

ZINC

By Jozef Plachy

Domestic survey data and tables were prepared by Samir Hakim, statistical assistant, and the world production table was prepared by Regina R. Coleman, international data coordinator.

In 2002, domestic zinc mine production, expressed in zinc content of ore, decreased by about 7% compared with 2001, when seven mines ceased production (table 1). Based on recoverable content of concentrate and annual average U.S. price, the value of zinc mine production was estimated to be about \$731 million, about 6% less than in 2001. By the end of 2002, only 11 mines in 5 States were operating in the United States. Alaska remained the leading zinc mining State, followed by Tennessee, Missouri, Montana, and Idaho, in descending order. In 2002, as in every year since the opening of Alaska's Red Dog Mine in 1989, U.S. mine production greatly exceeded smelter capacity (table 6), necessitating exports of concentrate and imports of refined zinc metal. Most of the concentrate, supplied entirely by the Red Dog Mine, was exported to Japan, followed by Canada, Spain, Belgium, and the Republic of Korea (table 14). Zinc metal production in the United States, which was provided by 2 primary and 12 large- and medium-sized smelters, declined by about 5% in 2002 (tables 4, 6). Nearly one-half of zinc metal imports was from Canada, followed by Mexico and Kazakhstan.

Apparent domestic consumption of refined zinc metal in 2002 increased slightly to 1.2 million metric tons (Mt). About one-half of the metal consumed in the United States was used for galvanizing, followed by use in zinc-based alloys and in brass and bronze (table 11). Zinc compounds and dust were used primarily by the agricultural, chemical, paint, and rubber industries.

The average U.S. producer price for refined zinc in 2002, which is based on the London Metal Exchange (LME) daily cash price plus a premium, declined by 12% to \$0.78 per kilogram (35.31 cents per pound).

World production of zinc concentrate in 2002 was marked by declining output owing to mine closures and delayed openings and reopenings of zinc mines. Zinc concentrate production by 42 countries decreased by more than 6%, to 8.4 Mt. It was the first decline since 1993. The largest producers, in decreasing order of magnitude, were China, Australia, Peru, Canada, and the United States (table 17). World smelter production declined by nearly 5% to 8.9 Mt. The largest producers of zinc metal, in descending order, were China, Canada, Japan, Australia, and the Republic of Korea (table 18).

Legislation and Government Programs

In September, the U.S. Environmental Protection Agency (EPA) issued its decision on mining-related heavy-metal pollution in the Spokane River Basin in Washington State and the Coeur d'Alene River Basin in Idaho. Responsibility for at least part of a planned \$359 million cleanup of tailings-contaminated soil was assumed by Hecla Mining Co. and

Asarco Inc. (a subsidiary of Grupo Mexico S.A. de C.V.), both of which operated lead and zinc mines in the Coeur d'Alene District, near the cities of Wallace and Kellogg. Together with other smaller companies, the two firms were sued by the EPA for \$1 billion in environmental damages. The EPA also was seeking \$12 million to \$20 million per year from the U.S. Congress for the cleanup (Platts Metals Week, 2002j).

The U.S. Environmental Protection Agency has issued its final regulation under the Resource Conservation and Recovery Act (RCRA) that applies to recycling of hazardous secondary materials to make zinc fertilizer. The new rule removed zinc fertilizers (made of electric arc furnace dust) from land disposal restrictions and treatment standards. It also established, in the RCRA definition of solid waste, an exemption for hazardous secondary materials that are legitimately recycled to make zinc micronutrient fertilizers. The effective date for implementation of this new rule was January 24, 2003 (ILZRO Environmental Update, 2002).

Production

Mine Production.—Operations at the Montana Tunnels Mine in Jefferson County, MT, were suspended in June in order to increase the size of the pit to access new mineralization. In anticipation of increased production from these new areas, and ensuing increase in waste, Montana Tunnels Mining Inc. (a subsidiary of Apollo Gold Corp.) sought permission to increase the height to which it can fill the tailings pond (CRU International Ltd., 2002b). After removing about 15 Mt of overburden and nearing the deposit, the company found traces of precious metals in the removed material. The unexpected revenue realized from the milling of the remaining overburden, which was not included in the original estimate of ore reserve, will help to offset the development cost until commercial production starts in 2003 (Apollo Gold Corp., 2002§¹).

OntZinc Corp. of Canada signed a letter of intent to purchase the Balmat Mine in New York from Zinc Corporation of America (ZCA) (a subsidiary of Horsehead Industries Inc.) for \$20 million. The purchase price will be paid out from profits generated by the operation after allowing for reasonable capital and exploration expenditures. The purchase is contingent upon receiving all the required approvals by State and local governments as well as other regulatory agencies. The sale also has to be approved by the U.S. Bankruptcy Court for the Southern District of New York, where Horsehead filed for bankruptcy protection. According to the agreement, OntZinc will have no liability for past operations in the area, and ZCA

¹References that include a section mark (§) are found in the Internet References Cited section.

will be responsible for all employee benefits and severance pay made necessary by placing the mine on care-and-maintenance status in May 2001. The Balmat Mine is in St. Lawrence County, NY, about 40 kilometers (km) south of the Canadian border. During its operation, from 1930 to 2001, the mine produced 33 Mt of ore with a mill head grade of 8.7% zinc. Recoverable reserves are estimated to be 2 Mt grading 11.9% zinc, with additional resources within the immediate vicinity amounting to 3 Mt grading 12.9% zinc (OntZinc Corp., 2002).

Pasminco Zinc Corp. (a subsidiary of Pasminco Ltd. of Australia) has decided to close its Clinch Valley and Gordonsville zinc mines in Tennessee as soon as these operations become unprofitable in the next few years. The Clinch Valley Mine, near Thorn Hill, Grainger County, is a small underground zinc mine producing about 350,000 metric tons per year (t/yr) of ore with a zinc content of about 3.2%. The ore is milled onsite, resulting in about 11,000 t/yr of zinc in concentrate that is processed at Pasminco's Clarksville smelter. The mine may remain open for up to 2 years or close immediately, depending on technical changes and concessions by the workers union. The Gordonsville Mine consists of three mines sharing one shaft—the Cumberland, Elmwood, and Gordonsville Mines. Currently, the Horseshoe Bend mineralization is being developed and will be accessible from the Cumberland Mine (CRU International Ltd., 2002a).

Smelter Production.—Big River Zinc Corp. (a subsidiary of Korea Zinc Co. Ltd.) closed its zinc refinery in Sauget, IL, for 3 months, starting in mid-June. The main objective of the closure was to rebuild the fluidized bed roasters and the acid scrubbing section. Related projects included replacement of a small wet ball mill with a larger dry mill, improvement of the leaching circuit, mechanization of cathode stripping, overhaul of the transformer, and installation of additional equipment to increase production of powdered zinc and to increase zinc recovery from furnace skimmings (Platts Metals Week, 2002b). Additional factors contributing to the closure were low zinc prices and the loss of domestic sources of concentrate. The shortfall in domestic supply of zinc concentrate was caused by closures of the Coy, Immel, and Young Mines in Tennessee by Grupo Mexico. The lost concentrate had been largely replaced with a more expensive imported concentrate, mostly from Peru, which has the needed low-iron content. This is important for the refinery because there are no treatment facilities for the leach residues (Platts Metals Week, 2002d). After the reopening on September 15, the refinery retained its former capacity (92,000 t/yr) but achieved lower labor and potentially lower maintenance costs (Platts Metals Week, 2002c).

Horsehead became the latest casualty of low zinc prices. The parent company of ZCA, the largest zinc producer in the United States, filed for Chapter 11 Federal Bankruptcy Code protection. Horsehead is based in New York and has electric arc furnace flue dust processing plants in Pennsylvania, Tennessee, and Texas. ZCA operates the pyrometallurgical zinc smelter in Monaca, PA, which has used concentrate, flue dust, and zinc scrap from its Pierrepont and Balmat Mines in New York. Shortly after August 2001—when Pierrepont was closed, Balmat was put on care-and-maintenance, and imported concentrate proved to be too expensive—ZCA switched to secondary production (Metal Bulletin, 2002j). For bankruptcy

protection, Horsehead claimed \$215 million in assets and \$231 million in liabilities. The largest secured creditor was Viacom Inc., with a claim for \$76 million secured by property. State Street Bank and Trust Co. was its largest unsecured creditor, with \$11 million, followed by the United Steelworkers Union with a claim of \$10 million in retiree benefits. Other unsecured debts included much smaller amounts owed to Glencore Trading AG (\$826,000) and Pechiney Group (\$304,000) (Platts Metals Week, 2002e).

Consumption

World zinc consumption gathered strength towards the end of 2002 and for the entire year it increased by about 3% compared with 2001, a year when global consumption declined after 7 years of consecutive increases. Despite its own declining consumption, the United States, with a 13% share of world consumption, remained the second largest consumer of zinc metal after China, where consumption increased by 10% in 2002 (International Lead and Zinc Study Group, 2003b). U.S. zinc consumption in the second half of 2002 benefited from sale incentives offered by car manufacturers, which are major zinc consumers; but by yearend, consumption slowed down as the car market became saturated. Owing to low interest rates, only the residential construction sector remained a steady consumer of zinc for galvanized steel. Despite its declining share of world consumption, the U.S. economy still plays an important role in the world zinc markets, mainly because many countries depend on exports of zinc and zinc-containing products to the United States.

Prices

London, United Kingdom-based Bloomsbury Mineral Economics Ltd. (BME) developed a new pricing model for primary nonferrous metals. BME maintained that changes in base-metal prices have three types of price drivers—primary, secondary, and tertiary. The primary price-drivers are changes in demand and supply curves. Of these, the demand curve is usually more volatile and changes rapidly with the cycle of global industrial production. It is also usually the initiator of the metal price cycle, whereas supply responds to changes in price. Price and supply both oscillate around equilibrium levels, initiating a cycle of stock changes. These stock changes are the secondary drivers of price. The relative strength or weakness of the U.S. dollar to other currencies is the tertiary price driver (Mining Journal, 2002b).

No pricing model, of course, can rescue the zinc industry from its current doldrums. From being one of the top performers in the late 1970s, zinc has now slipped to the bottom, in comparison with other base metals. Assuming a full reinvestment of dividends, \$100 invested in copper shares in 1989 would have been worth about \$250 at the end of 2002 according to one report; comparable figures for zinc shares would be \$20. The zinc industry has been suffering from depressed prices as a result of continued oversupply. Although there are some positive signs for the industry as a whole (such as few smelter closures, or at least capacity reductions and consolidation in the comparatively fragmented industry),

overcoming the disconnect between mining and smelting will be more difficult. Among 25 major companies, only 10 produced more than 100,000 t/yr of zinc in concentrate and zinc metal. Even fewer large integrated producers had a close balance between their mining and metal output. Consequently, the link between prices and mine output is far from direct. On average, only about one-half of the costs faced by mine owners reportedly are under their direct control. The other one-half is made up of payments to smelters on a long-term basis and transportation costs. Assured of treatment charges, smelters have no interest in reducing output when the prices decline. By the time mining companies react to low prices, there is a built-up concentrate surplus. Mine production cutbacks initiated at the end of 2001 and continued in the first half of 2002 reportedly were caused by price declines that began about 2 years earlier (Deller, 2003).

World Review

According to the International Lead and Zinc Study Group, the combination of temporary and permanent mine closures during the second half of 2001 resulted in a 5% decrease in mine output in 2002 compared with 2001. Of the major producing countries, the largest decrease in output was posted by Australia, followed by China and Canada. Owing to mostly temporary production cuts, the world output of zinc metal decreased by about 5% in 2002. Despite the decline, world production of zinc exceeded consumption by 414,000 metric tons (t) in 2002, following a 330,000 t oversupply in 2001 (International Lead and Zinc Study Group, 2003a).

As a result of low zinc prices, about 40% of the world's zinc is currently being produced at a loss, forcing some mining companies to close inefficient operations. The closures seem to have tipped the concentrates market into deficit, reversing an earlier forecast of a concentrate surplus (Mining Journal, 2002i). The growing disparity between concentrate output and smelter capacity resulted in a concentrate deficit of about 430,000 t of contained zinc in 2002.

Australia.—It appears that Pasmaenco Mining Ltd. of Australia will emerge from administration (similar to Chapter 11 bankruptcy protection in the United States) as a streamlined mining company after a committee representing the company's creditors endorsed a proposal to restructure Pasmaenco's debt burden. Since September 2001, Pasmaenco has been operating under administrators, appointed when the company's debt reached \$1.6 billion. According to the so-called "equity and float," approved in August 2002, Pasmaenco will exchange its debt for shares in the restructured company while keeping its flagship Century zinc mine in Queensland. This will result in the creditors owning about 95% of the company—a share that will subsequently be reduced by about one-half through a public offering of some of the shares held by the creditors. A significant amount of restructuring has already taken place in terms of cost reduction, staffing, and efficiency (Platts Metals Week, 2002i). In addition to the Century Mine, which is the company's foundation for recovery, Pasmaenco will retain its Roseberry Mine, the 215,000-t/yr Hobart and the 40,000-t/yr Port Pirie smelters (all in Australia), and the 215,000-t/yr Budel smelter in the Netherlands. Pasmaenco's Elura Mine and Cockle

Creek smelter, both in Australia, and all its operations in the United States will remain on sale (Platts Metals Week, 2002h).

Even before the equity and float restructure was approved, Pasmaenco had completed the sale of its Broken Hill lead-zinc-silver mine in western New South Wales to Perilya Ltd. for \$51 million. In order to share the financial burden, Perilya merged with Ranger Minerals Ltd. of Australia. An audit, completed prior to the purchase, identified resources of 23.4 Mt grading 9.8% zinc, 5.6% lead, and 56 grams per metric ton (g/t) silver (Mining Journal, 2002d). After the purchase, Perilya closed the mine for a month of maintenance and gradually returned to full production afterward. Output of zinc in concentrate at Broken Hill in 2002 was 112,200 t compared with 179,000 t in 2001 (Metal Bulletin, 2002g).

Pasmaenco has been negotiating the sale of its Elura zinc-lead-silver mine 40 km NW of Cobar and ship-loading facilities at Newcastle, both in New South Wales, to Consolidated Broken Hill (CBH) Ltd. for \$2.2 million. The agreement will probably require Pasmaenco to continue processing Elura's zinc concentrate at one of its three Australian smelters. The exclusive period for due diligence, negotiation, and completion of documentation for the sale of Elura ended in early 2003. Elura was producing at a rate of 1.1 million metric tons per year (Mt/yr) of ore and produced about 73,000 t/yr zinc in concentrate, 42,000 t/yr lead in concentrate, and about 27 t/yr silver in concentrate. The reserves in 2002 amounted to 4.6 Mt grading 8.8% zinc, 5% lead, and 52 g/t silver (Platts Metals Week, 2002a).

Kagara Zinc Ltd. of Australia continued the development of its Mount Garnet zinc mine near Cairns in northern Queensland with completion expected in 2003. After production begins, it will take another 3 months to achieve an initial design capacity of 80,000 t/yr of zinc in concentrate. The expected mine life is 11 years, with production initially coming from the Mount Garnet open pit, and by mid-2003, from Surveyor deposits 120 km south of Mount Garnet. Future deposits to be exploited include underground Mount Garnet, King Vol, and Dry River South. The initial rate of production will be 80,000 t/yr, which will increase to 150,000 t/yr of concentrate during the next 5 years. Concentrate will be trucked 500 km to Korea Zinc Co. Ltd.'s smelter in Townsville (Metal Bulletin, 2002c). The latest resource estimate for King Vol deposit stood at 1.15 Mt grading 18.5% zinc, 1.1% copper, 1% lead, and 48 g/t silver in the indicated and inferred categories (Mining Journal, 2002a). CBH, an unsuccessful bidder for the Pasmaenco's Broken Hill assets, is hoping to work with Perilya toward an integrated development of the Broken Hill area where it owns a mining lease (Mining Journal, 2002e).

The next target of Xstrata plc of Switzerland is one of the largest Australian diversified mining companies—MIM Holdings Ltd. MIM confirmed that it was in discussion with Xstrata, but it stressed that these discussions were at an early stage and that no agreement had yet been reached. MIM produced 319,200 t of zinc in concentrate from its Mount Isa Mine (Queensland) and the 75%-owned McArthur River Mine (Northern Territory), and 184,200 t of zinc metal from its Avonmouth smelter (United Kingdom) and the recently sold Duisburg smelter (Germany) in the fiscal year ending on June 30, 2002 (Mining Journal, 2002h).

In anticipation of the Avonmouth smelter closure and the ensuing loss of a possible third consumer of its bulk concentrate (the Noyelles-Godault smelter in France has decided to convert to zinc recycling, and the Duisburg smelter is also contemplating a similar switch), MIM has been developing a new process to recover zinc from the McArthur River concentrates. The new (Albion) process would treat the lead-zinc concentrate that currently can only be refined at plants employing the increasingly rare imperial smelting furnace (ISF) extraction process. The Albion process first involves the ultrafine grinding of an ore or concentrate to increase the surface area of the particles making them more reactive. Grinding is followed by oxidative leaching in agitator tanks that remove lead from the concentrate. The rate of the reaction and the temperature, which is maintained at about 70° C, is controlled by the amount of oxygen blown into tanks. Following the leaching, the slurry is neutralized to precipitate impurities. The neutralized slurry is then thickened and filtered. The filtrate is processed via solvent extraction and electrowinning to recover zinc and separate copper sulfate and cadmium. In the pilot plant that has been in operation since May 2002, zinc recovery averaged around 96%. In 2003, MIM will begin a full commercial-scale feasibility study, which will be completed by yearend (CRU International Ltd., 2003b).

Brazil.—The Brazilian industrial conglomerate Votorantim Inc. has acquired a 97% interest in the country's second largest zinc producer from Paranapanema SA for \$107 million. Even before the acquisition of Cia Paraibuna de Metais, Votorantim already owned Brazil's largest zinc producer—Companhia Mineira de Metais (CMM)—and the new acquisition will make it the country's sole producer of zinc. Paraibuna's Juiz de Fora smelter has a capacity of 95,000 t/yr of refined zinc and, after a period of electricity rationing in Brazil that forced the company to reduce output to 47,000 t/yr, it returned to full production at the end of 2001. The newly acquired smelter and CMM's own 160,000-t/yr-capacity Tres Marias smelter are in the State of Minas Gerais in southern Brazil (Mining Journal, 2002c).

Canada.—After 20 years of mining, Teck Cominco Ltd. closed its underground Polaris zinc mine on Little Cornwallis Island, Northwest Territories, after exhausting its ore reserves. Lost production will be replaced by production from the Pend Oreille Mine, WA, where development is proceeding according to schedule and should be completed by 2004 (Teck Cominco Ltd., 2002).

At about the same time as Cominco closed its mine, Breakwater Resources Ltd. also closed its Nanisivik Mine on Baffin Island, Northwest Territories. At the beginning of 2002, when the mine was mining the high-grade pillars and had a new dense media separation plant that separated gangue from ore-bearing sulfide ore, it appeared that the output in 2002 would be higher than during the previous year. However, rapidly diminishing reserves and declining head grades coupled with low zinc prices compelled Nanisivik Mines Ltd. (a subsidiary of Breakwater) to close the unprofitable mine (CRU International Ltd., 2003b§).

Noranda Inc. has decided to sell its Canadian Electrolytic Zinc (CEZinc) refinery in Valleyfield, Quebec, to a newly created income fund, in which Noranda will retain 49% interest. The remaining 51% interest in the fund, which was created to buy

the refinery, will be sold to investors. Noranda will continue to manage the plant and will have a 15-year supply and processing agreement supplying 550,000 t/yr of zinc concentrates. At 270,000 t/yr, CEZinc is one of the largest zinc processing facilities in the world; Noranda estimated that it supplied about 15% of zinc demand in the United States and about 35% of demand in Canada (Metal Bulletin, 2002f).

Because of low zinc prices, Noranda decided to postpone development of its Perseverance zinc deposit, near Matagami, northern Quebec. The Perseverance deposit, which consists of three high grade zones—Perseverance, Equinos, and Perseverance West—has a total resource estimated to be 5.1 Mt grading 15.8% zinc, 1.2% copper, 29 g/t silver, and 0.4 g/t gold (Platts Metals Week, 2002g).

Boliden Ltd. resumed production at its Myra Falls Mine in March 2002 after reaching new agreements with its unions concerning a 17% workforce reduction and adjustments to wages and salaries, yielding a 20% reduction in costs. The rate of contained zinc production was lower than that of 2001 owing to lower head grades (CRU International Ltd., 2003b§).

China.—At the same time as the Government was closing small and inefficient mines and smelters, consumption of zinc metal in China has been increasing at a rate of about 12% per year and should reach 1.5 Mt by 2005 (Antaika, 2003). The remaining smelters were trying to secure domestic concentrates, production of which declined by nearly 7% in 2002. Even the largest zinc smelter in China was affected by the shortage in concentrates. The Zhuzhou smelter decided to continue production in 2003 at the reduced 2002 level, which was about 50,000 t below its 2001 output (Metal Bulletin, 2002i). Shortage of concentrate was not an issue for at least one company—Yunnan Chihong Zinc & Germanium Co. The company submitted a proposal to the Chinese Government and, at the same time, began construction of a 100,000-t/yr addition to its existing 60,000-t/yr capacity zinc smelter, which it hoped to finish by yearend 2004. The feed for the expanded smelter will be sourced from the company's two nearby zinc mines that together are capable of producing 400,000 t/yr of concentrates. Most of the financing for the new smelter will come from state-subsidized bank loans, the parent company (Yunnan Metallurgical Group), and from proceeds of an initial public offering (Metal Bulletin, 2002a).

France.—At mid-2002, Metaleurop Nord (a subsidiary of Metaleurop SA) announced that it would switch from primary to secondary zinc production at its Noyelles-Godault plant in northern France owing to low zinc prices and a concentrate deficit. Following the conversion, Noyelles-Godault would have the capacity to produce 70,000 t/yr of recycled zinc (CRU International Ltd., 2002d). This conversion plan, however, was short lived. Before the year ended, the parent company announced that, after January 17, 2003, no further financial assistance would be provided for its insolvent subsidiary. Without funds for the conversion, the smelter was expected to discontinue operations (Platts Metals Week, 2003).

Germany.—A few months after Metaleurop Weser GmbH's Nordenham smelter became available, Xstrata announced that its subsidiary Asturiana de Zinc SA signed an agreement to purchase it from Metaleurop SA for \$100 million. The acquisition will be executed through a newly created

Metaleurop subsidiary, Metaleurop Zinc Holding GmbH, which would enable Xstrata to avoid environmental claims and other liabilities of the parent company. The Nordenham smelter, one of the world's most efficient and profitable zinc producers, is near Bremerhaven, northern Germany, and has capacity of 133,000 t/yr of zinc. The acquisition will increase Xstrata's annual zinc capacity to 600,000 t/yr from 470,000 t/yr, accounting for 20.5% of the European zinc production. Located in the industrial northern Europe, it will complement Xstrata's San Juan de Nieva zinc smelter in Spain (Brigitte Mattenberger, Xstrata plc, written commun., December 2002).

MIM paid \$53 million to Belgium-based Sudamin Investment GmbH (a subsidiary of U.S.-based private equity fund Safeguard International Fund) to take over the ownership of MIM's Duisburg smelter. According to MIM, the new owner will carry out an 18-month modernization program addressing environmental and feed issues, ultimately converting the smelter to a zinc recycling operation. At the time of the ownership change, the smelter drew one-half of its feed from secondary sources, and the remainder was concentrate, mostly from MIM's McArthur River Mine in Australia. Sudamin agreed to continue processing McArthur concentrates until the conversion was completed (Metal Bulletin, 2002d).

Ireland.—In September, after a 10-month suspension, Tara Mines Ltd. resumed production at its Tara zinc mine in Ireland. The subsidiary of Outokumpu Oy of Finland expected to produce about 2.6 Mt of ore in 2003, believing that the zinc market would improve by then, and Tara would be ready for increased demand. Tara is the largest zinc mine in Europe, formerly producing nearly 200,000 t/yr of zinc in concentrate (American Metal Market, 2002). Tara has the potential to be a low-cost and long-term operation, especially once its Southwest Extension (SWEX) Project is completed, and the Bula ore body, acquired in May 2001, is brought onstream. The Bula ore body measures 8 Mt grading 10% zinc and 2% lead and is situated adjacent to the northeastern boundary of the existing operation. With these additional resources, production at Tara could increase to 250,000 t/yr (Mining Journal, 2002f).

Japan.—Due to the depressed zinc market, Japanese companies are exploring ways to increase profit margins by combining certain aspects of their operations. Mitsui Mining & Smelting Co. and Sumitomo Metal Mining Co. Ltd. formed a jointly held company responsible for raw materials purchasing, finished product marketing, and other aspects of their operations to increase efficiency and cut administrative costs for both companies. Dowa Mining Co. Ltd. and Mitsubishi Materials were exploring possible consolidation of some downstream operations, such as production and marketing of zinc alloys for diecasting. Near yearend, they were considering a deal that would make better use of Mitsubishi's zinc alloy plant, which had been affected by the shutdown of the company's zinc smelter in 1996. Since the closure, the alloy plant has been relying on supplies of zinc metal from the Akita smelter, in which Dowa Mining owns 57% equity (Metal Bulletin, 2002b).

Mexico.—Teck Cominco Ltd. disclosed the results of a feasibility study for the San Nicolas copper-zinc deposit in the central State of Zacatecas. Because zinc will be the primary metal produced during the first years of operation, the company plans to wait for zinc prices to improve before making a final

decision about opening. The San Nicolas sulfide deposit is characterized by an upper high-grade zinc zone and a lower copper-rich zone and is open at depth. The study envisaged a 15,000-metric-ton-per-day open pit mine producing copper and zinc concentrates. A 3-km-long access road is needed to link the future mine with an existing paved highway, and a 30-km-long power line is necessary to connect the site to an existing power grid. The capital cost is estimated to be \$246 million. The plan is based on mineral reserves totaling 65 Mt grading 1.32% copper, 2.04% zinc, 32 g/t silver, and 0.5 g/t gold (Northern Miner, 2002).

The two largest shareholders in Mexico's Rey de Plata lead-zinc mine in Guerrero State have decided to permanently close the operation, which has been idled since December 2001. Industrias Peñoles, S.A. de C.V. (51%) and Dowa Mining Co. Ltd. (39%) believe that there was little chance that zinc prices will recover sufficiently to reopen the mine. The remaining 10% is owned by Sumitomo Metal Mining Corp. (Metal Bulletin, 2003).

Namibia.—Construction of the Skorpion zinc mine and refinery in southern Namibia is proceeding on schedule and should produce its first high-grade zinc metal ingot in early 2003, according to Anglo Base Metals Ltd. (a subsidiary of Anglo American plc.). Skorpion's ore consists mainly of oxide silicates and carbonates, enabling production of about 150,000 t/yr of refined zinc through direct acid leaching, solid-liquid separation, solvent extraction, and electrowinning. Mining will be by open pit and will exploit reserves measuring 21.4 Mt and grading 11% zinc at a rate of 1.5 Mt/yr (CRU International Ltd., 2003c§).

Peru.—Compañía Minera San Ignacio de Morococha S.A. (SIMSA) has idled its San Vicente underground zinc-lead mine 320 km east of Lima and has filed for the Peruvian equivalent of Chapter 11 bankruptcy protection with debts of \$18 million. The company, in which Phelps Dodge has a 40% stake, has suffered from significant technical difficulties that resulted in falling production rates (CRU International Ltd., 2002c).

Serbia and Montenegro.—The United Nations Interim Administration Mission in Kosovo (UNMIK) wants to find investors for the Trepca lead-zinc-silver mines and processing complex that is now under UNMIK administration. The complex consists of three clusters of mines and a lead-zinc smelter—the Crnac and Belo Brdo Mines near the concentrator at Leposavic in the far north of Kosovo; the Ajvalija, Novo Brdo, and Kisnica Mines and the Badovac Mine and concentrator in the west-central part of Kosovo, just southwest of the capital, Pristina; and the Stari Trg Mine and concentrator and the smelter near Mitrovica in the north-central region (Mining Journal, 2002g).

South Africa.—After 16 years of operation, BHP Billiton plc closed its Pering open pit mine 20 km northeast of Reivilo owing to depletion of ore reserves. The mine was expected to close in early 2004, but low zinc prices accelerated Billiton's shutdown schedule. During the life of the mine, production at Pering averaged about 39,000 t/yr of zinc concentrate (BHP Billiton, 2003§).

Spain.—Navan Mining plc of the United Kingdom said that its subsidiary Navan Mineral & Mining Resources Holdings B.V. sold its interest in the Aguas Tenidas zinc-copper mine

in southern Spain to Ingeniera de Suelos y Explotacion de Recursos SA (Inersa). In return, Navan will receive royalty payments based on future revenue from the currently suspended operation, up to a maximum of \$2.66 million. The actual amount will depend on when operations restart and future metal prices. Navan halted operations in December 2001 and filed for the Spanish equivalent of Chapter 11 bankruptcy protection. Another Navan Spanish subsidiary, Almagrera SA, consisting of a zinc-copper-lead mine and processing plant, had also filed for bankruptcy and liquidation (Platts Metals Week, 2002f). Since Aguas Tenidas ore was milled at Almagrera's concentrator, Inersa will have to make new arrangements for concentrate production.

Thailand.—In order to ensure future domestic supply of zinc concentrates, the Department of Mineral Resources of Thailand approved a new mining license for Padaeng Industry Public Co., Ltd., the sole zinc mining and smelting company in Southeast Asia. The license covers 39 hectares (96 acres) of land bordering the company's existing mine in the northern district of Mae Sot, Tak Province. The new license will enable Padaeng to access a larger amount of ore within its current mining area as well as new ore resources in the adjacent zone. At the end of 2001, total resources at Mae Sot Mine amounted to 5.14 Mt grading 12% zinc (Metal Bulletin, 2002e).

Vietnam.—Vietnam is attempting to create a joint venture for producing zinc powder as a step toward its long-term goal of building a smelting facility in the northern part of the country. The project is backed by the state-owned Vietnam National Minerals Corp. (Vimico), which mines the Cho Dien lead-zinc deposit in Bac Can Province, north of Ho Chi Minh City. The zinc powder plant, to be built in 2003, would be owned 70% by Thai interests and 30% by Vimico. Currently, Vimico is producing between 40,000 t/yr to 50,000 t/yr of concentrate at the Cho Dien Mine, with an average metal content of 25% zinc and 2% to 3% lead. The justification for the smelter has been the discovery of a major lead-zinc deposit in the Tuyen Quang Province, adjacent to Bac Can Province, where the only zinc producing mine in Vietnam is located. The newly discovered resource contains an estimated 0.5 Mt of metal, which is approximately 80% zinc and 20% lead (Metal Bulletin, 2002h).

United Kingdom.—MIM announced that it was considering the closure of the Avonmouth zinc smelter in the United Kingdom, which was operated by its subsidiary Britannia Zinc Ltd. The cost of the closure could total about \$46 million. The Avonmouth smelter used about 56,000 t/yr of zinc concentrate and 35,000 t/yr of secondary zinc, mainly Waelz zinc oxide, plus various residues and small quantities of flue dust to produce 90,300 t of refined zinc. About one-half of the concentrate was sourced from MIM's own McArthur River Mine in Australia, while the rest came from different sources, including bulk concentrates from the Greens Creek Mine in Alaska (CRU International Ltd., 2003a).

Current Research and Technology

Fuel cell developer Metallic Power Inc. has completed tests of what the company believes is the world's first refuelable zinc fuel-cell-powered vehicle. A "Geo Force" car was equipped with a new zinc fuel cell battery system and driven

at speeds reaching more than 50 miles per hour. The vehicle was refueled in about 30 minutes using fuel hoses that Metallic Power said can be optimized to make the process as simple as pumping gasoline. The fuel, in the form of small zinc pellets, is consumed in the fuel cells and releases electrons to drive a load (the anodic part of the electrochemical process), while the oxygen from the atmosphere accepts electrons from the load (the cathodic part). During the refueling, the zinc oxide (which remains dissolved in a liquid electrolyte) is pumped out of the vehicle while fresh fuel (zinc pellets) and electrolyte are pumped back in (Metallic Power, Inc., 2002§).

Outlook

The International Lead and Zinc Study Group (2002), at its annual meeting in Stockholm in October, reported its outlook for 2003. The reopening of the Tara Mine in Ireland, the commissioning of the Skorpion Mine in Namibia, and increased production in Australia, India, and Peru are expected to help increase world mine output by 5.4% in 2003, while world refinery production of zinc metal should increase by 4.6% in 2003. Because of large capacity increases, mainly in China and Eastern Europe, it will take more than 3 years for this excess smelter capacity to be absorbed even if no new plants or expansions (other than those already committed) are commissioned. Despite a larger percentage increase, mine production will most likely be unable to supply enough concentrate for the smelters to operate at full capacity, so future zinc metal output will be limited by the feed available from constrained mine and scrap supply. World consumption of zinc is expected to increase by about 3.3% in 2003, with a the largest increase originating in the United States (4.5%). Demand in China is expected to propel zinc consumption in Asia to a 4% increase in 2003.

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TABLE 1
SALIENT ZINC STATISTICS¹

(Metric tons unless otherwise specified)

| | 1998 | 1999 | 2000 | 2001 | 2002 |
|--|--------------------|--------------------|--------------------|------------------------|------------------------|
| United States: | | | | | |
| Production: | | | | | |
| Domestic ores, contained zinc | 755,000 | 852,000 | 852,000 | 842,000 | 780,000 |
| Domestic ores, recoverable zinc | 722,000 | 808,000 | 805,000 | 799,000 | 754,000 |
| Value, recoverable zinc thousands | \$819,000 | \$953,000 | \$987,000 | \$774,000 | \$731,000 ^e |
| Refined zinc: | | | | | |
| From domestic ores | 192,000 | 180,000 | 137,000 | 169,000 | 151,000 |
| From foreign ores | 41,900 | 61,100 | 90,800 | 34,000 | 30,800 |
| From scrap | 134,000 | 131,000 | 143,000 | 108,000 | 113,000 |
| Total | 368,000 | 371,000 | 371,000 | 311,000 | 294,000 |
| Secondary zinc ² | 300,000 | 268,000 | 297,000 | 267,000 ^r | 253,000 |
| Exports: | | | | | |
| Ores and concentrates, zinc content | 552,000 | 531,000 | 523,000 | 696,000 | 822,000 |
| Slab zinc | 2,330 | 1,880 | 2,770 | 1,180 | 1,160 |
| Rolled zinc | 9,920 | 3,870 | 3,530 | 5,700 | 7,200 |
| Imports for consumption: | | | | | |
| Ores and concentrates, zinc content | 46,300 | 74,600 | 52,800 | 84,000 | 122,000 |
| Refined (slab) zinc | 879,000 | 1,060,000 | 915,000 | 813,000 | 874,000 |
| Rolled zinc | 16,900 | 22,600 | 9,380 | 7,240 | 1,640 |
| Stocks of slab zinc, December 31: | | | | | |
| Producer | 9,060 | 9,960 | 7,890 | 7,380 | 8,550 |
| Consumer | 45,400 | 64,400 | 58,300 | 57,100 | 59,100 |
| Merchant | 13,300 | 9,690 | 10,500 | 10,300 | 9,970 |
| Total | 67,700 | 84,100 | 76,600 | 74,700 | 77,600 |
| Government stockpile | 199,000 | 177,000 | 138,000 | 120,000 | 109,000 |
| Consumption, refined zinc: | | | | | |
| Reported | 647,000 | 614,000 | 634,000 | 543,000 | 496,000 |
| Apparent ³ | 1,290,000 | 1,430,000 | 1,330,000 | 1,140,000 | 1,180,000 |
| All classes ⁴ | 1,590,000 | 1,700,000 | 1,630,000 | 1,410,000 ^r | 1,430,000 |
| Price, special high grade cents per pound | 51.43 | 53.48 | 55.61 | 43.96 | 38.64 |
| World: | | | | | |
| Production: | | | | | |
| Mine thousand metric tons | 7,570 ^r | 7,970 ^r | 8,790 ^r | 8,930 | 8,360 |
| Smelter do. | 8,120 ^r | 8,550 ^r | 9,190 ^r | 9,350 ^r | 8,910 |
| Price, London Metal Exchange cents per pound | 46.45 | 48.8 | 51.15 | 40.16 | 35.31 |

^eEstimated. ^rRevised.

¹Data are rounded to no more than three significant digits, except prices; may not add to totals shown.

²Zinc in metal products and compounds derived directly from scrap; refined secondary zinc is listed separately in the table.

³Domestic production plus net imports, plus or minus stock changes.

⁴Apparent consumption of refined zinc plus reported consumption of zinc in metal products and compounds derived directly from ore, concentrate, or scrap.

TABLE 2
MINE PRODUCTION OF RECOVERABLE ZINC
IN THE UNITED STATES, BY STATE¹

(Metric tons)

| State | 2001 | 2002 |
|---------------------|----------------------|---------|
| Alaska ² | 570,000 | 660,000 |
| Missouri | 43,600 | 41,800 |
| Montana | 22,600 | 10,300 |
| New York | W | -- |
| Other ³ | 163,000 ^r | 41,900 |
| Total | 799,000 | 754,000 |

^rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other." -- Zero.

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

²Data based, in part, on publicly available information.

³Includes production from Idaho and Tennessee.

TABLE 3
LEADING ZINC PRODUCING MINES IN THE UNITED STATES IN 2002, IN ORDER OF OUTPUT

| Rank | Mine | County and State | Operator | Source of zinc |
|------|-----------------|----------------------|-----------------------------------|----------------|
| 1 | Red Dog | Northwest Arctic, AK | Teck Cominco Alaska Inc. | Lead-zinc ore. |
| 2 | Gordonsville | Smith, TN | Pasminco Ltd. | Zinc ore. |
| 3 | Greens Creek | Juneau, AK | Kennecott Greens Creek Mining Co. | Do. |
| 4 | Cumberland | Smith, TN | Pasminco Ltd. | Do. |
| 5 | Brushy Creek | Reynolds, MO | Doe Run Resources Corp. | Lead ore. |
| 6 | Buick | Iron, MO | do. | Do. |
| 7 | Clinch Valley | Grainger, TN | Pasminco Ltd. | Zinc ore. |
| 8 | Montana Tunnels | Jefferson, MT | Montana Tunnels Mining, Inc. | Do. |
| 9 | Fletcher | Reynolds, MO | Doe Run Resources Corp. | Lead ore. |

TABLE 4
REFINED ZINC PRODUCED IN THE UNITED STATES¹

(Metric tons)

| | 2001 | 2002 |
|--------------------------|---------|---------|
| Primary: | | |
| From domestic ores | 169,000 | 151,000 |
| From foreign ores | 34,000 | 30,800 |
| Total | 203,000 | 182,000 |
| Secondary | 108,000 | 113,000 |
| Grand total ² | 311,000 | 294,000 |

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

²Excludes zinc recovered by remelting.

TABLE 5
REFINED ZINC PRODUCED IN THE UNITED STATES,
BY GRADE¹

(Metric tons)

| Grade | 2001 | 2002 |
|------------------------|---------|---------|
| Special high | 95,500 | 94,000 |
| Continuous galvanizing | 108,000 | 108,000 |
| Other ² | 107,000 | 91,900 |
| Total | 311,000 | 294,000 |

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

²Includes controlled lead, high, and prime western grades.

TABLE 6
SLAB ZINC CAPACITY OF PRIMARY ZINC PLANTS IN THE UNITED STATES,
BY TYPE OF PLANT AND COMPANY

(Metric tons)

| Type of plant and company | 2001 | 2002 |
|--|---------|---------|
| Electrolytic: | | |
| Big River Zinc Corp., Sauget, IL | 100,000 | 100,000 |
| Pasminco Ltd., Clarksville, TN | 115,000 | 115,000 |
| Electrothermic, Zinc Corporation of America, Monaca, PA ¹ | 155,000 | 155,000 |
| Total | 370,000 | 370,000 |

¹Includes secondary capacity.

TABLE 7
STOCKS AND CONSUMPTION OF NEW AND OLD ZINC SCRAP IN THE UNITED STATES
IN 2002, BY TYPE OF SCRAP¹

(Metric tons, zinc content)

| Type of scrap | Stocks, January 1 | Consumption | | | | Stocks, December 31 |
|----------------------------------|----------------------|-------------|--------------|--------------|---------|------------------------|
| | | Receipts | New scrap | Old scrap | Total | |
| Diecastings | 161 | W | -- | W | W | W |
| Flue dust | W | 61,300 | 30,700 | 30,700 | 61,300 | W |
| Galvanizer's dross | 2,830 | 41,000 | 41,000 | -- | 41,000 | 2,830 |
| Old zinc ² | 72 | 281 | -- | 267 | 267 | 86 |
| Remelt die-cast slab | 47 | W | -- | W | W | W |
| Remelt zinc ³ | W | W | W | -- | W | W |
| Skimmings and ashes ⁴ | 653 | 22,400 | 22,400 | -- | 22,400 | W |
| Other ⁵ | 1,640 ^r | 73,400 | 58,200 | 15,200 | 73,400 | 2,600 |
| Total | 5,400 ^r | 198,000 | 152,000 | 46,200 | 198,000 | 5,510 |

¹Revised. W Withheld to avoid disclosing company proprietary data; included with "Other." -- Zero.

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Includes engraver's plates and rod and die scrap.

⁴Includes new clippings.

⁵Includes slab and die-cast skimmings.

⁶Includes chemical residues and solutions, electrogalvanizing anodes, fragmented diecastings, and steelmaking dust.

TABLE 8
 PRODUCTION OF ZINC PRODUCTS FROM
 ZINC-BASE SCRAP IN THE UNITED STATES¹

(Metric tons)

| Products | 2001 | 2002 |
|--|----------------------|---------|
| Redistilled slab zinc | 108,000 ^r | 113,000 |
| Other zinc metal products ² | 4,990 | 7,380 |
| Zinc in chemical products | 47,400 ^r | 45,200 |
| Zinc dust | 2,440 | 5,040 |

^rRevised.

¹Data are rounded to no more than three significant digits.

²Includes electrogalvanizing anodes, remelt die-cast slab, and other metal alloys.

TABLE 9
 ZINC RECOVERED FROM SCRAP PROCESSED
 IN THE UNITED STATES BY TYPE OF SCRAP
 AND FORM OF RECOVERY¹

(Metric tons)

| | 2001 | 2002 |
|----------------------------|----------------------|------------------|
| Type of scrap: | | |
| New scrap: | | |
| Zinc-base | 147,000 ^r | 147,000 |
| Copper-base | 170,000 ^r | 171,000 |
| Magnesium-base | 548 | 548 ^c |
| Total | 317,000 ^r | 319,000 |
| Old scrap: | | |
| Zinc-base | 43,400 | 44,400 |
| Copper-base | 12,800 ^r | 2,040 |
| Aluminum-base | 548 | 548 |
| Magnesium-base | 338 | 338 ^c |
| Total | 57,100 ^r | 47,300 |
| Grand total | 375,000 ^r | 366,000 |
| Form of recovery: | | |
| Metal: | | |
| Slab zinc | 108,000 | 113,000 |
| Zinc dust | 2,440 | 5,040 |
| Total | 110,000 | 118,000 |
| In brass and bronze | 213,000 ^r | 198,000 |
| In chemical products: | | |
| Zinc oxide (lead free) | 19,700 | 15,600 |
| Zinc sulfate | 23,100 | 24,700 |
| Miscellaneous ² | 9,090 ^r | 10,200 |
| Total | 265,000 ^r | 248,000 |
| Grand total | 375,000 ^r | 366,000 |

^cEstimated. ^rRevised.

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

²Includes chlorine, electrogalvanizing anodes, and zinc content of slab made from remelt die-cast slab.

TABLE 10
U.S. CONSUMPTION OF ZINC¹

(Metric tons)

| | 2001 | 2002 |
|--------------------------------------|----------------------|-----------|
| Refined zinc, apparent | 1,140,000 | 1,180,000 |
| Ores and concentrates, zinc content | 727 | 617 |
| Secondary, zinc content ² | 267,000 ^r | 253,000 |
| Total | 1,410,000 | 1,430,000 |

^rRevised.

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

²Excludes secondary slab zinc and remelt zinc.

TABLE 11
U.S. REPORTED CONSUMPTION OF ZINC IN 2002, BY INDUSTRY USE AND GRADE¹

(Metric tons)

| Industry use | Special high grade | High grade | Prime western | Remelt and other grades | Total |
|------------------|--------------------|------------|---------------|-------------------------|---------|
| Galvanizing | 107,000 | 36,200 | 94,700 | 27,800 | 265,000 |
| Zinc-base alloys | 103,000 | W | W | W | 103,000 |
| Brass and bronze | 44,300 | W | W | W | 86,800 |
| Other | 40,200 | 25,200 | 18,300 | 139 | XX |
| Total | 294,000 | 61,400 | 113,000 | 28,000 | 496,000 |

W Withheld to avoid disclosing company proprietary data; included with "Other" and in "Total." XX Not applicable.

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

TABLE 12
ZINC CONTAINED IN PIGMENTS AND COMPOUNDS PRODUCED
AND SHIPPED IN THE UNITED STATES^{1,2}

(Metric tons)

| | 2001 | | 2002 | |
|--------------|------------|-----------|------------|-----------|
| | Production | Shipments | Production | Shipments |
| Zinc oxide | 61,800 | 64,600 | 29,500 | 29,500 |
| Zinc sulfate | 23,800 | 24,400 | 25,300 | 25,300 |

¹Excludes leaded zinc oxide, lithopone, and zinc chloride.

²Data are rounded to no more than three significant digits.

TABLE 13
 REPORTED SHIPMENTS OF ZINC CONTAINED
 IN ZINC OXIDE, BY INDUSTRY^{1,2}

(Metric tons)

| | 2001 | 2002 |
|--------------------|--------|--------|
| Ceramics | 2,220 | 418 |
| Chemicals | 12,700 | 5,320 |
| Paints | 3,140 | 1,840 |
| Rubber | 43,200 | 21,000 |
| Other ³ | 3,340 | 975 |
| Total | 64,600 | 29,500 |

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

²In addition, zinc contained in zinc oxide was imported as follows: 2001--71,993 and 2002--69,744; distribution cannot be distinguished by industry.

³Includes agriculture and photocopying.

TABLE 14
 U.S. EXPORTS OF ZINC ORES AND CONCENTRATES, BY COUNTRY¹

| | 2001 | | 2002 | |
|--------------------|--|----------------------|--|----------------------|
| | Quantity (metric tons of zinc content) | Value (thousands) | Quantity (metric tons of zinc content) | Value (thousands) |
| Australia | 24,400 | \$10,800 | 29,800 | \$13,200 |
| Belgium | 151,000 | 66,800 | 98,500 | 42,400 |
| Canada | 85,100 | 42,700 | 171,000 | 51,800 |
| China | 210 | 60 | 205 | 145 |
| Germany | 33,000 | 14,900 | 27,500 | 12,200 |
| India | 705 | 401 | -- | -- |
| Italy | 16,500 | 4,110 | 7,810 | 2,520 |
| Japan | 141,000 | 44,300 | 210,000 | 84,900 |
| Korea, Republic of | 141,000 | 56,600 | 78,100 | 29,200 |
| Mexico | 882 | 227 | 876 | 910 |
| Netherlands | 51,800 | 22,900 | 51,900 | 23,000 |
| Saudi Arabia | 328 | 547 | 28 | 45 |
| Singapore | 580 | 559 | -- | -- |
| Spain | -- | -- | 122,000 | 54,100 |
| United Kingdom | 13,700 | 3,360 | 24,500 | 7,590 |
| Other | 36,300 ^r | 16,300 ^r | 42 | 95 |
| Total | 696,000 | 285,000 | 822,000 | 322,000 |

^rRevised. -- Zero.

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

Source: U.S. Census Bureau.

TABLE 15
U.S. EXPORTS OF ZINC COMPOUNDS¹

| | 2001 | | 2002 | |
|--------------------------|--|----------------------|--|----------------------|
| | Quantity (metric tons of gross weight) | Value (thousands) | Quantity (metric tons of gross weight) | Value (thousands) |
| Zinc chloride | 1,730 | \$1,630 | 1,950 | \$1,930 |
| Zinc compounds, n.s.p.f. | 4,920 ^r | 7,730 ^r | 5,880 | 8,720 |
| Zinc oxide | 11,300 | 17,600 | 10,800 | 14,600 |
| Zinc sulfate | 4,780 ^r | 2,900 ^r | 2,900 | 1,760 |

^rRevised.

¹Data are rounded to no more than three significant digits.

Source: U.S. Census Bureau.

TABLE 16
U.S. IMPORTS FOR CONSUMPTION OF ZINC COMPOUNDS¹

| | 2001 | | 2002 | |
|--------------------------|--|----------------------|--|----------------------|
| | Quantity (metric tons of gross weight) | Value (thousands) | Quantity (metric tons of gross weight) | Value (thousands) |
| Lithopone | 1,290 | \$1,140 | 893 | \$782 |
| Zinc chloride | 946 | 1,020 | 716 | 775 |
| Zinc compounds, n.s.p.f. | 128 | 98 | -- | -- |
| Zinc hydrosulfite | 306 | 569 | 161 | 317 |
| Zinc oxide | 72,000 | 66,200 | 69,700 | 57,600 |
| Zinc sulfate | 16,200 | 7,330 | 20,100 | 10,300 |

-- Zero.

¹Data are rounded to no more than three significant digits.

Source: U.S. Census Bureau.

TABLE 17
ZINC: WORLD MINE PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

| Country | 1998 | 1999 | 2000 | 2001 | 2002 |
|-------------------------------------|---------------------|---------------------|------------------------|------------------------|----------------------|
| Algeria | 4,555 | 9,808 | 10,452 | 13,532 ^r | 14,000 ^e |
| Argentina | 35,560 | 34,192 | 34,858 | 39,703 ^r | 37,325 ^p |
| Australia | 1,059,000 | 1,163,000 | 1,420,000 | 1,519,000 | 1,154,000 |
| Bolivia | 152,110 | 146,316 | 149,134 | 141,226 ^r | 142,000 ^e |
| Bosnia and Herzegovina ^e | 300 | 300 | 300 | 300 | 300 |
| Brazil | 87,485 | 98,590 ^r | 100,254 | 111,432 ^r | 112,000 ^e |
| Bulgaria ^e | 18,000 ^r | 12,000 ^r | 10,000 ^r | 10,600 ^r | 11,000 |
| Burma | 474 | 279 | 437 | 467 ^r | 400 ^e |
| Canada | 1,061,645 | 963,321 | 1,002,242 ^r | 1,012,048 ^r | 894,399 ^p |
| Chile | 15,943 | 32,263 | 31,403 ^r | 32,762 ^r | 32,800 ^e |
| China | 1,270,000 | 1,480,000 | 1,780,000 | 1,700,000 ^r | 1,550,000 |
| Congo (Kinshasa) | 1,147 | -- | 215 | 1,014 | 1,000 ^e |
| Ecuador ^e | 100 | 100 | 100 | 100 | 100 |
| Finland | 30,700 ^e | 20,000 ^e | 30,493 ^r | 36,253 ^r | 34,100 |

See footnotes at end of table.

TABLE 17--Continued
ZINC: WORLD MINE PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

| Country | 1998 | 1999 | 2000 | 2001 | 2002 |
|------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Georgia ^c | 200 | 200 | 200 | 200 | 200 |
| Greece | 29,100 | 19,619 | 16,900 | 20,000 ^e | 30,000 |
| Honduras | 36,639 | 31,095 | 31,226 | 48,485 ^r | 46,339 |
| India ^e | 143,000 ³ | 145,000 | 144,000 | 146,000 | 130,000 |
| Iran ^e | 80,000 | 80,000 | 90,000 ^r | 120,000 ^r | 120,000 |
| Ireland | 182,000 | 226,000 | 262,877 | 225,135 | 250,000 |
| Italy ^e | 2,500 | -- | -- | -- | -- |
| Japan | 67,670 | 64,263 | 63,601 | 44,519 | 42,851 |
| Kazakhstan | 224,300 | 288,300 | 325,000 | 344,300 | 390,000 |
| Korea, North ^e | 100,000 ^r | 100,000 ^r | 100,000 ^r | 100,000 ^r | 100,000 |
| Korea, Republic of | 10,488 | 9,832 | 11,474 | 5,129 ^r | 6,000 |
| Macedonia | 20,000 ^r | 21,000 ^r | 25,000 ^r | 20,000 ^r | 20,000 |
| Mexico | 395,391 | 362,811 | 392,791 | 428,828 ^r | 475,000 ^e |
| Morocco | 112,000 | 111,703 | 103,064 ^r | 89,339 ^r | 90,000 ^e |
| Namibia | 42,274 | 35,140 | 39,126 ^r | 31,803 ^r | 37,500 ^e |
| Peru | 868,757 | 899,524 | 910,303 | 1,056,629 | 1,100,000 ^e |
| Poland | 157,900 | 154,800 ^r | 156,900 ^r | 152,700 ^r | 153,000 |
| Romania | 30,000 ^e | 26,536 | 27,455 | 25,000 ^e | 25,000 |
| Russia | 115,000 ^e | 132,000 | 136,000 | 124,000 ^e | 130,000 |
| Saudi Arabia | 3,550 | 3,161 | 3,000 ^e | 3,300 ^r | 3,000 ^e |
| Serbia and Montenegro ^e | 14,000 ³ | 1,000 | 2,500 | 1,200 | 800 |
| South Africa | 69,630 | 69,733 | 62,703 | 61,221 | 64,173 |
| Spain | 128,100 | 110,000 | 201,000 | 183,900 | 165,000 |
| Sweden | 164,711 | 174,400 | 176,788 ^r | 156,334 ^r | 142,900 |
| Thailand | 25,000 | 24,000 | 27,000 | 24,000 | 25,000 |
| Tunisia | 31,368 | 49,066 | 41,247 | 37,900 ^e | 33,800 ^e |
| Turkey ⁴ | 6,000 ^e | 545 | 39 ^r | 37 ^r | 35 ^e |
| United States | 755,000 | 852,000 | 852,000 | 842,000 | 780,000 ³ |
| Vietnam ^e | 18,000 | 18,000 | 16,000 | 16,000 | 16,000 |
| Total | 7,570,000 ^r | 7,970,000 ^r | 8,790,000 ^r | 8,930,000 ^r | 8,360,000 |

^eEstimated. ^pPreliminary. ^rRevised. -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Zinc content of concentrate and direct shipping ore unless otherwise noted. Table includes data available through July 1, 2003.

³Reported figure.

⁴Content in ore hoisted.

TABLE 18
ZINC: WORLD SMELTER PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

| Country ³ | 1998 | 1999 | 2000 | 2001 | 2002 ^e |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|
| Algeria, primary and secondary ^e | 31,000 | 32,200 ^r | 34,000 | 34,000 | 34,000 |
| Argentina: | | | | | |
| Primary | 38,677 | 40,224 | 36,359 | 39,727 ^r | 38,699 ^p |
| Secondary | 3,100 ^e | 3,220 | 2,910 | 3,180 ^r | 3,098 ^p |
| Total | 41,777 | 43,444 | 39,269 | 42,907 ^r | 41,797 ^p |
| Australia: | | | | | |
| Primary ⁵ | 312,000 | 344,000 | 490,000 | 554,000 | 567,000 ⁴ |
| Secondary ^e | 9,000 ^{r,4} | 4,500 ^r | 4,500 ^r | 4,500 ^r | 4,500 |
| Total | 321,000 ^r | 348,500 ^r | 494,500 ^r | 558,500 ^r | 571,500 ⁴ |
| Belgium, primary and secondary | 205,000 | 232,400 | 251,700 | 259,300 | 260,000 |
| Brazil: | | | | | |
| Primary | 176,806 | 187,010 | 191,777 | 193,061 ^r | 193,000 |
| Secondary ^e | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 |
| Total | 183,806 | 194,010 | 198,777 | 200,061 ^r | 200,000 |

See footnotes at end of table.

TABLE 18--Continued
ZINC: WORLD SMELTER PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

| Country ³ | 1998 | 1999 | 2000 | 2001 | 2002 ^e |
|---|------------------------|------------------------|------------------------|------------------------|----------------------|
| Bulgaria, primary and secondary | 86,100 ^r | 83,700 ^r | 84,200 ^r | 88,600 ^r | 85,000 |
| Canada, primary | 745,131 | 776,927 | 779,899 ^r | 661,172 ^r | 793,475 ^p |
| China, primary and secondary ^e | 1,490,000 | 1,700,000 | 1,980,000 ^r | 2,040,000 ^r | 2,100,000 |
| Czech Republic, secondary ^e | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Finland, primary | 199,000 | 225,200 | 222,881 ^r | 247,179 ^r | 235,300 ⁴ |
| France, primary and secondary | 321,000 ^e | 333,103 | 350,000 | 347,000 ^e | 350,000 |
| Germany, primary and secondary | 334,000 ^e | 333,000 | 356,000 | 358,300 | 360,000 ⁴ |
| India: ^e | | | | | |
| Primary | 171,900 ⁴ | 175,000 | 176,000 ⁴ | 205,000 | 196,000 |
| Secondary | 25,000 | 25,000 | 25,000 | 25,000 | 24,000 |
| Total | 196,900 ⁴ | 200,000 | 201,000 | 230,000 | 220,000 |
| Italy, primary and secondary | 231,600 | 152,800 | 170,300 | 177,800 | 176,000 ⁴ |
| Iran | 23,000 ^e | 31,000 | 49,000 | 73,000 ^e | 75,000 |
| Japan: | | | | | |
| Primary | 513,916 | 524,979 | 541,704 | 541,277 | 547,183 ⁴ |
| Secondary | 138,771 | 158,637 | 157,047 ^r | 142,777 ^r | 123,395 ⁴ |
| Total | 652,687 | 683,616 | 698,751 ^r | 684,054 ^r | 670,578 ⁴ |
| Kazakhstan, primary and secondary | 240,728 | 249,327 | 262,200 | 277,100 ^r | 286,300 ⁴ |
| Korea, North, primary and secondary | 100,000 ^r | 100,000 ^r | 100,000 ^r | 100,000 ^r | 100,000 |
| Korea, Republic of, primary | 390,260 | 430,108 | 473,897 | 508,000 ^r | 510,000 |
| Macedonia, primary and secondary ^e | 64,200 | 55,000 | 69,800 | 95,093 ^r | 20,000 |
| Mexico, primary | 230,325 | 218,913 | 303,810 ^r | 320,000 ^{r,e} | 320,000 |
| Netherlands, primary ⁶ | 218,700 | 220,000 ^e | 216,800 | 204,800 | 200,000 |
| Norway, primary | 128,000 ^e | 132,600 | 125,800 | 129,300 | 137,300 ⁴ |
| Peru, primary | 174,655 | 196,978 | 199,813 | 201,498 | 172,688 ⁴ |
| Poland, primary and secondary | 174,800 ^r | 178,900 ^r | 173,000 ^{r,e} | 174,700 ^r | 175,000 |
| Portugal, primary ^e | 3,600 | 3,600 | 3,600 | 3,600 | 3,600 |
| Romania, primary and secondary | 29,427 | 29,000 ^r | 51,900 ^r | 47,200 ^r | 50,000 |
| Russia, primary and secondary ^e | 192,000 | 221,000 | 230,000 | 237,000 | 244,000 |
| Serbia and Montenegro, primary and secondary | 14,000 ^e | 683 | 8,291 | 13,467 | 1,478 ⁴ |
| Slovakia, secondary ^e | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| South Africa, primary | 107,400 | 108,000 | 103,000 | 109,000 ^r | 105,000 |
| Spain, primary and secondary | 360,000 ^e | 393,000 | 386,300 | 418,000 ^r | 488,000 ⁴ |
| Thailand, primary | 75,904 | 75,639 | 77,525 | 74,129 | 72,502 ⁴ |
| Turkey, primary | 35,716 | 33,179 | -- | -- ^e | -- |
| United Kingdom, primary and secondary | 99,600 | 132,800 | 99,600 | 100,000 ^e | 100,000 |
| United States: | | | | | |
| Primary | 234,000 | 241,000 | 228,000 | 203,000 | 182,000 ⁴ |
| Secondary | 134,000 | 131,000 | 143,000 | 108,000 | 113,000 ⁴ |
| Total | 368,000 | 371,000 | 371,000 | 311,000 | 294,000 ⁴ |
| Uzbekistan, primary ^e | 52,000 | 27,000 | 18,000 | 20,000 | 20,000 |
| Grand total | 8,120,000 ^r | 8,550,000 ^r | 9,190,000 ^r | 9,350,000 ^r | 8,910,000 |
| Of which: | | | | | |
| Primary | 3,810,000 ^r | 3,960,000 ^r | 4,190,000 ^r | 4,210,000 ^r | 3,730,000 |
| Secondary | 319,000 ^r | 331,000 ^r | 341,000 ^r | 292,000 ^r | 277,000 |
| Undifferentiated | 4,000,000 ^r | 4,260,000 ^r | 4,660,000 ^r | 4,840,000 ^r | 4,900,000 |

^eEstimated. ^pPreliminary. ^rRevised. -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Wherever possible, detailed information on raw material source of output (primary--directly from ores, and secondary--from scrap) has been provided. In cases where raw material source is unreported and insufficient data are available to estimate the distribution of the total, that total has been left undifferentiated (primary and secondary). To the extent possible, this table reflects metal production at the first measurable stage of metal output. Table includes data available through July 1, 2003.

³In addition to the countries listed, Israel also produces small amounts of secondary zinc, but available information is inadequate to make reliable estimates of output levels.

⁴Reported figure.

⁵Excludes zinc dust.

⁶Sales.