



2008 Minerals Yearbook

ABRASIVES, MANUFACTURED [ADVANCE RELEASE]

ABRASIVES, MANUFACTURED

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In 2008, estimated Canadian and United States combined production of regular-grade fused aluminum oxide was 10,000 metric tons (t) with a value estimated to be \$1.7 million. The U.S. apparent consumption of fused aluminum oxide was estimated to be 270,000 t with an estimated value of \$121 million. U.S. silicon carbide production was estimated to be 35,000 t with an estimated value of \$25.9 million. The U.S. apparent consumption of crude silicon carbide was estimated to be 112,000 t with an estimated value of \$74.1 million. U.S. production of metallic abrasives was 212,000 t valued at \$106 million. U.S. shipments of metallic abrasives sold or used was 203,000 t, with a value of \$103 million. The U.S. apparent consumption of metallic abrasives was estimated to be 205,000 t with an estimated value of \$82.6 million.

This report 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 Canadian output to avoid disclosing company proprietary data and still provide useful data on the overall Canadian-United States market. Trade data in this report are from the U.S. Census Bureau. All percentages in the report were computed using the unrounded data.

Abrasives play an important role in the fashioning and finishing of many products with a wide range of uses. 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, grain shape and size, hardness (scratch hardness), purity (uniformity), and toughness (rigidity). Additional considerations 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. No single property is paramount for any use (Wellborn, 1996, p. 31, 43).

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. They are preferred in many industrial applications, such as metal finishing, cutting, and polishing. In the United States, large volumes of 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 fairly well defined by application (Kendall, 2001, p. 55).

Fused Aluminum Oxide

Production.—Production data for regular and high-purity fused aluminum oxide in this report were obtained by the U.S. Geological Survey (USGS) from producers in Canada and the United States. The data were collected from two companies that operated three plants and represented the entire Canadian and United States fused aluminum oxide industry (table 1). Saint-Gobain Grains & Powders operated a fused aluminum oxide plant in the United States, and Washington Mills Electro Minerals Corp. operated fused aluminum oxide plants in Canada and the United States. Quantity data from the two countries were combined to avoid disclosing company proprietary data and are reported by the producers, estimated, and rounded to the nearest 5,000 t.

Production of regular-grade fused aluminum oxide in 2008 was an amount rounded to 10,000 t with a value rounded to \$1.7 million. The weight and value were unchanged compared with 2007 regular-grade fused aluminum oxide production (table 2). Reporting on the output of high-purity fused aluminum oxide has been discontinued to avoid disclosing company proprietary data.

Consumption.—Abrasive-grade fused aluminum oxide has many end uses. Specific applications in 2008 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/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 as it is generally a very cost-effective abrasive. The total U.S. apparent consumption of all forms of fused aluminum oxide was estimated to be 270,000 t, with a value of \$121 million in 2008.

Prices.—The USGS canvassed fused aluminum oxide producers to determine the total value of their production for the year. The survey indicated that the average unit value of regular fused aluminum oxide produced in Canada during 2008 was \$165 per metric ton at the point of production; the average value of high-purity fused aluminum oxide output was \$670 per 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 2008 as reported in this publication are based on U.S. Census Bureau customs value data. The average value for U.S. exports of crude fused aluminum oxide during the year was about \$2,700 per ton. Average unit values of crude fused aluminum oxide imports during the year ranged from \$498 per ton (China) to \$3,220 per ton (Netherlands), and those of fused aluminum oxide grain imports ranged from \$677 per ton (Slovenia) to \$4,460 per ton (Australia).

Foreign Trade.—Compared with those of the previous year, crude fused aluminum oxide exports in 2008 increased by 20% to 21,900 t, and the value of those exports increased by 25% to \$59.0 million (table 5). Of the exports shipped to 31 countries, 77% went to Canada, Germany, Mexico, and Japan, in decreasing order by quantity.

During 2008, imports of crude fused aluminum oxide were received from 14 countries and increased by 27% to 244,000 t valued at \$125 million compared with those of 2007; imports of ground and refined fused aluminum oxide were received from 20 countries and decreased by 7% to 40,800 t valued at \$50.3 million (table 6). Some of the imported crude fused aluminum oxide was refractory-grade material. China, Venezuela, and Canada supplied 88%, 7%, and 1%, respectively, of the crude imports. Compared with those of 2007, crude imports from China increased by 33%, while imports from Canada decreased by 58% and from Venezuela decreased by 20%. Brazil, Germany, Austria, Italy, China, and Hungary provided 31%, 28%, 18%, 5%, 4%, and 2%, respectively, of the ground and refined material.

Silicon Carbide

Production.—One company produced abrasive-grade silicon carbide in the United States during 2008 (table 1). This company also produced similar amounts of metallurgical-grade silicon carbide. A second company, 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 decreased slightly during 2008 to an estimated 35,000 t, and the value of production decreased slightly to \$25.9 million (table 2).

Consumption.—Abrasive-grade silicon carbide has many end uses. Specific applications in 2008 included antislip abrasives, blasting abrasives, bonded abrasives, coated abrasives, polishing/buffing compounds, tumbling media, and wiresawing abrasives. The total silicon carbide consumed in the United States in 2008 was about 112,000 t valued at more than \$74.6 million.

Prices.—Based on information from industry sources and publications, the average value of abrasive-grade silicon carbide at the point of manufacture was \$696 per ton in 2008, a slight increase compared with that of the previous year. The average value for U.S. crude silicon carbide exports in 2008 was \$2,340 per ton, and the average value for U.S. ground silicon carbide exports was \$3,410 per ton.

During 2008, imports from China accounted for about 94% of total United States crude silicon carbide imports. This Chinese material had an average value of \$820 per ton. The average value of the remaining 6% of United States crude silicon carbide imports was \$1,080 per ton. Imports from China accounted for about 46% of total United States silicon carbide grain imports. This Chinese material had an average value of \$1,380 per ton. The average value of the remaining 54% of United States silicon carbide grain imports was \$2,370 per ton (table 6).

Global prices for silicon carbide steadily increased throughout 2007 (Kennedy, 2007). This trend continued in 2008 despite poor global economic conditions. This trend is demonstrated by the quarterly average unit values for imports of both types

of crude silicon carbide. Crude silicon carbide unit values increased by almost \$290 per ton and silicon carbide grain unit values increased by more than \$830 per ton during 2008.

Foreign Trade.—In 2008, the United States exported crude silicon carbide to 26 countries and refined and ground silicon carbide to 41 countries. The total crude silicon carbide exports for 2008 increased slightly compared with those of the previous year to 10,600 t valued at \$24.7 million (table 5). Compared with those of 2007, exports of refined or ground silicon carbide decreased by 29% to 6,420 t valued at \$21.9 million. Of the refined and ground material, 51% was shipped to Canada.

In 2008, the United States imported crude silicon carbide from 11 countries and imported ground and refined silicon carbide from 20 countries. Imports of crude silicon carbide decreased by 28% during the year to 87,300 t valued at \$72.9 million (table 6). Imports of silicon carbide in ground or refined form decreased by 8% to 39,600 t valued at \$75.7 million. China accounted for 94% of the crude silicon carbide imports and 46% of the ground and refined silicon carbide. A large part of the imports from China reportedly included metallurgical-grade material.

Aluminum-Zirconium Oxide

During 2008, fused aluminum-zirconium oxide for abrasive applications, such as resin-bonded grinding wheels, was produced at one plant in the United States, belonging to Saint-Gobain Grains & Powders and one plant in Canada, belonging to Saint-Gobain Ceramic Materials Canada Inc., but production data from the producing plants are withheld to avoid disclosing company proprietary information.

Boron Carbide

Washington Mills Electro Minerals Corp. was the only commercial producer of boron carbide in the United States during 2008. 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 pressure blasting nozzles, wire-drawing dies, powdered metal and ceramic forming dies, thread guides, and armor. Boron carbide was also used in nuclear applications, such as reactor control rods and neutron-absorbing shielding (Washington Mills Electro Minerals Corp., 2008). Domestic production data for boron carbide are withheld to avoid disclosing company proprietary data.

Metallic Abrasives

Production.—Data on U.S. production and shipments of metallic abrasives were based on a survey of domestic producers conducted by the USGS. Survey data were collected from 11 companies operating 12 plants in the United States and accounted for all domestic production (table 3).

Steel shot and grit accounted for almost all the metallic abrasives produced domestically (table 4). U.S. production of steel shot and grit in 2008 increased by 5% compared with that of 2007; the average value was \$466 per ton. Six companies reported production of cut wire shot in 2008, and most of that 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 similar to steel shot.

Consumption.—Metal abrasives are used primarily as loose particles propelled at high velocities for blast cleaning or to improve the properties of metal surfaces; 75% of the abrasives is employed in cleaning operations. Principal consumers include foundries, machine tool industries, metalworking plants (particularly those supporting the automotive and aircraft industries), and steel manufacturers.

During 2008, total sales of all steel shot and grit by U.S. producers decreased by 8% compared with shipments in 2007 to 201,000 t with an average value of \$470 per ton sold or used.

Prices.—The USGS compiles survey data on the value of production and shipments, but it does not collect price data. The values of production and shipments reported by metallic abrasive producers in 2008 are listed in table 4. Average values of steel shot and grit ranged from \$0.33 to \$1.53 per kilogram. Average values of cut wire shot ranged from \$1.90 to \$6.53 per kilogram for carbon steel, stainless steel, and zinc wire shot. Average unit values for metallic abrasives traded by the United States during 2008 were \$1.41 per kilogram for exports and \$0.77 per kilogram for imports.

Foreign Trade.—During 2008, the United States exported metallic abrasives to 44 countries and imported metallic abrasives from 17 countries. U.S. exports of metallic abrasives increased by 28% during the year to 34,400 t valued at \$48.5 million (table 5). Canada, China, and Mexico received 87% of the U.S. exports of metallic abrasives in 2008. U.S. imports increased by 63% during 2008 to 36,600 t valued at \$28.3 million (table 6). About 78% of the imports came from Canada and Sweden.

Outlook

Abrasives markets are greatly influenced by activity in the manufacturing sector in the United States. This is particularly true of manufacturing activities in the aerospace, automotive, furniture, housing, and steel industries. Even though 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. abrasive markets also are influenced by economic and technological trends. Improved technology in these manufacturing sectors has resulted in surface quality that requires less grinding and finishing operations that use abrasives (O'Driscoll, 2003). Less expensive imports coupled with higher domestic production costs and low domestic production capacity could continue to challenge U.S. producers of fused aluminum oxide and silicon carbide to maintain market share. Competition from developing nations, especially China, could lead to further decreases in domestic output. China has become a dominant force in both fused aluminum oxide and silicon carbide in recent years. This has changed the makeup of the manufactured abrasives market. Lower priced Chinese exports have displaced and could continue to displace manufactured abrasives produced in Europe

and North America (Gasser, 2002). The traditional suppliers among the Western industrialized nations are expected to continue consolidating and contracting.

Emerging suppliers of fused aluminum oxide and silicon carbide in China, Eastern Europe, India, the Republic of Korea, and South America could continue to increase their prominence in world markets. Further success for these suppliers, particularly in such major markets as Japan, the United States, and Western Europe, should depend on their ability to provide higher grades of material and levels of supply reliability while maintaining lower prices. Energy costs, furnace size, quality-control systems, and the availability of essential mineral inputs should be the dominant factors influencing the competitive stance of these suppliers (O'Driscoll, 1997; Zhilun, 1997; Lunghofer and Wolfe, 1998).

The aerospace and automotive manufacturing sectors should continue to be significant indirect influences on demand for manufactured abrasives used by metalworking operations supporting those sectors. The housing construction sector in North America should also 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 2008

Company	Plant location	Product
Saint-Gobain Ceramic Materials Canada Inc.	Chippewa, Ontario, Canada	Aluminum-zirconium oxide.
Saint-Gobain Grains & Powders	Huntsville, AL	Fused aluminum oxide (high-purity) and aluminum-zirconium oxide.
Washington Mills Electro Minerals Corp.	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.		

TABLE 2
ESTIMATED PRODUCTION OF CRUDE SILICON CARBIDE AND FUSED ALUMINUM OXIDE IN THE UNITED STATES AND CANADA^{1,2}

Product	2007		2008	
	Quantity ^{3,4} (metric tons)	Value ³ (thousands)	Quantity ^{3,4} (metric tons)	Value ³ (thousands)
Aluminum oxide, regular, abrasives ⁵	10,000	\$1,700	10,000	\$1,700
Silicon carbide ⁶	35,000	26,000	35,000	25,900

¹Data are rounded to no more than three significant digits.

²Yearend stock data are withheld to avoid disclosing company proprietary data.

³Owing to rounding, data do not match total quarterly Mineral Industry Surveys estimated data.

⁴Quantities are rounded to the nearest 5,000 metric tons to avoid disclosing company proprietary data.

⁵Regular grade accounts for about 62% of total output, and high-purity material accounts for the remainder.

⁶Approximately 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 2008

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 Steel, LLC (formerly Marwas Steel Co.)	Scottsdale, PA	Do.
Metaltec Steel Abrasive Co.	Canton, MI	Steel.
Peerless Metal Powders & Abrasive Co., Inc.	Detroit, MI	Steel and steel nuggets.
Pellets, LLC	Tonawanda, NY	Cut wire.
Platt Brothers & Co., Inc., The	Waterbury, CT	Do.
Premier Shot Co.	Cleveland, OH	Do.
Wheelabrator Abrasives Inc.	Bedford, VA	Steel.
Do. Ditto.		

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

Product	Production		Shipments ²	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
2007:				
Steel shot and grit	201,000	\$87,900	218,000	\$105,000
Cut wire shot and other ^c	2,180	9,350	2,120	9,750
Total	203,000	97,200	220,000	115,000
2008:				
Steel shot and grit	210,000	98,100	201,000	94,300
Cut wire shot and other ^c	1,910	7,710	1,910	8,460
Total	212,000	106,000	203,000	103,000

^cEstimated.

¹Data 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 AND TYPE¹

Country	2007		2008	
	Quantity (metric tons)	Value ² (thousands)	Quantity (metric tons)	Value ² (thousands)
Aluminum oxide, crude:				
Belgium	41	\$41	20	\$23
Brazil	485	2,070	682	2,710
Canada	5,670	5,870	8,160	8,740
China	266	1,780	248	1,700
Germany	4,330	15,600	3,760	15,400
India	406	1,650	308	1,280
Japan	1,430	5,740	2,010	8,640
Korea, Republic of	631	3,560	910	5,680
Mexico	2,530	3,370	3,000	4,890
Other	2,390	7,550	2,790	9,940
Total	18,200	47,200	21,900	59,000
Silicon carbide:				
Crude:				
Finland	--	--	8	32
Germany	11	1,170	8	1,080
Japan	438	2,180	142	2,130
Mexico	407	1,100	626	1,760
Norway	9,260	12,500	9,650	16,700
Other	198	1,790	143	3,000
Total	10,300	18,700	10,600	24,700
Ground and refined:				
Canada	6,650	5,760	3,260	3,910
China	10	115	249	531
Costa Rica	23	63	29	90
France	1	52	13	12
Germany	370	9,610	360	10,700
Italy	16	60	33	169
Japan	529	2,040	568	2,320
Korea, Republic of	41	201	85	245
Mexico	953	981	1,140	1,350
Norway	42	80	97	206
Spain	35	93	26	93
United Kingdom	147	229	232	387
Other	201	2,170	324	1,870
Total	9,020	21,500	6,420	21,900
Metallic abrasives:				
Australia	106	93	50	46
Canada	8,400	6,990	9,820	8,890
China	7,660	17,000	11,400	17,800
France	104	281	58	118
Italy	--	--	14	207
Japan	420	393	788	1,090
Mexico	6,970	9,130	8,800	11,300
Taiwan	98	179	633	661
United Kingdom	1,150	2,510	1,350	3,810
Other	1,890	3,580	1,420	4,530
Total	26,800	40,100	34,400	48,500

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Customs value.

Source: U.S. Census Bureau.

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

Country	2007		2008	
	Quantity (metric tons)	Value ² (thousands)	Quantity (metric tons)	Value ² (thousands)
Aluminum oxide:				
Crude:				
Canada	6,420	\$5,220	2,720	\$1,840
China	161,000	50,300	215,000	107,000
Venezuela	19,800	12,400	15,900	10,400
Other	5,130	1,710	10,600	5,720
Total	193,000	69,600	244,000	125,000
Ground and refined:				
Austria	7,400	11,300	7,390	11,000
Brazil	11,100	8,550	12,800	12,100
Canada	715	1,320	819	1,280
China	3,450	1,770	1,680	1,480
France	1,410	2,500	1,500	3,040
Germany	10,700	14,400	11,500	15,200
Hungary	1,880	1,640	1,240	1,150
Italy	4,060	3,170	2,240	2,120
Korea, Republic of	231	255	--	--
South Africa	22	31	--	--
United Kingdom	364	891	208	585
Other	2,630	3,030	1,390	2,220
Total	44,000	48,800	40,800	50,300
Silicon carbide:				
Crude:				
Brazil	456	273	228	177
China	106,000	59,100	82,300	67,500
Netherlands	6,800	1,450	--	--
Philippines	--	--	1,260	140
Russia	--	--	21	22
Venezuela	5,190	2,880	2,600	1,230
Other	2,270	2,910	959	3,900
Total	121,000	66,600	87,300	72,900
Ground and refined:				
Brazil	9,600	9,340	8,550	12,000
Canada	231	266	207	184
China	17,400	20,100	18,400	25,400
Japan	1,820	10,200	1,680	10,700
Norway	2,660	14,100	2,640	14,500
Russia	1,540	1,200	614	646
Venezuela	1,800	1,160	2,240	1,780
Vietnam	5,700	4,110	2,960	2,160
Other	2,220	7,850	2,300	8,410
Total	43,000	68,400	39,600	75,700
Metallic abrasives:				
Canada	13,800	8,370	11,900	8,690
China	2,970	2,640	2,030	3,120
Germany	2,740	3,830	2,120	2,760
Sweden	25	22	16,600	9,470
Other	2,870	2,500	3,980	4,260
Total	22,400	17,400	36,600	28,300

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Customs value.

Source: U.S. Census Bureau.