



2018 Minerals Yearbook

ABRASIVES, MANUFACTURED [ADVANCE RELEASE]

ABRASIVES, MANUFACTURED

By Lori E. Apodaca

Domestic survey data and tables were prepared by Hodan A. Fatah, statistical assistant.

In 2018, U.S. production of metallic abrasives was 180,000 metric tons (t), with a value of \$113 million, and shipments of metallic abrasives were 196,000 t valued at \$144 million (table 4). Estimated production of fused aluminum oxide in the United States and Canada, combined and rounded to the nearest 5,000 t, was 10,000 t, with an estimated value of \$1.7 million (table 2). U.S. silicon carbide production was estimated to be 35,000 t, also rounded to the nearest 5,000 t, with an estimated value of \$25.9 million (table 2). Combined U.S. exports for all types of abrasive aluminum oxide, abrasive silicon carbide, and metallic abrasives increased to 63,000 t in 2018 compared with 52,500 t in 2017 (table 5). Combined U.S. imports of abrasives for all types of aluminum oxide, abrasive silicon carbide, and metallic abrasives decreased slightly to 369,000 t in 2018 compared with 372,000 t in 2017 (table 6).

Abrasives are natural or manufactured substances that are used to abrade, clean, etch, grind, polish, scour, or otherwise remove solid material by rubbing action (as in a grinding wheel) or impact (as in pressure blasting). The most important physical properties for abrasives are character of fracture (cleavage), friability (tendency to break into smaller particles), grain shape and size, hardness (scratch hardness), purity (uniformity), and toughness (rigidity). Additional properties considered for application include availability, bonding characteristics, cost, and thermal stability. Manufactured abrasives are made from metals or minerals by heating or chemically treating them to enhance or give them abrasive properties. Abrasives play an important role in the fashioning and finishing of many products with a wide range of applications.

Manufactured abrasives generally dominate high-grade abrasives markets as opposed to natural abrasives because they have superior physical properties, more uniform quality, and can be tailored to meet users' needs. Consequently, manufactured abrasives typically are characterized by premium prices relative to natural abrasive minerals. Even though manufactured abrasives are usually more expensive, their durability and efficiency have proven to be more cost effective, and they are preferred in many industrial applications, such as metal finishing, cutting, and polishing. In the United States, large quantities of manufactured abrasives also are used in cutting and finishing wallboard and timber. The abrasives market is mature, and the use of various manufactured abrasive materials is well defined by application.

This chapter includes information on the following abrasives manufactured in the United States: aluminum-zirconium oxide, boron carbide, fused aluminum oxide, metallic shot and grit, and silicon carbide. In some cases, United States production data were combined with output from Canada to avoid disclosing company proprietary data and still provide useful information on the overall Canada–United States market. Trade data in this

chapter are from the U.S. Census Bureau. All percentages in the chapter were calculated using unrounded data.

Metallic Abrasives

Production.—In 2018, 11 companies operating 12 plants within the United States produced metallic abrasives (table 3). Data on U.S. production and shipments of metallic abrasives were based on a survey of domestic producers conducted by the U.S. Geological Survey (USGS) and were estimated for nonreporting producers on the basis of previously reported data and industry trends.

Five companies reported production of steel shot and grit in 2018, which accounted for most of the metallic abrasives produced domestically (table 4). U.S. production of steel shot and grit in 2018 decreased slightly to 176,000 t compared with that in 2017. Estimated production of cut wire shot by U.S. producers doubled to 4,000 t from 1,980 t in 2017 (table 4). Six companies reported production of cut wire shot in 2018, most of which was cut from carbon steel wire and stainless-steel wire. Other products reported included shot cut from aluminum, copper, and zinc wire. One company reported production of steel nuggets, a wrought carbon steel blast medium with properties like those of steel shot.

Consumption.—Metallic abrasives were used primarily as loose particles propelled at high velocities for blast cleaning or to improve the properties of metal surfaces. Principal consumers included foundries, machine tool industries, metalworking plants (particularly those supporting the automotive and aircraft industries), and steel manufacturers.

During 2018, shipments of steel shot and grit by U.S. producers decreased slightly to 192,000 t compared with those in 2017 (table 4). Domestic shipments of cut wire shot increased by 87% to an estimated 4,000 t compared with 2,140 t in 2017. The total quantity of all forms of metallic abrasives used in the United States in 2018 was about 192,000 t, compared with 195,000 t in 2017. Apparent consumption for metallic abrasives was calculated as shipments plus imports minus exports.

Prices.—The average unit value for U.S. production of steel shot and grit in 2018 was \$591 per metric ton, and the average unit value for sales of all steel shot and grit by U.S. producers was \$688 per metric ton (table 4). The estimated average unit value for U.S. production of cut wire shot in 2018 was \$2,150 per metric ton, and the estimated average unit value for sales of cut wire shot by U.S. producers was \$3,000 per metric ton. The average free alongside ship (f.a.s.) unit value for metallic abrasives exported from the United States during 2018 decreased to \$1,250 per metric ton, and the average customs unit value of imports of metallic abrasives increased to \$1,180 per metric ton (tables 5, 6).

Foreign Trade.—During 2018, the United States exported metallic abrasives to 39 countries and (or) localities and imported metallic abrasives from 19 countries and (or) localities. U.S. exports of metallic abrasives in 2018 increased by 8% to 33,600 t valued at \$42 million compared with those in 2017 (table 5). Mexico (65%), Canada (21%), China (4%), and Germany (3%) were the leading recipients of United States exports of metallic abrasives. U.S. imports in 2018 totaled 29,900 t valued at \$35.3 million (table 6). Most of the imports came from Canada (26%), China (20%), Germany (14%), Thailand (9%) and Japan (6%).

Fused Aluminum Oxide and Aluminum-Zirconium Oxide

Production.—Production data for crude and high-purity fused aluminum oxide in this chapter were obtained by the USGS from producers in Canada and the United States. The data were collected from two companies that operated four plants and represented the entire Canada and United States fused aluminum oxide industry (table 1). Saint-Gobain Abrasives operated a fused aluminum oxide plant in the United States (Huntsville, AL), and Saint-Gobain Ceramic Materials Canada Inc. operated an aluminum-zirconium oxide plant in Canada (Chippewa, Ontario). Washington Mills Electro Minerals Corp. operated fused aluminum oxide plants in Canada (Niagara Falls, Ontario) and the United States (Niagara Falls, NY). Quantity data from the two countries were combined to avoid disclosing company proprietary data and were reported by the producers, estimated for nonreporting producers, and rounded to the nearest 5,000 t. Estimates were based on previously reported data and industry trends.

Estimated production of crude fused aluminum oxide in 2018 was rounded to 10,000 t, with an estimated value rounded to \$1.7 million (table 2). The quantity and value were essentially unchanged compared with 2017. High-purity fused aluminum oxide output was not reported to avoid disclosing company proprietary data.

During 2018, fused aluminum-zirconium oxide for abrasive applications, such as resin-bonded grinding wheels, was produced at one plant in the United States operated by Saint-Gobain Abrasives and at one plant in Canada belonging to Saint-Gobain Ceramic Materials Canada. The general production trend indicates that the market is stable and relatively unchanged from previous years. Production data from these plants were withheld to avoid disclosing company proprietary data.

Consumption.—Crude fused aluminum oxide has many end uses. Specific applications in 2018 included antislip additives, bonded abrasives (such as abrasive grains that are made to adhere to each other and then are pressed or molded into abrasive tools), buffing and polishing compounds, coated abrasives (such as abrasive grains glued to a backing of paper or cloth), dry or wet blasting media, and tumbling media. Fused aluminum oxide in a micropowder form was used for industrial and electronic applications that require fine surface finishing. Fused aluminum oxide does not face any significant substitution threats at present because it is generally a very cost-effective abrasive. The total U.S. apparent consumption of crude fused aluminum oxide decreased by 22% in 2018. Apparent

consumption was calculated as imports minus exports to avoid disclosing company proprietary data.

Prices.—According to the USGS canvass of domestic producers, the estimated unit value of crude fused aluminum oxide produced in the United States and Canada during 2018 was \$170 per metric ton at the point of production. Prices of abrasive grain produced from these materials and sold to consumers were significantly higher.

Average unit values of fused aluminum oxide traded by the United States in 2018 were based on U.S. Census Bureau data. The average f.a.s. unit value for U.S. exports of crude fused aluminum oxide during the year was about \$3,090 per metric ton (table 5). Export unit values ranged from \$1,070 per metric ton (United Kingdom) to \$10,100 per metric ton (Germany). The average import customs unit value of crude aluminum oxide for 2018 was \$692 per metric ton (table 6), with values ranging from \$697 per metric ton (China) to \$2,310 per metric ton (Germany), and those of ground and refined imports averaged \$1,280 per metric ton and ranged from \$877 per metric ton (Canada) to \$2,070 per metric ton (France).

Foreign Trade.—Compared with those in 2017, crude fused aluminum oxide exports in 2018 increased by 25% to 19,300 t valued at \$59.6 million (table 5). Of the exports shipped to 40 countries and (or) localities, the leading destinations were Canada (50% of the tonnage), Mexico (23%), and Germany (8%).

During 2018, imports of crude fused aluminum oxide decreased by 17% to 122,000 t valued at \$84.3 million compared with those in 2017 (table 6). Some of the imported crude fused aluminum oxide was thought to be refractory-grade material, which would not have been used in abrasive applications. China accounted for 72% of the crude fused aluminum oxide imports received, followed by Hong Kong (25%), and all other countries and (or) localities combined (3%). Imports of ground and refined fused aluminum oxide increased by 21% to 70,600 t valued at \$90.7 million. Canada accounted for 20% of the ground and refined imports received, followed by Austria (16%), Brazil and China (15%, each), and Germany (11%).

World Review.—China was the world's leading producer of fused aluminum oxide with an estimated production capacity of 800,000 metric tons per year (t/yr); Germany ranked second with an estimated production capacity of 80,000 t/yr.

Silicon Carbide

Production.—One company, Washington Mills Hennepin, Inc., in Hennepin, IL, produced abrasive-grade silicon carbide in the United States during 2018 (table 1). This company also produced similar quantities of metallurgical-grade silicon carbide. A second company, Superior Graphite Co., in Hopkinsville, KY, produced a small quantity of silicon carbide, primarily intended for use in heat-resistant products rather than abrasives. U.S. silicon carbide production was an estimated 35,000 t during 2018, and the value of production was an estimated \$25.9 million, about the same as that of 2017 (table 2). About 50% of the production data were reported by producers, and the remaining 50% were estimated for nonreporting producers. Estimates were based on previously reported data and industry trends.

Consumption.—Abrasive-grade silicon carbide has many end uses. Specific applications in 2018 included antislip abrasives, blasting abrasives, bonded abrasives, coated abrasives, polishing and buffing compounds, tumbling media, and wire-sawing abrasives. The total quantity of silicon carbide (crude, ground and refined) consumed in the United States in 2018 was 171,000 t, compared with 165,000 t in 2017. Apparent consumption for silicon carbide was calculated as estimated production plus imports minus exports.

Prices.—According to information from industry sources, the average unit value of abrasive-grade silicon carbide at the point of manufacture was \$740 per metric ton in 2018, which was unchanged compared with 2017. The average f.a.s. unit value for U.S. crude silicon carbide exports in 2018 was \$1,430 per metric ton, a 23% decrease compared with 2017. The average f.a.s. unit value for U.S. ground and refined silicon carbide exports was \$2,900 per metric ton, a 26% decrease compared with 2017 (table 5).

The average customs unit value of crude silicon carbide imports in 2018 increased by 40% to \$670 per metric ton. China was the largest supplier of crude silicon carbide to the United States in 2018, providing 82,900 t of material. Crude silicon carbide imports from China had an average unit value of \$608 per metric ton, a 34% increase compared with 2017. The average customs unit value of ground and refined imports from all countries and (or) localities was \$1,940 per metric ton, an increase of 12% compared with 2017 (table 6). Ground and refined imports from China had an average customs unit value of \$1,180 per metric ton, a 16% increase compared with 2017.

Foreign Trade.—In 2018, the total quantity of U.S. crude silicon carbide exports increased by 58% to 3,500 t valued at \$5.01 million (table 5). Of the exported crude silicon carbide material shipped to 16 countries and (or) localities, 36% was shipped to Norway, 34% was shipped to the United Kingdom, and 19% was shipped to Germany. Exports of ground and refined silicon carbide in 2018 increased by 70% to 6,630 t valued at \$19.3 million. Of the exported ground and refined silicon carbide shipped to 36 countries and (or) localities, 77% was shipped to Canada, 7% to Mexico, and 6% to Japan.

In 2018, the United States imported crude silicon carbide from 11 countries and (or) localities and imported ground and refined silicon carbide from 22 countries and (or) localities. Imports of crude silicon carbide increased by 4% during the year to 107,000 t valued at \$71.6 million (table 6). Imports of silicon carbide in ground or refined form increased by 18% to 39,500 t valued at \$76.7 million. China accounted for 78% of the crude silicon carbide imports, followed by Hong Kong (15%). China accounted for 50% of the ground and refined silicon carbide imports, followed by Brazil (20%), and Russia (8%). Some of the imports from China may have included metallurgical-grade material.

World Review.—In 2018, China was the world's leading producer of silicon carbide. With all grades and end uses of silicon carbide combined, China held more than a two-thirds share of the global market.

Boron Carbide

Washington Mills Electro Minerals was the only commercial producer of boron carbide in the United States during 2018 (table 1). Boron carbide was used as an abrasive for lapping and ultrasonic cutting operations previously possible only with diamond dust; it was also molded to form highly wear-resistant products, such as armor, powdered metal and ceramic forming dies, pressure-blasting nozzles, thread guides, and wire-drawing dies. Boron carbide also was used in nuclear applications, such as neutron-absorbing shielding and reactor control rods (Washington Mills Electro Minerals Corp., undated). Domestic production and pricing data for boron carbide were withheld to avoid disclosing company proprietary data, and trade data were not available.

Outlook

Abrasives markets are influenced by activity in the manufacturing sector in the United States and by general economic trends. This is particularly true of manufacturing activities in the aerospace, automotive, furniture, housing, silicon wafers, and steel industries. Although abrasives markets are linked to these end-use manufacturing sectors, growth in these sectors may not necessarily lead to an increase in abrasives consumption.

The U.S. abrasives markets also are influenced by technological trends. Improved manufacturing technology has resulted in surface quality that requires fewer grinding and finishing operations that use abrasives. Less expensive imports coupled with higher domestic production costs and low domestic production capacity continue to challenge U.S. producers of fused aluminum oxide and silicon carbide to maintain market share. Competition from other countries and (or) localities, especially China, is likely to lead to further decreases in domestic output. China has become a dominant force in fused aluminum oxide and silicon carbide production in recent years, which has changed the supply makeup of the manufactured abrasives market. Lower priced exports from China have displaced and are expected to continue to displace manufactured abrasives produced in Europe and North America. The traditional suppliers among the Western industrialized nations are expected to continue consolidating and contracting (Lismore, 2013).

The aerospace and automotive industries are likely to continue to have significant indirect influences on demand for manufactured abrasives used by metalworking operations supporting those sectors. The housing construction sector in North America is expected to continue to have an indirect influence on demand for manufactured abrasives because of the large volumes of manufactured abrasives used in cutting and finishing wallboard and timber.

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TABLE 1
CRUDE ARTIFICIAL ABRASIVES MANUFACTURERS IN 2018¹

Company	Plant location	Product
Saint-Gobain Abrasives	Huntsville, AL	Fused aluminum oxide (high-purity) and aluminum-zirconium oxide.
Saint-Gobain Ceramic Materials Canada Inc.	Chippewa, Ontario, Canada	Aluminum-zirconium oxide.
Superior Graphite Co.	Hopkinsville, KY	Silicon carbide.
Washington Mills Electro Minerals	Niagara Falls, NY	Fused aluminum oxide (high-purity) and boron carbide.
Do.	Niagara Falls, Ontario, Canada	Fused aluminum oxide (regular).
Washington Mills Hennepin, Inc.	Hennepin, IL	Silicon carbide.
Do. Ditto.		

¹Table includes data available through May 21, 2020.

TABLE 2
ESTIMATED PRODUCTION OF ALUMINUM OXIDE AND SILICON CARBIDE ABRASIVES
IN THE UNITED STATES AND CANADA¹

Product	2017		2018	
	Quantity ^{2,3} (metric tons)	Value ² (thousands)	Quantity ^{2,3} (metric tons)	Value ² (thousands)
Aluminum oxide ⁴	10,000	\$1,700	10,000	\$1,700
Silicon carbide ⁵	35,000	25,900	35,000	25,900

¹Table includes data available through May 21, 2020. Data are rounded to no more than three significant digits.

²Owing to rounding, data do not match total quarterly Mineral Industry Surveys estimated data.

³Quantities are rounded to the nearest 5,000 metric tons to avoid disclosing company proprietary data.

⁴Regular grade accounts for about 62% of total output, and high-purity material accounts for the remainder.

⁵Approximately one-half of the quantity and value consists of material for metallurgical and other nonabrasive applications.

TABLE 3
U.S. PRODUCERS OF METALLIC ABRASIVES IN 2018¹

Company	Plant location	Product [shot and (or) grit]
Abrasive Materials, LLC	Hillsdale, MI	Cut wire.
Chesapeake Specialty Products, Inc.	Baltimore, MD	Steel.
Ervin Industries, Inc.	Adrian, MI	Do.
Do.	Butler, PA	Do.
FROHN North America, Inc.	Austell, GA	Cut wire.
MLP Specialty Metals, LLC (formerly Marwas Steel Co.)	Scottsdale, PA	Do.
Metaltec Steel Abrasives Co.	Canton, MI	Steel.
Peerless Metal Powders & Abrasives, LLC	Detroit, MI	Do.
Pellets LLC	Tonawanda, NY	Cut wire.
Platt Brothers & Co.	Waterbury, CT	Do.
Premier Shot Co.	Twinsburg, OH	Do.
Wheelabrator Abrasives Inc.	Bedford, VA	Steel.
Do. Ditto.		

¹Table includes data available through May 21, 2020.

TABLE 4
PRODUCTION AND SHIPMENTS OF METALLIC ABRASIVES IN THE
UNITED STATES, BY PRODUCT¹

Product	Production		Shipments ²	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
2017:				
Steel shot and grit	177,000	\$113,000	194,000	\$140,000
Cut wire shot and other ^c	1,980	7,450	2,140	8,750
Total	179,000	121,000	197,000	148,000
2018:				
Steel shot and grit	176,000	104,000	192,000	132,000
Cut wire shot and other ^c	4,000	8,600	4,000	12,000
Total	180,000	113,000	196,000	144,000

^cEstimated.

¹Table includes data available through May 21, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes reported exports.

TABLE 5
 U.S. EXPORTS OF ALUMINUM OXIDE, SILICON CARBIDE, AND METALLIC
 ABRASIVES, BY COUNTRY OR LOCALITY AND TYPE¹

Country or locality and type	2017		2018	
	Quantity (metric tons)	Value ² (thousands)	Quantity (metric tons)	Value ² (thousands)
Aluminum oxide, crude:				
Austria	58	\$565	53	\$623
Brazil	413	2,510	362	2,050
Canada	6,760 [†]	8,740 [†]	9,690	11,700
China	319	2,940	376	3,540
Germany	1,750	14,500	1,540	15,500
India	325	2,130	447	3,190
Japan	659	5,380	633	5,340
Korea, Republic of	354	2,300	443	2,970
Mexico	3,660	7,050	4,510	8,070
United Kingdom	243	1,510	289	310
Other	928	7,090	971	6,340
Total	15,500 [†]	54,700	19,300	59,600
Silicon carbide:				
Crude:				
Germany	110	172	671	1,040
Japan	22	1,510	1	365
Mexico	146	398	135	322
Norway	1,680	1,750	1,260	1,450
United Kingdom	1	15	1,180	1,460
Other	251 [†]	285 [†]	249	382
Total	2,210	4,130	3,500	5,010
Ground and refined:				
Canada	2,270	2,840	5,090	6,010
China	47	314	38	83
Germany	9	1,040	96	688
Japan	397	4,370	374	5,650
Mexico	706	1,800	434	1,050
Norway	5	5	--	--
Other	452	4,980	598	5,770
Total	3,890	15,300	6,630	19,300
Metallic abrasives:				
Canada	5,690	5,610	6,960	6,680
China	4,440	8,880	1,350	3,100
Germany	787	1,710	1,120	2,150
Japan	18	29	1	14
Mexico	18,500	27,200 [†]	21,800	24,500
Spain	(3)	4	--	--
Taiwan	72	116	112	204
United Kingdom	125	180	130	216
Other	1,360	4,120	2,100	5,150
Total	31,000	47,900 [†]	33,600	42,000

[†]Revised. -- Zero.

¹Table includes data available through May 21, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Free alongside ship value.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS OF ALUMINUM OXIDE, SILICON CARBIDE, AND METALLIC
ABRASIVES, BY COUNTRY OR LOCALITY AND TYPE¹

Country or locality and type	2017		2018	
	Quantity (metric tons)	Value ² (thousands)	Quantity (metric tons)	Value ² (thousands)
Aluminum oxide:				
Crude:				
Canada	1,330	\$1,100	290	\$203
China	98,700	52,200	87,800	61,200
Germany	2,570	242	206	475
Hong Kong	26,200	13,200	30,400	21,000
Other	18,300	5,250 ^r	3,290	1,460
Total	147,000	72,000	122,000	84,300
Ground and refined:				
Austria	9,930 ^r	18,200	11,000	20,600
Brazil	9,780	8,600	10,600	9,880
Canada	12,800	9,480	13,900	12,200
China	4,820 ^r	6,350 ^r	10,800	13,600
France	1,780 ^r	4,610 ^r	3,290	6,810
Germany	7,860	12,300	7,770	12,600
Hungary	2,940	2,850	3,570	4,040
Italy	2,360	2,370	2,630	2,930
Other	6,210 ^r	6,320 ^r	7,030	7,940
Total	58,400^r	71,100^r	70,600	90,700
Silicon carbide:				
Crude:				
Brazil	1,500	802	36	54
China	91,300	41,600	82,900	50,400
Hong Kong	--	--	15,800	12,500
Netherlands	3,350	591	75	4
Norway	639	2,040	605	1,970
South Africa	6,210	3,440	3,380	2,660
Other	95	939	4,120	3,980
Total	103,000	49,400	107,000	71,600
Ground and refined:				
Brazil	6,310 ^r	9,760 ^r	7,860	12,200
China	16,900	17,100	19,600	23,100
Germany	961	1,540	297	1,470
Japan	795 ^r	6,400 ^r	974	7,220
Norway	2,400	14,200	2,140	20,600
Russia	3,250	3,440	3,310	3,750
Vietnam	(3)	5	100	110
Other	2,920	5,720	5,180	8,240
Total	33,500	58,200^r	39,500	76,700
Metallic abrasives:				
Canada	10,800	9,200	7,770	7,010
China	5,660	4,290	6,040	6,290
Germany	4,620	4,570	4,060	6,210
Japan	1,990 ^r	4,870 ^r	1,730	3,920
Korea, Republic of	901	413	1,470	958
Sweden	20	34	164	197
Thailand	1,990	3,930	2,790	5,210
Other	3,590	2,820	5,850	5,510
Total	29,600^r	30,100^r	29,900	35,300

^rRevised. -- Zero.

¹Table includes data available through May 21, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Customs value.

³Less than ½ unit.

Source: U.S. Census Bureau.