

MOLYBDENUM

By Brian Nolk

In retrospect, 2001 will be seen as the year of over-correction for molybdenum; when cuts in both primary and by-product molybdenum cumulatively tipped the balance back in favour of shortage and created the conditions for a dramatic price spike in 2002.

In the past few years up to late 2001 the factors which kept molybdenum in oversupply included strong by-product output from copper operations in the US, Canada, Chile and Peru, as well as continuing supplies from China. The result was a long period of low prices for molybdenum with free market price indications locked into a range of US\$2.00 - 3.00/lb Mo. Since three quarters of the world's molybdenum enters the supply chain as a result of by-production from porphyry copper operations there seemed little the molybdenum industry could do to directly affect their own market balance. As a result the few but relatively large primary producers in the US were relegated in the 1990s to a position of swing producers, able to participate fully only during the brief periods of supply dislocation and price rises.

The scene was set in the late 1990s when large copper producers with significant molybdenum by-production merged. Asarco Inc. merged with Grupo Mexico and Phelps Dodge Mining Corp. (PDMC) with Cyprus Amax Inc., making Phelps Dodge the largest molybdenum producer in the world at that time. These copper groups were subjected to fierce pressures to reduce their costs at their operations by the concomitantly low prices for copper and molybdenum. Production cuts throughout the Cu/Mo mining industry in North and South America were the result of these groups and others responding to those pressures in 2001.

Supply

Since the mid-1990s, the molybdenum market has been in chronic oversupply, as exports from the CIS producers entered the world

market alongside increased output from China and South America. The primary producers and North American by-product producers have steadily cut back output since 1998 but this has been largely offset by new by-production from other copper operations, such as Los Pelambres in Chile. Latin American output jumped by one-third since the mid-1990s, offsetting cuts of one-third and one-half in Canada and the US respectively.

Molybdenum Production ('000 t)

	1999	2000	2001 ^e
Canada	6.8	6.83	6.8
Chile	27.3	29.1	35
China	27.9	28.9	28
CIS ¹	5.5	6.3	6.4
Mexico	6	6.8	6.9
Peru	6.8	7.1	7.2
US	43	41	38.3
Others ²	2.4	2.94	3
Total	125.7	128.9	131.6

Source: USGS Mineral Commodity Summaries.

Notes: Production from North Korea, Romania, Turkey and Yugoslavia is not included.

¹ Armenia, Kazakhstan, Kyrgyzstan, Russia and Uzbekistan.

² Chiefly Mongolia and Iran.

^e estimate.

Since 1997, world production has fallen from a peak of 138,820 t (306 Mlb) to 125,070 t (276 Mlb) in 1999 before climbing back slightly to 131,600 t (290 Mlb) in 2001.

For many years the US has been the world's largest producer of molybdenum, although with cuts in US output in the past six years

and growth in other producing nations, there is currently relatively little difference between production rates in the US and Chile.

A significant proportion of mine capacity in the US, and most of that in China, is accounted for by primary molybdenum mines and output at these can fluctuate according to price and perceived demand. The primary mines at Henderson, Thompson Creek and Questa in the US, and Endako in Canada, have reduced output since the late 1990s to help offset rising stocks of molybdenum in the market. Also, many of the copper-molybdenum operations have curbed output in recent years. This 'swing' production concept had become accepted by many in the North American sector by 2001.

In that year the pressures on the North American producers were intensified as low copper and molybdenum prices continued but soaring electricity prices made production costs rise.

PDMC, the largest North American producer, engaged in a series of cuts throughout 2001. In late May the company said it would curb molybdenum production at its Arizona and New Mexico operations by 7 Mlb for 2001. The bulk of the cuts centre on the company's copper concentrate production and its Chino mine in New Mexico, and Phelps warned at that time it might need to take further action.

In the fourth quarter, PDMC was forced to cut output even further at its Sierrita and Bagdad mines, causing molybdenum output to decline by an annualised 14 Mlb. Despite the cuts in the latter part of the year, however, PDMC produced 55.5 Mlb of molybdenum in 2001, up from 51.5 Mlb a year before.

For the full year 2001, PDMC reported an operating loss of US\$90.1 million (including a US\$16.1 million loss for molybdenum operations) before pre-tax, non-recurring charges of US\$2.1 million, compared with operating income of US\$249.1 million (including a US\$12.6 million loss for

molybdenum operations) before pre-tax, non-recurring charges of US\$5.8 million in 2000.

In July 2001, Thompson Creek said its production of molybdenum oxide was likely to be lower for the year and that it expected output at the 20 Mlb/y capacity mine to be 2 Mlb lower in 2001 than the 6-7 Mlb seen the year before. Production at its Endako operation in Canada, which the company reprieved in May, would remain at the previous year's level of 10 Mlb, the company said.

In Chile, and indeed in the rest of Latin America, molybdenum is produced solely as a by-product of copper mining. Because producers such as Codelco-Chile have increased their copper output their molybdenum by-production has also risen. The increased molybdenum output from Latin America has, over time, offset the reduced output from 'swing' producers in North America and helped to keep molybdenum in oversupply.

China

In China, molybdenum mining was for many years not subject to the usual economic pressures felt by producers in other nations as state agencies pushed exports for foreign exchange purposes. In their defence the Chinese producers generally had a competitive cost base and there was, and is, a strong domestic demand from a fast-growing steel industry.

By the mid-1990s, exports of low-cost material from China were contributing to the world oversupply. However, domestic molybdenum output is now stabilising and demand from the Chinese steel industry is growing rapidly. In addition, the pressure of anti-dumping duties in the US and Europe also helped to curb China's export volumes. As a result, Chinese exports of molybdenum dropped in 2001.

Production from the large number of small companies throughout China is erratic and some could close under tightening pollution-related legislation and rising production costs, and others are looking to shift production

away from commodity grades to higher-value products. This is likely to have a major impact on China's molybdenum industry over the next 3-5 years.

In one important example of producers shifting away from oxide exports, China's largest molybdenum producer, Jinduicheng Molybdenum Mining Corp. (JDC), announced its intention to halve molybdenum oxide production to around 5,000 t in 2002 as a part of a strategic shift to move into downstream processing. The company said the decision reflects JDC's shift in emphasis to expand into other downstream processing, like high-soluble molybdenum oxide, molybdenum powder and molybdenum wire production. The bulk of these products will be targeted at the export market, in Europe, the US and South Korea, while the rest will be sold inside China.

JDC also said early in 2001 it would cut its production of ferro-molybdenum (FeMo) significantly and will only produce small volumes for its existing customers. In August the firm admitted it had basically ceased to produce FeMo as a result of the European Commission's decision to introduce anti-dumping duties against Chinese ferro-molybdenum imports. In February 2001, the European Union Council of Ministers voted to impose definitive 22.5% anti-dumping duties on all imports of ferro-molybdenum from China.

The changes also followed from Shanxi-based JDC's announcement in early 2001 to terminate an exclusive distribution agreement with Shangxiang Minmetals, which had been marketing JDC's high-soluble molybdenum oxide throughout much of the world market.

As a result of these changes it appears primary output of molybdenum in China dropped by about 2.84% in 2001 to 28,200 t while domestic consumption increased by over 8.5% to 12,000 - 13,000 t. China's special steel production was estimated to have risen by almost 9% last year, to 14.5 Mt and accounted for approximately 10,000 t of molybdenum consumption nationally.

The higher levels of domestic consumption meant lower Chinese exports of molybdenum products in 2001 of approximately 15,200 - 16,200 t of net molybdenum production.

Supply from the CIS has also stabilised. The producers in Armenia, Kazakhstan and Russia have a variable performance and in the past have had some difficulties in getting their product to export markets. Nonetheless, producers have been quick to spot new opportunities in the markets and where possible to exploit them.

In July 2001, the Russian State Statistics Committee reported that January-May production of molybdenum concentrates increased by 33.9%.

In November 2001, Chelyabinsk Electrometallurgical Works in Russia confirmed it had restarted ferro-molybdenum production after a two-year stoppage. The firm is toll-processing concentrates for FeMo for export, taking advantage late in 2001 of the absence of Chinese FeMo because of the EU anti-dumping restrictions. The plant has a capacity to produce 20,000 t/y of ferro-molybdenum.

Uzmetal Technology, a molybdenum joint venture between Israeli company Metek Metal Technology, and Almalyk and Uzbek Heat Resistant Metals, based at Almalyk Mining & Metallurgical Complex in Uzbekistan, said it plans to commence molybdenum production in March 2002. The US\$19 million project will use 600 t/y of molybdenum concentrates supplied by Almalyk for further processing at the Uzbek Heat Resistant Metals Combine in the city of Chirchik near Tashkent. Uzmetal said it will produce finished molybdenum products and has begun modernising the plant's facilities. For its part, Almalyk said it would make cost savings by keeping the processing of concentrates close to its existing operations.

In 2001, the five largest producers, Codelco, Phelps Dodge, Grupo Mexico, JDC and Thompson Creek, accounted for nearly 75%

of world production; up from less than 60% of global supply as recently as 1999. This was a result of mergers amongst the North American suppliers and some production growth elsewhere. This concentration of control in such a small group over so much of world supply suggested to some market observers that over-supply in the world market, which had been chronic since 1995, might be controllable once again.

However, there are some new entrants to the ranks of the producers, notably Anaconda Chile, which has brought on its giant copper-molybdenum operation at Los Pelambres and which is now hitting its production capacity. Also, Peru's Antamina polymetallic mine began production by the end of 2001. This US\$2.2 billion project is owned 33.75% by Noranda, 33.75% by Rio Algom, 22.5% by Teck Corp. and 10% by Mitsubishi. The potential combined output from these two South American operations alone is expected to be equivalent to 6% of total world production in 2002.

By the end of 2001, the substantial round of cutbacks by several major copper producers had significantly trimmed expectations for 2002 supplies of molybdenum concentrate. Codelco said it was going to scale down production in late 2001 and throughout 2002, resulting in as much as a 5 Mlb reduction of concentrate supply over a two-year period. Rio Tinto's Kennecott operation in Utah also cut its molybdenum production forecasts for 2001 and 2002 and Thompson Creek also expected to be down year-on-year in 2001 and again in 2002. Output reductions earlier this year means 2001 production at Thompson Creek will also be down year-on-year, with the likelihood of further declines in 2002 to follow.

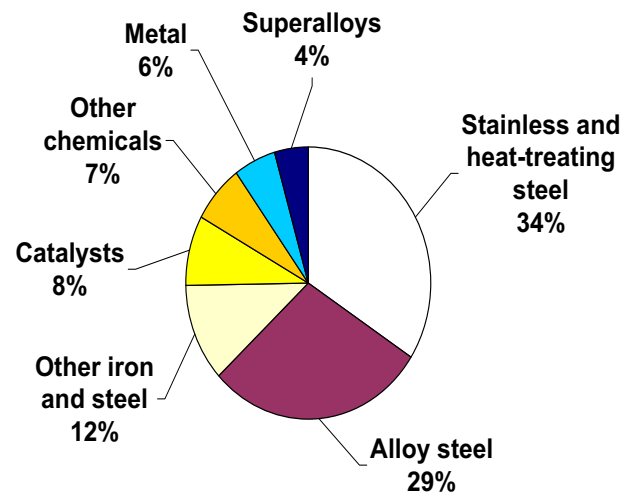
Demand

In the past eight years global molybdenum consumption has grown by approximately 2-3% per annum, and estimates for 2001 consumption generally fall in the range 125,000-132,000 t. The iron and steel industry

account for about 75% of molybdenum consumption, of which 30-35% goes to the stainless steel sector. The stainless steel industry has enjoyed an annual growth rate of around 4% per annum over the same period and this had helped molybdenum demand. The growing market for high strength-low alloy (HSLA) steels containing molybdenum has also been a good market for molybdenum and the International Molybdenum Association (IMO) and others have promoted the use of duplex steels, which contain relatively high levels of molybdenum.

The second largest consuming sector for molybdenum after iron and steel is the catalyst industry (including automotive catalysts as well as industrial catalysts for the petroleum and petro-chemical sectors). Catalyst demand has grown by over 5% annually since 1990 and Roskill said annual growth is set to continue at around 3-4% through to 2005.

Molybdenum Consumption by End-Use, 2001



Source: Industry estimates.

Notes: Other iron and steel includes tool steel, high-speed steel, cast iron and welding rods.

Other chemicals includes lubricants, pigments, water treatment, polymers and airbags.

Although the stainless steel and catalyst sectors have been largely responsible for much of the growth in world molybdenum demand since the mid-1990s, demand from the superalloys and molybdenum metal

markets have also shown significant growth. Superalloys are used in aerospace applications, which account for around 75% of this market, but large turbines for the gas industry are a high growth area as well.

Geographically, Europe is the world's largest molybdenum-consuming region, accounting for around one-third of total demand in 2001. The size of the European stainless and special steel industries, as well as a growing catalyst production, is largely responsible for its dominance in this market. The US still consumes about 25% of all molybdenum and Japan a little less than 15%.

China's consumption is now over 7% of the global total and still rising. It is expected that rising Chinese demand for molybdenum could see that nation emerge as a net importer, as its steel industry continues to expand, but in 2001 molybdenum consumption accounted for a little over one-third of its production.

Global molybdenum demand is predicted to grow by an annual 2-3% over the next few years. The highest growth rate is expected to come from non-metallurgical applications such as lubricants, pigments, water treatment, polymers and airbags, where demand is predicted to increase annually by about 3-4%, but these non-metallurgical applications still account for only about 7% of global demand at present. The petroleum refining and automotive catalysts sector continues to be a strong market for molybdenum.

Price

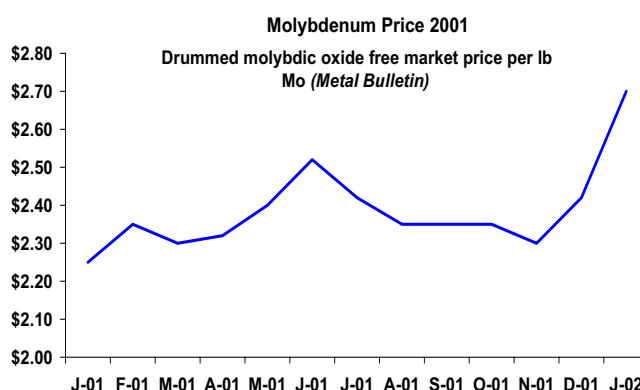
A look at the 20-year price graph for molybdenum shows it has a stable range of US\$2.00-5.00/lb for oxide and US\$6.00-12.00/kg (US\$2.70-5.40/lb) for ferromolybdenum. This 'natural range' has been exceeded only rarely in the past 20 years, most notably in 1994-1995. This was caused by a sharp rise in demand from growing world steel production which molybdenum producers were unable to meet, coupled with delays and cancellations of exports from China.

The main reason behind the low molybdenum prices in the second half of the 1990s was the large stocks of material in the marketplace. The growing proportion of supply as a by-product of copper mining and the concomitant reduction in the ability of primary mines to act as 'swing' producers, was also an important factor.

In 1999, the supply-demand balance changed however, and in that year it is thought demand exceeded supply by as much as 6,000 t, the first drop in the large surpluses, which dogged the late 1990s. Following further cuts in North American production in 2000 and 2001 and some growth in demand saw a steady draw-down in the large global stocks of molybdenum products. However, until stocks had dropped by a significant amount there had been almost no movement in prices.

In 2001, the price graph for oxide below (tracing the Metal Bulletin drummed molybdic oxide price, free market in warehouse low) described an arc, beginning the year near the low end of the historical cycle of US\$2.30 - 2.40/lb before the production cuts by major producers drove oxide prices to a short-lived peak of US\$2.60-2.65/lb in June 2001. Another rally in the second quarter took the price up to its mid-June high for the year of US\$2.55-2.65/lb.

The price retraced its steps back down to US\$2.30-2.35/lb in November. However, by then the cumulative effect of cutbacks by producers provided the basis for a sharp rise over the year-end into 2002. We know now the price went up from that point reaching over US\$7.00/lb in June 2002.



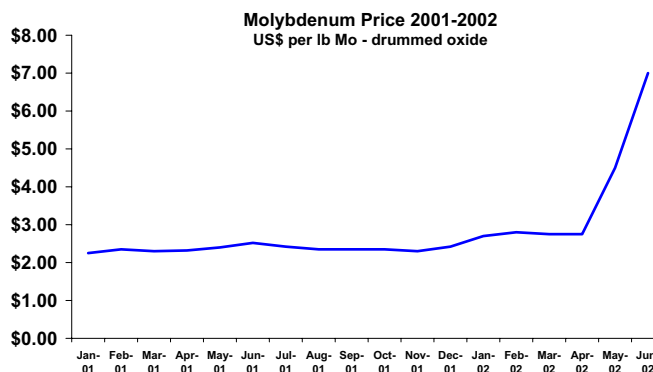
One of the biggest developments of the year was the imposition by the EU Commission in Brussels of an anti-dumping duty of 22.5% on imports of Chinese ferro-molybdenum. Anticipation of that move put pressure on Chinese FeMo prices in Europe as early as March 2001 (reaching US\$6.00-6.15/kg fob by early April).

The imposition, announced in the Official Journal of August 9, recorded provisional duties ranging as high as 26.3%, with four companies attracting Anti-Dumping (AD) duty rates of 3.6-17.2% (but these four firms account for only 20% or so of the EU's imports from China). When the existing customs duty of 2.7% is added it means that most FeMo imports from China now attract a 29% levy.

Industry group Euroalliances, which lodged the complaint on behalf of European ferro-molybdenum producers, welcomed the EC decision but several molybdenum consumers, notably German steel producers and foundries, lodged their complaints with the EC commission during the six-month period of consultation. In February 2002, the European Union Council of Ministers voted to impose definitive 22.5% anti-dumping duties on all imports of ferro-molybdenum from China, overturning the exceptions made to the four smaller firms.

The EC's investigation of dumping and injury to European ferro-molybdenum producers covered the period October 1999 to September 2000. From 1997, the volume of dumped imports increased by 70% to 13,257 t in the investigation period, and the imports' market share rose from less than one-third to nearly half.

The immediate effect of the anti-dumping duty was to allow FeMo prices to rise from the US\$6.10-6.15/kg fob basis for Chinese material in the EU in April. Ferro-molybdenum free market prices rose to US\$7.50-7.80/kg, delivered duty paid, and US\$6.70-7.00/kg for Chinese material on an in-warehouse duty unpaid basis in May 2001.



EU ferro-molybdenum producers such as Climax Molybdenum and Ferro-Alloys & Metals in the UK, Sadaci in Belgium and Treibacher in Austria were expected to benefit from the AD duties imposed on imported Chinese material, not least by being able to increase their conversion margins by at least US\$1/kg of molybdic oxide.

It was not just the Chinese AD duties which were having an effect, however. The large production cutbacks by copper producers such as Phelps Dodge, Codelco and BHP Billiton were eventually going to have a cumulative effect on the supply and the price.

A trader noted the one-third cut in molybdenum production announced by Phelps Dodge in its first quarter results, taking approximately 5 Mlb of molybdenum units out of the market. In addition, primary molybdenum producer Thompson Creek is continuing to operate at around 40% of capacity after low prices forced it to cut back last year.

Some producers were lucky enough to take advantage of the rising trend in the market price. Molycorp resumed mining and milling at its Questa molybdenum mine in New Mexico in September 2001 and planned to produce 5-7 Mlb in the remainder of that year. Some of its molybdenum output is processed into ferro-molybdenum at its Washington, Pennsylvania plant and the rest is sold as concentrates or oxide.

At the end of the year prices of molybdic oxide and ferro-molybdenum rose strongly, with

oxide prices in Europe up to US\$2.70-2.78/lb for drummed material in warehouse.

European FeMo prices also greatly increased, with Western material containing 65-70% Mo selling from US\$7.20/kg to as high as US\$7.85/kg delivered. Chinese material rose to US\$6.20-6.50/kg duty-unpaid in-warehouse Rotterdam.

Fuelled by cutbacks in North and South American production, oxide prices on both sides of the Atlantic and in Japan started to turn upwards in late 2001. Japan did not enjoy much of the increase in FeMo prices, however, with ferro-molybdenum prices in the region languishing around US\$6.40/kg at year-end.

Outlook

'Swing' producers, such as the Henderson, Thompson Creek, Questa and Endako mines will have a great deal of control over the future supply/demand balance for molybdenum. It was largely those operations, and others within Phelps Dodge and Grupo Mexico which cut back sufficiently in 1999-2001 to help the market recover from the huge overhang of stocks which had caused the poor prices of the preceding six years. The cutbacks have at long last had a significant impact on prices. Conversely, should the 'swing' producers jump back into higher production rates on the back of improved prices there is little doubt that the balance could be tipped back towards oversupply.

As well as production rates, the market is heavily influenced by stock fluctuations. While most market observers agree stocks had become a heavy burden by 1999-2000 there is less consensus on exactly how large they had become. Some reports estimated that the market surplus at the end of 2000 was around 40-45 Mlb (18,000-20,500 t) but some reports suggested even higher levels.

Oversupply drifted into undersupply in 1999 when demand exceeded supply for the first

time in several years, by as much as 6,000 t (13 Mlb). Production cuts in North America in 2000 helped to accelerate the undersupply but it was not until 2001 that this global stock reduction was acknowledged and led to higher prices for molybdenum products in the free market.

The other significant factor in the supply/demand balance and equally slow to be acknowledged, is the changing levels of Chinese molybdenum exports.

Primary output of molybdenum in China dropped by about 2.84% in 2001 to 28,200 t while domestic consumption increased by over 8.5% to 12,000 - 13,000 t. China's special steel production was estimated to have risen by almost 9% last year, to 14.5 Mt and accounted for approximately 10,000 t of molybdenum consumption nationally.

The higher levels of domestic consumption meant lower Chinese exports in 2001 of approximately 15,200 - 16,200 t of net molybdenum production but this net figure masks a complex trade of imports and exports of the various molybdenum products. For example, imports of molybdenum concentrate, and exports of roasted Mo sand and ferro-molybdenum, increased. Imports of molybdenum sand and concentrate totalled 22,948 t, 40.4% higher than in 2000; roasted molybdenum sand and concentrate exports totalled 22,582 t, 61.16% higher than in 2000; ferro-molybdenum exports decreased by 15.4% to 37,545 t.

The growing steel sector in China is expected to consume a progressively greater amount of domestic production so it is possible that China may eventually become a net importer of molybdenum products. Certainly, as Chinese exports slow there is already a significant effect on free market price levels.

The percentage of molybdenum production coming from copper-mining operations has grown by an annual average of around 2.5% since 1980 and was estimated at about 76%

in 2000. Clearly, if this rising trend continues and prices remain in the range that has typified the past 20 years, the future of some primary mines looks uncertain, particularly those in areas of high labour and energy costs.

The final factor on the supply side is recycling. Recovery of molybdenum units from spent catalysts because of environmental legislation that prevents the disposal of such catalysts is increasing. Catalyst recycling is estimated to be growing at 5% annually in Europe and North America, and by as much as 10% annually in the Asia/Pacific region. This is now equivalent to approximately 3,000 t/y of molybdenum.

In the five years following 2000, world molybdenum demand is predicted to grow by 2-3% each year. The highest growth rate is expected to come from non-metallurgical applications where demand is predicted to increase annually by about 3-4% on the back of the continued growth in the petroleum refining and automotive catalysts sector.

Growth will also continue to be heavily influenced by stainless and special steel producers, who will continue to be the dominant consumers. Growth in other steel sectors may be quite flat, although current preferences for HSLA steels will contribute towards moderate growth in the alloy steel sector.

Superalloys are highly dependent on aerospace applications, which account for around 75% of this market. However, large industrial turbines, notably for the gas industry, could become more important as this industry is predicted to grow rapidly, particularly in Europe and Central Asia where new large gas pipelines are needed.

Research into new applications continues, particularly in high-molybdenum duplex steels, and in the industry itself there is innovation. Treibacher of Austria has developed a new product called Molyquick. Described as more homogeneous and less dense than standard molybdenum the product comes in briquettes, so there are less fines, and it is said to dissolve faster in the steel melt.