

# ABRASIVES, MANUFACTURED

By Ronald F. Balazik

The manufactured abrasives industry typically is characterized by high-energy and high-cost production methods as well as premium prices relative to natural abrasive minerals. However, manufactured abrasives generally are harder and more durable than their natural counterparts, and therefore are preferred in many industrial applications such as metal finishing, cutting, and polishing.

This report presents information on the following abrasives manufactured in the United States: fused aluminum oxide, silicon carbide, metallic shot and grit, alumina-zirconia oxide, and boron carbide. Where indicated, U.S. production data are combined with Canadian output to protect proprietary information. Except where noted, quantities are reported in metric units.

## Fused Aluminum Oxide

**Legislation and Government Programs.**—On January 1, 1997, the National Defense Stockpile (NDS) operated by the Department of Defense contained 141,812 tons of crude fused aluminum oxide valued at \$33.3 million; 29,882 tons of fused aluminum oxide abrasive grain valued at \$15.7 million also was stockpiled. During 1997, however, the Department of Defense sold 13,607 tons of NDS crude fused aluminum oxide valued at \$3.5 million and 5,460 tons of NDS aluminum oxide abrasive grain valued at \$1.8 million. The Department of Defense plans to continue such sales under its authority to dispose of all remaining NDS aluminum oxide. If the current disposal rate and the NDS sales schedule are continued, all of the stockpiled aluminum oxide will be sold by 2003.

**Production.**—In this report, production data for fused aluminum oxide are based on a survey of United States and Canadian producers conducted by the U.S. Geological Survey (USGS). The data were collected from five companies operating nine plants in the United States and Canada during 1997 and represented the entire industry. (See table 1.) One company (Dakota Catalyst Products, Inc.) ceased operations early in the year.

Estimated production of fused aluminum oxide in 1997 was 108,000 tons, 27% less than in 1996; output declined for regular-grade and high-grade material. (See table 2.) Low-cost imports of fused aluminum oxide from China appeared to be a factor influencing the decline.

**Consumption.**—Abrasive-grade fused aluminum oxide has many end uses. Specific applications in 1997 included bonded abrasives, coated abrasives, tumbling media, air/water blasting media, polishing/buffing compounds, and antislip additives. The total value of fused aluminum oxide abrasive grain consumed in the United States was estimated to be more than \$120 million in 1997.

**Prices.**—The USGS surveys fused aluminum oxide producers to determine value of production. The survey indicates that the average value of regular fused aluminum oxide produced in the United States and Canada during 1997 was \$370 per ton; the average value of high-purity fused aluminum oxide output was \$570 per ton. Prices of abrasive grain produced from these materials and sold to consumers are significantly higher. In 1997, prices generally ranged from \$0.55 to \$1.50 per kilogram for regular-grade grain and from \$0.90 to \$1.80 per kilogram for high-purity grain.

**Foreign Trade.**—Exports of all fused aluminum oxide in 1997 declined 10% to 10,700 tons. These exports were valued at \$18 million. Most of the exports went to Canada and Mexico.

Imports of crude fused aluminum oxide increased 11% in 1997 to 90,000 tons (valued at \$40.1 million), while imports of ground and refined fused aluminum oxide declined slightly to 47,600 tons (valued at \$35.2 million). Some of the imported crude fused aluminum oxide reportedly is refractory-grade material. Canada supplied 80% of the crude imports; China provided 58% of the ground and refined material.

## Silicon Carbide

**Legislation and Government Programs.**—On January 1, 1997, the NDS contained 14,458 tons of silicon carbide valued at \$6.9 million. Under Federal legislation authorizing the disposal of all silicon carbide in the NDS, the Department of Defense sold over 5,774 tons of stockpiled silicon carbide (valued at \$2.8 million) in 1997. If the current disposal rate and the Department of Defense stockpile sales schedule are continued, all of the NDS silicon carbide will be sold by 2000.

**Production.**—The USGS collects production and sales information from all producers of silicon carbide in the United States and Canada. Three companies operating three plants (two in the United States and one in Canada) produced silicon carbide in 1997. Table 2 indicates production quantities and values for these companies in 1996 and 1997. Approximately one-half of the production is metallurgical-grade silicon carbide.

**Consumption.**—Abrasive-grade silicon carbide has many end uses. Specific applications in 1997 included bonded abrasives, coated abrasives, tumbling media, blasting abrasives, wiresawing abrasives, polishing/buffing compounds, and antislip abrasives. The total value of U.S. producer sales of silicon carbide graded grain for all uses was estimated to be more than \$100 million in 1997.

**Prices.**—The USGS does not collect price data on the various grades of silicon carbide. Based on the Department of Defense stockpile sales and other information from industry sources and publications, however, the average value of abrasive-grade silicon

carbide at the point of manufacture was estimated to be slightly more than \$600 per ton in 1997.

**Foreign Trade.**—Exports of crude silicon carbide increased sharply in 1997 to 2,650 tons (valued at \$3.2 million). Exports of refined and ground silicon carbide remained virtually unchanged at 13,400 tons (valued at \$12.2 million). Approximately 80% of the crude exports went to Belgium; about 80% of the refined and ground material was shipped to Canada.

Imports of crude silicon carbide rose 27% in 1997 to 212,500 tons (valued at \$71.7 million). Imports of silicon carbide in ground or refined form nearly doubled to 27,400 tons (valued at \$31.6 million). China accounted for 81% of the crude imports and 61% of the ground or refined imports; a large part of the crude silicon carbide reportedly is metallurgical-grade material. The value of the imports from China were significantly less than the average values of silicon carbide imports from other sources.

### Aluminum-Zirconium Oxide

Norton Company and Washington Mills Electro Minerals Corp. produced fused aluminum-zirconium oxide for abrasive applications (e.g., resin-bonded grinding wheels) in 1997; output was from three plants, two in the United States and one in Canada (W. Wellborn, Washington Mills Electro Minerals Corp., oral commun., 1998). In order to protect company proprietary information, the USGS does not publish production data regarding aluminum-zirconium oxide.

### Boron Carbide

Only one firm, Washington Mills Electro Minerals Corp., is known to be a commercial producer of boron carbide in the United States. Boron carbide is used for grinding and lapping operations previously possible only with diamond dust (Wellborn, 1996); it also is molded to form very wear-resistant products, such as pressure blast nozzle liners and extrusion dies.

Although production data are not available, the USGS can report the following 1997 trade information on boron carbide: U.S. imports were 232 tons (valued at \$5.8 million), primarily from Germany, China, Mexico, and the Ukraine; exports were 58 tons (valued at \$1.1 million), principally to Latin America and Japan.

### Metallic Abrasives

**Production.**—Data in this report on U.S. production and shipments of metallic abrasives are based on a survey of domestic producers conducted by the USGS. The survey data were collected from 13 producers operating 14 plants in the United States and accounted for virtually all of the domestic industry. (See table 3.)

Steel shot and grit account for almost all metallic abrasives produced domestically. (See table 4.) Output of steel shot and grit increased 7% relative to 1996 production; total value grew by 6%, but the average value per ton remained virtually unchanged at \$440. Six companies reported production of cut wire shot in 1997. Most of the shot is cut from carbon steel wire and stainless steel

wire; other products reportedly included shot cut from aluminum, copper, and zinc wire.

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

In 1997, total sales of all steel shot and grit by U.S. producers increased by 18%; total value increased by 17%. The average value per ton sold or used during the year decreased slightly to \$451.

**Prices.**—Although the USGS compiles survey data on the value of production and shipments, it does not collect price data. The value of production and shipments reported by metallic abrasive producers in 1997 are shown in table 4. It is estimated that prices of steel shot and grit were about \$0.45 to \$0.55 per kilogram in 1997. Estimated average prices of cut wire shot in 1997 were \$4.50 to \$9.00 per kilogram for aluminum wire shot and \$6.50 to \$9.00 per kilogram for stainless steel wire shot.

**Foreign Trade.**—U.S. exports of metallic abrasives increased 5% in 1997 to 26,200 tons (valued at 17.1 million). Most of the exports went to Canada; the remaining amount was shipped to Mexico, Taiwan, Japan, the United Kingdom, and Venezuela.

Domestic imports of metallic abrasives increased 16% in 1997 to 23,400 tons (valued at \$12.4 million). About 90% of the imports came from Canada; most of the remaining imports were shipped from Germany and the United Kingdom.

### Outlook

The outlook for U.S. manufacturers of abrasive materials is dependant on several economic and technological trends. Despite growing demand, low-cost imports coupled with higher operating expenditures will continue to challenge U.S. producers of fused aluminum oxide and silicon carbide; strong foreign competition, particularly from China, could further curtail domestic output. Markets for metal abrasives will be influenced by technological changes in industries where they are used; for example, new cleaning and finishing methods in foundries could reduce demand for some metal abrasives (Ted Giese, Abrasive Engineering Society, oral commun., 1998).

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

Motor vehicle manufacturing will remain a significant, albeit indirect, influence on demand for manufactured abrasives that are

used by metalworking operations supporting the industry. Curbs on metals consumption by the industry (substitution by plastics, downsizing of automobiles, etc.), however, are important factors to be considered in long-range demand forecasts for manufactured abrasives.

### References Cited

- Lunghofer, E.P. and Wolfe, L.A., 1998, Fused minerals—Where are they heading?: Industrial Minerals, no. 364, p. 19-25.
- O'Driscoll, Mike, 1997, Silicon carbide—Supply sector showdown: Industrial Minerals, no. 352, p. 19-27.
- Wellborn, W.W., 1996, Abrasives—Synthetics cut natural products down to size: Industrial Minerals, no. 347, p. 31-45.
- Zhilun, Yuan, 1997, Chinese bauxite and fused alumina—Exports spark EC debate: Industrial Minerals, no. 360, p. 93-99.

### SOURCES OF INFORMATION

### U.S. Geological Survey Publications

- Abrasives. Ch. in United States mineral resources. U.S. Geological Survey Professional Paper 820, 1973.
- Manufactured Abrasives. Mineral Industry Surveys, quarterly.<sup>1</sup>
- Manufactured Abrasives. Ch. in Mineral Commodity Summaries, annual.<sup>1</sup>

### Other

- Abrasives, Industry & Trade Summary. U.S. International Trade Commission, May 1995.
- Industrial Minerals (monthly).

---

<sup>1</sup>Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1  
CRUDE ARTIFICIAL ABRASIVES MANUFACTURERS IN 1997

Company	Location	Product
Dakota Catalyst Products, Inc.	Williston, ND	Fused aluminum oxide (regular and high-purity).
The Exolon-Esk Co.	Hennepin, IL	Silicon carbide.
Do.	Thorold, Ontario, Canada	Fused aluminum oxide (regular).
Saint-Gobain/Norton Co.	Huntsville, AL	Fused aluminum oxide (high-purity) and aluminum-zirconium oxide.
Do.	Worcester, MA	General abrasive processing.
Do.	Chippawa, Ontario, Canada	Fused aluminum oxide (regular and high-purity) and aluminum-zirconium oxide.
Do.	Shawinigan, Quebec, Canada	Silicon carbide.
Superior Graphite Co.	Hopkinsville, KY	Do.
Treibacher Schleifmittel Corp.	Niagara Falls, NY	Fused aluminum oxide (high-purity).
Do.	Niagara Falls, Ontario, Canada	Fused aluminum oxide (regular).
Washington Mills Electro Minerals Corp.	do.	Do.
Do.	Niagara Falls, NY	Fused aluminum oxide (high-purity), aluminum-zirconium oxide, and boron carbide.
Washington Mills Ltd.	Niagara Falls, Ontario, Canada	Fused aluminum oxide (regular).

TABLE 2  
PRODUCTION OF CRUDE SILICON CARBIDE AND FUSED ALUMINUM OXIDE  
IN THE UNITED STATES AND CANADA 1/

Product	1996			1997		
	Quantity (metric tons)	Value (thousands)	Yearend stocks	Quantity (metric tons)	Value e/ (thousands)	Yearend stocks
Silicon carbide 2/	73,600	\$36,000 e/	6,760	68,200	\$36,500	6,500
Aluminum oxide:						
Regular, abrasives	124,000 r/	43,800 r/	12,800 r/	93,500 e/	34,600	7,280
High purity	22,700 e/ r/	13,100 e/ r/	1,870	14,200 e/	8,100	W
Total	147,000 e/ r/	56,900 e/ r/	14,600 r/	108,000 e/	42,700	7,280

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Approximately 50% of the quantity and 40% of the value consists of material for metallurgical uses and other applications.

TABLE 3  
U.S. PRODUCERS OF METALLIC ABRASIVES IN 1997

Company	Location	Product (shot and/or grit)
Barnsteel Abrasives	Butler, PA	Iron and steel.
Chesapeake Specialty Products	Baltimore, MD	Steel.
Ervin Industries, Inc.	Adrian, MI	Do.
Do.	Butler, PA	Do.
Frohn North America, Inc.	Austell, GA	Cut wire.
Marwas Steel Co.	Scottsdale, PA	Do.
Metaltec Steel Abrasives Co.	Canton, MI	Steel.
National Metal Abrasive Co.	Wadsworth, OH	Do.
Peerless Metal Powders & Abrasive	Detroit, MI	Do.
Pellets, Inc.	Tonawanda, NY	Cut wire.
The Platt Brothers, Inc.	Waterbury, CT	Do.
Premier Shot Co.	Cleveland, OH	Do.
U.S. Filter Abrasive Products, Inc.	Fortville, IN	Cut wire, steel.
Wheelabrator Abrasives	Bedford, VA	Steel.

TABLE 4  
ANNUAL PRODUCTION AND SHIPMENTS FOR METALLIC  
ABRASIVES IN THE UNITED STATES, BY PRODUCT 1/

Product	Production		Shipments 2/	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
1996:				
Steel shot and grit r/	246,000	108,000	223,000	102,000
Cut wire shot and other r/	2,300 e/	12,500 e/	2,860	14,000
Total r/	248,000	121,000	226,000	116,000
1997:				
Steel shot and grit	262,000	115,000	264,000	119,000
Cut wire shot and other e/	2,450	12,900	2,390	12,600
Total	264,000	128,000	266,000	132,000

e/ Estimated. r/ Revised.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes reported exports.