

# ANTIMONY

By James F. Carlin, Jr.

More than one-half of the primary antimony used in the United States in 1997 went into flame-retardants; the rest was used in the transportation industry, in chemicals, in ceramics and glass, and in other uses. Secondary antimony, which was derived almost entirely from recycled lead-acid batteries, was used at the recovery plants to make new batteries. Total antimony consumption in 1997 was at about the same level as in 1996. The price of antimony metal, on average, was one-third lower than in 1996.

A small amount of antimony was recovered as a byproduct of the mining of domestic lead and silver-copper ores at one mine in Idaho, but almost all primary antimony metal and oxide produced domestically originated from imports. Primary smelter production increased 4% in 1997; most domestic smelting consisted of upgrading imported antimony trioxide to a higher purity. Primary antimony metal and oxide valued at \$70 million were produced by five companies operating five plants in 1997. Two smelters were in Texas, and one each in Montana, Nebraska, and New Jersey. The Nebraska smelter was permanently closed at midyear. Secondary antimony was recovered from scrapped lead-acid batteries at secondary lead smelters. The amount of antimony used by battery manufacturers has been declining in recent years, because of changing materials requirements for batteries.

Together, recycling and domestic mine output supplied less than 40% of the estimated domestic demand for antimony. Imports provided the rest.

Antimony was mined as a principal product and produced as a byproduct of the smelting of base metal ores in 19 countries. It was estimated that China alone accounted for more than 80% of world mine production. Bolivia, China, Russia, and South Africa together accounted for about 94% of world mine production. Identified world antimony reserves at yearend 1997 were estimated to be 2.4 million metric tons.

## Legislation and Government Programs

Sales of antimony from the National Defense Stockpile (NDS) proceeded for the fifth consecutive year. Sales were conducted on a negotiated bid basis and were held by the Defense Logistics Agency on the fourth Tuesday of every month. There was no maximum quantity that a company could bid on, but there was a minimum of 5 metric tons (11,000 pounds) for each transaction. The material offered was Grade A and B ingots or cakes, as well as broken pieces of Grade A material and antimony sulfide ore. In calendar year 1997, a total of 2,927 tons was sold. At yearend 1997, the antimony inventory in the NDS was 20,610 tons. Antimony is stockpiled in Government warehouses in 12 locations, with the Somerville, NJ, depot holding the largest amount.

## Production

**Mine Production.**—In the Coeur d'Alene District of Idaho, Sunshine Mining Co., the sole domestic producer, recovered antimony in concentrate as a byproduct of the treatment of

complex silver-copper-antimony sulfide ore. The company responded to the U.S. Geological Survey (USGS) voluntary canvass request.

**Smelter Production.**—The domestic producers of primary antimony metal and oxide products were ASARCO Incorporated, Omaha, NE; Amspec Chemical Corp., Gloucester City, NJ; Anzon Inc., Laredo, TX; Laurel Industries Inc., LaPorte, TX; and U.S. Antimony Corp., Thompson Falls, MT. All five primary smelters replied voluntarily to the USGS request for production data.

Great Lakes Chemical Corp. (West Lafayette, IN) announced its acquisition of Cookson Group Plc's global antimony products business, known as Anzon, for \$90 million cash. Great Lakes believed that its purchase of Anzon complemented its polymer additives business (flame retardants and polymer stabilizers) and positioned it as the foremost global supplier of antimony-based compounds for use as flame retardants. Anzon's operations include facilities in Mexico, South Africa, the United Kingdom, and the United States. Its sales in 1996 were about \$80 million. Great Lakes' stock is traded on the New York Stock Exchange. The firm considers itself the world's leading producer of certain specialty chemicals for such applications as flame-retardants, polymer stabilizers, fire extinguishants, water treatment, and petroleum additives (Great Lakes Chemicals Corp., 1997).

Laurel Industries, Inc., an operating unit of Occidental Chemical Corp., announced the acquisition of the flame-retardant business of Elf Atochem North America, Inc. The Elf Atochem flame-retardant business includes antimony oxide, sodium antimonate, and brominated plasticizer additives and concentrates (Laurel Industries, Inc., 1997).

ASARCO Incorporated announced that its lead refinery in Omaha, NE, would cease operation permanently as of June 30, 1997. The plant was also a smelter for antimony and bismuth products. In its antimony operations, this plant processed primarily antimony ore, but also treated crude antimony trioxide, upgrading it to a higher purity (ASARCO Incorporated, 1997).

Old scrap, predominantly lead battery plates, was the source of almost all of the secondary antimony output. New scrap, mostly in the form of drosses and residues from various sources, supplied the remainder. Antimonial lead was the main market for scrap antimony.

## Consumption

Domestic consumption of primary antimony declined slightly in 1997. Antimonial lead registered the largest relative decline. Lead-antimony alloys were used in automotive vehicle batteries, ammunition, corrosion-resistant pumps and pipes, tank linings, roofing sheets, solder, cable sheaths, and antifriction bearings. Antimony trioxide, often immersed in an organic solvent, was used to enhance the flame retardant properties of plastics, textiles, and other combustibles. Antimony was used as a decolorizing and refining agent in some forms of glass, such as optical glass.

Of the 148 companies to which a voluntary USGS canvass form

was sent, 124 firms responded; consumption data were estimated for 24 firms.

## Prices

In 1997, antimony prices generally continued the downward rift that had started in 1995, declining from the peak price established in late 1994, climaxing the dramatic surge in prices that began in the spring of 1994. The New York dealers' antimony metal price, published by Platt's Metals Week, started the year at \$0.90 to \$0.95 per pound, reached \$1.10 to \$1.20 per pound during the second quarter, and finished the year at \$0.75 to \$0.85 per pound. This dealer's price averaged \$0.98 per pound for the year, compared with \$1.47 per pound in 1996. The price range for high-tint antimony trioxide, published by American Metal Market, was \$1.60 to \$1.80 per pound at the start of the year, and \$1.05 to \$1.15 per pound at the end of the year.

## Foreign Trade

Imports of antimony were, as is typical, much larger than exports—about 10-fold larger in 1997. Imports of antimony metal declined 19% in 1997. China supplied about 87% of the antimony metal imports. Imports of antimony oxide increased 26% in 1997, with China supplying about 45% of the imports. (See tables 5, 6, 7, and 8.)

## World Review

**Canada.**—Roycefield Resources Ltd. reported that it was on schedule with the development of its new antimony mine and mill in central Newfoundland, near Gander. Annual mine output is expected to be about 4,500 tons of contained antimony, or 3% of world production. Roycefield officials expected that the mill would be operational in 1998. Mining and milling expenditures were estimated at about \$16 million, with an extra \$10 million being targeted to bring a new plant on-stream to produce antimony trioxide. Executives explained that they were developing a new process to make antimony trioxide that would require pilot-plant testing prior to commercial production. Roycefield's ore reserves were estimated at more than 1 million tons, grading 4.5% antimony. Officials projected a mine life of 13 years, with about 100,000 tons of ore being mined annually (Metal Bulletin, 1997b).

**China.**—China's Antimony Producers Association, after a meeting at Guilin, Guangxi Province, reportedly urged its members to reduce antimony production. A Chinese official reportedly complained that current prices were far below production costs. A leading antimony producer, Hsikwangshan, based in Hunan, and known for its Twinkling Star brand antimony products, announced that it had ceased antimony metal production and was planning to reduce its antimony trioxide production. Reportedly, Hsikwangshan had already closed four out of its seven trioxide lines early in the year and planned to shutter another two by yearend, leaving only one line operating. One of the two mines that the company operates as sources for its antimony concentrates was to be closed by yearend (Metal Bulletin, 1997a).

**Guatemala.**—It was reported that antimony ore and concentrate were being produced by Minas de Guatemala SA from several mines at Ixtahuacan. The output is exported mainly to Metaleurop Weser Bleib GmbH in France. After Bolivia and Mexico, Guatemala has been the third largest producer of

antimony in Latin America (Mining Journal, 1997).

**Japan.**—Flame retardants account for 96% of sales of antimony trioxide in Japan. Consumption of antimony trioxide in Japan has increased following the implementation of the Product Liability Act in July 1995, which requires the use of flame retardants in a wide range of products such as electronic appliances, textiles, building materials, furniture, and vehicles (Roskill's Letter from Japan, 1997).

## Outlook

Domestic antimony demand softened slightly in 1997, for the third consecutive year. The somewhat lesser consumption was reflected in a continuing decline in world prices. Use in nonmetal products, especially ceramics/glass and plastics, registered strong gains; while consumption in the major use category, flame-retardants, declined a bit. It is believed however, that use in the flame-retardant market is likely to remain fairly strong for some years.

Several new antimony mines have been developed in recent years, such as in Canada, although these may not come fully on-stream soon because of the current relatively low antimony prices. It appears that the U.S. Government stockpile will be in a selling mode for some years, and antimony from that source will be available.

## References Cited

- ASARCO Incorporated, 1997, Asarco reports second quarter results: New York, NY, ASARCO Incorporated press release, July 24, 4 p.
- Great Lakes Chemicals Corp., 1997, Great Lakes completes acquisition of antimony products business: Great Lakes Chemical Corp., West Lafayette, IN, news release, November 3, 1 p.
- Laurel Industries, Inc. 1997, Laurel Industries acquires Elf Atochem North American flame-retardant business: Laurel Industries, Inc., Cleveland, OH, news release, December 8, 1 p.
- Metal Bulletin, 1997a, China urges producers to cut production: Metal Bulletin, no. 8236, December 11, p. 7.
- 1997b, Roycefield mine on schedule: Metal Bulletin, no. 8170, April 17, p. 10.
- Mining Journal, 1997, Mining Annual Review, Guatemala: Mining Journal, Mining Annual Review, p. 101.
- Roskill's Letter from Japan, 1997, Antimony—Steady increase in demand in flame-retardants: Roskill's Letter from Japan, no. 254, p. 12-17.

## SOURCES OF INFORMATION

### U.S. Geological Survey Publications

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

### Other

- American Metal Market, daily.
- Antimony. Ch. in Mineral facts and problems, U.S. Bureau of Mines, Bulletin 675, 1985.
- Engineering and Mining Journal.
- Metal Bulletin (London).
- Platt's Metals Week.

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

TABLE 1  
SALIENT ANTIMONY STATISTICS 1/

(Metric tons of antimony content unless otherwise specified)

	1993	1994	1995	1996	1997
United States:					
Production					
Primary:					
Mine (recoverable antimony) 2/	266	215	262	242	356
Smelter	22,000	25,500	23,500	25,600 r/	26,700
Secondary 3/	9,620	12,200	10,500	7,780 r/	7,550
Exports of metal, alloys, waste and scrap (gross weight)	315	1,350	1,610	462	652
Exports of antimony oxide 4/	3,900	6,500	6,590	3,990	3,230
Imports for consumption	30,900	41,500	36,600	37,600	39,300
Reported industrial consumption, primary antimony	12,400	14,800	14,300 r/	13,600 r/	13,500
Stocks: Primary antimony, all classes, Dec. 31	9,080	10,900	10,600 r/	11,000 r/	10,600
Price: Average, cents per pound 5/	76.9	177.7	227.8	146.5	97.8
World: Mine production	87,000 r/	118,000 r/	151,000 r/	156,000 r/	149,000 e/

e/ Estimated. r/ Revised.

1/ Data are rounded to three significant digits, except prices.

2/ Data from 10-K reports.

3/ A review of secondary lead smelting, the source of nearly all secondary antimony, showed that recovery of secondary antimony had been markedly overstated in the 1994 and earlier annual reviews.

4/ Antimony content is calculated by the U.S. Geological Survey.

5/ New York dealer price for 99.5% to 99.6% metal, c.i.f. U.S. ports.

TABLE 2  
REPORTED INDUSTRIAL CONSUMPTION OF PRIMARY ANTIMONY  
IN THE UNITED STATES 1/

(Metric tons of antimony content)

Year	Class of material consumed			Total
	Metal	Oxide	Other 2/	
1996	2,060	11,400	133 r/	13,600
1997	2,060	11,300	131	13,500

r/ Revised.

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

2/ Includes residues and sulfide.

TABLE 3  
 REPORTED INDUSTRIAL CONSUMPTION OF PRIMARY  
 ANTIMONY IN THE UNITED STATES, BY PRODUCT 1/

(Metric tons of antimony content)

Product	1996	1997
<b>Metal products:</b>		
Antimonial lead	1,760	1,170
Bearing metal and bearings	44	45
Solder	256 r/	226
Other 2/	1,050	1,150
Total	3,110	2,600
<b>Nonmetal products:</b>		
Ammunition primers	18 r/	20
Ceramics and glass	1,030	1,080
Pigments	450	824
Plastics	1,080	1,220
Other 3/	115	159
Total	2,690	3,300
<b>Flame-retardants:</b>		
Adhesives	260 r/	344
Plastics	6,850	6,610
Rubber	403	342
Textiles	275	247
Other 4/	5	7
Total	7,770	7,550
Grand total	13,600	13,500

r/ Revised.

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

2/ Includes ammunition, cable covering, castings, sheet and pipe, and type metal.

3/ Includes fireworks and rubber products.

4/ Includes paper and pigments.

TABLE 4  
 INDUSTRY STOCKS OF PRIMARY ANTIMONY  
 IN THE UNITED STATES, DECEMBER 31 1/

(Metric tons of antimony content)

Type of material	1996 r/	1997
Metal	3,520	3,070
Oxide	4,420	4,300
Other 2/	3,060	3,240
Total	11,000	10,600

r/ Revised.

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

2/ Includes ore and concentrate, residues and sulfide.

TABLE 5  
 U.S. EXPORTS OF ANTIMONY METAL, ALLOYS, AND  
 WASTE AND SCRAP, BY COUNTRY 1/

Country	1996		1997	
	Gross weight (metric tons)	Value (thousands)	Gross weight (metric tons)	Value (thousands)
Belgium	60	\$209	82	\$135
Canada	147	392	231	525
Mexico	240	945	267	920
Netherlands	--	--	17	83
Other	15 r/	218 r/	55	618
Total	462	1,760	652	2,280

r/ Revised.

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

Source: Bureau of the Census.

TABLE 6  
U.S. EXPORTS OF ANTIMONY OXIDE, BY COUNTRY 1/

Country	1996			1997		
	Gross weight (metric tons)	Antimony content 2/ (metric tons)	Value (thousands)	Gross weight (metric tons)	Antimony content 2/ (metric tons)	Value (thousands)
Australia	60	50	\$211	59	49	\$182
Belgium	37	31	145	39	32	221
Brazil	162	134	647	26	22	161
Canada	1,420	1,180	5,400	1,180	978	4,340
Colombia	120	100	584	83	69	230
Germany	98	81	430	44	37	146
Indonesia	10	8	55	6	5	33
Italy	171	142	649	51	42	169
Japan	852	707	2,300	717	595	1,910
Korea, Republic of	172	143	755	58	48	292
Mexico	274	227	1,590	306	254	1,670
Netherlands	26	22	69	20	17	119
Singapore	589	489	2,040	623	517	1,700
Spain	8	7	73	60	50	397
Taiwan	411	341	1,580	227	188	671
Turkey	50	42	337	67	56	361
United Kingdom	154	128	703	65	54	526
Other	194 r/	160 r/	992 r/	264	219	890
Total	4,810	3,990	18,600	3,900	3,230	14,000

r/ Revised.

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

2/ Antimony content is calculated by the U.S. Geological Survey.

Source: Bureau of the Census.

TABLE 7  
U.S. IMPORTS FOR CONSUMPTION OF ANTIMONY, BY CLASS AND COUNTRY 1/

Country	1996			1997		
	Gross weight (metric tons)	Antimony content 2/ (metric tons)	Value (thousands)	Gross weight (metric tons)	Antimony content 2/ (metric tons)	Value (thousands)
<b>Antimony ore and concentrate:</b>						
Australia	8	5	\$49	92	75	\$95
Austria	117	82	670	245	170	727
Bolivia	270	221	336	21	17	15
Canada	542	144	415	195	117	266
Chile	--	--	--	80	66	97
China	511	473	1,190	819	778	1,500
Other	165 r/	80 r/	220 r/	80	71	94
Total	1,610	1,000	2,880	1,530	1,300	2,800
<b>Antimony oxide:</b>						
Belgium	1,300	1,080	5,620	2,170	1,800	6,950
Bolivia	2,990	2,480	8,710	3,260	2,700	7,200
Chile	--	--	--	130	108	269
China	9,310	7,730	27,400	12,600	10,400	25,700
France	259	215	1020	262	218	755
Guatemala	220	183	729	1,060	880	2,450
Hong Kong	253	210	887	295	245	707
Kyrgyzstan	180	150	424	663	550	1290
Mexico	3,800	3,150	6,850	3,440	2,860	6,330
Netherlands	--	--	--	179	148	294
Russia	--	--	--	376	312	639
South Africa	3,440	2,860	870	3,130	2,600	860
United Kingdom	181	150	718	173	144	612
Other	172	143	997	197	165	1,150
Total	22,100	18,300	54,200	27,900	23,200	55,200

r/ Revised.

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

2/ Antimony ore and concentrate content reported by Bureau of the Census. Antimony oxide content is calculated by the U.S. Geological Survey.

Source: Bureau of the Census.

TABLE 8  
U.S. IMPORTS FOR CONSUMPTION OF ANTIMONY METAL, BY COUNTRY 1/

Country	1996		1997	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Bolivia	153	\$424	22	\$37
Canada	128	338	48	313
Chile	5	36	20	33
China	13,500	38,000	12,900	25,100
Hong Kong	1,620	4,710	620	1,120
Japan	24	1,090	23	1,000
Kyrgyzstan	1,240	4,040	177	420
Mexico	1,330	1,030	755	579
Thailand	119	387	20	46
United Kingdom	58	304	20	257
Other	88	530	259	1,380
Total	18,300	50,900	14,800	30,300

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

Source: Bureau of the Census.

TABLE 9  
ANTIMONY: WORLD MINE PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1993	1994	1995	1996	1997 e/
Australia 3/	2,300 r/	1,300 r/	900	1,800 r/	1,900 4/
Bolivia	5,556	7,050	6,426	6,489 r/	8,700
Canada 5/	673	643 r/	684 r/	1,716 r/	652
China e/	60,000	91,000	125,000	129,000 r/	120,000
Czech Republic e/	-- r/	--	--	--	--
Guatemala	90 r/ e/	296 r/	665 r/	880 r/	880
Honduras	--	--	-- r/	-- r/	--
Kyrgyzstan e/	2,500	2,000	1,500	1,200	1,200 4/
Mexico 6/	1,469	1,758 r/	1,783 r/	983 r/	1,909 4/
Morocco 5/	180	175	198 r/	152 r/	160
Namibia ( Sb content of sodium antimonate)	6 r/	14 r/	--	8 r/	8
Pakistan e/	--	--	6 4/	-- r/	--
Peru (recoverable) e/	240 4/	460	460	460	460
Russia (recoverable)	7,120 r/	7,000 r/	6,000 e/	6,000 e/	6,000
Slovakia e/	450	-- r/	-- r/	-- r/	--
South Africa 5/	4,111	4,534	5,537	5,137 r/	5,000
Tajikistan e/	1,200	1,000	1,000	1,000 r/	1,200 4/
Thailand (content of ore and concentrate) e/	620	500	230	70 r/	60
Turkey	111	75	416 r/	450 r/ e/	400
United States	266 r/	215 r/	262 r/	242 r/	356 4/
Zimbabwe 5/	95	65	37	5 r/ e/	5
Total	87,000 r/	118,000 r/	151,000 r/	156,000 r/	149,000

e/ Estimated. r/ Revised.

1/ World totals and estimated data have been rounded to three significant digits; may not add to totals shown.

2/ Antimony content of ore unless otherwise indicated. Table includes data available through June 10, 1998.

3/ Antimony content of antimony ore and concentrate, lead concentrates, and lead-zinc concentrates.

4/ Reported figure.

5/ Antimony content of concentrate.

6/ Antimony content of ores for export plus antimony content of antimonial lead and other smelter products produced.