USGS
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2018 Minerals Yearbook

SILICA [ADVANCE RELEASE]

U.S. Department of the Interior
U.S. Geological Survey

November 2021

Silica

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Domestic survey data and tables were prepared by Susan M. Weaver, statistical assistant.

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 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 increased to 121 million metric tons (Mt) in 2018 from the revised 103 Mt in 2017 (table 1). Industrial sand production increased by 18%, and industrial gravel production increased by 4% compared with those in 2017. The value of production in 2018 was $6.84 billion—an increase of 28% compared with the revised $5.34 billion in 2017. Estimated world production of industrial sand and gravel in 2018 was 335 Mt, a 5% increase compared with 2017 production (table 10).

The production of 121 Mt of industrial sand and gravel in the United States in 2018 is the largest ever reported by the USGS. During the past several years, the most important driving force in the industrial sand and gravel industry remained the production and sale of hydraulic fracturing sand (frac sand). The consumption of frac sand increased greatly as hydrocarbon exploration in the United States transitioned to natural gas and petroleum extracted from shale deposits. Frac sand production increased by 21% to a record 87.3 Mt in 2018 compared with the previous year (table 6). In 2018, frac sand production increased in concert with increased 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 uses open pit or dredging methods with standard mining equipment. Except for temporarily disturbing the immediate area while operations are active, sand and gravel mining usually has limited environmental impact. Following extraction, the silica sand is processed because it is important that the sand is free of any contaminants and separated by grain size, regardless of the eventual end use.

[1]Deceased.

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 23, 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 new regulations was scheduled to take effect through 2021 (Occupational Safety and Health Administration, 2016, p. 16286, 16288). On August 22, 2018, OSHA announced that new frequently asked questions and training videos on OSHA's standard for respirable crystalline silica in construction were available online. Developed in cooperation with industry and labor organizations, the frequently asked questions and training videos provide employers and workers with OSHA guidance on the standards. The training videos instruct users on methods for controlling exposure to silica dust when performing common construction tasks or using construction equipment (Occupational Safety and Health Administration, 2018).

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 191 active producers with 308 operations known to produce industrial sand and gravel. Of the 308 surveyed operations, 292 (95%) were active, and 16 were idle or closed. The USGS received responses from 69 operations, and their combined production represented 29% of the U.S. total tonnage. Production data for the nonrespondents were estimated primarily on the basis of previously reported information and were supplemented with worker-hour reports from the Mine Safety and Health Administration (MSHA), information from State agencies, preliminary survey data, and company reports.

The Midwest (East North Central and West North Central divisions) led the Nation with 57% of the 121 Mt of industrial sand and gravel produced in the United States, followed by the South (South Atlantic, East South Central, and West South Central divisions) with 38%, the West (Pacific and Mountain divisions) with 4%, and the Northeast (New England and Middle Atlantic divisions) with 1% (table 2).

The leading producing States were, in descending order, Wisconsin, Texas, Illinois, Missouri, Minnesota, Oklahoma,

Mississippi, North Carolina, Iowa, and Louisiana (table 3). Their combined production accounted for 86% of the national total.

Of the total industrial sand and gravel produced, 93% was produced at 134 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 Corp.; U.S. Silica Holdings, Inc.; Hi-Crush Partners LP; Superior Silica Sands, LLC; Shale Support Holdings, LLC; Vista Proppants and Logistics, Inc.; Capital Sand Proppants, LLC; SmartSand, Inc.; Badger Mining Corp.; and Pattison Sand Company, Inc. Their combined production represented 65% of the U.S. total.

In 2017, Fairmount Santrol Holdings, Inc. and Unimin Corp. (a wholly owned subsidiary of Belgium's SCR-Sibelco NV), announced that the two companies would merge to form a new single company. On June 1, 2018, the merger was made official with the announcement of the creation of Covia Holdings Corp. and its immediate listing on the New York Stock Exchange (NYSE). Additionally, Fairmount Santrol Holdings, Inc. was delisted from the NYSE (Covia Holdings Corp., 2018). For the past several years, Unimin Corp. and Fairmount Santrol Holdings, Inc. have consistently ranked as the first- and third-leading producers, respectively, according to the USGS voluntary survey of U.S. silica sand producers.

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 is not reported until consumed or sold. Of the 121 Mt of industrial sand and gravel sold or used, 73% was consumed as frac sand and sand for well packing and cementing, 7% as glassmaking sand, and 7% as other whole-grain silica (table 6). Other leading uses were foundry sand (3%), ceramics, other ground silica, whole-grain fillers for building products (2% each), and recreational sand (1%). Abrasives, chemicals, fillers, filtration sand, metallurgical flux, roofing granules, silica gravel, and traction sand, combined, accounted for about 3% of industrial sand and gravel end uses (table 6). Consumption of silica sand as frac sand increased by 21% in 2018 compared with that in 2017. Increased consumption was noted for many end uses, including abrasives, ceramics, chemicals, foundry sand, glassmaking sand, ground fillers, other whole grain silica, recreational sand, roofing granules and fillers, traction sand, and whole-grain fillers. Consumption of silica sand for the remaining end uses in 2018 declined compared with that in 2017. Overall, silica gravel consumption increased by 6%, with the exception of the silicon and ferrosilicon metal production end use (table 6).

In some cases, consuming industries are intentionally located near a silica resource. For example, the automotive industry was originally located in the Midwest near clay, coal, iron, and silica resources. Therefore, foundry sands have been widely produced in Illinois, Indiana, Michigan, Ohio, and other Midwestern States. In 2018, 80% of foundry sand was produced in the Midwest (table 6).

In 2018, 63% of frac sand was produced in the Midwest. The principal sources of "Northern White" or "Ottawa" sand in the upper Midwest are the Middle and Upper Ordovician St. Peter Sandstone and the Lower Ordovician and Upper Cambrian Jordan Formation, along with the Upper Cambrian Wonewoc and Mount Simon Formations, which are gaining in importance. The St. Peter Sandstone in the Midwest is a primary source of "Northern White" or "Ottawa" sand for many end uses, including frac sand. Mined in five States, frac sand from the St. Peter Sandstone is within reasonable transport distance to numerous underground shale formations producing natural gas. Additional frac sand sources to the south include 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).

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. Because some producers did not provide this information, their data were estimated or assigned to the "Destination unknown" category. In 2018, 71% of industrial sand and gravel shipped by producers was assigned to that 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, Wisconsin, North Dakota, Pennsylvania, Oklahoma, Ohio, North Carolina, Louisiana, California, and Minnesota. Producers reported exporting 266,000 metric tons (t) of silica to Mexico (table 7).

The share of silica sold for all types of glassmaking increased by 17% compared with that in 2017. Sales of sand for container glass production increased by 33% in 2018, sales for flat glass increased by 3%, but sales to specialty glass manufacturers decreased by 3% compared with those in 2017. The amount of unground silica sand consumed for fiberglass production increased by 17%, but ground silica sand consumed for fiberglass production decreased slightly compared with that in 2017. Silica sand is the largest mineral by volume used in glassmaking and accounts for more than 70% of total batch composition (Industrial Minerals, 2017).

The demand for foundry sand is dependent mainly on automobile and light truck production. Sales of foundry sand increased by about 3% compared with those in 2017.

Whole-grain silica is used regularly in filler-type and building applications. In 2018, consumption of whole-grain fillers for building products was 2.36 Mt, a 10% increase compared with that in 2017.

In 2018, silica sand sales for chemical production were 821,000 t, an increase of about 25% compared with those in 2017. Total sales of silica gravel for silicon and ferrosilicon production, filtration, and other uses increased by 6% in 2018 compared with those in 2017. The main uses for silicon metal are in the manufacture of silanes, silicones, and semiconductor-grade silicon and in the production of aluminum alloys.

Transportation.—According to the USGS voluntary survey of U.S. producers, of all industrial sand and gravel produced in 2018, 37% was transported by truck from the plant to the

site of first sale or use, 25% 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 value, free on board plant, of U.S. industrial sand and gravel increased to $56.40 per metric ton in 2018, an 8% increase compared with the average value of $52.00 per metric ton in 2017 (table 6). Average values increased for most end uses. The average unit values for industrial sand and industrial gravel were $56.55 per metric ton and $23.33 per metric ton, respectively. The average unit value for sand ranged from $18.90 per metric ton for other whole grain silica to $70.03 per metric ton for sand for swimming pool filtration. For gravel, unit values ranged from $20.77 per metric ton for other uses to $44.38 per metric ton for filtration uses. Nationally, sand for swimming pool filtration had the highest value ($70.03 per metric ton), followed by ground sand for ceramics ($67.78 per metric ton); frac sand ($63.61 per metric ton); ground sand for fiberglass ($58.68 per metric ton); ground sand for fillers ($57.44 per metric ton); ground sand for molding and core ($55.08 per metric ton); and traction sand ($50.78 per metric ton). Strengthened demand for sand for various industrial end uses placed upward pressure on prices in 2018, along with increased frac sand use per well.

In any given year, producer prices reported to the USGS for silica commonly ranged from several dollars per ton to hundreds of dollars per ton. Prices for certain high-purity quartz products for specialized end uses, not covered in this chapter, can reach thousands of dollars per 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 value of industrial sand and gravel was highest in the Midwest ($59.64 per metric ton), followed by the South ($54.37 per metric ton), the Northeast ($45.64 per metric ton), and the West ($31.96 per metric ton) (table 6). Prices can vary greatly for similar grades of silica at various locations in the United States, owing to tighter supplies and higher production costs in certain regions of the country. For example, the average value of container glass sand varied from $35.47 per metric ton in the Northeast to $45.76 per metric ton in the Midwest.

Foreign Trade.—Exports of industrial sand and gravel in 2018 increased by 40% compared with the amount exported in 2017, and the associated value increased by about 27% (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, 4%. The remainder went to many other countries. The average unit value of exports decreased to $89.59 per metric ton in 2018 from $98.64 per metric ton in 2017. In 2018, export unit values varied widely by region; exports of silica to Oceania averaged $1,959.21 per metric ton, and exports to the rest of the world averaged $85.59 per metric ton (table 8).

Imports for consumption of industrial sand and gravel increased by 7% to 392,000 t, compared with those in 2017 (table 9). Canada supplied about 86% of the silica imports, and imports from Canada averaged $18.85 per metric ton; this included cost, insurance, and freight to the U.S. ports of entry. The total value of imports was $19.5 million, with an average unit value of $49.87 per metric ton. Higher priced imports came from Australia, Belgium, Brazil, Chile, China, Germany, Japan, and Taiwan.

World Review.—On the basis of information provided mainly by foreign Governments, world production of industrial sand and gravel was estimated to be 335 Mt (table 10). Of the countries listed, the United States was the leading global producer with 36% of world production, followed, in descending order, by the Netherlands, Spain, Italy, Turkey, India, Malaysia, France, Germany, Bulgaria, 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.

Outlook.—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 2018. By yearend 2018 and continuing into early 2019, leading indicators showed stability of oil and gas drilling and completion activity in North America. Rising global oil and gas prices and increased oilfield activity are likely to result in greater consumption of frac sand and sand for well packing and cementing. Conversely, reduced demand and (or) oversupply could result in reduced 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 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 anywhere from 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 approximately 2% to 3%. In 2018, 40% of beer and soft drink glass bottles were recovered for recycling in the United States. An additional 40% of wine and liquor glass bottles and 15% of food and other glass jars were recycled. In total, about 33% of all glass containers were recycled (Glass Packaging Institute, 2019). On the basis of these factors, production of silica sand for glassmaking in 2019 is expected to be 7.4 to 9 Mt.

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 most electronic and optical applications until 1971, when it was surpassed by cultured quartz crystal. Cultured quartz is not a mined mineral commodity. Historically, it is synthetically produced from natural feedstock quartz, termed "lascas," which is mined. However, 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, 2018, 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, however, 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 2018, and the Federal Government did not intend to dispose of or sell any of the remaining material.

Quartz crystal 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.—The USGS collects production data for quartz crystal through a survey of the domestic industry. In 2018, no domestic companies reported the production of cultured quartz crystal. However, cultured quartz crystal production was thought to take place in the United States, but production statistics were not available. Anecdotal evidence indicated that two companies produced cultured quartz crystal in the United States. At least one of these companies used cultured quartz crystal that had been rejected owing to crystallographic imperfections as feedstock for growing cultured quartz crystal. Larger quantities of cultured quartz crystal were produced overseas, primarily in Asia and Europe.

Consumption.—In 2018, 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, 5 responded to the survey. Total U.S. consumption of quartz crystal in 2018, including nonrespondents, was estimated to be in the range of 3,000 to 6,000 kg; consumption of quartz crystal may be greater.

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 are 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 all demand for electronic-grade quartz crystal. A smaller amount of optical-grade quartz crystal is used for lenses and windows in specialized devices, including some lasers.

Prices.—The price of as-grown cultured quartz was estimated to be $300 per kilogram in 2018. Lumbered quartz, which is as-grown cultured quartz that has been processed by sawing and grinding, was estimated to be $500 per kilogram in 2018, but the price can range 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. The U.S. Census Bureau collects export and import statistics on electronic- and optical-grade quartz crystal. Cultured quartz crystal imports more than doubled to 16,052 kg in 2018 from 6,762 kg in 2017. Cultured quartz crystal exports decreased by 18% to 47,531 kg in 2018 from 57,934 kg in 2017. Cultured quartz crystal is thought to be mostly imported from China, Japan, Russia, and Switzerland.

World Review.—Cultured quartz crystal production was concentrated in China, Japan, and Russia; several companies produced crystal in each country. Other producing countries or localities were thought to be Belgium, Brazil, Bulgaria, France, Germany, Italy, Romania, South Africa, Switzerland, Taiwan, and the United Kingdom. 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.—Demand for cultured quartz crystal for frequency-control oscillators and frequency filters in a variety of electronic devices should remain stable. However, during the past several

years, silicon has gradually replaced cultured quartz in two very important markets—cellular phones and automotive stability control applications. Future capacity increases to grow cultured quartz crystal may be negatively affected by this development. 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

Estimated crude production of special silica stone in 2018 was unchanged compared with that in 2017 (table 1). The value of crude production in 2018 was $76,000—unchanged compared with that in 2017. 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 are 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.—In response to a USGS production survey, none of the four domestic firms thought to produce special silica stone responded in 2018. 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 range 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 consists of a combination of craft, household, industrial, and leisure uses. The leading household use is for sharpening knives and other cutlery, lawn and garden tools, scissors, and shears. Major industrial uses include deburring metal and plastic castings, polishing metal surfaces, and sharpening and honing cutting surfaces. The major recreational use is in sharpening arrowheads, fishhooks, spear points, and sports knives. The leading craft application is sharpening tools for engraving, jewelry making, and woodcarving. Silica stone files also are used in the manufacture, modification, and repair of firearms.

Prices.—In 2018, the average value of crude material suitable for cutting into finished products was estimated to be $239 per metric ton.

Foreign Trade.—In 2018, silica stone product exports had a value of $16.3 million, up slightly from that in 2017. 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 2018.

In 2018, the value of imported silica stone products was $18.9 million, an increase of 19% from that in 2017. These imports were hand sharpening or polishing stones, which accounted for most or all of the imported silica stone products in 2018. 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 the probability of new uses being created is low.

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 also 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 2018, three U.S. firms 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. Unimin 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.—Estimated sales of processed tripoli in 2018 decreased by 12% in quantity to 67,600 t with a value of $18.8 million (table 1). The decrease in tripoli sales was due to decreased demand for its use as a functional filler and extender in adhesives, plastics, rubber, and sealants. In 2018, about 93% 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 in the past 48 years. In 1970, nearly 70% of processed tripoli was used as an abrasive. In 2018, about 7% of tripoli output was used as an abrasive.

Price.—The average unit value as reported by domestic producers of all tripoli sold or used in the United States was estimated to be $278 per metric ton in 2018. The average unit value of abrasive-grade tripoli sold or used in the United States during 2018 was estimated to be $311 per metric ton, and the average unit value of filler-grade tripoli sold or used domestically was estimated to be $279 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)

		2014	2015	2016	2017	2018
Industrial sand and gravel:[2]						
Sold or used:						
Quantity:						
Sand		109,000	101,000	78,800	102,000 r	121,000
Gravel		744	962	574	513 r	531
Total		110,000	102,000	79,400	103,000 r	121,000
Value:						
Sand		8,230,000	4,820,000	2,800,000	5,330,000	6,820,000
Gravel		7,540	16,100	9,850	11,300 r	12,400
Total		8,240,000	4,840,000	2,810,000	5,340,000	6,840,000
Exports:						
Quantity		4,470	3,910	2,780	4,680	6,560
Value		464,000	382,000	316,000	462,000	588,000
Imports for consumption:						
Quantity		245	289	281	366 r	392
Value		18,100	16,400	15,400	18,600	19,500
Processed tripoli:[3]						
Quantity	metric tons	93,100	70,500	56,600	77,300	67,600
Value		19,500	19,400	17,300	19,000	18,800
Special silica stone:						
Crude production:						
Quantity	metric tons	146 e	205	300 e	318 e	318 e
Value		36 e	49	72 e	76 e	76 e
Sold or used:[e]						
Quantity	metric tons	465	465	400	418	418
Value		765	765	700	732	732

[e]Estimated. [r]Revised.
[1]Table includes data available through April 1, 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]

	2017				2018			
Geographic division[2]	Quantity (thousand metric tons)	Percent of total	Value (thousands)	Percent of total	Quantity (thousand metric tons)	Percent of total	Value (thousands)	Percent of total
Northeast:								
New England	131	(3)	$4,320	(3)	127	(3)	$4,200	(3)
Middle Atlantic	2,060 r	2 r	76,100 r	1	2,200	2	102,000	1
Midwest:								
East North Central	45,800 r	45 r	2,620,000 r	49 r	51,400	42	3,030,000	44
West North Central	16,000	16	980,000	18	17,300	14	1,060,000	16
South:								
South Atlantic	6,210 r	6	155,000 r	3	6,080	5	178,000	3
East South Central	6,030	6	284,000	5	7,650	6	399,000	6
West South Central	22,300 r	22 r	1,100,000 r	21 r	32,200	27	1,920,000	28
West:								
Mountain	2,100 r	2	63,800 r	1	2,200	2	61,000	1
Pacific	2,060	2	68,700	1	2,060	2	75,000	1
Total	103,000 r	100	5,340,000	100	121,000	100	6,840,000	100

[r]Revised.
[1]Table includes data available through April 1, 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	2017		2018	
	Quantity	Value	Quantity	Value
Alabama	1,170	29,800	1,600	44,200
Arizona	W	W	W	W
Arkansas	1,990	109,000	2,040	134,000
California	1,780	55,000	1,760	60,500
Colorado	W	W	W	W
Florida	363	9,330	291	9,610
Georgia	W	W	W	W
Idaho	W	W	W	W
Illinois	12,600	730,000	15,300	994,000
Indiana	W	W	W	W
Iowa	2,120	135,000	2,860	178,000
Kentucky	W	W	W	W
Louisiana	1,470	44,800	2,500	160,000
Michigan	618	28,700	669	33,200
Minnesota	4,520	286,000	5,200	315,000
Mississippi	3,250	193,000	4,450	290,000
Missouri	8,470	502,000	8,330	514,000
Nebraska	W	W	W	W
Nevada	W	W	W	W
New Jersey	1,110	44,900	1,220	69,600
New York	W	W	W	W
North Carolina	3,630 r	54,100 r	3,140	43,800
North Dakota	W	W	W	W
Ohio	1,050 r	46,000 r	1,010	48,000
Oklahoma	4,570 r	188,000 r	5,000	226,000
Oregon	--	--	--	--
Pennsylvania	W	W	W	W
Rhode Island	W	W	W	W
South Carolina	522	24,600	532	26,000
South Dakota	W	W	W	W
Tennessee	1,500	56,400	1,490	59,400
Texas	14,300	755,000	22,700	1,400,000
Virginia	W	W	W	W
Washington	W	W	W	W
West Virginia	94	5,260	543	33,100
Wisconsin	31,500	1,810,000	34,300	1,950,000
Other	6,120 r	240,000 r	6,210	243,000
Total	103,000 r	5,340,000	121,000	6,840,000

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other." -- Zero.
[1]Table includes data available through April 1, 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 2018, BY SIZE OF OPERATION[1]

Capacity (metric tons per year)	Number of operations	Percent of total	Quantity (thousand metric tons)	Percent of total
Less than 25,000	62	21	550	--
25,000 to 49,999	19	7	608	1
50,000 to 99,999	33	11	2,200	2
100,000 to 199,999	44	15	5,690	5
200,000 to 299,999	27	9	5,950	5
300,000 to 399,999	15	5	4,690	4
400,000 to 499,999	15	5	5,890	5
500,000 to 599,999	9	3	4,490	4
600,000 to 699,999	12	4	6,940	6
700,000 and more	56	20	84,200	68
Total	292	100	121,000	100

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

TABLE 5
NUMBER OF INDUSTRIAL SAND AND GRAVEL OPERATIONS AND PROCESSING PLANTS IN THE UNITED STATES IN 2018, BY GEOGRAPHIC DIVISION[1]

	Mining operations on land			Total
Geographic region	Stationary	Stationary and portable	Dredging operations	active operations
Northeast:				
New England	1	--	--	1
Middle Atlantic	3	1	4	8
Midwest:				
East North Central	76	7	5	88
West North Central	13	11	8	32
South:				
South Atlantic	25	8	7	40
East South Central	13	1	5	19
West South Central	65	2	13	80
West:				
Mountain	5	--	--	5
Pacific	17	2	--	19
Total	218	32	42	292

-- Zero.
[1]Table includes data available through April 1, 2020.

TABLE 6
INDUSTRIAL SAND AND GRAVEL SOLD OR USED BY U.S. PRODUCERS IN 2018, 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	35.47	1,570	$71,700	45.76	W	W	43.80	351	$14,000	39.95	4,710	$200,000	42.35
Flat, plate and window	--	--	--	924	47,900	51.85	W	W	36.67	W	W	36.05	2,830	117,000	41.54
Specialty	W	W	48.50	W	W	33.47	151	$5,100	33.77	W	W	62.24	528	17,800	33.78
Fiberglass, unground	W	W	44.09	W	W	49.02	W	W	37.47	--	--	--	263	10,900	41.32
Fiberglass, ground	--	--	--	14	548	39.14	W	W	59.43	W	W	63.31	372	21,800	58.68
Foundry:															
Molding and core, unground	W	W	42.81	3,050	147,000	48.34	331	15,400	46.47	W	W	33.27	3,470	166,000	47.97
Molding and core, ground	--	--	--	W	W	55.12	W	W	56.22	--	--	--	183	10,100	55.08
Refractory	W	W	104.04	45	1,950	43.36	W	W	37.85	--	--	--	195	7,980	40.94
Metallurgical, flux for metal smelting	--	--	--	W	W	66.12	W	W	43.01	W	W	10.95	42	1,080	25.79
Abrasives, blasting	W	W	33.74	W	W	60.58	362	13,200	36.49	W	W	94.79	495	18,100	36.64
Chemicals, ground and unground	(3)	(3)	--	416	13,300	31.88	405	23,700	58.61	--	--	--	821	37,000	45.07
Fillers, ground, rubber, paints, putty, etc.	W	W	88.18	253	14,000	55.26	63	4,140	65.73	W	W	62.24	322	18,500	57.44
Whole-grain fillers/building products	280	$18,300	65.31	651	43,500	66.90	520	17,800	34.29	910	19,800	21.73	2,360	99,500	42.12
Ceramic, ground, pottery, brick, tile, etc.	W	W	75.97	W	W	68.25	87	4,790	55.10	W	W	74.47	2,420	164,000	67.78
Filtration:															
Water, municipal, county, local	W	W	80.40	202	8,910	44.08	48	3,120	64.92	W	W	33.58	483	22,000	45.57
Swimming pool, other	21	1,150	54.81	11	866	78.73	W	W	59.67	W	W	122.62	76	5,320	70.03
Petroleum industry:															
Hydraulic fracturing	374	25,500	68.26	55,000	3,430,000	62.34	31,100	2,060,000	66.48	W	W	38.58	87,300	5,550,000	63.61
Well packing and cementing	--	--	--	994	63,100	63.49	648	5,630	8.69	10	1,420	142.40	1,650	70,200	42.47
Recreational:															
Golf course, greens and traps	W	W	29.73	178	7,330	41.20	977	32,800	33.59	W	W	39.87	1,310	45,300	34.51
Baseball, volleyball, play sand, beaches	W	W	42.40	94	4,170	44.40	143	4,500	31.45	W	W	46.72	336	13,000	38.60
Traction, engine	5	241	48.20	W	W	59.01	34	1,370	40.15	W	W	62.06	77	3,910	50.78
Roofing granules and fillers	84	2,780	33.05	W	W	32.83	W	W	49.00	W	W	45.99	418	18,800	44.93
Other, ground	W	W	57.67	W	W	34.17	1,370	27,600	20.15	W	W	33.60	2,070	51,300	24.85
Other, whole grain	71	2,350	33.07	1,850	38,900	20.99	5,170	85,900	16.60	839	22,900	27.24	7,930	150,000	18.90
Total or average	2,310	106,000	45.80	68,600	4,090,000	59.65	45,600	2,490,000	54.60	4,150	135,000	32.52	121,000	6,820,000	56.55
Gravel:															
Silicon, ferrosilicon	--	--	--	(4)	(4)	33.06	(4)	(4)	44.46	--	--	--	32	1,410	44.09
Filtration	(4)	(4)	32.00	(4)	(4)	60.77	(4)	(4)	27.56	--	--	--	26	1,150	44.38
Other uses, specified	(4)	(4)	18.58	(4)	(4)	24.55	336	8,010	23.83	109	1,160	10.68	473	9,820	20.77
Total or average	20	536	26.80	35	1,290	36.91	368	9,390	25.53	109	1,160	10.68	531	12,400	23.33
Grand total or average	2,330	106,000	45.64	68,700	4,100,000	59.64	46,000	2,500,000	54.37	4,260	136,000	31.96	121,000	6,840,000	56.40

W Withheld to avoid disclosing company proprietary data; included in "Other, whole grain" and "U.S. total." -- Zero.

[1]Table includes data available through April 1, 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.

[3]Less than ½ unit.

[4]Withheld to avoid disclosing company proprietary data; included in "Total or average" and "U.S. total."

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

(Thousand metric tons)

Destination	2017	2018	Destination	2017	2018
State:			State—Continued:		
Alabama	193	172	New Mexico	W	W
Alaska	W	W	New York	W	W
Arizona	8	17	North Carolina	1,640	1,330
Arkansas	220	13	North Dakota	1,120	2,150
California	403	914	Ohio	967 r	1,700
Colorado	W	W	Oklahoma	1,780	1,840
Connecticut	W	W	Oregon	W	W
Delaware	W	W	Pennsylvania	1,280 r	1,990
Florida	98	24	Rhode Island	W	W
Georgia	W	W	South Carolina	197	205
Hawaii	W	W	South Dakota	24	23
Idaho	W	W	Tennessee	541	555
Illinois	115	255	Texas	8,390 r	10,800
Indiana	W	W	Utah	W	W
Iowa	W	W	Vermont	W	W
Kansas	22	17	Virginia	W	W
Kentucky	W	W	Washington	W	W
Louisiana	586	934	West Virginia	W	W
Maine	W	W	Wisconsin	2,580	2,930
Maryland	W	W	Wyoming	W	W
Massachusetts	W	W	Countries:		
Michigan	24	26	Canada	W	W
Minnesota	20	634	Mexico	287	266
Mississippi	W	W	Other	--	W
Missouri	449	438	Other:		
Montana	277	237	Puerto Rico	W	W
Nebraska	W	W	U.S. possessions and territories	--	--
Nevada	W	W	Destination unknown	73,500 r	85,900
New Hampshire	W	W	Total	103,000 r	121,000
New Jersey	134	489			

[r]Revised. W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.
[1]Table includes data available through April 1, 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	2017		2018	
	Quantity	Value[2]	Quantity	Value[2]
Africa and the Middle East:				
Israel	2	650	(3)	299
Saudi Arabia	(3)	68	(3)	45
United Arab Emirates	(3)	104	(3)	179
Other	(3)	495	1	297
Total	2	1,320	1	820
Asia:				
China	25	62,600	25	60,000
Hong Kong	(3)	75	(3)	43
India	2	2,230	2	2,250
Japan	176	44,300	272	47,900
Korea, Republic of	5	4,290	1	1,390
Singapore	1	397	1	479
Taiwan	1	544	1	919
Thailand	1	885	1	880
Other	3	2,210	1	1,260
Total	214	118,000	304	115,000
Europe:				
Belgium	1	598	1	672
France	31	5,770	26	6,230
Germany	13	23,200	17	28,400
Italy	(3)	42	(3)	50
Netherlands	10	7,120	15	7,950
Norway	13	9,330	16	12,000
Russia	--	--	(3)	126
United Kingdom	1	892	2	1,450
Other	5	3,000	5	3,220
Total	74	50,000	84	60,100
North America:				
Bahamas, The	2	247	2	343
Canada	3,980	243,000	5,580	304,000
Costa Rica	1	345	1	288
Dominican Republic	4	1,020	3	1,050
Jamaica	3	598	4	702
Mexico	336	26,500	472	51,800
Trinidad and Tobago	1	136	1	244
Other	3	1,200	4	1,130
Total	4,330	273,000	6,070	360,000
Oceania:				
Australia	1	1,470	14	26,800
Marshall Islands	--	--	(3)	117
Micronesia	(3)	17	--	--
New Zealand	1	365	(3)	516
Total	2	1,850	14	27,400
South America:				
Argentina	30	8,000	54	16,100
Brazil	9	1,570	11	2,190
Chile	7	2,090	(3)	186
Colombia	2	1,760	4	785
Peru	17	4,500	17	4,840
Venezuela	(3)	72	(3)	8
Other	(3)	90	1	143
Total	65	18,100	86	24,200
Grand total	4,680	462,000	6,560	588,000

-- Zero.
[1]Table includes data available through April 1, 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)

	2017		2018	
Country or locality	Quantity	Value[2]	Quantity	Value[2]
Australia	5	4,270	3	2,820
Belgium	7	1,730	10	2,480
Brazil	4	2,330	3	2,670
Canada	306	5,570	336	6,340
Chile	1	98	(3)	76
China	2	476	2	365
Germany	(3)	191	(3)	176
Japan	(3)	14	(3)	26
Mexico	1	82	--	--
Netherlands	(3)	38	(3)	36
Taiwan	13	1,550	4	895
Other	27 r	2,250	34	3,680
Total	366 r	18,600	392	19,500

rRevised. -- Zero.
[1]Table includes data available through April 1, 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]	2014	2015	2016	2017	2018
Algeria, unspecified[e]	100	65	60	60	60
Angola:[e]					
Quartz	10	10	10	10	10
Unspecified	50	50	50	50	50
Argentina, unspecified	673	1,098	949	949 [e]	949 [e]
Australia, quartz and quartzite[e]	3,000	3,000	3,000	3,000	3,000
Austria:					
Quartz and quartzite, including pegmatite	370	319	388	421 [r]	421 [e]
Quartz	912	1,008	841 [r]	885 [r]	885 [e]
Bhutan, quartzite	84	80	93	176 [r]	176 [e]
Bosnia and Herzegovina, unspecified	92	214	71	65 [r]	65 [e]
Bulgaria:					
Quartz	680 [e]	947	947	947 [e]	947 [e]
Sand	NA	7,640	6,289	6,300 [e]	6,300 [e]
Cameroon:[e]					
Quartzite	6 [r]	6 [r]	6 [r]	6 [r]	6
Quartzite, silica	4 [r]	4 [r]	4 [r]	4 [r]	4
Canada, quartz	2,011	2,053	2,256 [r]	2,540 [r]	2,500 [e]
Chile:					
Quartz	269	434	400	552 [r]	552 [e]
Silica sand	924	824	912	888 [r]	888 [e]
Croatia, quartz and quartzite	127	195	176	141	141 [e]
Cuba, unspecified	47	25	19	22 [r]	22 [e]
Czechia:					
Foundry sand	603	535	521	556 [r]	559
Glass sand	734	812	801	755 [r]	743
Quartz and quartzite	16	14	18	17 [r]	16
Denmark, quartz	403	459	502	536	521
Ecuador, unspecified	30 [e]	30	62	41 [r]	41 [e]
Egypt:					
Quartz	100	101	101	100 [e]	100 [e]
Unspecified	579	416	600 [e]	600 [e]	600 [e]
Estonia, unspecified	23	26	57	50 [r]	41
Ethiopia:					
Quartz	3	3 [e]	3	3 [e]	3 [e]
Sand	16	10	10 [e]	10 [e]	10 [e]
France:					
Other	8,750 [r]	8,818 [r]	9,282 [r]	9,300 [r, e]	9,300 [e]
Unspecified	8 [r]	9 [r]	9 [r]	9 [r, e]	9 [e]
Germany, unspecified	7,836	7,500	7,500 [e]	7,500 [e]	7,500 [e]
Greece, unspecified	--	75	142	77	77 [e]
Guatemala, sand	53	325	516	69 [r]	69 [e]
Hungary:					
Foundry sand	63	62 [e]	66	71	71 [e]
Glass sand	58	66	69	66	66 [e]
Unspecified	75	80	80 [e]	80 [e]	80 [e]
India:					
Quartz and quartzite	3,778	4,000	4,530 [e]	4,500 [e]	4,500 [e]
Sand	2,728	3,000	3,200 [r, e]	3,400 [r, e]	3,400 [e]
Unspecified	6,302	4,000	4,000 [e]	4,000 [e]	4,000 [e]
Indonesia:[e]					
Silica, in the form of quartz	3,700	4,400	4,900	5,500	5,500
Unspecified	35	35	35	35	35
Iran, glass sand[e]	1,500	1,500	1,500	1,500	1,500
Iraq, unspecified	3	--	--	--	-- [e]
Israel, unspecified	200 [e]	218	302	560 [r]	560 [e]
Italy, unspecified	11,602	13,900	13,900	14,000 [e]	14,000 [e]
Jamaica, unspecified	16	16	20	20 [e]	20 [e]
Japan, unspecified	2,932	2,845	2,762	2,695	2,524
Jordan, unspecified	200 [r, e]	200 [r, e]	3,612 [r]	426 [r]	400 [e]

See footnotes at 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]	2014	2015	2016	2017	2018
Kenya, glass sand[e]	22	27	27	25	25
Korea, Republic of:					
Quartzite	4,057	3,569	3,778	4,334 [r]	3,247
Sand	732	661	682	952 [r]	1,048
Kyrgyzstan, silica	1,203	1,172	601	816 [r]	710
Lithuania, unspecified	54	52	45	48	58
Malaysia, unspecified	1,923	9,003	10,353	10,000 [e]	10,000 [e]
Mexico, quartz and quartzite	2,548	1,751	2,399	2,356 [r]	2,360 [e]
Netherlands, unspecified	124,488	71,239	54,725	54,000	54,000 [e]
New Zealand:					
Sand	1,412	1,457	1,355	2,262	2,260 [e]
Unspecified	114	43	25	53	53 [e]
Nigeria, silica sand	16 [e]	10 [e]	4	28 [r]	28 [e]
Norway, quartz and quartzite	1,100 [e]	1,000	1,174 [r]	1,066 [r]	1,070 [e]
Oman:					
Quartz	283	351	362	314 [r]	314 [e]
Unspecified	--	9	17	34 [r]	34 [e]
Pakistan:					
Sand	2	NA	46	24	24 [e]
Unspecified	222	359	395	312	312 [e]
Peru, quartz and quartzite	47	85	75	73	67
Philippines, silica sand	467	525	693	438 [r]	438 [e]
Poland:					
Foundry sand	1,353	1,103	1,081	1,023 [r]	1,030 [e]
Glass sand	2,071	2,669	2,262	2,472 [r]	2,435
Moulding sand	1,796	1,633	1,253	1,643 [r]	1,512
Quartzite	83	55	65	78 [r]	138
Portugal:					
Quartz	7	1	1	3	3 [e]
Quartzite	30	27	25	25	25 [e]
Saudi Arabia, unspecified	1,210	1,230	1,300	1,365	1,433
Serbia, common sand	462	259	205	205	205 [e]
Slovakia, unspecified	502	500	500 [e]	500 [e]	500 [e]
Slovenia, quartz and quartzite	207	343	338	359	359 [e]
South Africa, unspecified	2,605	2,278 [r]	1,886 [r]	2,401 [r]	2,400 [e]
Spain:					
Quartz	900	900 [e]	900 [e]	900 [e]	900 [e]
Quartzite	2,000	2,000 [e]	2,000 [e]	2,000 [e]	2,000 [e]
Unspecified	33,600 [r]	34,000 [r]	31,000 [r]	32,600 [r]	32,600 [e]
Sri Lanka, unspecified[e]	82	82	82	82	82
Taiwan, unspecified	132	132	176	139 [r]	58
Thailand, unspecified	1,083 [r]	1,192	1,103	1,776	1,780 [e]
Turkey, unspecified	10,259	12,014	10,472	13,472 [r]	13,500 [e]
United Kingdom, unspecified	3,948	4,000 [e]	4,000 [e]	4,000 [e]	4,000 [e]
United States, unspecified	110,000	102,000	79,400	103,000 [r]	121,000
Venezuela, unspecified	7	7 [e]	7 [e]	7 [e]	7 [e]
Total	373,000 [r]	329,000 [r]	290,000 [r]	318,000 [r]	335,000

[e]Estimated. [r]Revised. NA Not available. -- Zero.

[1]Table includes data available through September 4, 2019. 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, Antigua and Barbuda, The Bahamas, Belgium, Brazil (silex), Ireland, Latvia, Paraguay, and Romania may have produced industrial sand, but available information was inadequate to make reliable estimates of output. Based on estimates of glass end use consumption, China is thought to be the world's leading producer of industrial sand; however, available information was inadequate to make reliable estimates of output.