	392	19,500	389	20,700

rRevised. -- Zero.
[1]Table includes data available through July 15, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Cost, insurance, and freight value of material at U.S. port of entry. Based on purchase price; includes all charges (except U.S. import duties) in bringing material from foreign country to alongside carrier.
[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 10
INDUSTRIAL SAND AND GRAVEL (SILICA): WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Thousand metric tons)

Country or locality[2]	2015	2016	2017	2018	2019
Algeria, unspecified[e]	65	60	60	60	60
Angola:[e]					
Quartz	10	10	10	10	10
Unspecified	50	50	50	50	50
Argentina, unspecified	1,098	949	1,137 [r]	1,584 [r]	1,600 [e]
Australia, quartz and quartzite[e]	3,000	3,000	3,000	3,000	3,000
Austria:					
Quartz and quartzite, including pegmatite	319	388	421	475 [r]	475 [e]
Quartz	1,008	841	902 [r]	1,126 [r]	1,130 [e]
Bhutan, quartzite	80	93	176	146 [r]	146 [e]
Bosnia and Herzegovina, unspecified	214	71	65	65 [e]	65 [e]
Bulgaria:					
Quartz[e]	947	947	947	947	947
Sand	7,640	6,289	6,300 [e]	6,660 [r]	6,700 [e]
Cameroon:[e]					
Quartzite	6	6	6	6	6
Quartzite, silica	4	4	4	4	4
Canada, quartz	2,053	2,256	2,540	2,778 [r]	2,800 [e]
Chile:					
Quartz	434	400	552	584 [r]	584 [e]
Silica sand	824	912	888	792 [r]	792 [e]
Croatia, quartz and quartzite	195	176	141	141 [e]	141 [e]
Cuba, unspecified	25	19	22	23 [r]	23 [e]
Czechia:					
Foundry sand	535	521	556	559	560 [e]
Glass sand	812	801	755	743	743 [e]
Quartz and quartzite	14	18	17	16	16 [e]
Denmark, quartz	459	502	536	521	573
Dominican Republic, silica sand	27	74	94	46	46 [e]
Ecuador, unspecified	84 [r]	62	41	106 [r]	106 [e]
Egypt:					
Quartz	101	101	100 [e]	100 [e]	100 [e]
Unspecified	416	600 [e]	600 [e]	600 [e]	600 [e]
Estonia, unspecified	26	57	50	41	41 [e]
Ethiopia:					
Quartz	3 [e]	3	3 [e]	3 [e]	3 [e]
Sand	10	10 [e]	10 [e]	10 [e]	10 [e]
France:					
Silica	8,818	9,282	9,300 [e]	9,300 [e]	9,300 [e]
Unspecified	9	9	9 [e]	9 [e]	9 [e]
Germany, unspecified	7,500	7,500 [e]	7,500 [e]	7,500 [e]	7,500 [e]
Greece, unspecified	75	142	77	80 [r]	51
Guatemala, sand	325	516	69	69 [e]	69 [e]
Hungary:					
Foundry sand	62 [e]	66	110 [r]	110 [r]	110 [e]
Glass sand	66	69	66	66 [e]	66 [e]
Unspecified	80	80 [e]	80 [e]	80 [e]	80 [e]
India:					
Quartz and quartzite	4,000	4,530 [e]	4,500 [e]	4,500 [e]	4,500 [e]
Sand	3,000	3,200 [e]	3,400	3,400 [e]	3,400 [e]
Unspecified	4,000	4,000 [e]	4,000 [e]	4,000 [e]	4,000 [e]
Indonesia:[e]					
Silica, in the form of quartz	4,400	4,900	5,500	5,500	5,500
Unspecified	35	35	35	35	35
Iran, glass sand[e]	1,500	1,500	1,500	1,500	1,500
Israel, unspecified	218	302	560	560 [e]	560 [e]
Italy	13,900	13,900	14,000 [e]	14,000 [e]	14,000 [e]
Jamaica, unspecified	16	20	20 [e]	20 [e]	20 [e]
Japan, unspecified	2,845	2,762	2,695	2,524	2,273
Jordan, unspecified	200 [e]	362 [r]	426	400 [e]	400 [e]

See footnotes at the end of table.

TABLE 10—Continued
INDUSTRIAL SAND AND GRAVEL (SILICA): WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Thousand metric tons)

Country or locality[2]	2015	2016	2017	2018	2019
Kenya, glass sand[e]	27	27	25	25	25
Korea, Republic of:					
Quartzite	3,569	3,778	4,334	3,247	3,250 [e]
Sand	661	682	952	1,048	1,000 [e]
Kyrgyzstan, silica	1,172	601	816	696 [r]	710 [e]
Lithuania	52	45	48	58	58
Malaysia, unspecified	9,003	10,353	10,000 [e]	10,000 [e]	10,000
Mexico, quartz and quartzite	1,751	2,399	2,356	2,360 [e]	2,360 [e]
Netherlands	71,239	54,725	54,000	54,000 [e]	54,000 [e]
New Zealand:					
Sand	1,457	1,355	2,262	1,566 [r]	1,570 [e]
Unspecified	43	25	53	53 [e]	53 [e]
Nigeria, silica sand	10 [e]	4	28	38 [r]	38 [e]
Norway, quartz and quartzite	1,112 [r]	1,174	1,066	1,358 [r]	1,360 [e]
Oman:					
Quartz	351	362	314	314 [e]	314 [e]
Unspecified	9	17	34	21 [r]	21 [e]
Pakistan:					
Sand	7	51 [r]	28 [r]	18 [r]	20 [e]
Unspecified	359	395	315 [r]	683 [r]	594 [e]
Peru, quartz and quartzite	85	75	73	68 [r]	44
Philippines, silica sand	438 [r]	502 [r]	507 [r]	1,220 [r]	1,220 [e]
Poland:					
Foundry sand	1,103	1,081	1,023	1,030 [e]	1,030 [e]
Glass sand	2,669	2,262	2,472	2,435	2,435
Moulding sand	1,633	1,253	1,643	1,512	1,510 [e]
Quartzite	55	65	78	138	138 [e]
Portugal:					
Quartz	1	1	3	3 [e]	3 [e]
Quartzite	27	25	25	25	25 [e]
Saudi Arabia, unspecified	1,230	1,300	1,365	1,433	1,400 [e]
Serbia, common sand	259	205	205	185 [r]	185 [e]
Slovakia, unspecified	500	500 [e]	500 [e]	400 [r]	400 [e]
Slovenia, quartz and quartzite	343	338	359	344 [r]	344 [e]
South Africa, unspecified	2,278	1,886	2,401	2,287 [r]	2,300 [e]
Spain:					
Quartz[e]	900	900	900	900	900
Quartzite[e]	2,000	2,000	2,000	2,000	2,000
Unspecified	34,000	31,000	32,600	32,600 [e]	32,600 [e]
Sri Lanka, unspecified	65 [r]	50 [r]	41 [r]	41 [r,e]	41 [e]
Taiwan, unspecified	132	176	139	58	70
Thailand, unspecified	1,192	1,103	1,756 [r]	1,557 [r]	1,248
Turkey, unspecified	12,014	10,472	13,472	9,100 [r,e]	9,100 [e]
United Kingdom, unspecified[e]	4,000	4,000	4,000	4,000	4,000
United States, unspecified	102,000	79,400	103,000	123,000 [r]	114,000
Venezuela, unspecified[e]	7	7	7	7	7
Total	329,000	287,000 [r]	319,000 [r]	335,000 [e]	325,000 [e]

[e]Estimated. [r]Revised.

[1]Table includes data available through October 1, 2020. All data are reported unless otherwise noted. Totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]In addition to the countries and (or) localities listed, Angola, Antigua and Barbuda, The Bahamas, Belgium, Brazil, China, Denmark, Iran, Ireland, Latvia, the Netherlands, Paraguay, Romania, and other countries or localities may have produced industrial sand and gravel, but available information was inadequate to make reliable estimates of output. Based on estimates of glass production, China was thought to be the world's leading producer of industrial sand.