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MOLYBDENUM

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Molybdenum

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In the United States, mine production of molybdenum concentrate in 2011 increased by 7% to 63,700 metric tons (t) from 59,400 t in 2010. Estimated world mine production of molybdenum in 2011 was about 264,000 t, an 8% increase from 244,000 t in 2010 (table 1). The U.S. share of world production was 24% in 2011. Reported U.S. consumption of molybdenum concentrate for roasting in 2011 increased by 18% compared with that of 2010.

Molybdenum is a refractory metallic element used principally as an alloying agent in cast iron, steel, 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 (MoO_3, called MoX) or ferromolybdenum (FeMo), is frequently used in combination with or added to chromium, manganese, nickel, niobium (columbium), 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 can sustain high stress, expanded temperature ranges, and highly corrosive environments. There is significant use of molybdenum as a refractory metal and in numerous chemical applications, including catalysts, lubricants, and pigments.

U.S. molybdenum reserves were estimated to be about 2.7 million metric tons (Mt), about 31% of the world molybdenum reserves. About 90% of U.S. reserves occur in large low-grade porphyry molybdenum deposits mined or anticipated to be mined primarily for molybdenum and as an associated metal sulfide in low-grade porphyry copper deposits. These deposits are in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Utah. Other molybdenum sources do not contribute significantly to U.S. reserves.

Production

Domestic molybdenum mine production data were derived from three separate voluntary surveys by the U.S. Geological Survey. These surveys are "Molybdenum Ore and Concentrate" (annual), "Molybdenum Concentrate" (monthly), and "Molybdenum Products and Molybdenum Concentrates" (monthly). Surveys were sent to all 12 U.S. operations that currently produce molybdenum concentrates and products from ore, and all responded, representing 100% of the U.S. production listed in table 1.

As of December 31, 2011, U.S. rated capacity for mines and mills was estimated to be about 85,900 metric tons per year (t/yr) of contained metal. Rated capacity was defined as the maximum quantity of product that could be produced in a period of time at a normally sustainable long-term operating rate based on the physical equipment of the plant and given acceptable routine operating procedures involving energy, labor, maintenance, and materials. Capacity included operating plants temporarily closed, which could be brought into production within a short period of time with minimal capital expenditure.

Primary molybdenum production continued at the Ashdown Mine in Nevada, the Henderson Mine in Colorado, the Questa Mine in New Mexico, and the Thompson Creek Mine in Idaho. Freeport-McMoRan Copper & Gold Inc. (FCX) announced that its Henderson Mine produced 17,240 t of molybdenum in 2011, a 5% decrease compared with 18,140 t produced in 2010. The Henderson underground mine produces high-purity, chemical-grade molybdenum concentrates, which typically are further processed into value-added molybdenum chemical products. The Henderson operation consists of a large underground mining complex feeding a concentrator with the capacity to produce approximately 32,000 metric tons per day (t/d) of molybdenum. Henderson has the capacity to produce approximately 18,140 t/yr of molybdenum (Freeport-McMoRan Copper & Gold Inc., 2012, p. 14). The majority of the molybdenum concentrate produced at Henderson is shipped to FCX's Fort Madison, Iowa, processing facility.

FCX announced that construction activities at its Climax molybdenum mine were substantially complete and production was expected to commence in 2012. Production from the Climax Mine was expected to ramp up to a rate of 9,070 t/yr of molybdenum during 2013, and depending on market conditions, may be increased to 13,600 t/yr of molybdenum. The company announced that it intended to operate its Climax and Henderson Mines in a flexible manner to meet market requirements (Freeport-McMoRan Copper & Gold Inc., 2012, p. 15).

Thompson Creek Metals Company Inc. (TCMC) owns the Thompson Creek open pit molybdenum mine and mill near Challis, ID, a metallurgical roasting facility in Langeloth, PA, and a 75% share of the Endako open pit mine, mill, and roasting facility in northern British Columbia, Canada. The molybdenum concentrate produced at the Thompson Creek Mine is transported to the Langeloth facility, which produces ferromolybdenum products, molybdenum trioxide, and other specialty products. The Langeloth facility also processes nonmolybdenum catalysts for various customers, primarily in the food industry. TCMC has two high-grade underground molybdenum deposits, the Davidson deposit near Smithers, British Columbia, Canada, and the Mount Emmons deposit near Crested Butte, CO (Thompson Creek Metals Company Inc., 2011, p. 42).

TCMC announced that its Thompson Creek Mine produced 9,690 t of molybdenum in 2011, a 15% decrease from the record 11,370 t of molybdenum produced in 2010. The decrease was primarily because of lower grade production from the Thompson Creek Mine in the second half of 2011. The company

expected the Thompson Creek Mine to have lower production for 2012 (7,250 to 7,700 t of molybdenum) mainly owing to the continued tapering off of higher grade production. TCMC expected to increase production in 2013 (8,600 t to 9,980 t of molybdenum) (Thompson Creek Metals Company Inc., 2012, p. 65–66).

Molybdenum was produced as a byproduct of copper production at the Bagdad, Mineral Park, Morenci, and Sierrita Mines in Arizona; the Continental Pit Mine in Montana; the Robinson Mine in Nevada; the Chino Mine in New Mexico; and the Bingham Canyon Mine in Utah (table 10). The Mission Mine did not produce molybdenum in 2011. In the case of byproduct molybdenum recovery at a copper mine, all mining costs associated with producing molybdenum concentrate are allocated to the primary metal (copper). In 2011, byproduct molybdenite recovery accounted for approximately 54% of the U.S. molybdenum supply.

The Bagdad operation of FCX includes a 75,000-t/d concentrator that produces copper and molybdenum concentrates, as well as a pressure leach plant that processes molybdenum concentrate. In 2011, molybdenum production at Bagdad was 4,540 t, a 43% increase compared with 3,180 t of molybdenum in 2010 (Freeport-McMoRan Copper & Gold Inc., 2012, p. 9).

The Sierrita operation of FCX includes a 102,000-t/d concentrator that produces copper and molybdenum concentrates. It also has molybdenum facilities consisting of a leaching circuit, two molybdenum roasters, and a packaging facility. The molybdenum facilities process concentrate from Sierrita, concentrate from other FCX mines, and concentrate from third-party sources. Molybdenum production at Sierrita in 2011 was 10,430 t, a 28% increase compared with 8,160 t of molybdenum produced in 2010 (Freeport-McMoRan Copper & Gold Inc., 2012, p. 11).

FCX's Chino Mine is an open pit copper mining complex located in southwestern New Mexico in Grant County. The Chino operation consists of a 39,000-t/d concentrator that produces copper and molybdenum concentrates. During 2011, FCX restarted mining and milling activities at the Chino Mine, which were suspended in late 2008 (Freeport-McMoRan Copper & Gold Inc., 2012, p. 14).

Rio Tinto plc (London, United Kingdom) announced that molybdenum concentrate production at its Bingham Canyon Mine (operated by Kennecott Utah Copper) was 13,600 t in 2011 compared with 12,900 t of molybdenum in 2010 (Rio Tinto plc, 2012, p. 24). In the first half of 2011, Kennecott began a $238 million feasibility study to extend the mine life of the Bingham Canyon Mine. With this extension, Bingham Canyon planned to recover an additional 265,000 t of molybdenum. In 2012, the company was expected to complete construction of a molybdenum autoclave process facility, which was expected to improve recovery rates by 7%. Phase I was expected to begin commissioning towards the end of 2012, with an initial capacity of 13,600 t of molybdenum, increasing to 27,200 t of molybdenum in early 2015 (Rio Tinto, 2012, p. 24).

In December, General Moly Inc. was granted water permits providing sufficient water necessary for its Mt. Hope project in central Nevada. The company also made significant progress toward completion of the Mt. Hope environmental impact statement process. In 2012, the company hoped to receive all Federal and State permits necessary to commence construction and secure more than $800 million in financing, including a $665 million bank loan, $40 million in stock sales to Hanlong (USA) Mining Investment Inc., a wholly owned subsidiary of Sichuan Hanlong Group (Hanlong), and approximately $100 million from their Mt. Hope project partner, Pohang Iron and Steel Co. (POSCO). General Moly has an 80% stake in the project, with reserves of 590,000 t of molybdenum and a mine life in excess of 40 years (General Moly Inc., 2012, p. 4–6).

Consumption

In 2011, U.S. reported consumption of molybdenum contained in concentrate for roasting was approximately 18% more than that of 2010. Domestic mine production of molybdenum concentrate was roasted, exported for conversion, or purified to lubricant-grade molybdenum disulfide (MoS_2). Technical-grade MoX consumption in 2011 was 3% less than that of 2010. MoX was the leading form of molybdenum used by industry, particularly in making stainless steel. Overall, total molybdenum use in steel in 2011 increased by 9% from that of 2010 (table 3).

Metallurgical applications dominated molybdenum use in 2011, accounting for about 90% of 2011 grand total reported consumption. In 2010, FeMo accounted for 40% of the molybdenum-bearing materials used to make steel (table 3). Nonmetallurgical applications included catalysts, chemicals, lubricants, and pigments. The dominant nonmetallurgical use was in catalysts.

Molybdenum is playing a more important role in green technology than ever before, with use focused on biofuels, catalysts, ethanol, solar panels, and wind power. A new type of solar panel made of copper-indium-gallium-selenide (CIGS) cells contains molybdenum in a thin layer near the bottom of the cell. The molybdenum helps to transfer the electricity generated from the solar cell to circuits external to the panel. Although photovoltaic solar power capacity is small, CIGS technology has demonstrated the highest conversion efficiency and the longest product life within the solar power-production industry. Analysts estimate that CIGS cells use approximately 1,100 t of molybdenum per gigawatt of capacity (Compound Semiconductor, 2010).

Stocks

At yearend 2011, producer plus consumer industry stocks increased compared with yearend 2010 stocks. Inventories of molybdenum in concentrate at mines and plants increased about 370 t (table 1). Producer stocks of molybdenum in FeMo, molybdates, MoX, metal powders, and other products increased compared with producer stocks of 2010 (table 2).

Prices

In 2011, the annual average price for domestic FeMo, as published in Ryan's Notes, ranged from $17.489 to $17.828 per pound of molybdenum content, compared with $18.225 to $18.685 per pound reported in 2010. The Ryan's Notes

published annual average price for domestic MoX ranged from $15.367 to $15.598 per pound in 2011, compared with $15.625 to $16.068 per pound in 2010.

Foreign Trade

In 2011, molybdenum-containing material exports (excluding molybdenum ore and concentrates) collectively contained about 11,800 t (gross weight) and were valued at $1.76 million (table 6). Imports for consumption of molybdenum-containing products collectively contained about 39,200 t (gross weight) and were valued at $736 million (table 9).

World Review

World molybdenum reserves and production capacity were concentrated in a few countries. In 2011, world mine output was estimated to have been 264,000 t (molybdenum contained in concentrate), of which, in descending order of production, China, the United States, Chile, Peru, Mexico, and Canada provided about 94% (table 11).

In North America, most Canadian reserves of molybdenum were contained in porphyry molybdenum and porphyry copper-molybdenum deposits in British Columbia. Other Canadian reserves were associated with minor porphyry copper-molybdenum deposits in New Brunswick and Quebec. The La Caridad porphyry copper-molybdenum deposit in Mexico was a leading producer. Molybdenum reserves in Central America and South America were associated mainly with large porphyry copper deposits. Of several such deposits in Chile, the Chuquicamata and El Teniente deposits were among the largest in the world and accounted for 85% of molybdenum reserves in Chile. Peru also had substantial reserves. Reserves of molybdenum in China and the Commonwealth of Independent States (CIS) 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.

According to the International Molybdenum Association (IMOA), global molybdenum consumption reached a new record high of 244,000 t in 2011. The highest usage of molybdenum in 2011 was in China, where usage increased from 67,400 t in 2010 to 76,200 t in 2011 (Metal-Pages, 2012c).

In 2011, IMOA, assisted by the Steel & Metals Market Research Company (Austria), completed a detailed analysis of molybdenum end uses. According to the study, in 2009, global molybdenum consumption in all applications was 212,000 t, which included new and recycled molybdenum. Most recycled molybdenum is introduced as scrap in steelmaking. The study's analysis was based on more than 250 interviews with key molybdenum end users. For all applications, approximately 15% of molybdenum input material originated from scrap. Molybdenum was used in the following end uses—engineering steels (34%), stainless steels (26%), chemical products (13%), tool and high-speed steels (10%), cast iron (7%), superalloys (5%), and molybdenum metal (5%) (International Molybdenum Association, 2011, p. 2).

Armenia.—The main priority of Zangezur Copper and Molybdenum Combine CJSC, a subsidiary of Cronimet Mining AG (Germany), was to continue expansion of its production facilities at the Karajan copper-molybdenum mine. According to the company, more than $500 million has been invested in the project. In 2011, the annual volume of ore extracted totaled 16 Mt, while the capacity of the processing facilities was approximately 20 million metric tons per year (Mt/yr) of ore. In 2010, 8,800 t of molybdenum was produced. The Karajan copper-molybdenum mine is in the southeastern corner of Armenia in the Province of Syunik (Cronimet Mining GmbH, 2012).

Australia.—Moly Mines Ltd. (Perth, Australia) announced that the Spinifex Ridge molybdenum project in the Pilbara region of Western Australia was placed on hold pending more favorable economic conditions. The company initially planned to develop and operate a 20-Mt/yr open pit mining operation and processing plant (Moly Mines Ltd., 2012).

In October, Ivanhoe Mines Ltd. announced final results of the prefeasibility study for its high-grade Merlin molybdenum and rhenium deposit, which comprises the Mt. Dore project in the Cloncurry District in northwestern Queensland, part of Ivanhoe Australia Ltd. (Vancouver, British Columbia, Canada). According to the company, the prefeasibility study demonstrated that the project was expected to provide strong, long-term cash flows. In the fourth quarter of 2011, the company started a feasibility study that was expected to be completed in late March 2012 (Ivanhoe Mines Ltd., 2012, p. 10–11).

Canada.—TCMC announced that its 75%-owned Endako Mine produced 3,160 t of molybdenum in 2011 compared with 3,400 t of molybdenum in 2010. The Endako operation is an open pit molybdenum mine, concentrator, and roaster located 190 kilometers (km) west of Prince George, British Columbia with an estimated mine life of approximately 16 years. In the third quarter of 2009, the company resumed construction of the mill expansion project, which was postponed in late 2008. The expansion project included construction of a new, modern mill with increased ore-processing capacity from 31,000 t/d to 55,000 t/d. Commissioning of the new Endako mill was complete and commercial production was achieved on February 1, 2012 (Thompson Creek Metals Company Inc., 2012, p. 18–19).

Taseko Mines Ltd. announced that it produced 590 t of molybdenum in 2011, a 37% increase from the 430 t of molybdenum produced in 2010 at its Gibraltar Mine in south-central British Columbia. The company announced that construction of Development Plan 3 was progressing as planned. All major equipment was purchased for the 55,000 t/d concentrator and the new molybdenum recovery facility that was expected to roughly triple molybdenum production to 1,360 t/yr by 2013 (Taseko Mines Ltd., 2012).

Chile.—Corporación Nacional del Cobre de Chile (Codelco), the state-controlled copper and molybdenum producer, announced that its molybdenum production increased by 4.5% in 2011 to 23,000 t of molybdenum compared with 22,000 t of molybdenum produced in 2010 (TEX Report Ltd., 2012). Codelco announced plans to invest $400 million in a molybdenum processing plant at Mejillones in Chile. Construction was expected to commence in 2015 and could potentially increase its molybdenum capacity from 12,000 t/yr to 30,000 t/yr. In 2011, Codelco sold 23,000 t of molybdenum concentrate (Metal-Pages, 2012b).

Antofagasta plc announced that 2011 molybdenum production at its Los Pelambres Mine was 9,900 t, a 13% increase compared with 8,800 t of molybdenum produced in 2010. Los Pelambres is in Chile's Coquimbo Region, 240 km northeast of Santiago. The company announced that the Los Pelambres prefeasibility study was examining a large scale expansion, which could eventually more than double the existing processing capacity. Key considerations for the expansion were environmental impact, tailings disposal, and water supply issues. According to the company, current plans were assessing a possible staggered development, with the first incremental production potentially starting in 2019. The company forecast further production growth for 2012, with expected production of approximately 11,000 t of molybdenum (Antofagasta plc, 2012, p. 1–2, 5).

China.—In 2011, China's MoO_3 imports decreased by 41% to 14,206 t compared with 24,010 t in 2010. Imports of molybdenum disulfide and FeMo decreased by 48% to 15,655 t compared with 30,000 t in 2010 (Ryan's Notes, 2012).

China issued a second list of 2012 export quotas. The export quota for molybdenum and molybdenum products was 16,345 t. In the first list, announced in December 2011, the molybdenum and molybdenum products export quota was 24,517 t. Combining both lists, the 2012 molybdenum and molybdenum products export quota was 40,862 t, a 2% decrease from that of 2011 (Platts Metals Week, 2012).

China Molybdenum Co., also known as the Luoyang Luanchuan Molybdenum Co., announced that it expected 2012 output for molybdenum concentrate to decrease 10% to 29,750 t, production of roasted concentrate to decrease 21.5% to 29,000 t, and FeMo output to decrease 14.6% to 25,200 t. The company attributed the decrease to the decreasing demand from the steel sector as well as the weakening of the global economy (Metal-Pages, 2012a).

Kazakhstan.—Kazakhmys plc announced that it completed a feasibility study for its Bozshakol project in August. The development of the mine and associated infrastructure, expected to cost $1.8 billion, was approved. The Bozshakol sulphide ore deposit is located in the north of Kazakhstan and according to the company is one of the largest undeveloped deposits in the world. The company expected mine construction to begin in 2012 and copper production to commence in 2015. The company expected to also produce gold, molybdenum, and silver (Kazakhmys plc, 2012, p. 61).

Mexico.— In July, Molibdenos y Metales S.A. (Molymet) announced that it invested $135 million in a recycling plant in Cumpas, Mexico, which also hosts the El Creston molybdenum project, owned by Mercator Minerals. Molymet expected to recycle catalysts used in the oil industry. Construction was expected to start in 2012 with startup operations in 2014 (Metal-Pages, 2011).

Mongolia.—In June, Erdene Resource Development Corp. (Dartmouth, Nova Scotia, Canada) announced the receipt of an updated resource estimate for its Zuun Mod molybdenum project in southwestern Mongolia. The updated resource estimate has a measured and indicated resource of 218 Mt at an average grade of 0.057% molybdenum. The company was also granted a 30-year mining license by the Mongolian government. At yearend, the company announced that it will continue to work on a pit optimization study that was expected to provide high level production and a review of operating and capital costs, and was expected to help in determining the parameters of additional prefeasibility studies in 2012 and 2013 (Erdene Resource Development Corp., 2012).

Peru.—The Cerro Verde Mine of FCX is an open pit copper and molybdenum mining complex, 16 km southwest of Arequipa. The current operation consisted of an open pit copper mine, a 120,000 t/d concentrator, and leaching facilities. In 2011, molybdenum production at Cerro Verde was approximately 4,540 t of molybdenum compared with 3,180 t of molybdenum produced in 2010 (Freeport-McMoRan Copper & Gold Inc., 2012, p. 15). Plans for a large-scale concentrator at Cerro Verde continued to be advanced. The project was expected to expand the concentrator facilities to 360,000 t/d of ore, targeting annual production of approximately 6,800 t of molybdenum beginning in 2016. FCX filed an environmental impact assessment in the fourth quarter of 2011 (Freeport-McMoRan Copper & Gold Inc., 2012, p. 29).

Outlook

The principal uses for molybdenum were expected to continue to be in chemicals and catalysts and as an additive in steel manufacturing, most importantly alloy and stainless steel. Molybdenum plays a vital role in the energy industry, and it may become an increasingly essential factor in green technology, where it is used in high-strength steels for automobiles to reduce weight and improve fuel economy and safety. Molybdenum may play a critical role in reducing sulfur in liquid fuels by acting as a cracking agent. Production of diesel fuels having ultra-low-sulfur levels was expected to more than double the amount of molybdenum used in oil refineries. Analysts expected global demand for these types of catalysts to increase by more than 5% annually until 2013. The need for companies to reduce carbon dioxide emissions from coal-fired power stations will require plants to run at higher temperatures, resulting in greater demand for higher grade molybdenum-bearing steels.

Primary molybdenum mines were the first to respond to the recovery in demand in 2010, but in 2011 byproduct molybdenum mines (54%) outpaced production growth from primary mines (46%). In 2012, mine capacity was expected to be sufficient to meet demand, and supply was expected to show a surplus during the next coming years. Approximately 60 new projects and expansions could potentially produce molybdenum, yielding an additional 240,000 t/yr of molybdenum (Roskill Information Services Ltd., 2012, p. 3). In the past, insufficient roasting capacity has resulted in a bottleneck, but additional roasting capacity has been installed and further additions are under construction in Chile, China, and the United States.

During the past decade, molybdenum consumption has shown a strong annual average growth rate, primarily fueled by rapid increases in China's industrial growth. Molybdenum demand continues to be driven largely by the steel sector. As emerging economies, such as China and India, continue on the path to industrialization, they are expected to need increasing amounts of molybdenum, and this trend is expected to contribute to global demand growth in the coming years (Virga and Horn,

2009). The outlook for the molybdenum market in 2012 appears to be strong. Roskill Information Services Ltd. reported that global demand for molybdenum was expected to increase at an average of 4.6% until 2016. The principal areas of growth were expected to increase with the use of stainless and other steels containing molybdenum in oil and gas production, motor vehicle components, and powerplants, and the potential for a new market from alternative and renewable energy.

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TABLE 1
SALIENT MOLYBDENUM STATISTICS[1]

(Metric tons of contained molybdenum)

	2007	2008	2009	2010	2011
United States:					
Concentrate:					
Production	57,000	55,900	47,800	59,400	63,700
Shipments	57,100	57,800	63,700	59,400	62,800
Reported consumption[2]	43,900	44,500	W	W	W
Imports for consumption	12,400	10,200	7,520	12,900	14,700
Stocks, December 31:					
Concentrate, mine and plant	2,630	1,690	2,550	2,200	2,560
Product producers[3]	3,140	3,680	3,660	W	W
Consumers	1,870	1,620	1,540	1,630	1,840
Total	7,640	6,990	7,750 r	3,820	4,410
Primary products:					
Production	72,800	72,900	59,900	68,600	W
Shipments	48,700	51,300	43,300	51,100	W
Reported consumption	21,000	21,100	17,700	19,200	19,300
World, mine production	212,000	218,000	220,000 r	244,000 r	264,000 e

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data.

[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 ammonium, calcium, and sodium molybdate; briquets; ferromolybdenum; molybdenum hexacarbonyl; molybdenum metal; molybdenum pentachloride; molybdic acid; pellets; phosphomolybdic disulfide; and technical and purified molybdic oxide.

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

(Metric tons of contained molybdenum)

	Metal powder		Other[2]		Total	
	2010	2011	2010	2011	2010	2011
Received from other producers	--	--	W	W	W	W
Gross production during year	(3)	W	(3)	W	68,600	W
Molybdenum products used to make other products	W	W	W	W	W	W
Net production	(3)	(3)	(3)	(3)	42,100	45,500
Shipments	(3)	W	(3)	W	51,100	W
Producer stocks, December 31	W	W	W	W	W	W

W Withheld to avoid disclosing company proprietary data. -- Zero.

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

[2]Includes ammonium, calcium, and sodium molybdate; ferromolybdenum; molybdenum disulfide; molybdenum hexacarbonyl; molybdenum metal; molybdenum pentachloride; molybdic acid; molybdic oxides; pellets; and phosphomolybdic acid.

[3]Withheld to avoid disclosing company proprietary data; included in "Total."

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

(Kilograms of contained molybdenum)

End use	Molybdic oxides	Ferromolybdenum[2]	Ammonium and sodium molybdate	Molybdenum scrap	Other	Total
2010:						
Steel:						
Carbon	426,000	281,000	--	--	W	707,000
High-strength low-alloy	682,000	117,000	--	--	--	800,000
Stainless and heat-resisting	2,160,000	721,000	--	(3)	93,900	2,980,000
Full alloy	3,410,000	3,000,000	--	--	W	6,410,000
Tool	551,000	W	--	(3)	--	551,000
Total	7,230,000	4,120,000	--	--	93,900	11,400,000
Cast irons (gray, malleable, ductile iron)	W	339,000 r	--	--	W	339,000 r
Superalloys	517,000	W	--	(3)	1,240,000	1,760,000
Alloys (other than steels, cast irons, superalloys):						
Welding materials (structural and hard-facing)	--	48,300	--	--	W	48,300
Other alloys	1,560	73,000	--	--	W	74,500
Mill products made from metal powder[4]	W	--	--	--	W	W
Cemented carbides and related products[5]	--	--	--	--	77 r	77 r
Chemical and ceramic uses:						
Pigments	W	--	7,870	--	--	7,870
Catalysts	945,000	--	(3)	--	W	945,000
Other	--	--	--	--	3,030	3,030
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	237,000	237,000
Other	54,300	89,300	(3)	--	4,180,000	4,320,000
Grand total	8,750,000	4,670,000	7,870	--	5,750,000	19,200,000
Stocks, December 31	346,000	347,000	3,850	(6)	(6)	1,620,000
2011:						
Steel:						
Carbon	445,000	310,000	--	--	W	755,000
High-strength low-alloy	737,000	122,000	--	--	--	859,000
Stainless and heat-resisting	2,090,000	784,000	--	(3)	93,900	2,970,000
Full alloy	3,580,000	3,750,000	--	--	W	7,330,000
Tool	607,000	W	--	(3)	--	607,000
Total	7,460,000	4,970,000	--	--	93,900	12,500,000
Cast irons (gray, malleable, ductile iron)	W	337,000	--	--	W	337,000
Superalloys	(7)	(7)	--	(7)	1,520,000	1,520,000
Alloys (other than steels, cast irons, superalloys):						
Welding materials (structural and hard-facing)	--	41,500	--	--	W	41,500
Other alloys	1,300	97,700	--	--	W	99,000
Mill products made from metal powder[4]	W	--	--	--	W	W
Cemented carbides and related products[5]	--	--	--	--	77	77
Chemical and ceramic uses:						
Pigments	W	--	10,600	--	--	10,600
Catalysts	941,000	--	(3)	--	W	941,000
Other	--	--	--	--	W	W
Miscellaneous and unspecified uses:						
Lubricants	--	--	--	--	219,000	219,000
Other	43,400	92,800	(3)	--	3,480,000	3,610,000
Grand total	8,440,000	5,540,000	10,600	--	5,320,000	19,300,000
Stocks, December 31	555,000	355,000	3,500	(6)	(6)	1,840,000

rRevised. W Withheld to avoid disclosing company proprietary data; included in "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]Withheld to avoid disclosing company proprietary data; included in "Miscellaneous and unspecified uses: Other" of the "Other" category.
[4]Includes ingot, wire, rod, and sheet.
[5]Includes construction, mining, oil and gas, and metal working machinery.
[6]Withheld to avoid disclosing company proprietary data; included in "Total."
[7]Withheld to avoid disclosing company proprietary data.

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

Product and country	HTS[2] code	2010 Quantity (metric tons)	2010 Value (thousands)	2011 Quantity (metric tons)	2011 Value (thousands)
Oxides and hydroxides, gross weight:[3]	2825.70.0000				
Austria		432	$9,560	34	$1,420
Belgium		2	69	46	1,170
Canada		2,760	32,600	2,330	29,800
Japan		1,190	23,600	892	22,200
Kuwait		--	--	12	84
Latvia		--	--	17	476
Mexico		80	2,020	106	2,740
Netherlands		134	2,630	1,140	28,500
Russia		20	584	164	3,750
Turkey		60	1,260	80	2,040
Other (13 countries)		1,370 r	26,900 r	14	303
Total		6,040	99,300	4,840	92,400
Molybdates, all, gross weight:[4]	2841.70.0000	.		.	
Canada		707	10,500	244	3,470
Japan		72	1,760	236	5,390
Korea, Republic of		48	375	146	1,740
Mexico		22	531	104	1,530
Netherlands		573	7,760	1,090	19,000
Other (30 countries)		256 r	5,260 r	183	4,500
Total		1,680	26,200	2,010	35,600
Ferromolybdenum, contained weight:[4, 5]	7202.70.0000				
Canada		677	22,300	871	30,200
Denmark		(6)	23	1	37
Mexico		13	525	48	1,720
Netherlands		196	7,070	293	10,500
Turkey		(6)	4	116	4,610
Other (13 countries)		92 r	3,210 r	(6)	25
Total		978	33,100	1,330	47,100
Molybdenum, other, gross weight:[3, 7]	Various[8]				
Austria		159	10,500	323	18,800
Belgium		28	1,040	44	983
Canada		97	4,240	69	3,660
Germany		85	4,130	215	16,300
Israel		93	7,290	84	6,570
Japan		299	29,800	206	12,400
Korea, Republic of		504	39,900	744	32,200
Mexico		110	7,380	87	6,080
Taiwan		161	11,700	77	4,790
United Kingdom		600	14,000	887	21,800
Other (50 countries)		400 r	23,300 r	230	20,300
Total		2,540	153,000	2,970	144,000

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule (HTS) of the United States.
[3]Presentation of annual data is based on the quantities (gross weight) of the 10 leading countries in 2011.
[4]Presentation of annual data is based on the quantities (gross weight) of the five leading countries in 2011.
[5]Ferromolybdenum contains about 60% to 65% molybdenum.
[6]Less than ½ unit.
[7]Includes powder, unwrought, waste and scrap, wire, wrought, and other.
[8]Includes HTS codes 8102.10.0000, 8102.94.0000, 8102.95.0000, 8102.96.0000, 8102.97.0000, and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 5
U.S. EXPORTS OF MOLYBDENUM ORE AND CONCENTRATES
(INCLUDING ROASTED AND OTHER CONCENTRATES), BY COUNTRY[1, 2]

	2010		2011	
Country	Quantity (metric tons of contained Mo)	Value (thousands)	Quantity (metric tons of contained Mo)	Value (thousands)
Belgium	9,610	$251,000	6,620	$220,000
Canada	1,150	30,100	1,400	52,000
Chile	--	--	3,220	108,000
China	5,280	165,000	2,580	90,000
India	924	30,500	901	30,800
Japan	2,630	82,600	4,150	135,000
Korea, Republic of	805	26,500	1,460	48,200
Mexico	5,040	38,500	7,270	108,000
Netherlands	8,210	231,000	11,500	375,000
United Kingdom	5,000	148,000	6,210	216,000
Other (25 countries)	1,930 r	52,500 r	1,770	62,600
Total	40,600	1,050,000	47,100	1,450,000

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Presentation of annual data is based on the quantities (gross weight) of the 10 leading countries in 2011.

Source: U.S. Census Bureau.

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

		2010			2011		
Item	HTS[2] code	Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)	Gross weight (metric tons)	Contained Mo (metric tons)	Value (thousands)
Molybdenum ore and concentrates, roasted	2613.10.0000	NA	18,800	$571,000	NA	21,300	$725,000
Molybdenum ore and concentrates, other	2613.90.0000	NA	21,800	484,000	NA	25,800	721,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	6,040	NA	99,300	4,840	NA	92,400
Molybdates, all	2841.70.0000	1,680	NA	26,200	2,010	NA	35,600
Ferromolybdenum	7202.70.0000	1,430	978	33,100	1,950	1,330	47,100
Molybdenum powders	8102.10.0000	509	NA	20,900	625	NA	28,000
Molybdenum unwrought, bars and rods	8102.94.0000	273	NA	11,300	667	NA	24,100
Molybdenum waste and scrap	8102.97.0000	707	NA	12,400	810	NA	15,700
Molybdenum wire	8102.96.0000	175	NA	15,200	130	NA	11,500
Molybdenum, other	Various[3]	872	NA	93,500	733	NA	64,700
Total		XX	XX	1,370,000	XX	XX	1,760,000

NA Not available. XX Not applicable.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule (HTS) of the United States.
[3]Includes HTS codes 8102.95.0000 and 8102.99.0000.

Source: U.S. Census Bureau.

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

Product and country	HTS[2] code	2010 Quantity (metric tons)	2010 Value (thousands)	2011 Quantity (metric tons)	2011 Value (thousands)
Oxides and hydroxides, gross weight:[3]	2825.70.0000				
Chile		378	$9,510	146	$3,800
China		16	337	1	15
Mexico		92	1,760	--	--
United Kingdom		--	--	(4)	8
Uzbekistan		20	529	--	--
Other (2 countries)		2 r	21 r	--	--
Total		508	12,200	147	3,820
Molybdates, all, contained weight:[3]	Various[5]				
Chile		468	16,000	420	15,800
China		400	11,800	117	4,560
Germany		39	896	42	1,080
Japan		15	549	7	854
United Kingdom		(4)	2	2	38
Other (4 countries)		6 r	880 r	(4)	190
Total		928	30,100	588	22,500
Molybdenum orange, gross weight:[3]	3206.20.0020				
Canada		247	2,220	237	2,230
China		3	18	4	27
Colombia		10	49	65	386
Germany		6	29	3	29
Mexico		50	293	19	112
Other (4 countries)		33 r	116 r	(4)	11
Total		349 r	2,730	328	2,790
Ferromolybdenum, contained weight:[3, 6]	7202.70.0000				
Canada		348	14,300	227	9,580
Chile		2,520	89,800	2,600	97,200
Russia		36	1,410	21	887
United Kingdom		340	11,900	285	8,140
Vietnam		--	--	25	983
Other (12 countries)		322 r	12,200 r	54	2,230
Total		3,560	130,000	3,210	119,000
Other, gross weight:[7]	Various[8]				
Austria		334	23,200	327	27,700
Canada		85	3,250	348	12,600
China		1,070	43,800	1,400	64,500
Germany		114	6,040	202	9,330
Hong Kong		41	1,770	38	1,670
Japan		59	2,390	41	1,680
Russia		28	3,130	53	6,560
Taiwan		18	697	26	720
Thailand		--	--	20	388
United Kingdom		12	512	49	2,200
Other (22 countries)		81 r	3,050 r	16	934
Total		1,840	87,800	2,520	128,000

r Revised. -- Zero.
[1] Data are rounded to no more than three significant digits; may not add to totals shown.
[2] Harmonized Tariff Schedule of the United States.
[3] Presentation of annual data based on the quantities (gross weight) of the five leading countries in 2011.
[4] Less than ½ unit.
[5] Includes HTS codes 2841.70.1000 and 2841.70.5000.
[6] Ferromolybdenum contains about 60% to 65% molybdenum.
[7] Presentation of annual data based on the quantities (gross weight) of the 10 leading countries in 2011.
[8] Includes HTS codes 8102.10.0000, 8102.94.0000, 8102.95.3000, 8102.95.6000, 8102.96.0000, 8102.97.0000, and 8102.99.0000.

Source: U.S. Census Bureau.

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

Country	2010 Quantity (metric tons of contained Mo)	2010 Value (thousands)	2011 Quantity (metric tons of contained Mo)	2011 Value (thousands)
Argentina	--	--	99	$3,090
Belgium	25	$782	--	--
Canada	1,620	51,300	1,420	47,000
Chile	3,000	99,200	3,840	133,000
China	(2)	3	--	--
Germany	25	935	--	--
Kazakhstan	--	--	117	4,170
Mexico	4,600	53,500	5,290	74,300
Peru	3,680	108,000	3,880	198,000
Total	12,900	314,000	14,700	460,000

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than ½ unit.

Source: U.S. Census Bureau.

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

Item	HTS[2] code	2010 Gross weight (metric tons)	2010 Contained Mo (metric tons)	2010 Value (thousands)	2011 Gross weight (metric tons)	2011 Contained Mo (metric tons)	2011 Value (thousands)
Molybdenum ore and concentrates, roasted	2613.10.0000	10,300	6,340	$112,000	11,700	7,080	$136,000
Molybdenum ore and concentrates, other	2613.90.0000	13,500	6,610	202,000	18,700	7,570	323,000
Molybdenum chemicals:							
Oxides and hydroxides	2825.70.0000	508	NA	12,200	146	NA	3,820
Molybdates, all	Various[3]	1,650	928	30,100	1,000	588	22,500
Molybdenum orange	3206.20.0020	349	NA	2,730	328	NA	2,790
Ferromolybdenum	7202.70.0000	5,330	3,560	130,000	4,810	3,210	119,000
Molybdenum powders	8102.10.0000	232	221	10,100	281	264	13,600
Molybdenum unwrought, bars and rods	8102.94.0000	307	301	10,200	566	545	20,800
Molybdenum waste and scrap	8102.97.0000	703	682	26,900	748	700	27,400
Molybdenum wire	8102.96.0000	19	NA	3,030	21	NA	3,230
Molybdenum, other	Various[4]	582	NA	37,500	903	NA	63,200
Total		33,500	XX	576,000	39,200	XX	736,000

NA Not available. XX Not applicable.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule (HTS) of the United States.
[3]Includes HTS codes 2841.70.1000 and 2841.70.5000.
[4]Includes HTS codes 8102.95.3000, 8102.95.6000, and 8102.99.0000.

Source: U.S. Census Bureau.

TABLE 10
MOLYBDENUM-PRODUCING MINES IN THE UNITED STATES IN 2011

State and mine	County	Operator	Source of molybdenum
Arizona:			
Bagdad	Yavapai	Freeport-McMoRan Copper & Gold Inc.	Copper-molybdenum ore, concentrated.
Mineral Park	Mohave	Mercator Minerals Ltd.	Do.
Morenci	Greenlee	Freeport-McMoRan Copper & Gold Inc.	Do.
Sierrita	Pima	do.	Do.
Colorado, Henderson	Clear Creek	do.	Molybdenum ore, concentrated.
Idaho, Thompson Creek	Custer	Thompson Creek Metals Co. Inc.	Do.
Montana, Continental Pit	Silver Bow	Montana Resources	Copper-molybdenum ore, concentrated.
Nevada:			
Ashdown	Humboldt	Win-Eldrich Mines Ltd.	Molybdenum ore, concentrated.
Robinson	White Pine	Quadra FNX Mining Ltd.	Copper-molybdenum ore, concentrated.
New Mexico:			
Chino	Grant	Freeport-McMoRan Copper & Gold Inc.	Copper-molybdenum ore, concentrated.
Questa	Taos	Chevron Mining	Molybdenum ore, concentrated.
Utah, Bingham Canyon	Salt Lake	Kennecott Utah Copper Corp.[1]	Copper-molybdenum ore, concentrated.

Do., do. Ditto.
[1]Wholly owned subsidiary of Rio Tinto plc.

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

(Metric tons of contained molybdenum)

Country[3]	2007	2008	2009	2010	2011[e]
Armenia	4,295 [r]	4,472 [r]	4,365 [r]	4,335 [r]	4,500
Canada	6,681	8,602	8,641	8,261	8,404 [p, 4]
Chile	44,912	33,687	34,925	37,186	40,889 [4]
China[e]	66,700	81,000	93,500	93,600	106,000
Iran[e]	3,600	3,700	3,700	3,800 [r]	3,700
Kazakhstan[e]	-- [r]	-- [r]	-- [r]	-- [r]	--
Kyrgyzstan[e]	250	250	250	250	250
Mexico	6,159	7,812	7,800	10,849	10,881 [4]
Mongolia	1,978	1,899	2,408 [r]	2,198 [r]	1,956 [4]
Peru	16,787 [r]	16,721	12,297 [r]	16,963	19,141 [4]
Russia[e]	3,300	3,600	3,800	3,800	3,900
United States	57,000	55,900	47,800	59,400	63,700 [4]
Uzbekistan[e]	600	500	550	550	550
Total	212,000	218,000	220,000 [r]	244,000 [r]	264,000

[e]Estimated. [P]Preliminary. [r]Revised. -- Zero.
[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 June 29, 2012.
[3]In addition to the countries listed, North Korea, Romania, and Turkey are thought 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.