

BISMUTH

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January 2002 started the second year of low to steady demand for most major and minor metals worldwide. Even though bismuth is a by-product, and production of major metals was lower, bismuth's availability, particularly from China remained good. This resulted in bismuth prices continuing to fall to lows not seen for years (Bismuth began the year at US\$3.20/lb and dropped to levels below US\$2.50/lb from August onwards).

Demand for bismuth for use in lead-free solders in Japan grew strongly in 2002, but the tonnages involved as a percentage of world production (approximately 6,000-7,000 t/y) were not enough to stop prices falling.

Occurrence

China still remains the world's leading miner, refiner and exporter of bismuth. Unlike sources from the West (by-products from lead and copper concentrates), China's bismuth output is from polymetallic ores in which tungsten is the primary valuable constituent. It is also produced from tin and zinc sources. China also has one of the world's few primary bismuth mines. Korea, Japan and Australia are other Pacific region producers.

The principal Western mine sources of bismuth are located in South and Central America and parts of Africa. Mexico and Peru continue to be the largest Western producers. The Tosna mine in Bolivia remains mothballed, and stable higher prices are needed for the project to be considered. Significant quantities of bismuth come from Kazakhstan in the form of bismuth lead bullion.

Extraction

Bismuth is occasionally found in elemental form, but more usually as an oxide or carbonate. It is essentially produced as a by-product from processing lead or copper ores. After smelting of lead ore in the blast furnace, lead bullion will typically contain 10% bismuth. The Betts process (electro-refining) or the Kroll-Betterton process (slag formation using calcium and magnesium) concentrates the bismuth. The Betts process is used in Canada, South Korea and Japan. The Kroll-Betterton process is used in Europe, Mexico, Canada and Australia.

When copper ores are smelted, most of the bismuth is partially volatilised in the flue dusts and, to a lesser extent, in the matte and slag.

In China, bismuth is mainly associated with tungsten ore. After separation by gravity, magnetic or differential flotation techniques are used and the concentrates are smelted in reverberatory furnaces to produce crude bismuth for refining. The Chinese also convert concentrates from Russia, South America, South Africa and Kazakhstan.

In 1999, the US Geological Survey (USGS) revised its estimate of reserves (bismuth content of lead and copper deposits) and the reserve base (economic reserves plus marginal and sub-economic reserves). Its estimates are shown in Table 1.

Production

Annual world production of bismuth is estimated at 6,000-7,000 t. The single biggest producing country is still China, where output is somewhere in the range of 2500-3,000 t/y. The Chinese domestic market, reported to be growing each year, is supplied almost entirely by Chinese production, and is in the range of 1,000-1,500 t/y.

Hunan Shizhuyuan Non Ferrous Metals in Hunan Province is the largest producer and has ore reserves sufficient for between 300 and 400 years' supply. A few Chinese producers closed their operations last year but as there are over 15 producers these closures made very little impact on output. Moreover, three producers have successfully completed expansion plans. Falling prices had little or no effect on output.

In Latin America, production at Doe Run's La Oroya smelter in the Peruvian Andes continued at average levels. Very little additional material was available, mainly owing to the continuing low price of lead. Industrias Peñoles in Mexico maintained production at 1,000-1,200 t.

Elsewhere, Japanese production was reported to have been lower, although consumption was supported by excess Chinese stocks. In Europe, Sidech of Belgium produced its normal levels of refined metal from imported lead bullion in line with European and US sales demand. Mining and Chemical Products of the UK refined and processed bismuth-containing raw materials and industrial scrap to meet its customers' demands for metallic products and chemicals worldwide.

Consumption

As reliable information on the growing domestic demand in China is difficult to acquire, the comments here are based on the experience in the US. (Table 2).

Surprisingly, US bismuth consumption last year was maintained at a similar level to 2001, the world economic slowdown, apparently, having had little effect on demand. Over the years, there has been a rising trend in bismuth consumption in the US as a lead replacement.

With Japan's Electronics Industries Association on track to see all electronics production completely lead-free by 2004, and the constant, steady use of bismuth in chemicals, pigments and catalysts, the outlook for the metal remains very positive.

Prices/Outlook

At the time of writing (May 2003), bismuth prices have recovered from the US\$2.50/lb level, and a range between US\$2.60 and 2.70/lb is realistic.

Prices during 2002 were very low (US\$2.50-2.60/lb) and difficult for producers. However, business for customers of bismuth products was also competitive. As the world economy improves, prices should rise steadily. As a lead replacement, bismuth will work, as long as prices fit into the equation.

For 2003, it is unlikely that the traditional price range of US\$3.50-4.00/lb will be reached; Chinese expansion plans for the past three years have been realised and although world demand for bismuth is growing it is not at a rate that matches the increases in Chinese production. A new top price range of US\$3.00-3.30/lb is very possible.

The market for bismuth has never been so large and the applications more broadly based. Hence, growth should be sustained. 2003 should prove a better year for all metals, albeit not as high as the late 1990s, and bismuth consumption could steady at levels last seen prior to the dot.com bubble years.

Table 1

Country	Reserves (t)	Reserves Base (t)
Australia	18,000	27,000
Bolivia	10,000	20,000
Canada	5,000	30,000
China	200,000	470,000
Japan	9,000	18,000
Kazakhstan	5,000	10,000
Mexico	10,000	20,000
Peru	11,000	42,000
US	9,000	14,000
Others	15,000	35,000
Total (rounded)	290,000	690,000

Source: USGS

Table 2

US Consumption (t)

	1996	1997	1998	1999	2000	2001	2002
Fusible Alloys	401	593	741	823	889	997	985
Metallurgical Activities	231	252	335	340	346	373	383
Chemicals	855	655	884	855	861	829	814
Others	33	30	32	31	34	45	45
Total	1,520	1,530	1,992	2,049	2,130	2,240	2,230