

MOLYBDENUM

By Brian Nolk

Production cutbacks in US and Mexican mines in 2001 and 2002 were the biggest single factors in the supply/demand equation which saw the molybdenum market fall into a shortfall in 2002 and 2003. A small increase in global production in 2003, largely in the US and Chile, was not enough to restore stability to the market after a turbulent 2002. When combined with lower and sporadic shipments from China this created the tight market conditions, which saw spot prices rise throughout the year, nearly matching the cycle highs in the second quarter of 2002.

The moly market continued to provide thrills for traders and disturbances to consumers in 2003 as the price rose, fell and then rose again but with each new crest higher than the last. Benchmark drummed oxide spot prices started the year at just over US\$3/lb Mo and ended the year at over US\$7/lb. China's demand for its own material was the key factor in the spot tightness that plagued the market, buttressed each time by merchant speculation.

Meanwhile moly end-use markets in stainless and speciality steels, and in chemicals and lubricants, have remained largely buoyant and resistant to substitution until now. The price fluctuations that dog consumers have been largely passed on in the form of alloy surcharges, which track the free-market price of the errant alloy. The major stainless producers in Asia, Europe and the US have incorporated moly surcharges into the quarterly pricing of their products.

While this may increase the pressure on the users of those steels to find substitutes, and indeed for the steel producers to find new alloy mixtures, this may not be easy and is certainly not quick or likely to affect consumption patterns any time soon.

This was a dramatic turnaround for the molybdenum market, which had seen ample free-market supplies and steady low prices for some years. Until 2002, 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. Free-market price indications were locked into a range of US\$2.00 - 3.00/lb Mo for several years up to early 2002.

Since nearly 75% 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 directly to affect its 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 only during the brief periods of supply dislocation and price rises. Just such a price rise did occur in mid-2002 before drifting away in the second half and then returning with a vengeance in 2003.

The scene was set in North America 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 PDMC 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 concomitant 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 2002.

Supply

The roller coaster ride of 2002 had seen moly prices rise and peak in mid-2002, with reports of ferro-molybdenum changing hands in the range of US\$17-20/kg duty paid, and moly oxide offers were said to be in the range of US\$6.50-8.00/lb in Europe. This prompted some producers to restart marginal production which had been taken out of the market in the big cutbacks of 1998-2002, but much less of this restarting occurred than had been expected. Indeed, global production of molybdenum dropped to a low of 123,000 t in 2002 as cuts in the US and Mexico more than offset the increased production elsewhere, notably in Canada, Chile, China and Peru.

In 2003 continued increases in supply from Chile, China and the CIS were seen and this was augmented (rather than offset) by US production, which rose by nearly 5% from 2002's low point.

Since 1997, world production has fallen from a peak of 138,820 t (306 Mlb) to a low of 123,000 t (271 Mlb) in 2002 (Table 1). Production in 2003 is estimated at 127,000 t (280 Mlb). Even so, the extra 4,000 or so of extra moly production in 2003 was insufficient to keep prices in check.

Over 8,000 t of production was taken out of the market in 2002 by producers in the US and Mexico alone according to the statistics from the USGS Mineral Commodity Summaries, yet global production dropped by only 7,000 t from 2001. Some of the offsetting production increases can be traced to just two operations: Anaconda Chile's Los Pelambres operation and the Antamina mine in Peru, which saw its first full year of production in 2002.

In 2003, production increased by 1,900 t in Chile, 1,500 t in the US 700 t in China and 500 t in Armenia, as well as a 100 t recovery in Mexico's output.

US/Canada

The US has been for many years the world's largest producer of molybdenum although, with cuts in US output in the period 1996-2002 and increases in Chile and China, it looked as though the US would cede its top spot to Chile. For 2003 it appears the US has retained its position at the top of the league table but by a small margin. The US has enormous reserves and substantial molybdenum production capacity in mothballs, so the potential is still present for the US to retain its production supremacy, but much of this capacity is hostage to the long-term view of the copper price. Meanwhile, Chile's generally richer copper-molybdenum deposits and generally lower costs of

production will mean a close race between these two producing nations, with China coming a close third.

The US had six producing mines for most of 2003, one primary mine each in Colorado (Henderson), Idaho (Thompson Creek) and New Mexico (Questa) as well as three by-product producers in Arizona (Sierrita and Bagdad) and Utah (Bingham Canyon). Primary production accounts for less than 20% of the total, the rest coming as a by-product.

PDMC, through its subsidiary Climax Molybdenum, is still a world leader in molybdenum production and was one of the few North American producers to increase output in 2003 to take advantage of higher prices. Its Henderson underground primary molybdenum mine was reported to have edged up production in 2003 and this output is supplemented by molybdenum units from its Sierrita and Bagdad, Arizona copper mines. The company processes at Fort Madison, Iowa; Stowmarket, UK and Rotterdam. The company said it produced 52 Mlb of molybdenum from its own mines in 2003 (up from 45 Mlb in 2002), and sales of its own production totalled 54.2 Mlb (46.7 Mlb).

Thompson Creek Metals operates the Thompson Creek mine near Clayton, Idaho, and the Endako joint venture (with Nissho Iwai) near Fraser Lake in British Columbia, and has a conversion plant at Langeloth, Pennsylvania.

Rio Tinto's Kennecott operation is thought to have produced approximately 18 Mlb of molybdenum in 2003 as a by-product of the copper processing operations at Kennecott's Copperton concentrator in Utah.

In September 2003, Montana Resources announced it was planning to restart its Continental Pit copper and molybdenum mine, which has a capacity of 7-10 Mlb/y. The mine was closed in June 2000 due to high electricity prices and having secured a better power deal the mine commenced its restart in December 2003.

Chile

It had been expected that in 2002 Chile would become the largest producer of molybdenum in the world but the country remained in second place behind the US. In 2003 the gap between these nations narrowed further, with Chile producing approximately 31,400 t, almost all of which is exported. Chilean production rose about 6.4% from 2002 levels, largely as a result of Los Pelambres, which produces about 7,000 t/y of moly.

In Chile, and indeed in the rest of Latin America, molybdenum is produced solely as a by-product of copper mining. Over the past 20 years, as the copper producers have increased their copper output, their molybdenum by-production has also risen. The increased molybdenum output from Latin America has, over time, helped offset the reduced output from 'swing' producers in North America.

Molibdenos y Metales (Molymet) announced in mid-2003 it plans to invest US\$17.4 million in a new plant near the capital, Santiago, to wash and treat

molybdenum concentrates. The project will increase the company's capacity to produce molybdenum oxide at its Chilean facilities by 20%. Molymet is one of the world's largest producers of molybdenum, with output of 46 Mlb/y of molybdenum contained in oxides from the Chilean operations

China

China is the third-largest producer of molybdenum in the world and in 2003 it produced approximately 30,000 t, 2.4% more than in 2002. China's identified reserves of approximately 8.55 Mt puts it in second place in world ranking of reserves. Three of the six largest molybdenum mines in the world are located in China: Luanchuan in Henan Province, containing reserves of 1.3 Mt; Daheishan in Jilin Province, with 1.1 Mt; and Jinduicheng in Shanxi Province, with 970,000 t.

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, the rate of growth of domestic molybdenum output is now slowing 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 early 2002 but exporters quickly moved to take advantage of higher prices from June onwards.

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; 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 three-five years.

Chinese ferro-molybdenum producers responded to the effective closure of the EU market against them in 2002 by shifting some production facilities to other molybdenum products and shutting many of the older and higher cost Fe-Mo units.

One major producer, Shanxi-based JDC, had announced in early 2001 it was 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. The contract was terminated with effect from February 10, 2002. From that date, all new sales for JDC's oxide were handled by JDC's own trading arm, Jinduicheng Molybdenum Import & Export Corp, which was expanding its operations, including opening a Tokyo office.

In February 2002, the EU Council of Ministers voted to impose definitive 22.5% anti-dumping duties on all imports of ferro-molybdenum from China following a complaint from Euroalliances, a trade association of European

ferro-alloys companies. The EC found that dumping of Chinese Fe-Mo had led to European producers cutting production by 44%. A provisional anti-dumping duty on imports from China had been imposed in August 2001, with varying rates up to 26.3%, but this was harmonised in 2002.

JDC said it was concentrating on Mo oxide products, such as 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, and the rest will be sold inside China. JDC said it expected to produce approximately 6,000 t of Mo oxide in 2002.

Jilin Nickel acquired Daheishan Mining Corp in early 2002 and began the investment of Yu100 million (US\$12 million), buying the formerly state-run mining operation in China's north-eastern Jilin province. Despite its large reserves, Daheishan Molybdenum had run into difficulties in the past few years and was reorganised in June 2002. Out of it, Jilin Nickel Daheishan Ltd was established. Production was suspended until 2003 whilst the new owner made essential repairs.

Luoyang Luanchuan Molybdenum Group began an expansion of its mining and concentrating facilities in mid-2002, raising its output from 8,600 t/y of molybdenum concentrate to 10,000 t/y in the second half of the year. The group said it intends to use all of its increased output for its own Fe-Mo and molybdenum oxide plants. In 2001, the group had the capacity to produce 3,000 t/y of oxide and 8,000 t/y of Fe-Mo, most of it destined for US and South Korean markets.

A government-imposed one-month ban on all mining activity in China's Liaoning Province, following a small accident at the privately-owned Yangjiajiangzi mine in May 2003, exacerbated a serious shortage of moly concentrates in the country and was quickly jumped on by Fe-Mo exporters who were looking to secure higher export prices.

As European customers scrambled to find alternative sources of Fe-Mo to replace the Chinese supply, European converters found themselves relying on Chinese Mo oxide sources for conversion into Fe-Mo within the EU. A hitch developed, with some shipments rejected for exceeding permitted lead levels. European converters said they were able to use 55% Mo oxide material with up to 0.2% Pb, but that several shipments had exceeded that level (with some reported as high as 0.4% Pb) and had been refused.

There were other small disruptions during the year but they had a disproportionate effect on world markets. For example, Jinduicheng Molybdenum Mining Corp was reportedly informing its customers in September 2003 that it might not be able to deliver contracted amounts on schedule in the fourth quarter because of recent flooding in China. This was seized on at the time as a major market announcement but the net effect was actually quite modest.

Xuzhou Huanyu Special Alloy Co expanded upstream in late 2003 by acquiring the state-owned Fuchuan mine in Luanchuan city, situated in western Henan, which currently produces 200 t/mth of concentrate. Mining operations were halted as purchase negotiations commenced, adding to mid-year shortages of concentrates in China. Production resumed after the purchase was finalised. Mine production is expected to increase to 250 t/mth by next year. All raw materials feed from the Fuchuan mine will be transported by truck to Xuzhou Huangyu's smelter in Huludao, Liaoning Province, for further processing into molybdenum oxide and ferro-molybdenum. At its Huludao smelter, Xuzhou Huanyu is currently producing around 400 t/mth of ferro-molybdenum and 300 t/mth of moly oxide. Exports account for most of the company's sales, with its main customers located in Europe, Japan and South Korea.

An attempt to set an export price-fixing mechanism failed in December 2003 when Chinese moly producers, the China Chamber of Minerals, Metals & Chemicals Import & Export Co and others, met to reach agreement but failed to do so. The producers had called for a price-setting reference of moly oxide, Fe-Mo and molybdenum concentrate deliveries out of China, but there were reports that China's largest producer, JDC, and the smelters in the north of the country failed to agree the terms. Nonetheless, the government proceeded with an export certificate programme effective January 1, 2004, despite the lack of agreement on price fixing.

Although it appears that primary output of molybdenum in China rose by a modest 2.4% in 2003, domestic consumption continued to increase to over 14,000 t.

CIS

Supply from the CIS nations continued to increase in 2003, according to statistics from the US Geological Survey, with the increase mostly coming from Armenia.

Chelyabinsk Electrometallurgical Works in Russia restarted ferro-molybdenum production in 2002 after a two-year stoppage. The firm is toll-processing concentrates for Fe-Mo for export. The plant has a capacity to produce 20,000 t/y of ferro-molybdenum.

The Sorsk molybdenum plant in Russia declared force majeure after a fire in late November 2003, traders report. Sorsk produces around 6-7Mlb/y of molybdenum concentrates, of which it exports half to China and half to the rest of the world.

Uzmetal Technology based at Almalyk Mining and Metallurgical Complex in Uzbekistan, is a molybdenum joint venture between Israeli company Metek Metal Technology and Almalyk and Uzbek Heat Resistant Metals. It commenced molybdenum production in 2002. The US\$19 million project is reported to 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, Amalyk said it would make cost savings by keeping the processing of concentrates close to its existing operations.

Western Europe

In early 2003, Chile's Molybdenum acquired Belgian alloys producer Sadaci for €8.5 million from French group Eramet. The purchase was handled through Molybdenum's Dutch subsidiary Strategic Metals BV. Sadaci roasts molybdenum concentrates in Ghent, Belgium, to produce a variety of products: oxides, Fe-Mo and sodium molybdate (as well as ferro-vanadium and manganese alloys).

Molybdenum is now one of the major global producers, with operations in San Bernardo, south of Santiago, Chile (annual capacity of 68 Mlb) and in Cumpas in northern Mexico, known as Molybex (annual capacity of 22 Mlb of Mo oxide). The plan was to integrate Sadaci into Molybdenum's global operations.

Molybdenum's acquisition raises a question mark over the European merchant market for molybdenum as Sadaci has been largely used by traders as a tolling facility. Of the other three plants in Western Europe, only Eastlink Lanker's plant in the UK is 100% dedicated to tolling. Climax in the Netherlands has some capacity currently used for tolling but Treibacher in Austria is thought to use all its existing capacity for its own account.

Eastlink Ferro Alloys in Glossop, UK, formerly known as Ferro Alloys & Metals Ltd, was purchased by Russia's Eastlink Lanker in 2000. The company said it intended to switch some of its 7,000 t/y Fe-Mo capacity over to the production of ferro-vanadium, using vanadium pentoxide feed from its parent group's Tula plant. Fe-Mo production was intended to drop to 4,000-4,500 t/y.

Commet Holding of Hong Kong also plans to enter the molybdenum market, through its acquisition of Golden Ferro-Alloys and USK Ferro-Alloys, both in southern India. Although the major existing business is the production of 3,500 t/y of ferro-silicon, the company said it was planning to build a molybdenum conversion plant in southern India to produce around 2,400 t/y of Fe-Mo. Commet said it expects the plant to come into operation in the third quarter of 2003. The Mo oxide and concentrates will come from China.

Demand

In the past eight years, global molybdenum consumption has grown by approximately 2-3% per annum, and estimates for 2002 consumption generally fall in the range 129,000-132,000 t, well above new production in that year. The iron and steel industry accounts 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% 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 (IMOA) 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.

European demand has dropped slightly in recent years. Consumption in 2002 was approximately 42,650 t, according to Euroalliages, down from 44,010 t in 2001. Consumption by material was roughly equal with Fe-Mo consumption in Europe at 22,686 t and oxide demand at 19,964 past year.

Consumption by end-use

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 has 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 still the world's largest molybdenum-consuming region, accounting for around one-third of total demand in 2003. 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 20% of all molybdenum and Japan a little less than 15%.

China's consumption is now thought to be over 8.2% 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.

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.

The International Molybdenum Association (IMOA) estimates that the US construction industry uses approximately 6,000 t/y of 316-type stainless (which has a 2% Mo content) and the potential for that market is as high as 60,000 t/y.

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

ferro-molybdenum. 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 that 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 period 1996-2001 was the suggestion of large stocks of material in the market place. The growing proportion of supplies 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, 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. Further cuts in North American production in 2000-02, and some growth in demand, saw a steady drawdown 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.

It all changed in 2002. The price for molybdic oxide in drums started 2002 at about US\$2.60-2.65/lb in Europe and slightly higher in the North American market. The Fe-Mo price started the year at about US\$7.20/kg, with Chinese material fetching a lower price of perhaps a dollar less per kilogram. However, the trend line was already well established and, starting from a low for Mo oxide of US\$2.30-2.35/lb in November 2001, the price mounted steadily.

It was dubbed 'moly mania' and by June 2002 the spot market was peaking as traders talked of shortages. The market peaked with reports of Fe-Mo changing hands in the range of US\$17-20/kg duty paid. Oxide offers were said to be in the range of US\$6.50-8.00/lb in Europe.

Those much-talked-about benchmark prices – US\$20 for Western grades of Fe-Mo and US\$8/lb for Mo oxide – may never have been actually achieved in the June madness. What is clear is that most consumers stayed out of the market that month and the inter-merchant frenzy died away.

Meanwhile the spot markets retraced their price rises back down throughout the second half of 2002, and, by October, Fe-Mo spot prices had dropped back to around US\$10/kg, and oxide was changing hands at US\$4.20-4.40/lb.

By November 2002, spot oxide prices in Europe had dropped to US\$3.16-3.50/lb and FeMo was selling at under US\$7/kg. The sudden collapse of a lucrative spot market in Europe apparently prompted some Chinese suppliers to tighten up sales late in the year and the prices rallied again. Chinese Fe-Mo parcels were once again reported to be fetching US\$8.50-9.50/kg fob early in 2003.

In early 2003, the market seemed calmer than it had for most of 2002 but reports of a planned 4 Mlb/y cut at Los Pelambres in Chile and a 2 Mlb/y cutback at Kennecott's Utah operation helped to firm sentiment in the year.

Also, reports that China's Luoyang Luanchuan Molybdenum Group Co had embarked on a plan to expand molybdenum ore mining at its Luanchuan mine in the city of Luoyang, Henan Province, helped to calm market fears of a shortage. The Chinese company, owned by the Luoyang city government, is currently producing 8,600 t/y of moly concentrate and announced it was expecting to boost output to over 10,000 t/y via a series of improvements at its mining and concentrating facilities.

Free market drummed moly oxide prices started 2003 at roughly US\$3.50/lb Mo (in warehouse basis) up from below US\$3/lb in November 2002. Tenders for material early in the year saw prices relatively stable. The calm did not last long, however, and free-market prices began to climb throughout the first half of 2003

Speculative activity was building as traders withheld material from European markets in the second quarter, driving spot prices for oxide and ferro-molybdenum higher. At the same time, a stoppage at Codelco's Chuquicamata roaster, combined with stronger demand from downstream converters and end users, added to bullish merchant sentiment which sent drummed moly oxide jumping from around US\$4.10/lb in February to through the US\$5.50/lb Mo mark in May 2003. Beginning in February 2003, the US prices for canned moly oxide tracked the European prices but at a premium, and prices crossed the US\$5.50/lb barrier as early as March in some spot sales.

Chinese Fe-Mo spot sales prices lagged the market in the second quarter. European consumer spot sales were put at around US\$12.00-12.50/kg for duty-paid 65-70% Fe-Mo in Europe in April, and Chinese material was reported at around US\$10.00-US\$10.60/lb basis in warehouse Rotterdam. However, showing just how nervous the market was, a Chinese Government ban on all mining activity in China's Liaoning Province following a small accident at the Yangjiajiangzi mine near Huludao, drove Chinese ferro-molybdenum upwards again rapidly in May.

The move to place a one-month ban on all mining activity in Liaoning, rather than close the privately-owned Yangjiajiangzi mine alone, was behind the dramatic price increase to US\$11.40-11.60/kg fob for new spot deliveries immediately following the announcement. Traders bid the market up higher in the US and Europe on such small news stories all year.

Consolidation in prices during the summer did little to convince consumers that they were safe to return to the spot market and there was even merchant short-selling in the mid-summer lull in Europe following the restart of mining operations in Liaoning.

China was again the source of market rumours in the late summer/early autumn of 2003 as JDC said it would cut molybdenum oxide production by at least 300 t/mth for four months, starting in August. The company's raw materials department said that JDC's mining operations had been hampered by heavy rain and poorer ore grades. A 50-day maintenance shutdown at the

company's primary smelter also contributed to the cutback. A strong drive by China's government to improve mine-worker safety was also cited as a restraint on China's molybdenum concentrate output in mid-2003, adding to the general tightness.

The result was a second half of strong price rises in consumer markets, with prices in Europe in late August at approximately US\$6/lb for molybdenum oxide and US\$14-15/kg for Fe-Mo.

In September 2003, Montana Resources announced it was planning to restart its Continental Pit copper and molybdenum mine, which has a capacity of 7-10 Mlb molybdenum, but that this material would not be available until 2004 so it did little to calm the market.

Strong fourth quarter demand pushed markets higher, with a dramatic rise in US spot prices at year-end well beyond the US\$7/lb Mo for canned oxide, and slightly less in Europe. Chinese offers at year-end for Fe-Mo were said to be US\$16.40-16.50/kg fob, with Western material changing hands in the spot market at Christmas at US\$17/kg.

Outlook

After years of ample supplies, it is now clear that the molybdenum market entered a period of tightness in 2002 and edged into shortage, both real and contrived, in some periods of 2003.

It is in the nature of balanced markets to be sensitive, sometimes excessively so, to market reports and rumours of any fresh dislocation of supply or demand. Such market reports, largely centred on activities in China, had a great deal to do with the price peaks of 2002 and 2003 when reports of supply dislocations in China prompted merchants and traders to buy up spot supplies and add to the tightness. It was this amplification of market trend that saw spot moly oxide prices range from as low as US\$3/lb to over US\$7 over the course of 2003.

With such prices available to producers, the temptation must be for some to increase their mothballed output to take advantage of the bull market. It would appear that in such an environment the producers with underutilised production capacity in the US and to a lesser degree in Mexico might be reviewing their plans. Cutbacks by those producers in the period 1998-2002 were instrumental in bringing supply back into line with demand, and if those producers were to 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 quite swiftly

The other significant factor in the supply/demand balance and by now fully acknowledged, is the changing levels of Chinese molybdenum exports. Production of molybdenum in China increased only marginally to about 30,000 t in 2003 whereas domestic consumption steadily increased to approximately half that amount, leaving less for export despite the production increases. China's special steel production was estimated to have risen by

almost 8% last year, to over 15 Mt and accounted for over 10,500 t of molybdenum consumption nationally.

The higher levels of domestic consumption meant lower Chinese exports in 2003 of approximately 14,000 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 in 2002 but Fe-Mo exports may have fallen in 2003 as the trend to higher margin oxide sales in the second half of the year prompted some producers to alter their production plans.

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 (even temporarily as in the second quarter of 2003) there is already a significant effect on free-market price levels.

The final factor on the supply side is recycling. Recovery of molybdenum units from spent catalysts is increasing because of environmental legislation that prevents the disposal of such catalysts. Catalyst recycling is estimated to be growing at 5% annually in Europe and North America, and by as much as 8% annually in the Asia/Pacific region. This is now equivalent to approximately 3,000 t/y of molybdenum.

Roskill Information Services says that in recent years global molybdenum demand has been growing at an annual rate of 2-4%, and is estimated to total around 131,000 t in 2002. Demand from the iron and steel industry, which accounts for around 75% of consumption, is strong and stainless steel production grew by 6% annually through the 1990s and annual growth is expected to continue at 4-5%.

Roskill says that molybdenum output in the near future largely depends on the timing of recovery in the copper market. If copper output increases in 2004, as some producers are already planning, the levels of molybdenum produced as a by-product will rise too.

In the five years following 2000, world molybdenum demand is predicted to grow by 2-3% each year. The expansion in demand is not likely to be evenly spread, however, with European growth estimated at 5% annually, Asian (including China) at more than 8% and the US and Japan demand at 2-2.5%.

About one-third of all molybdenum is used for stainless steels, another third for low-alloy speciality steels used in construction and oil and gas applications, and the remainder in non-ferrous, high-temperature uses, such as aerospace and lighting applications, catalysts for the petrochemical industry and several other downstream operations that need high-purity molybdenum.

World demand for stainless steel is approaching 17 Mt/y, and for flat products is close to 13 Mt/y. Stainless steel has enjoyed 5% annual average demand growth over the past 20 years, ahead of other metals, and a forecast for annual growth through 2001-05 indicates that stainless could average over 5% per annum.

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 Molybdenumquick. 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.

Sandvik Materials Technology has developed a duplex stainless steel bar with greatly enhanced machinability. Called Sanmac SAF 2205 it gives "40% better productivity compared with similar alloys produced by competitors", it said. The company explained that the steel is weldable and machinable.

In duplex steels, austenite and ferrite grains are evenly distributed throughout the metal, combining the strength of ferrite material with the low risk of cracking of austenite. Not widely available until the 1980s, duplex steels contain lower levels of nickel but higher amounts of chrome and molybdenum than standard austenitic stainless steels.

In August 2002, Alcoa Inc, announced that it had developed three new aluminium alloys for use in the Airbus A380 super-jumbo airliner scheduled to debut in early 2006. The Alcoa alloys combine aluminium with metals such as cobalt, hafnium, molybdenum and titanium.

Table/graphs following pages.

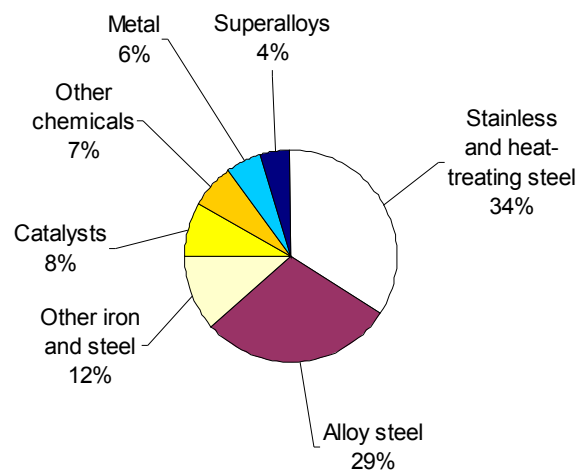
Table 1
Molybdenum Production ('000 t)

	2000	2002	2003e
US	41	32.6	34.1
Chile	29.1	29.5	31.4
China	28.9	29.3	30.0
Peru	7.2	9.5	9.5
CIS ¹	6.3	7.4	7.9
Canada	6.8	7.5	7.5
Mexico	6.9	3.4	3.5
Others ²	2.94	3.3	3.2
Total	129	123.0	127.0

Source: USGS Mineral Commodity Summaries. Notes: Production from North Korea, Romania, Turkey and the former Yugoslavia is not included.

¹ Armenia, Kazakhstan, Kyrgyzstan, Russia and Uzbekistan. ² Chiefly Mongolia and Iran. e estimate.

Consumption pie chart



Source: Industry estimates.

Notes: Other iron and steel includes tool steel, high-speed steel, cast iron and welding rods. Other chemicals include lubricants, pigments, water treatment, polymers and airbags.

