



2009 Minerals Yearbook

ABRASIVES, MANUFACTURED [ADVANCE RELEASE]

ABRASIVES, MANUFACTURED

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In 2009, 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 35,900 t. 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 77,900 t. U.S. production of metallic abrasives was 138,000 t valued at \$70.3 million. U.S. shipments of metallic abrasives were 152,000 t, with a value of \$89.5 million. The U.S. apparent consumption of metallic abrasives was estimated to be 142,000 t.

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 Abrasives 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 2009 was an amount rounded to 10,000 t with a value rounded to \$1.7 million. The weight and value were unchanged compared with 2008 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 2009 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 2009 U.S. apparent consumption of all forms of fused aluminum oxide was estimated to be 35,900 t, with a value of \$21.8 million, based on the average customs unit value for imports.

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 2009 was \$165 per metric ton at the point of production; the average value of high-purity fused aluminum oxide output was \$671 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 2009 as reported in this publication are based on U.S. Census Bureau data. The average value for U.S. exports of crude fused aluminum oxide during the year was

about \$2,600 per ton. The average customs value of crude fused aluminum oxide imports during the year was \$608 per ton, but values ranged from \$181 per ton (Hungary) to \$7,870 per ton (Slovakia), and those of fused aluminum oxide grain imports averaged \$1,170 per ton and ranged from \$788 per ton (Brazil) to \$1.22 million per ton (Israel). The extremely high values represent small quantities of highly specialized materials.

Foreign Trade.—Compared with those of the previous year, crude fused aluminum oxide exports in 2009 decreased by 44% to 12,300 t, and the value of those exports decreased by 46% to \$32.0 million (table 5). Of the exports shipped to 34 countries, 81% went to Canada, Mexico, Germany, and Japan, in decreasing order by quantity.

During 2009, imports of crude fused aluminum oxide were received from 13 countries and decreased by 84% to 38,200 t valued at \$23.2 million compared with those of 2008; imports of ground and refined fused aluminum oxide were received from 21 countries and decreased by 36% to 26,000 t valued at \$30.5 million (table 6). Some of the imported crude fused aluminum oxide was refractory-grade material. China, Canada, and Venezuela supplied 63%, 22%, and 13%, respectively, of the crude imports. Compared with those of 2008, crude imports from Canada increased to 8,450 t from 2,720 t, while imports from China decreased from 215,000 t to 24,200 t, and those from Venezuela decreased from 15,900 t to 5,090 t. Brazil, Germany, Austria, China, Hungary, and Italy provided 36%, 19%, 16%, 14%, 4%, and 4%, respectively, of the ground and refined material.

Silicon Carbide

Production.—One company produced abrasive-grade silicon carbide in the United States during 2009 (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 2009 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 2009 included antislip abrasives, blasting abrasives, bonded abrasives, coated abrasives, polishing/buffing compounds, tumbling media, and wiresawing abrasives. The total abrasive-grade silicon carbide consumed in the United States in 2009 was about 77,900 t valued at about \$33.1 million.

Prices.—Based on information from industry sources and publications, the average value of abrasive-grade silicon carbide at the point of manufacture was \$739 per ton in 2009, which was unchanged compared with that of the previous year. The average value for U.S. crude silicon carbide exports in 2009 was \$1,550 per ton, a 34% decrease compared with that of the previous year. The average value for U.S. ground silicon carbide exports was \$3,070 per ton, a 10% decrease compared with that of the previous year.

Crude silicon carbide imports from China had an average value of \$604 per ton. The average value of crude silicon carbide imports from other countries was \$465 per ton. Silicon

carbide grain imports from China material had an average customs value of \$1,380 per ton. The average customs value of silicon carbide grain imports from other countries was \$2,795 per ton (table 6).

Global prices for silicon carbide steadily increased throughout 2008 despite poor global economic conditions (Kennedy, 2008); however, the poor global economic conditions did cause average prices to drop each quarter during 2009. This trend was demonstrated by the quarterly average unit values for imports of both types of crude silicon carbide. Crude silicon carbide unit values decreased from \$692 per ton in the first quarter to \$442 per ton in the fourth quarter, and silicon carbide grain unit values decreased from \$2,660 per ton in the first quarter to \$1,880 per ton in the fourth quarter of 2009.

Foreign Trade.—In 2009, the United States exported crude silicon carbide to 22 countries and refined and ground silicon carbide to 36 countries. The total crude silicon carbide exports for 2009 increased by 60% compared with those of the previous year to 16,900 t valued at \$26.2 million (table 5). Of the exported crude silicon carbide material, 79% was shipped to Norway. Compared with those of 2008, exports of refined or ground silicon carbide decreased by 42% to 3,750 t valued at \$11.5 million. Of the exported refined and ground material, 45% was shipped to Canada.

In 2009, the United States imported crude silicon carbide from 15 countries and imported ground and refined silicon carbide from 23 countries. Imports of crude silicon carbide decreased by 31% during the year to 59,900 t valued at \$33.4 million (table 6). Imports of silicon carbide in ground or refined form decreased by 54% to 18,100 t valued at \$41.1 million. China accounted for 66% of the crude silicon carbide imports and 37% of the ground and refined silicon carbide imports. A large part of the imports from China reportedly included metallurgical-grade material.

Aluminum-Zirconium Oxide

During 2009, 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 Abrasives, and one plant in Canada, belonging to Saint-Gobain Ceramic Materials Canada Inc., but production data from these plants are withheld to avoid disclosing company proprietary information.

Boron Carbide

Washington Mills Electro Minerals was the only commercial producer of boron carbide in the United States during 2009. 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 also was 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 2009 decreased by 35% compared with that of 2008; the average unit value in 2009 was \$474 per ton. Six companies reported production of cut wire shot in 2009, 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 2009, total sales of all steel shot and grit by U.S. producers decreased by 25% compared with shipments in 2008 to 151,000 t with an average value of \$555 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 2009 are listed in table 4. Average unit values of steel shot and grit ranged from \$0.33 to \$1.06 per kilogram. Average unit values of cut wire shot ranged from \$1.90 to \$5.75 per kilogram for carbon steel, stainless steel, and zinc wire shot. Average unit values for metallic abrasives traded by the United States during 2009 were \$1.24 per kilogram for exports and \$0.76 per kilogram for imports.

Foreign Trade.—During 2009, the United States exported metallic abrasives to 45 countries and imported metallic abrasives from 17 countries. U.S. exports of metallic abrasives decreased by 25% during the year to 25,900 t valued at \$32.2 million (table 5). Canada, China, and Mexico received 82% of the U.S. exports of metallic abrasives in 2009. U.S. imports decreased by 57% during 2009 to 15,800 t valued at \$12.1 million (table 6). About 81% of the imports came from Canada, China, Germany, and Sweden.

Outlook

Abrasives markets are greatly influenced by activity in the manufacturing sector in the United States. During the past year, downturns in the U.S. manufacturing sector owing to the impacts of the global economic recession have caused decreases in U.S. manufactured abrasives production and consumption. 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. As the world and the United States slowly begin to recover from the global economic recession, it is most likely that U.S. manufactured abrasives production and consumption will also slowly begin to show signs of improvement.

Improved technology in these manufacturing sectors has resulted in surface quality that requires fewer grinding and finishing operations that use abrasives (O'Driscoll, 2003). 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 developing nations, especially China, will probably lead to further decreases in domestic output. China has become a dominant force in both fused aluminum oxide and silicon carbide production in recent years. This has changed the makeup of the manufactured abrasives market. Lower priced Chinese exports have displaced and are expected to 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 are likely to 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, will 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 are expected to be the dominant factors influencing the competitive stance of these suppliers.

The aerospace and automotive manufacturing sectors are likely to 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 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 2009

Company	Plant location	Product
Saint-Gobain Ceramic Materials Canada Inc.	Chippewa, Ontario, Canada	Aluminum-zirconium oxide.
Saint-Gobain Abrasives	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	2008		2009	
	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	25,900	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 2009

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)
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
2009:				
Steel shot and grit	137,000	64,900	151,000	83,700
Cut wire shot and other ^c	1,470	5,390	1,490	5,800
Total	138,000	70,300	152,000	89,500

^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	2008		2009	
	Quantity (metric tons)	Value ² (thousands)	Quantity (metric tons)	Value ² (thousands)
Aluminum oxide, crude:				
Brazil	682	\$2,710	141	\$650
Canada	8,160	8,740	5,470	7,210
China	248	1,700	143	959
Germany	3,760	15,400	1,680	6,020
India	308	1,280	189	878
Japan	2,010	8,640	724	4,450
Korea, Republic of	910	5,680	430	3,180
Mexico	3,000	4,890	2,060	3,430
United Kingdom	1,370	2,750	634	1,640
Other	1,450 ^r	7,210 ^r	854	3,620
Total	21,900	59,000	12,300	32,000
Silicon carbide:				
Crude:				
Germany	8	1,080	2,550	3,020
Japan	142	2,130	32	458
Mexico	626	1,760	759	1,310
Norway	9,650	16,700	13,400	19,500
Other	151 ^r	3,030 ^r	182	1,890
Total	10,600	24,700	16,900	26,200
Ground and refined:				
Canada	3,260	3,910	1,680	2,540
China	249	531	71	475
Germany	360	10,700	349	4,440
Japan	568	2,320	270	873
Mexico	1,140	1,350	996	1,570
Norway	97	206	76	158
United Kingdom	232	387	25	26
Other	509 ^r	2,480 ^r	280	1,410
Total	6,420	21,900	3,750	11,500
Metallic abrasives:				
Canada	9,820	8,890	5,160	4,730
China	11,400	17,800	7,470	10,400
Germany	201	448	172	572
Indonesia	167	124	824	1,500
Japan	788	1,090	963	972
Mexico	8,800	11,300	8,750	9,390
Taiwan	633	661	458	447
United Kingdom	1,350	3,810	753	2,080
Other	1,170 ^r	4,330 ^r	1,370	2,170
Total	34,400	48,500	25,900	32,200

^rRevised.

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	2008		2009	
	Quantity (metric tons)	Value ² (thousands)	Quantity (metric tons)	Value ² (thousands)
Aluminum oxide:				
Crude:				
Canada	2,720	\$1,840	8,450	\$6,530
China	215,000	107,000	24,200	12,900
Venezuela	15,900	10,400	5,090	3,610
Other	10,600	5,720	489	181
Total	244,000	125,000	38,200	23,200
Ground and refined:				
Austria	7,390	11,000	4,210	7,100
Brazil	12,800	12,100	9,240	7,280
Canada	819	1,280	390	804
China	1,680	1,480	3,710	2,920
France	1,500	3,040	402	873
Germany	11,500	15,200	5,020	7,390
Hungary	1,240	1,150	1,100	1,090
Italy	2,240	2,120	982	1,210
Other	1,600 ^r	2,810 ^r	963	1,820
Total	40,800	50,300	26,000	30,500
Silicon carbide:				
Crude:				
China	82,300	67,500	39,700	24,000
Netherlands	--	--	4,540	1,330
Venezuela	2,600	1,230	4,500	2,000
Other	2,470 ^r	4,240 ^r	11,200	6,070
Total	87,300	72,900	59,900	33,400
Ground and refined:				
Brazil	8,550	12,000	4,000	5,760
China	18,400	25,400	6,660	9,200
Germany	1,340	5,740	1,570	6,800
Japan	1,680	10,700	1,070	7,330
Norway	2,640	14,500	1,660	8,120
Russia	614	646	1,280	1,410
Vietnam	2,960	2,160	1,120	1,080
Other	3,410 ^r	4,630 ^r	725	1,430
Total	39,600	75,700	18,100	41,100
Metallic abrasives:				
Canada	11,900	8,690	6,380	3,920
China	2,030	3,120	1,690	3,680
Germany	2,120	2,760	1,300	1,040
Sweden	16,600	9,470	3,400	1,100
Other	3,980	4,260	3,040	2,330
Total	36,600	28,300	15,800	12,100

^rRevised. -- Zero.

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

²Customs value.

Source: U.S. Census Bureau.