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2016 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 decreased to 77.7 million metric tons (Mt) in 2016 from 102 Mt in 2015 (table 1). Industrial sand production decreased by 24%, and industrial gravel production decreased by 40% compared with those of 2015. The value of production in 2016 was $2.63 billion—a decrease of 46% compared with the revised $4.84 billion of 2015. Estimated world production of industrial sand and gravel in 2016 was 179 Mt, a 12% decrease compared with 2015 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. However, frac sand production declined in 2016 compared to the previous year. Beginning in 2015 and continuing in 2016, frac sand production was negatively affected by reduced 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).

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 196 active producers with 330 operations known to produce industrial sand and gravel. Of the 330 surveyed operations, 278 (84%) were active, and 52 were idle or closed. The USGS received responses from 84 operations, and their combined production represented 24% 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 58% of the 77.7 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 35%, the West (Pacific and Mountain divisions) with 4%, and the Northeast (New England and Middle Atlantic divisions) with 2% (table 2).

The leading producing States were, in descending order, Wisconsin, Texas, Illinois, Missouri, North Carolina, Oklahoma, Michigan, Minnesota, California, and Tennessee (table 3). Their combined production accounted for 82% of the national total.

Of the total industrial sand and gravel produced, 90% was produced at 100 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.; Capital Sand Proppants, LLC; Hi-Crush Partners LP; Superior Silica Sands, LLC; Great Lakes Aggregates, LLC; Badger Mining Corp.; Liberty Materials, Inc.; and Lonestar Prospects, Ltd. Their combined production represented 61% of the U.S. total.

In 2016, some U.S. silica sand producers continued a trend in industry consolidation and vertical integration. For example,

in order to cut rising logistics costs, U.S. Silica Holdings announced plans to purchase frac sand logistics company Sandbox Enterprises in August 2016. By yearend 2016, improvement in oil and gas activity prompted Fairmount Santrol to reopen its Menomonie, WI, frac sand facility and complete expansion of its Wedron silica mine in Illinois. Additionally, Hi-Crush Partners reopened a frac sand facility in Wisconsin (Industrial Minerals, 2016).

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 77.7 Mt of industrial sand and gravel sold or used, 63% was consumed as frac sand and sand for well packing and cementing, 10% as other whole- grain silica, and 10% as glassmaking sand (table 6). Other leading uses were foundry sand (6%), whole-grain fillers for building products (3%), other ground silica and recreational sand (2% each), and chemicals (1%). Abrasives, ceramics, fillers, filtration, metallurgical flux, roofing granules, silica gravel, and traction sand, combined, accounted for about 3% of industrial sand and gravel end uses. Consumption of silica sand as frac sand decreased by 36% in 2016, compared with that of 2015. Increased consumption was noted for most other uses, including ceramics, chemicals, fillers, glassmaking sand, filtration sand for swimming pools, foundry sand, 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 2016 declined compared with that of 2015. Silica gravel consumption decreased substantially for all end uses, including silicon and ferrosilicon metal production, filtration, and other 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 2016, 83% of foundry sand was produced in the Midwest (table 6).

In 2016, 74% 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 Upper Cambrian and Lower Ordovician 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). In 2016 as in the previous year, despite the decreased production and demand for frac sand owing to lower global oil and gas prices, frac sand demand was rising on a per well basis, helping to protect the silica sand mining industry from further oil market changes. Additionally, frac sand use per well has risen 80% when comparing old completion wells to new completion wells (Industrial Minerals, 2015).

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 2016, 66% 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, Oklahoma, North Carolina, Wisconsin, Pennsylvania, Ohio, Illinois, California, Tennessee, and Louisiana. Producers reported exporting 408,000 metric tons (t) of silica to Mexico (table 7).

The share of silica sold for all types of glassmaking increased slightly compared with that of 2015. Sales of sand for container glass production decreased by 3% in 2016, sales for flat glass increased by 9%, and sales to specialty glass manufacturers decreased slightly compared with those in 2015. On average, in the container glassmaking industry, silica accounts for 60% of raw materials used (Industrial Minerals, 2004). The amount of unground silica sand consumed for fiberglass production decreased by 23% and ground silica sand consumed for fiberglass production increased by 25% compared with those of 2015.

The demand for foundry sand is dependent mainly on automobile and light truck production. Sales of foundry sand increased by about 7% compared with those of 2015.

Whole-grain silica is used regularly in filler-type and building applications. In 2016, consumption of whole-grain fillers for building products was 1.98 Mt, a 32% increase compared with that of 2015.

In 2016, silica sand sales for chemical production were 935,000 t, an increase of about 4% compared with those in 2015. Total sales of silica gravel for silicon and ferrosilicon production, filtration, and other uses decreased by 50% in 2016 compared with those in 2015. The main uses for silicon metal are in the manufacture of silanes 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, 48% was transported by truck from the plant to the site of first sale or use, 26% was transported by rail, 1% was transported by waterway, and 25% 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 decreased to $33.79 per metric ton

in 2016, a 28% decrease compared with the average value of $47.08 per ton in 2015 (table 6). Average values decreased for most end uses, but substantial decreases for the leading end uses resulted in overall decreased unit values. The average unit values for industrial sand and industrial gravel were $33.91 per ton and $17.15 per ton, respectively. The average unit value for sand ranged from $13.08 per ton for other whole grain silica to $77.00 per ton for sand for swimming pool filtration. For gravel, unit values ranged from $14.80 per ton for other uses to $56.75 per ton for filtration uses. Nationally, sand for swimming pool filtration had the highest value ($77.00 per ton), followed by ground sand used as filler for paint, putty, and rubber ($50.23 per ton); ground sand used for ceramics ($49.65 per ton); ground sand for fiberglass ($48.11 per ton); sand for municipal, county, and local water filtration ($47.02 per ton); sand for metallurgical flux for metal smelting ($46.08 per ton); and ground and unground sand for chemicals ($44.38 per ton). Increased frac sand use per well notwithstanding, decreased overall demand for frac sand placed strong downward pressure on frac sand prices in 2016.

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 Northeast ($46.77 per ton), followed by the Midwest ($35.84 per ton), the South ($30.36 per ton), and the West ($28.87 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 $22.10 per ton in the West to $52.10 per ton in the Northeast.

Foreign Trade.—Exports of industrial sand and gravel in 2016 decreased by 29% compared with the amount exported in 2015 and the associated value decreased by about 17% (table 8). Canada was the leading recipient of United States exports, receiving 75% of total industrial sand and gravel exports; Mexico received 12%, and Japan, 7%. The remainder went to many other countries. The average unit value of exports increased to $113.71 per ton in 2016 from $97.86 per ton in 2015. In 2016, export unit values varied widely by region; exports of silica to Africa averaged $792.00 per ton, and exports to the rest of the world averaged $113.22 per ton.

Imports for consumption of industrial sand and gravel decreased by 3% to 281,000 t, compared with those of 2015 (table 9). Canada supplied about 85% of the silica imports, and imports from Canada averaged $14.05 per ton; this included cost, insurance, and freight to the U.S. ports of entry. The total value of imports was $15.4 million, with an average unit value of $54.87 per ton. Higher priced imports came from Australia, Belgium, Brazil, Chile, China, Germany, Japan, and the Netherlands.

World Review.—On the basis of information provided mainly by foreign governments, world production of industrial sand and gravel was estimated to be 179 Mt (table 10). Of the countries listed, the United States was the leading global producer with 43% of world production, followed, in descending order, by Italy, Malaysia, France, India, Turkey, Germany, Spain, the Republic of Korea, the United Kingdom, and Australia. 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 2016. By yearend 2016 and continuing into 2017, 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 2013, 41% of beer and soft drink glass bottles were recovered for recycling in the United States. An additional 34% of wine and liquor glass bottles and 15% of food and other glass jars were recycled. In total, about 34% of all glass containers were recycled (Glass Packaging Institute, 2016). On the basis of these factors, production of silica sand for glassmaking in 2017 is expected to be 7.5 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.

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, 2016, 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 2016, 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 2016, 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 2016, 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, 5 responded to the survey. Total U.S. consumption of quartz crystal in 2016, including nonrespondents, was estimated to be 2,500 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, games, television receivers, and toys). Such uses generate practically all of 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 2016. Lumbered quartz, which is as-grown cultured quartz that has been processed by sawing and grinding, was estimated to be $890 per kilogram in 2016, 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; however, the quartz crystal export and import quantities and values reported were thought to include large quantities of fused mullite and fused zirconia, which was inadvertently reported as quartz crystal, not including mounted piezoelectric crystals. Although no definitive data exist listing import sources for cultured quartz crystal, imported material was thought to be mostly from China, Japan, Romania, and the United Kingdom.

World Review.—Cultured quartz crystal production was concentrated in China, Japan, and Russia; several companies produced crystal in each country. Other producing countries were Belgium, Brazil, Bulgaria, France, Germany, Romania, South Africa, 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 2016, crude production of special silica stone increased by 46% when compared to that of 2015 (table 1). The value of crude production in 2016 was $72,000—an increase of 47% compared with that of 2015. 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 2016. 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 2016, the average value of crude material suitable for cutting into finished products was estimated to be $240 per metric ton.

Foreign Trade.—In 2016, silica stone product exports had a value of $14.5 million, up slightly from that in 2015. These exports were categorized as "hand sharpening or polishing stones" by the U.S. Census Bureau. This category accounted for most of or all the silica stone products exported in 2016.

In 2016, the value of imported silica stone products was $14.9 million, up slightly from that in 2015. These imports were hand sharpening or polishing stones, which accounted for most or all of the imported silica stone products in 2016. 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 2016, 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 on the basis of reports from previous years and supplemented with worker-hour reports from MSHA.

Consumption.—It was estimated that sales of processed tripoli in 2016 decreased by 20% in quantity to 56,600 t with a value of $17.3 million (table 1). The decrease in tripoli sales was due to lessened demand for its use as an abrasive and as a functional filler and extender in adhesives, plastics, rubber, and sealants. Tripoli was mostly 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. In 2016, the primary use of tripoli (91%) was as a filler and extender. 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 46 years. In 1970, nearly 70% of processed tripoli was used as an abrasive. In 2016, about 8.7% of tripoli output was used as an abrasive.

Prices.—The average unit value as reported by domestic producers of all tripoli sold or used in the United States was estimated to be $305 per metric ton in 2016. The average unit value of abrasive-grade tripoli sold or used in the United States during 2016 was estimated to be $308 per metric ton, and the average unit value of filler-grade tripoli sold or used domestically was estimated to be $309 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)

		2012	2013	2014	2015	2016
Industrial sand and gravel:[2]						
Sold or used:						
Quantity:						
Sand		50,300	61,900	109,000	101,000 r	77,100
Gravel		345	276	744	962 r	574
Total		50,600	62,100	110,000	102,000 r	77,700
Value:						
Sand		2,670,000	3,460,000	8,230,000	4,820,000 r	2,620,000
Gravel		8,880	9,350	7,540	16,100 r	9,850
Total		2,670,000	3,470,000	8,240,000	4,840,000 r	2,630,000
Exports:						
Quantity		4,310 r	2,960	4,470 r	3,910 r	2,780
Value		325,000 r	351,000 r	464,000 r	382,000 r	316,000
Imports for consumption:						
Quantity		306	161 r	245 r	289 r	281
Value		35,300 r	10,500 r	18,100 r	16,400 r	15,400
Processed tripoli:[3]						
Quantity	metric tons	120,000	110,000	93,100	70,500	56,600
Value		18,900	17,600	19,500	19,400	17,300
Special silica stone:						
Crude production:						
Quantity	metric tons	156	146	146 e	205	300 e
Value		39	36	36 e	49	72 e
Sold or used:						
Quantity	metric tons	500	465	465 e	465 e	400 e
Value		823	765	765 e	765 e	700 e

eEstimated. rRevised.
[1]Table includes data available through April 18, 2018. 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]

Geographic division[2]	2015				2016			
	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	184	(3)	$6,090	(3)	136	(3)	$4,730	(3)
Middle Atlantic	1,540	1	73,500	2	1,260	2	60,700	2
Midwest:								
East North Central	51,200	50	2,420,000	50	32,200	41	1,100,000	41
West North Central	14,600	14	952,000	20	13,200	17	531,000	20
South:								
South Atlantic	7,070	7	186,000	4	7,060	9	163,000	6
East South Central	3,100	3	85,500	2	3,460	4	77,200	3
West South Central	20,600 r	20 r	985,000 r	20 r	17,000	22	594,000	23
West:								
Mountain	1,780	2	48,600	1	1,520	2	31,200	1
Pacific	2,130	2	79,200	2	1,920	2	68,000	3
Total	102,000 r	100	4,840,000 r	100	77,700	100	2,630,000	100

rRevised.

[1]Table includes data available through April 18, 2018. 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	2015		2016	
	Quantity	Value	Quantity	Value
Alabama	972	23,700	664	16,700
Arizona	W	W	W	W
Arkansas	1,990	146,000	1,330	60,700
California	1,860	66,100	1,620	54,200
Colorado	W	W	W	W
Florida	485	32,100	392	12,900
Georgia	W	W	W	W
Illinois	14,100	867,000	10,600	350,000
Indiana	W	W	W	W
Iowa	1,790	133,000	1,340	53,600
Kentucky	W	W	W	W
Louisiana	1,530 r	62,000 r	1,330	44,200
Michigan	3,370	77,300	3,410	54,000
Minnesota	5,170	335,000	3,110	180,000
Mississippi	451	5,260	1,100	6,500
Missouri	6,290	385,000	8,050	268,000
Nebraska	W	W	W	W
Nevada	W	W	W	W
New Jersey	950	35,500	879	35,900
New York	W	W	W	W
North Carolina	4,050	55,100	4,180	58,900
North Dakota	W	W	W	W
Ohio	1,440	79,400	1,310	51,800
Oklahoma	2,980 r	70,700 r	3,420	72,800
Oregon	W	W	W	W
Pennsylvania	W	W	W	W
Rhode Island	W	W	W	W
South Carolina	551	24,400	495	21,000
South Dakota	W	W	W	W
Tennessee	1,540	49,100	1,570	48,500
Texas	14,200	706,000	10,900	417,000
Virginia	W	W	W	W
Washington	W	W	W	W
West Virginia	681	37,500	588	32,400
Wisconsin	32,200	1,390,000	16,800	637,000
Other	5,650	252,000	4,620	151,000
Total	102,000 r	4,840,000 r	77,700	2,630,000

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other."

[1]Table includes data available through April 18, 2018. 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 2016, 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	68	24	544	(2)
25,000 to 49,999	35	12	1,170	1
50,000 to 99,999	36	12	2,350	3
100,000 to 199,999	39	14	4,940	6
200,000 to 299,999	24	9	5,520	8
300,000 to 399,999	10	4	3,260	5
400,000 to 499,999	12	5	4,730	6
500,000 to 599,999	8	3	3,920	5
600,000 to 699,999	12	5	6,960	9
700,000 and more	34	12	44,300	57
Total	278	100	77,700	100

[1]Table includes data available through April 18, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than ½ unit.

TABLE 5
NUMBER OF INDUSTRIAL SAND AND GRAVEL OPERATIONS AND PROCESSING PLANTS IN THE UNITED STATES IN 2016, BY GEOGRAPHIC DIVISION[1]

	Mining operations on land			Total active operations
Geographic division[2]	Stationary	Stationary and portable	Dredging operations	
Northeast:				
New England	1	--	--	1
Middle Atlantic	2	1	4	7
Midwest:				
East North Central	68	8	5	81
West North Central	16	9	7	32
South:				
South Atlantic	33	8	4	45
East South Central	14	--	4	18
West South Central	54	4	10	68
West:				
Mountain	5	1	--	6
Pacific	17	3	--	20
Total	210	34	34	278

-- Zero.
[1]Table includes data available through April 18, 2018.
[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 2016, 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	$52.10	1,140	$32,100	$28.24	W	W	$28.15	334	W	$22.10	3,750	$113,000	$30.24
Flat, plate and window	--	--	--	908	30,500	33.63	1,530	$43,600	28.55	W	W	10.49	2,890	78,900	27.30
Specialty	--	--	--	W	W	40.69	207	6,540	31.59	W	W	56.20	574	21,600	37.54
Fiberglass, unground	W	W	32.50	W	W	32.05	W	W	30.32	--	--	--	224	6,950	31.01
Fiberglass, ground	--	--	--	W	W	44.14	347	16,600	47.91	W	W	63.88	369	17,800	48.11
Foundry:															
Molding and core, unground	36	$1,480	41.08	3,840	128,000	33.44	442	13,900	31.44	W	W	W	4,340	144,000	33.08
Molding and core, ground	--	--	--	W	W	22.26	W	W	87.00	--	--	--	184	4,140	22.49
Refractory	W	W	95.25	43	1,520	35.44	90	3,300	36.67	--	--	--	137	5,210	37.99
Metallurgical, flux for metal smelting	--	--	--	--	--	--	W	W	53.15	W	W	11.00	W	W	46.08
Abrasives, blasting	W	W	20.75	23	857	37.26	317	12,000	37.74	W	W	66.75	395	14,100	35.82
Chemicals, ground and unground	(3)	(3)	--	412	15,300	37.17	524	26,200	49.96	--	--	--	935	41,500	44.38
Fillers, ground, rubber, paints, putty, etc.	W	W	110.00	43	2,230	51.91	66	2,990	45.35	W	W	64.40	117	5,880	50.23
Whole-grain fillers/building products	250	11,700	46.96	611	19,400	31.77	464	16,100	34.68	653	$10,500	16.15	1,980	57,800	29.23
Ceramic, ground, pottery, brick, tile, etc.	--	--	--	W	W	41.17	108	5,430	50.27	W	W	41.00	116	5,760	49.65
Filtration:															
Water, municipal, county, local	W	W	77.86	111	4,340	39.12	64	4,850	75.70	W	W	33.50	387	18,200	47.02
Swimming pool, other	14	1,490	106.64	36	3,380	93.83	W	W	45.51	W	W	99.10	98	7,550	77.00
Petroleum industry:															
Hydraulic fracturing	W	W	66.51	34,900	1,300,000	37.39	11,700	466,000	39.92	W	W	61.91	47,100	1,800,000	38.29
Well packing and cementing	327	9,620	29.42	1,130	34,300	30.50	352	5,450	15.48	6	837	139.50	1,810	50,200	27.76
Recreational:															
Golf course, greens and traps	W	W	38.34	203	7,470	36.79	589	15,400	26.23	W	W	29.55	970	28,800	29.67
Baseball, volleyball, play sand, beaches	W	W	64.50	122	4,610	37.80	395	13,200	33.47	W	W	38.90	585	21,400	36.59
Traction, engine	8	379	47.38	19	676	35.58	35	1,380	39.43	W	W	57.38	75	3,180	42.40
Roofing granules and fillers	W	W	45.00	19	679	35.74	275	9,630	35.03	W	W	42.14	344	12,500	36.33
Other:															
Ground silica	W	W	60.50	243	6,240	33.31	1,440	37,300	25.81	W	W	35.66	1,760	48,500	27.59
Whole grain	754	40,300	53.46	1,510	28,400	18.85	8,220	129,000	11.31	2,320	85,100	36.76	8,010	106,000	13.08
Total or average	1,390	65,000	46.81	45,300	1,620,000	35.88	27,100	829,000	30.66	3,310	96,500	29.17	77,100	2,620,000	33.91
Gravel:															
Silicon, ferrosilicon	--	--	--	--	--	--	93	2,390	25.71	--	--	--	93	2,390	25.71
Filtration	2	255	127.50	7	199	28.43	--	--	--	--	--	--	8	454	56.75
Other uses, specified	8	108	13.50	83	1,330	16.00	253	2,810	11.10	129	2,760	21.38	473	7,000	14.80
Total or average	10	363	36.30	90	1,530	16.97	346	5,200	15.03	129	2,760	21.38	574	9,850	17.15
Grand total or average	1,400	65,400	46.77	45,400	1,630,000	35.84	27,500	834,000	30.36	3,440	99,300	28.87	77,700	2,630,000	33.79

W Withheld to avoid disclosing company proprietary data; included in "Other: Whole grain." -- Zero.

[1]Table includes data available through April 18, 2018. 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.

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

(Thousand metric tons)

Destination	2015	2016	Destination	2015	2016
State:			State—Continued:		
Alabama	222	221	New Jersey	24	112
Alaska	W	W	New Mexico	W	W
Arizona	24	25	New York	W	W
Arkansas	206	297	North Carolina	858	1,730
California	954	882	North Dakota	780	450
Colorado	W	W	Ohio	1,240	1,040
Connecticut	W	W	Oklahoma	2,000	2,330
Delaware	W	W	Oregon	W	W
Florida	336	315	Pennsylvania	1,130	1,060
Georgia	W	W	Rhode Island	--	W
Hawaii	W	W	South Carolina	59	194
Idaho	W	W	South Dakota	69	21
Illinois	1,350	953	Tennessee	544	568
Indiana	W	W	Texas	6,390	7,420
Iowa	W	W	Utah	W	W
Kansas	62	62	Vermont	W	W
Kentucky	W	W	Virginia	W	W
Louisiana	447	541	Washington	W	W
Maine	W	W	West Virginia	W	W
Maryland	W	W	Wisconsin	1,120	1,380
Massachusetts	W	W	Wyoming	W	W
Michigan	19	20	Country:		
Minnesota	77	74	Canada	W	W
Mississippi	W	W	Mexico	347	408
Missouri	501	512	Other	W	W
Montana	74	164	Other:		
Nebraska	W	W	Puerto Rico	W	W
Nevada	W	W	U.S. possessions and territories	--	--
New Hampshire	W	W	Destination unknown	78,600 [r]	51,400
			Total	102,000 [r]	77,700

[r]Revised. W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.

[1]Table includes data available through April 18, 2018. 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 DESTINATION[1]

(Thousand metric tons and thousand dollars)

Destination	2015		2016	
	Quantity	Value[2]	Quantity	Value[2]
Africa and the Middle East:				
Israel	(3)	180	1	514
Saudi Arabia	1	367	(3)	66
United Arab Emirates	1	333	1	380
Other	1 r	453 r	(3)	624
Total	3 r	1,330 r	2	1,580
Asia:				
China	9	23,800 r	13	33,900
Hong Kong	(3)	69	(3)	211
India	1	1,300	2	2,160
Japan	226 r	39,400 r	198	38,300
Korea, Republic of	4	4,920 r	2	3,350
Singapore	1	533	1	443
Taiwan	1	707 r	1	431
Thailand	1	520	1	470
Other	1 r	776 r	3	2,380
Total	244 r	72,000 r	221	81,600
Europe:				
Belgium	6	2,440	9	2,270
France	30	5,570	23	4,640
Germany	16 r	23,100	8	20,700
Italy	(3)	213	(3)	107
Netherlands	14	6,960 r	7	6,840
Norway	12	6,680	9	5,010
Russia	(3)	692	(3)	110
United Kingdom	1	569	1	411
Other	2 r	1,380 r	2	1,190
Total	81 r	47,600 r	59	41,300
North America:				
Bahamas, The	3	161	1	205
Canada	3,060 r	196,000	2,090	142,000
Costa Rica	1	418	1	214
Dominican Republic	2	712	2	728
Jamaica	3	533	3	569
Mexico	392 r	25,000	320	23,700
Trinidad and Tobago	2	955	1	301
Other	5 r	1,210 r	2	1,260
Total	3,470 r	225,000	2,420	169,000
Oceania:				
Australia	1	389	(3)	223
Marshall Islands	--	--	(3)	15
New Zealand	(3)	121	(3)	77
Total	1	510	(3)	315
South America:				
Argentina	77 r	26,900 r	52	15,900
Brazil	1	379	2	926
Chile	25	5,620	8	2,500
Colombia	2	874	1	355
Peru	7	1,560	5	1,530
Venezuela	(3)	44 r	3	674
Other	1 r	614 r	1	324
Total	113 r	36,000 r	72	22,200
Grand total	3,910 r	382,000 r	2,780	316,000

rRevised. -- Zero.

[1]Table includes data available through April 18, 2018. 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)

	2015		2016	
Country or locality	Quantity	Value[2]	Quantity	Value[2]
Australia	7	6,010 r	5	4,180
Belgium	1	385	4	795
Brazil	5	2,870	3	1,760
Canada	258	2,990 r	240	3,370
Chile	(3)	8 r	(3)	49
China	2	471 r	4	697
Germany	(3)	29 r	(3)	23
Japan	(3)	8 r	(3)	405
Mexico	2	278 r	--	--
Netherlands	(3)	9	(3)	16
Taiwan	12	2,020	23	3,090
Other	2 r	1,360 r	2	1,040
Total	289 r	16,400 r	281	15,400

rRevised. -- Zero.
[1]Table includes data available through April 18, 2018. 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]	2012	2013	2014	2015	2016
Algeria, unspecified[e]	95	100	100	106	106
Angola:					
Quartz	12	10	10	10	10 [e]
Unspecified	--	50	50	50	50 [e]
Argentina, unspecified	615	659 [r]	673 [r, e]	675 [r, e]	675 [e]
Australia, quartz and quartzite[e]	3,500	3,000 [r]	3,000 [r]	3,000 [r]	3,000
Austria:					
Quartz and quartzite, including pegmatite	315	311	370 [r]	368 [r]	368 [e]
Quartz	820	803 [r]	912 [r]	960 [r]	960 [e]
Bhutan, quartzite	89	91	84	80	80 [e]
Bosnia and Herzegovina, unspecified[e]	121	114	92 [r]	214 [r]	214 [e]
Bulgaria, quartz	660	660	680 [r]	947 [r]	947
Cameroon, quartzite	--	4	4	4	4 [e]
Canada, quartz	1,517 [r]	2,331 [r]	2,011 [r]	2,053 [r]	2,050 [e]
Chile:					
Quartz	360	360	269	434	434 [e]
Unspecified	908 [r]	998 [r]	924 [r]	824 [r]	824 [e]
Croatia, quartz and quartzite	106	102	127 [r]	195 [r]	195 [e]
Cuba, unspecified	25	26	47 [r]	25 [r]	25 [e]
Czechia, quartz and quartzite	1,340	1,274	1,270	1,270	1,270 [e]
Ecuador, unspecified	30	30 [e]	30	30	30 [e]
Egypt:					
Quartz	8 [r]	4 [r]	100 [r]	101 [r]	101 [e]
Unspecified	448 [r]	322 [r]	400 [r]	400 [r]	400 [e]
Estonia, unspecified	21	20	23 [r]	22 [r]	22 [e]
Ethiopia:					
Quartz	1	2	3	3 [r]	3 [e]
Unspecified	11	10	16	17 [r]	17 [e]
France, unspecified	8,880	8,752	8,750	8,750	8,750 [e]
Germany, unspecified	7,498	7,500	7,836 [r]	7,500	7,500 [e]
Greece, unspecified	7 [r]	10 [r]	-- [r]	75 [r]	75 [e]
Guatemala, unspecified	49 [e]	53	53	325 [r]	325 [e]
Hungary, unspecified	35 [r]	33 [r]	75 [r]	80 [r]	80 [e]
India:					
Quartz and quartzite	3,950	3,288	3,778	4,000	4,000 [e]
Unspecified	7,493 [r]	6,942 [r]	6,302 [r]	4,000 [r]	4,000 [e]
Indonesia, unspecified[e]	38	35	35	35	35
Iraq, unspecified	1 [r]	13 [r]	3 [r]	3 [r, e]	3 [e]
Israel, unspecified	180 [e]	200 [e]	200 [e]	218 [r]	218 [e]
Italy, unspecified	13,946	13,870	11,602 [r]	13,900	13,900 [e]
Jamaica, unspecified	14	16	16	16 [e]	16 [e]
Japan, unspecified	2,877	2,856 [r]	2,932 [r]	2,845 [r]	2,850 [e]
Jordan, unspecified[e]	111 [r]	112 [r]	112 [r]	112 [r]	112
Kenya, unspecified[e]	26 [r]	21 [r]	22 [r]	27 [r]	27
Korea, Republic of:					
Quartzite	4,184 [r]	4,194 [r]	4,057 [r]	3,569 [r]	3,570 [e]
Sand	709	747	732	661	661 [e]
Kyrgyzstan, unspecified	1,328	1,550	1,203	1,172	640 [e]
Lithuania, unspecified	54	57	54 [r]	52 [r]	45 [e]
Madagascar, quartz	--	--	--	1	1 [e]
Malaysia, unspecified	932	1,244	1,920 [r, e]	9,000 [r, e]	10,400 [e]
Mexico, quartz and quartzite	3,593	2,938 [r]	2,548 [r]	1,742 [r]	1,740 [e]
Moldova, unspecified	1,373 [r]	1,522 [r]	1,660 [r]	1,600 [r]	1,600 [e]
New Zealand, unspecified	73	102	114 [r]	43 [r]	43 [e]
Nigeria, unspecified[e]	40 [r]	47 [r]	54 [r]	58 [r]	48 [e]
Norway, quartz and quartzite	1,083	1,451 [r]	1,100 [r, e]	1,000	1,000 [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]	2012	2013	2014	2015	2016
Oman:					
Quartz	623	347	283	351	351 e
Unspecified	47	47	4	9	9 e
Pakistan, unspecified	371	308	222	359	359 e
Peru, quartz and quartzite	89 r, e	74 r	47 r, e	85 r, e	75 e
Philippines, sand	260	429	467 r	525 r	525 e
Poland:					
Quartzite	53	88	83 r	55 r	55 e
Unspecified	2,149	2,114 r	2,071 r	2,669 r	2,670 e
Portugal:					
Quartz	38	4	7	1 r	1 e
Quartzite	42	30 r	30	30 r	30 e
Saudi Arabia, unspecified	1,270 r	1,160 r	1,210 r	1,260	1,260 e
Serbia, common sand	1	633	462 r	108	108 e
Slovakia, unspecified[e]	479 r	476 r	480 r	480 r	480
Slovenia, quartz and quartzite	219	224	207 r	343 r	343 e
South Africa, unspecified	2,155 r	2,296 r	2,605 r	2,271 r	1,880 e
Spain:					
Quartz	1,023	949	900	900 r	900 e
Quartzite	2,082	2,058	2,000	2,000 r	2,000 e
Unspecified	3,416	3,400	3,400	3,400	3,400 e
Sri Lanka, unspecified	74 r	81 r	82 r	82 r	82 e
Sudan, quartz	5	--	--	--	-- e
Taiwan, unspecified	58	62	132	132	176 e
Thailand, unspecified	434 r	876 r	1,134 r	1,192 r	1,190 e
Turkey, unspecified	7,085	7,969	10,259 r	8,000 e	8,000 e
United Kingdom, unspecified	3,888	3,961 r	3,948 r	4,000 e	4,000 e
United States, unspecified, sold or used by producers	50,600	62,100	110,000	102,000 r	77,700
Venezuela:					
Quartz	118	8	--	--	-- e
Unspecified	118 e	8	7 r	7 r, e	7 e
Total	146,000 r	159,000 r	206,000 r	203,000 r	179,000

[e]Estimated. [r]Revised. -- Zero.

[1]Table includes data available through November 23, 2017. All data are reported unless otherwise noted. Totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

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