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2017 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 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 102 million metric tons (Mt) in 2017 from 79.4 Mt in 2016 (table 1). Industrial sand production increased by 28%, and industrial gravel production decreased by 13% compared with those of 2016. The value of production in 2017 was $5.34 billion—an increase of 90% compared with the revised $2.81 billion of 2016. Estimated world production of industrial sand and gravel in 2017 was 273 Mt, a 9% increase compared with 2016 production (table 10).

The most important driving force in the industrial sand and gravel industry remained the production and sale of hydraulic fracturing sand (frac sand). During the past several years, the consumption of frac sand increased greatly as hydrocarbon exploration in the United States shifted to natural gas and petroleum in shale deposits. Frac sand production increased in 2017 compared with that of the previous year. In 2017, 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. Some examples of end uses for these sands and gravels are in 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.

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 from 2017 through 2021 (Occupational Safety and Health Administration, 2016, p. 16286, 16288). Subsequently, OSHA announced a delay in enforcement of the crystalline silica standard for the construction industry in order to conduct further outreach and education with employers in the construction industry. Enforcement in the construction industry began on September 23, 2017—delayed from June 23, 2017 (Occupational Safety and Health Administration, 2017).

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 321 operations known to produce industrial sand and gravel. Of the 321 surveyed operations, 286 (89%) were active, and 35 were idle or closed. The USGS received responses from 84 operations, and their combined production represented 31% 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 61% of the 102 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 34%, the West (Mountain and Pacific 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, North Carolina, Mississippi, Iowa, and Arkansas (table 3). Their combined production accounted for 85% of the national total.

Of the total industrial sand and gravel produced, 91% was produced at 119 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, Unimin Corp.; U.S. Silica Holdings, Inc.; Fairmount Santrol Holdings, Inc.; Hi-Crush Partners LP; Superior Silica Sands, LLC; Capital Sand Proppants, LLC; Shale Support

Holdings, LLC; Badger Mining Corp.; Vista Proppants and Logistics, Inc.; and Pattison Sand Company, Inc. Their combined production represented 66% of the U.S. total.

In 2017, some U.S. silica sand producers continued a trend in industry consolidation. By yearend 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 and form a new single company. The new company would be listed on the New York Stock Exchange. Additionally, the newly created company was expected to have about 41 million metric tons per year of silica sand and mineral-processing capacity. The completion of the merger was expected by mid-2018 (Rock Products, 2017). 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 102 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 (4%); other ground silica and whole-grain fillers for building products (2% each); and chemicals, filtration sand, and recreational sand (1% each). Abrasives, ceramics, fillers, metallurgical flux, roofing granules, silica gravel, and traction sand, combined, accounted for about 2% of industrial sand and gravel end uses. Consumption of silica sand as frac sand increased by 53% in 2017, compared with that of 2016. Increased consumption was noted for some end uses, including abrasives, filtration sand for water, other ground silica, golf course sand, roofing granules and fillers, sand for well packing and cementing, and whole-grain fillers. Consumption of silica sand for the remaining end uses in 2017 declined compared with that of 2016. Overall, silica gravel consumption decreased by 13%, with the exception of the silicon and ferrosilicon metal production and filtration end uses.

Minable deposits of industrial sand and gravel occur throughout the United States, and mining operations are located near markets that have traditionally been in the Eastern United States. 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 2017, 69% of foundry sand was produced in the Midwest (table 6).

In 2017, 73% 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 (Benson and Wilson, 2015, p. 8–22). Primarily as a cost savings, during 2017 more frac sand consumers were increasingly moving away from ceramic proppants and "Northern White" sand in favor of "Brown" sand. However, most industry observers speculated that as hydraulic fracturing activity increases, higher consumption of all types of frac sand would take place (Industrial Minerals, 2017a).

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 2017, 73% 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, Oklahoma, North Carolina, North Dakota, Pennsylvania, Ohio, Louisiana, Tennessee, and Missouri. Producers reported exporting 287,000 metric tons (t) of silica to Mexico (table 7).

The share of silica sold for all types of glassmaking decreased by 5% compared with that of 2016. Sales of sand for container glass production decreased by 5% in 2017, sales for flat glass decreased by 6%, and sales to specialty glass manufacturers decreased by 6% compared with those in 2016. The amount of unground silica sand consumed for fiberglass production was essentially unchanged and ground silica sand consumed for fiberglass production increased by 3% compared with that of 2016. Silica sand is the largest mineral by volume used in glassmaking and accounts for more than 70% of total batch composition (Industrial Minerals, 2017b).

The demand for foundry sand is dependent mainly on automobile and light truck production. Sales of foundry sand decreased by about 20% compared with those of 2016.

Whole-grain silica is used regularly in filler-type and building applications. In 2017, consumption of whole-grain fillers for building products was 2.15 Mt, a 9% increase compared with that of 2016.

In 2017, silica sand sales for chemical production were 659,000 t, a decrease of about 30% compared with those in 2016. Total sales of silica gravel for silicon and ferrosilicon production, filtration, and other uses decreased by 13% in 2017 compared with those in 2016. 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 2017, 43% was transported by truck from the plant to

the site of first sale or use, 24% was transported by rail, 2% was transported by waterway, and 31% 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 $52.63 per metric ton in 2017 (table 6), a 56% increase compared with the average value of $33.79 per ton in 2016. Average values increased for most end uses. The average unit values for industrial sand and industrial gravel were $52.78 per ton and $21.84 per ton, respectively. The average unit value for sand ranged from $17.55 per ton for other whole-grain silica to $60.74 per ton for frac sand. For gravel, unit values ranged from $13.37 per ton for other uses to $87.02 per ton for filtration uses. Nationally, frac sand had the highest value ($60.74 per ton), followed by sand for swimming pool filtration ($59.64 per ton); ground sand for molding and core ($55.12 per ton); ground sand for ceramics ($52.09 per ton); ground sand for fiberglass ($48.76 per ton); sand for municipal, county, and local water filtration ($48.07 per ton); and traction sand ($46.68 per ton). Strengthening demand placed upward pressure on frac sand prices in 2017, 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 $5,000 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 ($58.33 per ton), followed by the South ($44.76 per ton), the Northeast ($38.38 per ton), and the West ($34.79 per 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 $28.72 per ton in the Northeast to $50.93 per ton in the Midwest.

Foreign Trade.—Exports of industrial sand and gravel in 2017 increased by 69% compared with the amount exported in 2016 and the associated value increased by about 46% (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 $98.64 per ton in 2017 from $113.69 per ton in 2016. In 2017, export unit values varied widely by region; exports of silica to Oceania averaged $926.50 per ton, and exports to the rest of the world averaged $98.29 per ton.

Imports for consumption of industrial sand and gravel increased by 30% to 365,000 t, compared with those of 2016 (table 9). Canada supplied about 84% of the silica imports, and imports from Canada averaged $18.19 per ton; this included cost, insurance, and freight to the U.S. ports of entry. The total value of imports was $18.6 million, with an average unit value of $50.96 per ton. Higher priced imports came from Australia, Belgium, Brazil, Chile, China, Germany, 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 273 Mt (table 10). Of the countries listed, the United States was the leading global producer with 37% of world production, followed, in descending order, by the Netherlands, Italy, Turkey, Malaysia, France, India, Germany, Bulgaria, Spain, and Poland. 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 2017. By yearend 2017 and continuing into 2018, leading indicators showed an increase and stabilization of oil and gas drilling and completion activity in North America. Rising global oil and gas prices and increased oilfield activity is likely to result in greater consumption of frac sand and sand for well packing and cementing.

Because the unit price of silica sand is relatively low, except for a few end uses that require a high degree of processing, the location of a silica sand deposit in relation 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 also would be likely to lower the demand for mined glass sand. Glass cullet is an industry term for furnace-ready scrap glass and is an important material used in the manufacturing of glass. Recycling of glass cullet has been increasing 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 2015, 42% of beer and soft drink glass bottles were recovered for recycling in the United States. An additional 28% 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 2018 is expected to be 7.4 to 8 Mt.

Health concerns about the use of silica sand and stricter legislative and regulatory measures concerning crystalline silica exposure could reduce the 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" abrasive 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 officially 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, 2017, 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.

No natural quartz crystal was sold from the NDS in 2017, 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" 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. In 2017, no domestic companies reported the production of cultured quartz crystal. However, cultured quartz crystal production was thought to have taken 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 2017, the USGS collected domestic consumption data for quartz crystal through a survey of 11 U.S. operations that fabricate quartz crystal devices in seven States. Of the 11 operations, 6 responded to the survey. Total U.S. consumption of quartz crystal in 2017, including nonrespondents, was estimated to be in the range of 3,000 to 6,000 kg.

Electronic-grade quartz crystal, also known as cultured quartz crystal, is single-crystal silica with properties that make it 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, electronic games, television receivers, and toys). Such uses generate practically all the demand for electronic-grade quartz crystal. A smaller amount of optical-grade quartz crystal is used for lenses and windows in specialized devices, which include some lasers.

Prices.—The price of as-grown cultured quartz was estimated to be $280 per kilogram in 2017. Lumbered quartz, which is as-grown cultured quartz that has been processed by sawing and grinding, was estimated to be $300 per kilogram in 2017, 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 increased by 15% to 7,205 kg in 2017 from 6,279 kg in 2016. Cultured quartz crystal exports decreased by 4% to 57,934 kg in 2017 from 60,529 kg in 2016. Cultured quartz crystal is thought to be mostly imported from China, Italy, Japan, and Taiwan.

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 Belgium, Brazil, Bulgaria, France, Germany, Italy, Romania, South Africa, 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 telephones 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

It was estimated that in 2017, crude production of special silica stone increased by 6% when compared with that of 2016 (table 1). The value of crude production in 2017 was $76,000—a 6% increase compared with that of 2016. 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, one of the four domestic firms thought to produce special silica stone responded in 2017. In recent years, Arkansas accounted for most of the value and quantity of production that was reported. 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 2017, the average value of crude material suitable for cutting into finished products was estimated to be $239 per metric ton.

Foreign Trade.—In 2017, silica stone product exports had a value of $16.1 million, up 11% from that in 2016. 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 2017.

In 2017, the value of imported silica stone products was $15.9 million, up 7% from that in 2016. These imports were hand sharpening or polishing stones, which accounted for most or all the imported silica stone products in 2017. 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 2017, 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.—It was estimated that sales of processed tripoli in 2017 increased by 37% in quantity to 77,300 t with a value of $19 million (table 1). The increase in tripoli sales was due to increased demand for its use as a functional filler and extender in adhesives, plastics, rubber, and sealants. In 2017, 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 during the past 47 years. In 1970, nearly 70% of processed tripoli was used as an abrasive. In 2017, 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 $245 per metric ton in 2017. The average unit value of abrasive-grade tripoli sold or used in the United States during 2017 was estimated to be $313 per ton, and the average

unit value of filler-grade tripoli sold or used domestically was estimated to be $244 per 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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TABLE 1
SALIENT U.S. SILICA STATISTICS[1]

(Thousand metric tons and thousand dollars unless otherwise specified)

		2013	2014	2015	2016	2017
Industrial sand and gravel:[2]						
Sold or used:						
Quantity:						
Sand		61,900	109,000	101,000	78,800 r	101,000
Gravel		276	744	962	574	499
Total		62,100	110,000	102,000	79,400 r	102,000
Value:						
Sand		3,460,000	8,230,000	4,820,000	2,800,000 r	5,330,000
Gravel		9,350	7,540	16,100	9,850	10,900
Total		3,470,000	8,240,000	4,840,000	2,810,000 r	5,340,000
Exports:						
Quantity		2,960	4,470	3,910	2,780 r	4,680
Value		351,000	464,000	382,000	316,000	462,000
Imports for consumption:						
Quantity		161	245	289	281	365
Value		10,500	18,100	16,400	15,400	18,600
Processed tripoli:[3]						
Quantity	metric tons	110,000	93,100	70,500	56,600	77,300
Value		17,600	19,500	19,400	17,300	19,000
Special silica stone:						
Crude production:						
Quantity	metric tons	146	146 e	205	300 e	318
Value		36	36 e	49	72 e	76
Sold or used:						
Quantity	metric tons	465	465 e	465 e	400 e	418
Value		765	765 e	765 e	700 e	732

eEstimated. rRevised.
[1]Table includes data available through September 17, 2019. 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]

	2016				2017			
Geographic region[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	136	(3)	$4,730	(3)	131	(3)	$4,320	(3)
Middle Atlantic	1,260	2	60,700	2	1,400	1	54,500	1
Midwest:								
East North Central	32,200	41	1,100,000	39 r	46,300	46	2,650,000	50
West North Central	13,200	17	567,000 r	20	16,000	16	980,000	18
South:								
South Atlantic	7,060	9	163,000	6	6,250	6	157,000	3
East South Central	5,280 r	7 r	164,000 r	6 r	6,030	6	284,000	5
West South Central	16,800 r	21 r	646,000 r	23	21,800	21	1,080,000	20
West:								
Mountain	1,520	2	37,300 r	1	1,590	2	58,300	1
Pacific	1,920	2	68,000	2 r	2,060	2	68,700	1
Total	79,400 r	100	2,810,000 r	100	102,000	100	5,340,000	100

rRevised.
[1]Table includes data available through September 17, 2019. 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	2016		2017	
	Quantity	Value	Quantity	Value
Alabama	664	16,700	1,170	29,800
Arizona	W	W	W	W
Arkansas	1,330	72,400 r	1,990	109,000
California	1,620	54,200	1,780	55,000
Colorado	W	W	W	W
Florida	392	12,900	363	9,330
Georgia	W	W	W	W
Idaho	--	--	W	W
Illinois	10,600	353,000 r	12,600	730,000
Indiana	W	W	W	W
Iowa	1,340	58,700 r	2,120	135,000
Kentucky	W	W	W	W
Louisiana	1,440 r	47,800 r	1,470	44,800
Michigan	3,410	54,000	618	28,700
Minnesota	3,110	180,000	4,520	286,000
Mississippi	2,920 r	93,700 r	3,250	193,000
Missouri	8,050	299,000 r	8,470	502,000
Nebraska	W	W	W	W
Nevada	W	W	W	W
New Jersey	879	35,900	1,110	44,900
New York	W	W	W	W
North Carolina	4,180	58,900	3,610	53,900
North Dakota	W	W	W	W
Ohio	1,310	51,800	1,560	83,600
Oklahoma	3,210 r	71,900 r	4,030	177,000
Oregon	W	W	--	--
Pennsylvania	W	W	W	W
Rhode Island	W	W	W	W
South Carolina	495	21,000	522	24,600
South Dakota	W	W	W	W
Tennessee	1,570	48,500	1,500	56,400
Texas	10,800 r	454,000 r	14,300	755,000
Virginia	W	W	W	W
Washington	W	W	W	W
West Virginia	588	32,400	94	5,260
Wisconsin	16,800	637,000	31,500	1,810,000
Other	4,620	157,000 r	5,020	215,000
Total	79,400 r	2,810,000 r	102,000	5,340,000

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other." -- Zero.
[1]Table includes data available through September 17, 2019. 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 2017, 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	59	21	482	--
25,000 to 49,999	26	9	839	1
50,000 to 99,999	35	12	2,250	2
100,000 to 199,999	47	16	5,740	6
200,000 to 299,999	26	9	5,680	6
300,000 to 399,999	15	5	4,530	4
400,000 to 499,999	15	5	6,080	6
500,000 to 599,999	9	3	4,470	4
600,000 to 699,999	9	3	5,220	5
700,000 and more	45	17	66,300	66
Total	286	100	102,000	100

-- Zero.
[1]Table includes data available through September 17, 2019. 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 2017, 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	4	1	4	9
Midwest:				
East North Central	75	7	4	86
West North Central	17	10	8	35
South:				
South Atlantic	26	9	4	39
East South Central	15	--	5	20
West South Central	54	2	15	71
West:				
Mountain	6	--	--	6
Pacific	17	2	--	19
Total	215	31	40	286

-- Zero.
[1]Table includes data available through September 17, 2019.
[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).

TABLE 6
INDUSTRIAL SAND AND GRAVEL SOLD OR USED BY U.S. PRODUCERS IN 2017, 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	28.72	1,150	$58,500	50.93	W	W	38.89	255	$10,800	42.33	3,560	$157,000	44.14
Flat, plate and window	--	--	--	912	49,800	54.64	W	W	31.68	W	W	32.69	2,730	114,000	41.69
Specialty	--	--	--	W	W	34.41	160	$3,860	24.10	W	W	31.87	542	17,000	31.34
Fiberglass, unground	W	W	40.00	W	W	44.47	W	W	34.50	--	--	--	225	9,530	42.30
Fiberglass, ground	--	--	--	12	465	38.75	W	W	44.34	W	W	56.30	379	18,500	48.76
Foundry:															
Molding and core, unground	W	W	47.12	2,540	122,000	47.98	748	22,000	29.47	W	W	30.10	3,370	147,000	43.75
Molding and core, ground	--	--	--	W	W	50.00	W	W	50.00	--	--	--	182	10,100	55.12
Refractory	W	W	94.38	31	1,760	56.74	W	W	33.88	--	--	--	198	8,350	42.10
Metallurgical, flux for metal smelting	--	--	--	--	--	--	W	W	46.19	W	W	9.93	52	2,260	43.38
Abrasives:															
Blasting	W	W	31.96	W	W	54.67	338	12,500	36.89	W	W	46.10	447	16,700	37.26
Chemicals, ground and unground	(3)	(3)	--	416	13,300	31.94	242	14,100	58.29	--	--	--	659	27,400	41.60
Fillers, ground, rubber, paints, putty, etc.	W	W	122.21	44	1,440	32.75	36	1,310	36.42	W	W	54.97	88	3,560	40.44
Whole-grain fillers and building products	249	$12,600	50.45	610	29,200	47.89	569	15,100	26.51	719	16,100	22.45	2,150	73,000	33.98
Ceramic, ground, pottery, brick, tile, etc.	W	W	68.92	W	W	31.73	74	3,840	51.82	W	W	105.49	86	4,460	52.09
Filtration:															
Water, municipal, county, local	W	W	93.79	201	10,600	52.72	159	6,790	42.69	W	W	30.40	559	26,900	48.07
Swimming pool, other	23	1,560	67.91	10	776	77.60	W	W	44.11	W	W	41.87	61	3,640	59.64
Petroleum industry:															
Hydraulic fracturing	--	--	--	52,300	3,190,000	61.05	W	W	59.67	W	W	63.41	71,900	4,370,000	60.74
Well packing and cementing	327	9,620	29.42	964	62,800	65.16	722	6,020	8.34	5	580	116.00	2,020	79,000	39.16
Recreational:															
Golf course, greens and traps	W	W	30.68	195	7,590	38.93	672	14,000	20.86	W	W	40.54	1,060	28,500	27.04
Baseball, volleyball, play sand, beaches	W	W	43.49	87	3,700	42.52	128	4,080	31.89	W	W	41.15	289	11,000	38.15
Traction, engine	5	239	47.80	W	W	54.84	24	773	32.21	W	W	45.45	66	3,070	46.68
Roofing granules and fillers	87	2,800	32.22	W	W	56.08	W	W	41.65	W	W	41.81	390	16,800	43.03
Other, ground	W	W	30.09	W	W	31.09	1,810	32,900	18.17	W	W	31.30	2,500	56,600	22.65
Other, whole grain	817	31,300	29.11	2,790	77,600	27.80	28,000	1,380,000	49.23	2,600	98,700	38.00	7,570	133,000	17.55
Total or average	1,510	58,100	38.51	62,200	3,630,000	58.34	33,700	1,520,000	45.01	3,580	126,000	35.29	101,000	5,330,000	52.78
Gravel:															
Silicon, ferrosilicon	--	--	--	(4)	(4)	30.00	(4)	(4)	26.21	--	--	--	211	5,590	26.50
Filtration	(4)	(4)	100.50	(4)	(4)	51.72	(4)	(4)	132.00	--	--	--	20	1,730	87.02
Other uses, specified	(4)	(4)	24.17	(4)	(4)	5.25	161	2,120	13.14	76	870	11.45	268	3,580	13.37
Total or average	25	757	30.28	26	886	34.08	372	8,390	22.54	76	870	11.45	499	10,900	21.84
Grand total or average	1,530	58,800	38.38	62,300	3,630,000	58.33	34,100	1,530,000	44.76	3,650	127,000	34.79	102,000	5,340,000	52.63

W Withheld to avoid disclosing company proprietary data; included in "Other, whole grain" and "U.S. total." -- Zero.
[1]Table includes data available through September 17, 2019. Data are rounded to no more than three significant digits, except 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	2016	2017	Destination	2016	2017
State:			State—Continued:		
Alabama	221	193	New Jersey	112	134
Alaska	W	W	New Mexico	W	W
Arizona	25	8	New York	W	W
Arkansas	297	220	North Carolina	1,730	1,640
California	882	403	North Dakota	450	1,120
Colorado	W	W	Ohio	1,040	816
Connecticut	W	W	Oklahoma	2,330	1,780
Delaware	W	W	Oregon	W	W
Florida	315	98	Pennsylvania	1,060	961
Georgia	W	W	Rhode Island	W	W
Hawaii	W	W	South Carolina	194	197
Idaho	W	W	South Dakota	21	24
Illinois	953	115	Tennessee	568	541
Indiana	W	W	Texas	7,420	7,900
Iowa	W	W	Utah	W	W
Kansas	62	22	Vermont	W	W
Kentucky	W	W	Virginia	W	W
Louisiana	541	586	Washington	W	W
Maine	W	W	West Virginia	W	W
Maryland	W	W	Wisconsin	1,380	2,580
Massachusetts	W	W	Wyoming	W	W
Michigan	20	24	Country:		
Minnesota	74	20	Canada	W	W
Mississippi	W	W	Mexico	408	287
Missouri	512	449	Other	W	--
Montana	164	277	Other:		
Nebraska	W	W	Puerto Rico	W	W
Nevada	W	W	U.S. possessions and territories	--	--
New Hampshire	W	W	Destination unknown	52,700 r	73,800
			Total	79,400 r	102,000

[r]Revised. W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.
[1]Table includes data available through September 17, 2019. 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)

Region and country or locality	2016		2017	
	Quantity	Value[2]	Quantity	Value[2]
Africa and the Middle East:				
Israel	1	514	2	650
Saudi Arabia	(3)	66	(3)	68
United Arab Emirates	1	380	(3)	104
Other	1 r	624	(3)	495
Total	3 r	1,580	2	1,320
Asia:				
China	13	33,900	25	62,600
Hong Kong	(3)	211	(3)	75
India	2	2,160	2	2,230
Japan	198	38,300	176	44,300
Korea, Republic of	2	3,350	5	4,290
Singapore	1	443	1	397
Taiwan	1	431	1	544
Thailand	1	470	1	885
Other	3	2,380	3	2,210
Total	221	81,700 r	214	118,000
Europe:				
Belgium	9	2,270	1	598
France	23	4,640	31	5,770
Germany	8	20,700	13	23,200
Italy	(3)	107	(3)	42
Netherlands	7	6,840	10	7,120
Norway	9	5,010	13	9,330
Russia	(3)	110	--	--
United Kingdom	1	411	1	892
Other	2	1,190	5	3,000
Total	59	41,300	74	50,000
North America:				
Bahamas, The	1	205	2	247
Canada	2,090	142,000	3,980	243,000
Costa Rica	1	214	1	345
Dominican Republic	2	728	4	1,020
Jamaica	3	569	3	598
Mexico	320	23,700	336	26,500
Trinidad and Tobago	1	301	1	136
Other	2	1,260	3	1,200
Total	2,420	169,000	4,330	273,000
Oceania:				
Australia	(3)	223	1	1,470
Marshall Islands	(3)	15	--	--
Micronesia	--	--	(3)	17
New Zealand	(3)	77	1	365
Total	(3)	315	2	1,850
South America:				
Argentina	52	15,900	30	8,000
Brazil	2	926	9	1,570
Chile	8	2,500	7	2,090
Colombia	1	355	2	1,760
Peru	5	1,530	17	4,500
Venezuela	3	674	(3)	72
Other	1	324	(3)	90
Total	72	22,200	65	18,100
Grand total	2,780	316,000	4,680	462,000

rRevised. -- Zero.
[1]Table includes data available through September 17, 2019. 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)

	2016		2017	
Country or locality	Quantity	Value[2]	Quantity	Value[2]
Australia	5	4,180	5	4,270
Belgium	4	795	7	1,730
Brazil	3	1,760	4	2,330
Canada	240	3,370	306	5,570
Chile	(3)	49	1	98
China	4	697	2	476
Germany	(3)	23	(3)	191
Japan	(3)	405	(3)	14
Mexico	--	--	1	82
Netherlands	(3)	16	(3)	38
Taiwan	23	3,090	13	1,550
Other	2	1,040	26	2,250
Total	281	15,400	365	18,600

-- Zero.
[1]Table includes data available through September 17, 2019. 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]	2013	2014	2015	2016	2017
Algeria, unspecified[e]	100	100	65 [r]	60 [r]	60
Angola:					
Quartz	10	10	10	10 [e]	10 [e]
Unspecified	50	50 [e]	50 [e]	50 [e]	50 [e]
Argentina, unspecified	659	673	1,098 [r]	949 [r]	949 [e]
Australia, quartz and quartzite[e]	3,000	3,000	3,000	3,000	3,000
Austria:					
Quartz and quartzite, including pegmatite	311	370	319 [r]	388 [r]	388 [e]
Quartz	803	912	1,008 [r]	776 [r]	776 [e]
Bhutan, quartzite	91	84	80	93 [r]	93 [e]
Bosnia and Herzegovina, unspecified	114	92	214	71 [r]	71 [e]
Bulgaria:					
Quartz	660 [e]	680 [e]	947	947	947 [e]
Sand	NA	NA	7,640	6,289	6,300 [e]
Cameroon:					
Quartzite	4	4 [e]	4 [e]	4 [e]	4 [e]
Quartzite, silica	6	6 [e]	6 [e]	6 [r, e]	6
Canada, quartz	2,331	2,011	2,053	2,515 [r]	2,300 [e]
Chile:					
Quartz	360	269	434	400 [r]	400 [e]
Unspecified	998	924	824	912 [r]	912 [e]
Croatia, quartz and quartzite	102	127	195	176 [r]	141
Cuba, unspecified	26	47	25	19 [r, e]	19 [e]
Czechia:					
Foundry sand	412	603	535	521	521 [e]
Glass sand	862	734	812	801	801 [e]
Quartz and quartzite	15 [r]	16 [r]	14 [r]	18 [r]	18 [e]
Ecuador, unspecified	30 [e]	30	30	62 [r, e]	62 [e]
Egypt:					
Quartz	4	100	101	101	100 [e]
Unspecified	322	579 [r]	416 [r]	600 [r, e]	600 [e]
Estonia, unspecified	20	23	26 [r]	57 [r]	57 [e]
Ethiopia:					
Quartz	2 [e]	3	3 [e]	3 [e]	3 [e]
Sand	10 [e]	16	10 [r]	10 [r, e]	10 [e]
France:					
Other	9	8	9	9	9 [e]
Unspecified	8,752	8,750	8,818 [r]	9,282 [r]	9,300 [e]
Germany, unspecified	7,500	7,836	7,500	7,500 [e]	7,500 [e]
Greece, unspecified	10	--	75	142 [r]	77
Guatemala, sand	53	53	325	516 [r]	516 [e]
Hungary:					
Foundry sand	52	63	62 [e]	66	71
Glass sand	--	58	66	69	66
Unspecified	33	75	80	80 [e]	80 [e]
India:					
Quartz and quartzite	3,288	3,778	4,000	4,530 [r, e]	4,500 [e]
Sand	2,575	2,728	3,000	NA	NA
Unspecified	6,942	6,302	4,000	4,000 [e]	4,000 [e]
Indonesia, unspecified[e]	35	35	35	35	35
Iran, glass sand[e]	1,500	1,500	1,500	1,500	1,500
Iraq, unspecified	13	3	-- [r]	-- [r]	--
Israel, unspecified	200 [e]	200 [e]	218	302 [r]	302 [e]
Italy, unspecified	13,870	11,602	13,900	13,900	14,000 [e]
Jamaica, unspecified	16	16	16	20 [r]	20 [e]
Japan, unspecified	2,964 [r]	2,932	2,845	2,762 [r]	2,695
Jordan, unspecified	9 [r]	2 [r]	5 [r]	10 [r]	23
Kenya, glass sand[e]	21	22	27	27	25
Korea, Republic of:					
Quartzite	4,194	4,057	3,569	3,778 [r]	3,800 [e]
Sand	747	732	661	682 [r]	680 [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]	2013	2014	2015	2016	2017
Kyrgyzstan, silica	1,550	1,203	1,172	601 r	718
Lithuania, unspecified	57	54	52	45 r	48
Malaysia, unspecified	1,244	1,920 e	9,000 e	10,353 r	10,000 e
Mexico, quartz and quartzite	2,938	2,548	1,751 r	2,399 r	2,400 e
Mozambique, quartz	57	--	1	1	NA
Netherlands, unspecified	63,301 r	124,488 r	71,239 r	54,725 r	54,000
New Zealand:					
Sand	1,283	1,412	1,457	1,355	2,262
Unspecified	102	114	43	25 r	53
Nigeria, silica sand[e]	22 r	16 r	10 r	4 r	4
Norway, quartz and quartzite	1,451	1,100 e	1,000	1,030 r, e	1,000 e
Oman:					
Quartz	347	283	351 r	362 r	362 e
Unspecified	47	-- r	9	17 r	17 e
Pakistan:					
Sand	4	2	NA	46	24
Unspecified	308	222	359	395 r	312
Peru, quartz and quartzite	74	47 e	85 e	75 r	73
Philippines, silica sand	429	467	525	693 r	693 e
Poland:					
Foundry sand	1,311 r	1,353	1,103	1,081	1,100 e
Glass sand	2,112 r	2,071	2,669	2,262	2,300 e
Molding sand	3,361	1,796	1,633	1,253	1,300 e
Quartzite	88	83	55	65 r	66 e
Portugal:					
Quartz	4	7	1	1	3
Quartzite	30	30	27 r	25 r	25
Saudi Arabia, unspecified	1,160	1,210	1,230 r	1,300 r	1,365
Serbia, common sand	633	462	259 r	205 r	205 e
Slovakia, unspecified	476	502 r	500 r	500 r, e	500 e
Slovenia, quartz and quartzite	224	207	343	338 r	359
South Africa, unspecified	2,296	2,605	2,271	1,879 r	1,900
Spain:					
Quartz	949	900	900	900	900
Quartzite	2,058	2,000	2,000	2,000	2,000
Spain, unspecified	3,400	3,400 e	3,400	3,400	3,400 e
Sri Lanka, unspecified	81	82	82	82 e	82 e
Taiwan, unspecified	62	132	132	176	180 e
Thailand, unspecified	876	1,134	1,192	1,103 r	1,776
Turkey, unspecified	7,969	10,259	12,014 r	10,472 r	10,500 e
United Kingdom, unspecified	3,961	3,948	4,000 e	4,000 e	4,000 e
United States, unspecified	62,100	110,000	102,000	79,400 r	102,000
Venezuela:					
Quartz	8	--	--	--	-- e
Unspecified	8	7	7 e	7 e	7 e
Total	231,000 r	338,000 r	294,000 r	251,000 r	273,000

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

[1]Table includes data available through October 11, 2018. All data are reported unless otherwise noted. Totals, U.S. data, and estimated data are rounded to 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), Denmark, 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.