MOLYBDENUM

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Molybdenum is a refractory metallic element used principally as an alloying agent in steel, cast iron, and superalloys to enhance hardenability, strength, toughness, and wear and corrosion resistance. To achieve desired metallurgical properties, molybdenum, primarily in the form of molybdic oxide or ferromolybdenum, is frequently used in combination with or added to chromium, columbium, manganese, nickel, tungsten, or other alloy metals. The versatility of molybdenum in enhancing a variety of alloy properties has ensured it a significant role in contemporary industrial technology, which increasingly requires materials that are serviceable under high stress, expanded temperature ranges, and highly corrosive environments. Moreover, molybdenum finds significant use as a refractory metal in numerous chemical applications, including catalysts, lubricants, and pigments. The variety of uses for molybdenum materials, few of which afford acceptable substitution, has resulted in a doubling of demand in the Western World to about 136,000 metric tons per year (t/yr) (300 million pounds per year) in 2000 from about 68,000 t/yr (150 million pounds per year) in 1983 (Adams, 2001).

Distribution of molybdenum reserves and production capacity was concentrated in a few countries of the world. World mine output was estimated to be 122,000 metric tons (t) (molybdenum contained in concentrate), of which, in descending order of production, the United States, Chile, China, Peru, Canada, Armenia, and Mexico provided almost 94%. Chile, China, and the United States also possessed about 85% of the estimated 19 million metric tons (Mt) of molybdenum in the world reserve base.

Voynick (1996) described the history of the Climax Molybdenum Mine, Leadville, CO, and the development of the molybdenum industry. The first significant factor in the evolution of the molybdenum industry was the use of flotation technology to exploit porphyry (disseminated) molybdenum deposits. This led to the establishment of the Climax deposit as the world's premier molybdenum source. The Climax deposit was developed during World War I when molybdenum saw significant use as a replacement for tungsten in armor and tool steel. After World War I, Climax Molybdenum Co. established a research laboratory in Detroit, MI, to be close to the automobile industry. In addition, a market development staff of metallurgists and chemists was established to develop new uses and markets for molybdenum. Initial successes included introducing low-alloy steels into the automobile industry and developing a line of molybdenum-containing high speed and tool steels. Climax maintained its pre-eminent market position, and during the next five decades, the market grew at an average rate of 7% per year. In the mid-1970s, Climax brought the Henderson Mine in Empire, CO, into production.

The second significant factor in the evolution of the molybdenum industry was the initiation of byproduct molybdenite recovery at selected porphyry copper mines. This was initially implemented by Anaconda Copper Co. and quickly adopted by Kennecott Copper Co. These byproduct recovery circuits are now installed at many of the porphyry copper mines. Owing partly to successful market development by Climax, consumption exceeded supply from 1976 through 1980. Byproduct molybdenite recovery from copper circuits began to fill the supply deficit, introducing market forces that permanently changed the industry. With a copper mine, all mining costs associated with producing the molybdenum concentrate are allocated to the primary metal (i.e. copper). Owing to this cost advantage, the current situation, where byproduct recovery is estimated to account for 75% of Western and 50% of worldwide molybdenum supply, evolved.

Production

Domestic production data for molybdenum were derived by the U.S. Geological Survey by means of three separate voluntary surveys. These surveys are "Molybdenum Ore and Concentrate" (annual), "Molybdenum Concentrate" (monthly), and "Molybdenum Products and Molybdenum Concentrates" (monthly). Surveys are sent to all operations that produce molybdenum ore and products. All eight operations to which surveys were sent responded, representing 100% of the U.S. production shown in table 1.

In 2002, U.S. mine production of molybdenum concentrate was 32,600 t, a 13% decrease from 37,600 t in 2001. World mine production of molybdenum in 2002 decreased to 122,000 t, a 7% decrease from 132,000 t in 2001. The U.S. share of world production was 27% in 2002 compared with 28% in 2001. Net production of molybdenum products decreased to 10,500 t in 2002 from 15,700 t in 2001 (table 2).

Primary molybdenum production continued at the Henderson Mine in Colorado, the Questa Mine in New Mexico, and the Thompson Creek Mine in Idaho. The Tonopah Mine in Nevada has been in care-and-maintenance status since 2001. The Climax Mine has been inactive since 1995 and will not be brought back online until after the nearby Henderson deposit in Empire, CO, about 100 kilometers (km) east, is exhausted. Molybdenum is produced as a byproduct of copper production at the Bagdad and Sierrita Mines in Arizona and at the Bingham Canyon Mine in Utah. The byproduct molybdenum recovery circuits at the Chino Mine in New Mexico and at the Continental Pit in Montana remain on care and maintenance because of depressed conditions in the copper market.

Phelps Dodge reduced copper output at the Bagdad and Sierrita Mines in the first quarter of 2002 in an effort to stabilize

copper prices and reduce the copper surplus on the world market. Kennecott also reduced production at the Bingham Canyon Mine. After the molybdenum price spike in June, Phelps Dodge and Kennecott restored copper production and byproduct molybdenum recovery, but Kennecott production of byproduct molybdenum remained reduced owing to unexpectedly low ore grades. Thompson Creek produced at less than 50% of its 20-million-pound-per-year capacity in 2002, Henderson also operated at less than 50% of its 40-million-pound-per-year capacity, and Questa operated sporadically (Ryan's Notes, 2002a). Staff reductions at the primary mines during the past few years, owing to low molybdenum prices, limited production capacity. Thompson Creek initiated an overburden stripping campaign at mid-year 2002 running through June 2003, which was to extend mine life. Neither the Henderson Mine nor the Questa Mine have any announced expansion plans.

Consumption

In 2002, reported consumption (roasting) of molybdenum concentrate was 20,000 t, a decrease of 13,300 t compared with that of 2001. The sharp drop resulted because Thompson Creek's Langeloth roaster was switched to roasting zinc-bearing materials, and the molybdenum concentrates from Thompson Creek were not accounted for at either the Fort Madison or Sierrita roasters (Ryan's Notes, 2002a). Domestic mine production of molybdenum concentrate was roasted, exported for conversion, or purified to lubricant-grade molybdenum disulfide. Technical-grade molybdic oxide consumption decreased by about 9% in 2002 compared with that of 2001. Oxide was the chief form of molybdenum used by industry, particularly in making full alloy, stainless, and tool steel, and superalloys; however, some of the oxide was converted to other molybdenum products such as ammonium and sodium molybdates, ferromolybdenum, high-purity oxide, and metal powder (tables 1, 3).

Metallurgical applications continued to dominate molybdenum use in 2002, accounting for about 80% of total consumption. In 2002, ferromolybdenum accounted for 36% of the molybdenum-bearing forms used to make steel, a 5% increase from that of 2001. Nonmetallurgical applications included catalysts, chemicals, lubricants, and pigments. The dominant nonmetallurgical use was in catalysts.

Stocks

In 2002, producer plus consumer industry stocks were 10,000 t, a decrease of 800 t compared with those of 2001. Inventories of molybdenum in concentrate at mines and plants decreased by about 260 t. Producer stocks of molybdenum in such products as ferromolybdenum, molybdates, oxide, metal powders, and other types decreased by 1,300 t compared with those of 2001. Stocks of 10,000 t represented about a 36-week supply. Supply was calculated as reported stocks divided by annual consumption (tables 1, 3).

Prices

Prices were reported in Platts Metals Week in U.S. dollars per kilogram of contained molybdenum. The time-average prices for 2002 were $8.270 per kilogram of contained molybdenum for molybdenum oxide and $10.790 per kilogram of contained molybdenum for ferromolybdenum, which represented increases of 59% and 57%, respectively, compared with 2001 prices. Molybdenum prices experienced wide swings in 2002 with molybdenum oxide prices ranging from $5.838 to $15.267 per kilogram and ferromolybdenum prices ranging from $6.812 to $17.513 per kilogram. The molybdenum oxide price was level at about $6 per kilogram from January to April, rose to $8 in May, and spiked at more than $15 in June before receding slowly during the rest of the year to finish at about $7 per kilogram. Ferromolybdenum followed a similar pattern. Production at copper mines was cut back in the fourth quarter of 2001 owing to low copper prices and surplus copper on the market. This reduced the amount of byproduct molybdenum available. Reduced supply, coupled with a surge in demand, led to the price spike in June. Primary mines, which were staffed to operate at less than 50% of capacity, were unable to quickly ramp up to meet the demand.

Foreign Trade

In 2002, molybdenum-containing material exports collectively contained about 21,500 t (molybdenum content of exported molybdates, oxides and hydroxides not included) of molybdenum and were valued at $156 million (table 6). Imports for consumption of molybdenum-containing materials (products) collectively were valued at $109 million (table 9).

World Review

Capacity.—As of December 31, U.S. rated capacity for mines and mills was estimated to be 74,000 t/yr of contained metal. Rated capacity is defined as the maximum quantity of product that can be produced in a period of time on a normally sustainable long-term operating rate based on the physical equipment of the plant and given acceptable routine operating procedures involving labor, energy, materials, and maintenance. Capacity included operating plants temporarily closed that, in the judgment of the author, can be brought into production within a short period of time with minimal capital expenditure.

Reserves.—The U.S. molybdenum reserve base was estimated to be about 5.4 Mt, about 28% of the world molybdenum reserve base. About 90% of U.S. reserves was in large porphyry or disseminated deposits mined or anticipated to be mined primarily for molybdenum; these deposits were in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Utah. Other molybdenum sources contribute insignificantly to U.S. reserves.

Most Canadian reserves of molybdenum were associated with porphyry molybdenum and porphyry copper-molybdenum deposits in British Columbia. Other Canadian reserves were

associated with minor copper-molybdenum porphyry deposits in New Brunswick and Quebec. Molybdenum reserves in Central America and South America were associated mainly with large copper porphyry deposits. Of several such deposits in Chile, the Chuquicamata and El Teniente deposits were among the world's largest and accounted for 85% of molybdenum reserves in Chile. Mexico and Peru had substantial reserves. La Caridad deposit in Mexico was a large producer. Numerous other porphyry copper deposits that may contain recoverable quantities of molybdenum have been identified in Central America and South America. Many of these deposits were being actively explored and evaluated and could substantially add to reserves in the future. Reserves of molybdenum in China and the Commonwealth of Independent States were thought to be substantial, but definitive information about the current sources of supply or prospects for future development in these two areas was lacking.

China.—In July, Jilin Nickel Industry, a major Chinese nickel producer, completed its merger with a local molybdenum mine to diversify its product range. The molybdenum mine had a current production capacity of 1,800 t/yr of 48% molybdenum concentrates, but with reserves estimated to be 1.5 to 1.6 Mt, there was a huge potential for expansion. Jilin intended to expand production capacity to about 10,000 t/yr from 1,800 t/yr of concentrates within the next 2 years. In addition, the company was interested in the possibility of developing such downstream molybdenum products as ammonium molybdate and ferromolybdenum (Metal Pages, 2002§[1]).

Outlook

In addition to using flotation technology to exploit molybdenum deposits at porphyry molybdenum mines and initiating byproduct recovery at porphyry copper mines, the third significant force shaping the molybdenum market has been the emergence of China as a supplier. During the past two decades, China has dramatically increased its export of molybdenum to the West to about 30% of the market in 2002 from about 5% in 1983. During a period of depressed prices (1997-2001), China almost doubled its exports to the West with most of that going to Europe (Adams, 2002; Ryan's Notes, 2002c). Most of the molybdenum units were in the form of ferromolybdenum. In August 2001, the European Union (EU) concluded that dumping of Chinese ferromolybdenum resulted in damage to the European ferromolybdenum market, and the EU instituted duties on Chinese ferromolybdenum (Ryan's Notes, 2002b). The Chinese reacted by changing the mix of units to mostly roasted concentrates but continued high levels of exports, resulting in a surplus of Chinese roasted concentrate on the market in Europe. Many of the steel producers in Europe cannot or will not use this material because of its lower molybdenum content and higher lead impurities. As there was a shortage of high-grade, Western molybdenum concentrate for blending, the overall market was in a deficit position in spite of excess Chinese molybdenum oxide.

The key for the molybdenum market during the next 3 years will be the recovery of the copper market and the potential increased byproduct molybdenum supply. If the copper market recovers and advances, then the Western molybdenum concentrate supply tightness will ease and the primary molybdenum mines can continue to operate as swing producers at present levels (Platts Metals Week, 2002b). If, however, copper prices do not recover, then the primary mines will need to increase staff and bring additional resources online. The challenge for the primary mines will be to estimate how long the molybdenum prices will stay above a level (about $3.25 per pound of molybdenum oxide) that justifies capital investment and staff increases (Ryan's Notes, 2002a).

Growth in the production of stainless steel and superalloys in Europe was expected to continue. There was potential for growth in the United States as economic conditions improve and the benefits of consolidation in the steel industry take effect. Finally, the growth of the domestic Chinese steel industry will continue to consume additional molybdenum units. China's growing demand for stainless steel will also influence the molybdenum market as major steel producers plan to build steel plants in China to satisfy stainless steel demand (Platts Metals Week, 2002a).

Because of abundant resources and adequate production capacity in Chile, China, the United States, and other countries, the future requirement for molybdenum was expected to be readily met by world producers. The principal use for molybdenum will continue to be in chemicals and catalysts and as an additive in steel manufacturing in general, most importantly alloy and stainless steel.

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GENERAL SOURCES OF INFORMATION

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TABLE 1
SALIENT MOLYBDENUM STATISTICS[1]

(Metric tons of contained molybdenum unless otherwise specified)

	1998	1999	2000	2001	2002
United States:					
Concentrate:					
Production	53,300	42,400	40,900	37,600	32,600
Shipments:					
Quantity	52,100	42,800	40,400 r	37,000	32,300
Value thousands	$200,000	$251,000	$210,000 r	$192,000	$236,000
Reported consumption[2]	35,900	34,500	33,800	33,300	20,000
Imports for consumption	6,570	6,390	6,120	6,010	4,710
Stocks, December 31:					
Concentrate, mine and plant	6,270	4,580	4,030	4,210	3,950
Product producers[3]	7,780	5,340	5,360	5,600	4,300
Consumers	2,170	2,070	2,050	869	1,780
Total	16,200	12,000	11,400	10,700	10,000
Primary products:					
Production	57,200	39,800	42,900	40,300	31,300
Shipments	38,000	39,000	34,600	32,600	27,500
Reported consumption	18,800	18,700	18,300	15,800 r	14,400
World, mine production	136,000	129,000	133,000	132,000 r	123,000 e

eEstimated. rRevised.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Molybdenum concentrates roasted to make molybdenum oxide.
[3]Includes technical and purified molybdic oxide, briquets, ferromolybdenum, phosphomolybdic disulfide, molybdic acid, ammonium molybdate, sodium molybdate, calcium molybdate, molybdenum metal, pellets, molybdenum pentachloride, and molybdenum hexacarbonyl.

TABLE 2
PRODUCTION, SHIPMENTS, AND STOCKS OF MOLYBDENUM PRODUCTS IN THE UNITED STATES[1]

(Metric tons of contained molybdenum)

	Metal powder		Other[2]		Total	
	2001	2002	2001	2002	2001	2002
Received from other producers	--	--	17,100	15,500	17,100	15,500
Gross production during year	5,120	2,700	35,200	28,600	40,300	31,300
Molybdenum products used to make other products	4,340	2,190	20,300	18,600	24,600	20,700
Net production	771	513	14,900	10,000	15,700	10,500
Shipments	771	601	31,900	26,900	32,600	27,500
Producer stocks, December 31	259	172	5,340	4,130	5,600	4,300

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes ferromolybdenum, molybdic oxides, phosphomolybdic acid, molybdenum disulfide, molybdic acid, ammonium molybdate, calcium molybdate, sodium molybdate, molybdenum metal, pellets, molybdenum pentachloride, and molybdenum hexacarbonyl.

TABLE 3
U.S. REPORTED CONSUMPTION, BY END USES, AND CONSUMER STOCKS OF MOLYBDENUM MATERIALS[1]

(Kilograms of contained molybdenum)

End use	Molybdic oxides	Ferro-molyb-denum[2]	Ammonium and sodium molybdate	Molyb-denum scrap	Other	Total
2001:						
Steel:						
Carbon	322,000	382,000	--	--	W	704,000 r
High-strength low-alloy	520,000	116,000	--	--	218,000	854,000
Stainless and heat-resisting	2,310,000 r	422,000 r	--	--	125,000 r	2,860,000 r
Full alloy	1,230,000 r	1,510,000 r	--	--	-- r	2,740,000 r
Tool	766,000 r	W	--	--	345 r	766,000 r
Total	5,150,000 r	2,430,000 r	--	--	343,000 r	7,930,000 r
Cast irons, gray, malleable, ductile iron	W	417,000	--	--	27,000	444,000
Superalloys	1,060,000	W	--	(3)	1,380,000 r	2,430,000 r
Alloys, other than steels, cast irons, superalloys:						
Welding materials, structural and hard-facing	--	37,800	--	--	638	38,500
Other alloys	W	57,900	--	--	7,820 r	65,700 r
Mill products made from metal powder[4]	-- r	--	--	--	1,910,000	1,910,000
Cemented carbides and related products[5]	--	--	--	--	172	172
Chemical and ceramic uses:						
Pigments	W	--	238,000	--	W	238,000
Catalysts	1,030,000	--	W	--	179,000 r	1,210,000 r
Other	-- r	--	--	--	13,200 r	13,200 r
Miscellaneous and unspecified uses:						
Lubricants	--	--	-- r	--	257,000 r	257,000 r
Other	116,000	140,000 r	891,000	--	75,500 r	1,220,000 r
Grand total	7,360,000 r	3,080,000 r	1,130,000 r	--	4,190,000 r	15,800,000 r
Stocks, December 31	505,000	167,000	30,700	11,300	154,000	869,000
2002:						
Steel:						
Carbon	238,000	361,000	--	--	W	598,000
High-strength low-alloy	353,000	119,000	--	--	W	472,000
Stainless and heat-resisting	2,240,000	496,000	--	--	137,000	2,880,000
Full alloy	1,240,000	1,940,000	--	--	23,500	3,210,000
Tool	846,000	W	--	--	34,300	881,000
Total	4,920,000	2,920,000	--	--	195,000	8,040,000
Cast irons, gray, malleable, ductile iron	W	361,000	--	--	27,100	388,000
Superalloys	672,000	55,300	--	(3)	1,140,000	1,870,000
Alloys, other than steels, cast irons, superalloys:						
Welding materials, structural and hard-facing	--	38,000	--	--	339	38,400
Other alloys	W	53,600	--	--	36,500	90,100
Mill products made from metal powder[4]	--	--	--	--	1,040,000	1,040,000
Cemented carbides and related products[5]	--	--	--	--	150	150
Chemical and ceramic uses:						
Pigments	W	--	235,000	--	--	235,000
Catalysts	1,010,000	--	W	--	179,000	1,190,000
Other	--	--	--	--	14,400	14,400
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	269,000	269,000
Other	114,000	110,000	892,000	--	113,000	1,230,000
Grand total	6,720,000	3,540,000	1,130,000	--	3,010,000	14,400,000
Stocks, December 31	462,000	428,000	18,200	14,200	861,000	1,780,000

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other" of the "Miscellaneous and unspecified uses" category. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes calcium molybdate.
[3]Included in the (column heading) (Other of Superalloys) End use category.
[4]Includes construction, mining, oil and gas, and metal working machinery.
[5]Includes ingot, wire, rod, and sheet.

TABLE 4
U.S. EXPORTS OF MOLYBDENUM PRODUCTS, BY PRODUCT AND COUNTRY[1]

Product and country	HTS No.	2001 Quantity (metric tons)	2001 Value (thousands)	2002 Quantity (metric tons)	2002 Value (thousands)
Oxides and hydroxides, gross weight:	2825.70.0000				
Belgium		22	$343	17	$119
Brazil		20	63	4	67
Canada		673	4,630	1,300	8,490
Japan		177	1,310	123	1,160
Mexico		48	296	96	757
Other		1	14	123	1,180
Total		940	6,660	1,670	11,800
Molybdates all, contained weight:	2841.70.0000				
Australia		6	49	14	83
Brazil		1	10	33	198
Canada		305	1,250	320	1,340
Colombia		(2) r	2 r	1	15
Honduras		2	10	3	20
Japan		297	1,810	226	1,670
Korea, Republic of		5	37	2	17
Mexico		249	4,150	200	2,480
Netherlands		210	990	468	2,310
Switzerland		(2)	3	47	478
Taiwan		(2)	14	21	148
Other		109	1,340 r	12	152
Total		1,180	9,670	1,350	8,910
Ferromolybdenum, contained weight:[3]	7202.70.0000				
Canada		442	3,960	597	6,110
China		12	169	--	--
Germany		111	1,630	--	--
Mexico		50	565	51	483
Netherlands		13	94	--	--
Other		1 r	21 r	28	375
Total		629	6,440	676	6,970
Molybdenum other, gross weight:[4]	Various[5]				
Australia		24	286	8	234
Brazil		39	1,130	42	1,120
Canada		68	2,030	27	931
France		43	1,580	23	696
Germany		102	2,950	139	2,500
Hungary		51	2,410	4	319
India		20	980	18	752
Italy		10	441	(2)	48
Japan		256	8,750	30	853
Mexico		8	897	11	1,040
Netherlands		29	1,860	42	2,500
Spain		14	601	10	344
Sweden		16	542	8	301
Taiwan		54	900	61	1,250
United Kingdom		261	7,170	45	773
Other		66	3,490	130	2,080
Total		1,060	36,000	598	15,700

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than 1/2 unit.
[3]Ferromolybdenum contains about 60% to 65% molybdenum.
[4]Includes powder, unwrought, wrought, wire, and other.
[5]Includes HTS codes: 8102.10.0000 (2001 and 2002); 8102.91.0000 (2001), 8102.97.0000 (2002); 8102.92.0000 (2001), 8102.95.0000 (2002); 8102.93.0000 (2001), 8102.96.0000 (2002); 8102.99.0000 (2001 and 2002).

Source: U.S. Census Bureau.

TABLE 5
U.S. EXPORTS OF MOLYBDENUM ORE AND CONCENTRATES
(INCLUDING ROASTED AND OTHER CONCENTRATES), BY COUNTRY[1]

Country	2001 Quantity (metric tons of contained molybdenum)	2001 Value (thousands)	2002 Quantity (metric tons of contained molybdenum)	2002 Value (thousands)
Australia	147	$2,290	27	$446
Belgium	3,380	12,300	4,380	25,600
Brazil	30	279	33	310
Canada	650	3,200	1,080	5,370
Chile	11 r	148	17	190
China	201	204	57	223
Germany	512	2,110	65	403
India	294	1,610	141	1,040
Italy	95	458	52	291
Japan	1,700	10,400	1,130	10,400
Korea, Republic of	29	320	71	460
Mexico	763 r	3,320 r	484	1,820
Netherlands	13,600 r	51,100	7,330	44,100
Sweden	48 r	257 r	35	242
United Kingdom	6,210	20,500	4,330	20,100
Other	161 r	1,560 r	222	1,320
Total	27,800	110,000	19,500	112,000

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

Source: U.S. Census Bureau.

TABLE 6
U.S. EXPORTS OF MOLYBDENUM PRODUCTS[1]

Item	HTS No.	2001 Gross weight (metric tons)	2001 Contained molybdenum	2001 Value (thousands)	2002 Gross weight (metric tons)	2002 Contained molybdenum	2002 Value (thousands)
Molybdenum ore and concentrates, roasted	2613.10.0000	NA	13,200	$51,600	NA	9,290	$50,300
Molybdenum ore and concentrates, other	2613.90.0000	NA	14,600	58,500	NA	10,200	62,100
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	940	NA	6,660	1,670	NA	11,800
Molybdates, all	2841.70.0000	NA	1,180	9,670	NA	1,350	8,910
Ferromolybdenum	7202.70.0000	1,050	629	6,440	1,130	676	6,970
Molybdenum powders	8102.10.0000	219	NA	4,520	122	NA	3,040
Molybdenum unwrought, waste and scrap[2]		334	NA	5,770	266	NA	2,750
Molybdenum wrought[3]		259	NA	11,600	--	--	--
Molybdenum wire[4]		178	NA	8,770	119	NA	4,730
Molybdenum other	8102.99.0000	70	NA	5,340	90	NA	5,210
Total		3,050	29,600	169,000	3,390	21,500	156,000

NA Not available. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]HTS codes 8102.91.0000 (2001) and 8102.97.0000 (2002).
[3]HTS codes 8102.92.0000 (2001) and 8102.95.0000 (2002).
[4]HTS codes 8102.93.0000 (2001) and 8102.96.0000 (2002).

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS OF MOLYBDENUM PRODUCTS, BY PRODUCT AND COUNTRY[1]

Product and country	HTS No.	2001 Quantity (metric tons)	2001 Value (thousands)	2002 Quantity (metric tons)	2002 Value (thousands)
Oxides and hydroxides, gross weight:	2825.70.0000				
Belgium		--	--	121	$691
Chile		410	$2,490	380	2,960
China		497	2,090	444	2,320
Kyrgyzstan		40	172	177	757
Russia		(2)	4	14	121
Other		65	615	69	651
Total		1,010	5,370	1,210	7,500
Molybdates all, contained weight:	Various[3]				
Belgium		--	--	4	87
Canada		(2)	6	5	74
Chile		680	6,830	445	5,260
China		977	7,840	604	6,390
Germany		42	431	8	107
Korea, Republic of		1	3	--	--
Switzerland		--	--	20	448
Other		20	182	8	89
Total		1,720	15,300	1,090	12,500
Molybdenum orange, gross weight:	3206.20.0020				
Canada		1,010	4,730	1,150	4,980
Colombia		42	106	58	139
Korea, Republic of		--	--	1	3
Mexico		39	100	26	58
Philippines		13	46	6	31
United Kingdom		--	--	38	37
Other		21	67	26	81
Total		1,120	5,050	1,300	5,330
Ferromolybdenum, contained weight:[4]	7202.70.0000				
Belgium		--	--	4	45
Canada		22	148	19	260
Chile		--	--	51	343
China		2,340	14,300	3,250	28,200
Korea, Republic of		51	311	13	107
United Kingdom		1,130	6,090	211	1,390
Other		34	192	34	519
Total		3,580	21,000	3,590	30,900
Other, gross weight:	Various[5]				
Austria		189	2,670	238	6,790
Canada		5	24	(2)	22
China		391	4,000	398	4,060
Germany		212	3,220	66	1,720
Hong Kong		43	435	50	470
Japan		40	986	16	643
Korea, Republic of		26	118	(2)	4
Russia		57	960	19	1,140
United Kingdom		9	328	8	306
Other		31	736	83	891
Total		1,000	13,500	878	16,000

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than 1/2 unit.
[3]Includes HTS codes: 2841.70.10000 and 2841.70.5000.
[4]Ferromolybdenum contains about 60% to 65% molybdenum.
[5]Includes HTS codes: 8102.10.0000 (2001 and 2002); 8102.91.1000 (2001), 8102.94.0000, 8102.95.3000 (2002); 8102.91.5000 (2001), 8102.97.0000 (2002); 8102.93.0000 (2001), 8102.96.0000 (2002); 8102.95.6000; 8102.99.0000 (2001 and 2002).

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS OF MOLYBDENUM ORE AND CONCENTRATES (INCLUDING ROASTED AND OTHER CONCENTRATES), BY COUNTRY[1]

Country	2001 Quantity (metric tons of contained molybdenum)	2001 Value (thousands)	2002 Quantity (metric tons of contained molybdenum)	2002 Value (thousands)
Belgium	--	--	19	$132
Canada	1,800	$10,100	2,290	18,100
Chile	103	553	109	873
China	10	57	142	1,340
France	(2)	5	--	--
Italy	--	--	2	25
Mexico	4,100	22,000	2,150	16,300
Netherlands	--	--	(2)	2
Russia	2	9	--	--
Total	6,010	32,800	4,710	36,800

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 9
U.S. IMPORTS FOR CONSUMPTION OF MOLYBDENUM PRODUCTS[1]

Item	HTS No.	2001 Gross weight (metric tons)	2001 Contained molybdenum	2001 Value (thousands)	2002 Gross weight (metric tons)	2002 Contained molybdenum	2002 Value (thousands)
Molybdenum ore and concentrates, roasted	2613.10.0000	9,470	6,000	$32,700	7,030	4,370	$33,300
Molybdenum ore and concentrates, other	2613.90.0000	10	12	70	664	340	3,440
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	1,010	NA	5,370	1,210	NA	7,500
Molybdates, all	Various[2]	3,050	1,720	15,300	2,170	1,090	12,500
Molybdenum orange	3206.20.0020	1,120	NA	5,050	1,300	NA	5,330
Ferromolybdenum	7202.70.0000	5,580	3,580	21,000	5,570	3,590	30,900
Molybdenum powders	8102.10.0000	172	163	3,280	39	32	1,080
Molybdenum waste and scrap[3]		775	714	7,030	697	617	6,810
Molybdenum unwrought[4]		25	24	258	43	43	531
Molybdenum wire[5]		17	NA	1,040	15	NA	674
Other	Various[6]	14	NA	1,870	85	NA	6,940
Total		21,200	12,200	93,000	18,800	10,100	109,000

NA Not available.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes HTS codes: 2841.70.1000 and 2841.70.5000.
[3]HTS code 8102.91.5000 (2001) and 8102.97.0000 (2002).
[4]HTS code 8102.91.1000 (2001) and 8102.94.0000 (2002).
[5]HTS code 8102.93.0000 (2001) and 8102.96.0000 (2002).
[6]HTS code 8102.99.0000 (2001 and 2002), and 8102.95.3000, 8102.95.6000 (2002).

Source: U.S. Census Bureau.

TABLE 10
MOLYBDENUM-PRODUCING MINES IN THE UNITED STATES IN 2002

State and mine	County	Operator	Source of molybdenum
Arizona:			
Bagdad	Yavapai	Phelps Dodge Corp.	Copper-molybdenum ore, concentrated.
Sierrita	Pima	do.	Do.
Colorado, Henderson	Clear Creek	do.	Molybdenum ore, concentrated.
Idaho, Thompson Creek	Custer	Thompson Creek Metals Co.	Do.
New Mexico, Questa	Taos	Molycorp, Inc.	Do.
Utah, Bingham Canyon	Salt Lake	Kennecott Utah Copper Corp.	Copper-molybdenum ore, concentrated.

TABLE 11
MOLYBDENUM: WORLD MINE PRODUCTION, BY COUNTRY[1, 2]

(Metric tons of contained molybdenum)

Country[3]	1998	1999	2000	2001	2002[e]
Armenia[e]	2,300 [r]	2,800	3,100	3,400 [r]	3,500
Canada	8,469	6,250	6,800	7,556 [r]	7,521 [4]
Chile	25,297 [e]	27,309 [r]	33,187 [r]	33,492 [r]	29,466 [4]
China[e]	30,000	29,700	28,800	28,200	29,300
Iran[e]	1,400	1,600	1,600	1,700 [r]	1,700
Kazakhstan	100 [e]	155	215	225 [e]	230
Kyrgyzstan[e]	225	250 [4]	250	250	250
Mexico	5,949	7,961	6,886	5,518 [r]	3,428 [4]
Mongolia	2,000 [e]	1,910	1,335	1,514 [r]	1,590 [4]
Peru	4,344	5,470	7,190	9,500 [r]	9,500
Russia[e]	2,000	2,400	2,400	2,600	2,900
United States	53,343	42,400	40,900	37,600	32,600 [4]
Uzbekistan[e]	500	500	500	500	500
Total	136,000	129,000	133,000	132,000 [r]	123,000

[e]Estimated. [r]Revised.
[1]World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]Table includes data available through July 13, 2003.
[3]In addition to the countries listed, North Korea, Romania, and Turkey are believed to produce molybdenum, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.
[4]Reported figure.