

BISMUTH

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In January 2001, demand for bismuth, like most other metals, started to decline, first in the US, then spreading into Europe during the second quarter. Bismuth prices began the year at US\$3.80/lb and ended at US\$3.20/lb. The decline has continued into 2002, falling below US\$3.00/lb.

Demand in some applications returned to levels seen in 2000 during the third quarter, but large stocks both in China and in Western countries resulted in the continuing weakening of the price.

Occurrence and Extraction

The principal Western mine sources of bismuth are located in South and Central America. Peru and Mexico have continued to be important production sources of bismuth in recent decades, but no meaningful quantities have been mined or smelted in Bolivia during the past 25 years. The Bolivians have been sidelined because of the low bismuth price, in historical terms, during this period. Notwithstanding this, Bolivia holds important reserves around the Potosi-La Paz axis, centred on Oruro.

Bismuth is occasionally found in elemental form, but more usually as an oxide or carbonate. It is essentially produced as a by-product of the processing of lead and copper ores. A crude bullion containing typically 10% bismuth is generated during the blast-furnace smelting of lead ores. The bismuth is concentrated by the Betts process (electro-refining), or the Kroll-Betterton process (slag-formation using calcium and magnesium). When copper ores are smelted, most of the bismuth reports in the flue dusts and, to a lesser extent, in the matte and slag. Further concentration is achieved by chlorination, leaching and cementation. The crude bullion from all these sources is traditionally fire-refined

under caustic soda and any precious metal content is removed by the Parkes process.

China is at present the world's leading miner, refiner and exporter of bismuth. Unlike the West, more than half of its output is from polymetallic ores in which tungsten is the primary valuable constituent. It is also produced from lead, tin and zinc sources. After separation by gravity, magnetic or differential flotation techniques, the concentrates are smelted in reverberatory furnaces to produce a crude bismuth for refining.

In 1999, the US Geological Survey (USGS) revised its estimate of Reserves (bismuth content of lead and copper deposits) and Reserve Base (economic reserves plus marginal and sub-economic reserves).

World Bismuth Reserves (t)

Country	Reserves	Reserves Base
US	9,000	14,000
Australia	18,000	27,000
Bolivia	10,000	20,000
Canada	5,000	30,000
China	20,000	40,000
Japan	9,000	18,000
Kazakhstan	5,000	10,000
Mexico	10,000	20,000
Peru	11,000	42,000
Others	15,000	35,000
TOTAL	112,000	256,000

Production

China is now undoubtedly the largest producer of bismuth in the world. Actual production from China is still very difficult to quantify, but is now in the region of 2,500 t/y - over one third of the world's required consumption.

Several producers exist in China, but the industry is still fragmented. The largest producer, Hunan Shizhuyuan Non Ferrous Metals in Hunan Province, is state-owned and has the world's largest reserves.

A few Chinese companies had huge plans for expansion and new plants in 2001 but, as exports to the US and Europe diminished by the week, nearly all their plans were put on hold.

Production at Doe Run's La Oroya smelter in the Peruvian Andes continued as normal. Perhaps volumes were reduced slightly due to changes in the mix of lead and copper feed materials and lower concentrations of bismuth in the ores. Lead and copper also did not escape the economic situation in 2001. Bismuth output for the year averaged out at the traditional 700-800 t.

US Consumption (t)

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

Japan has also had its share of problems. Output was between 400-500 t, slightly down on previous years. The picture in Europe, where Sidech of Belgium produced significant quantities of refined metal from imported lead bullion, was adjusted in line with European

demand. Mining and Chemical Products of the UK processed bismuth containing raw materials and industrial scraps.

Finally, in Mexico, Industrias Penoles maintained levels of 1,100-1,200 t.

Because very few production cutbacks occurred across the world to reflect slower demand and consumption, stocks, particularly in China and 'in warehouse' were readily available.

Consumption

We rely heavily, as ever, on US published data but the applications for bismuth are increasing year by year, mainly as a lead replacement, and the above applications perhaps need expanding in future.

The table is surprising because the US economy moved towards recession in January 2001, but the USGS data indicate that consumption was at a record level. fusible alloys being the main area for continued strong growth.

The future trend for bismuth remains unchanged. Lead replacement continues to be an issue, whether for scientific reasons or because certain countries are banning it completely. Chemical applications in pharmaceuticals, cosmetics, catalysts, pigments and electronics continued to hold up in 2001.

Prices

Prices at the time of writing (June 2, 2002), are at levels of US\$2.75/lb and below.

In 2001, the price fell from US\$3.80/lb down to US\$3.20/lb and the average for the year was US\$3.50/lb. Even with a difficult year, bismuth prices showed remarkable stability for the first and second quarters, but finished averaging out at the lower range of its traditional band of US\$3.50-4.00/lb.

For 2002, and perhaps for part of 2003, prices will not even approach such a band, and it seems more likely that a new level

between US\$3.00 and 3.50/lb will be established, particularly if Chinese expansion plans continue.

Outlook

The market for bismuth has never been so large and the applications never more broadly-based. Hence, the growth prospects are excellent. What is needed is consumer

confidence in order to increase all metal applications. With China now part of the World trade organisation (WTO), and numerous metal companies globally restructuring, the outlook for 2002 is starting to improve and it is anticipated that the bismuth price will also improve as demand reappears. This should help to provide a balanced market in line with new Far East production.