LEAD

By Gerald R. Smith

Domestic survey data and tables were prepared by Joshua I. Martinez, statistical assistant, and the world production tables were prepared by Glenn J. Wallace, international data coordinator.

Domestic lead mine production increased by 2% compared with that of 2002. Alaska and Missouri were the dominant producing States with a 96% share. Other appreciable lead mine production was in Idaho and Montana. Lead was produced at 10 U.S. mines employing about 800 people. The value of domestic mine production was more than $430 million. A significant portion of the lead concentrates produced from the mined ore was processed into primary metal at two smelter-refineries in Missouri.

Secondary lead, derived principally from scrapped lead-acid batteries, accounted for 82% of refined lead production in the United States. Nearly all the secondary lead was produced by 7 companies operating 15 smelters.

Lead was consumed in about 110 U.S. plants to manufacture end-use products, including ammunition; building-construction materials; covering for power and communication cable; lead oxides in glass, ceramics, pigments and chemicals; solders for motor vehicles, metal containers, construction, and electrical/electronic components and accessories; and storage batteries.

Lead-acid batteries, including starting-lighting-ignition (SLI) and industrial types, continued to be the overwhelmingly dominant use of lead, accounting for about 84% of reported lead consumption. SLI battery shipments in North America totaled 107.2 million units in 2003. This total included original equipment and replacement automotive-type batteries. An estimated 1.14 million metric tons (Mt) of lead was contained in new SLI batteries shipped during the year.

Monthly sales of lead from the National Defense Stockpile (NDS) totaled about 60,300 metric tons (t) (66,500 short tons), leaving about 112,000 t (123,000 short tons) in the NDS at yearend.

Lead prices increased during the year to an average of $0.2334 on the London Metal Exchange (LME) and to $0.4376 for the North American Producer price.

Legislation and Government Programs

Monthly sales of lead from the NDS continued during 2003 under the basic ordering agreement (BOA) DLA-Lead-005. The BOA had replaced the monthly sealed bid and periodic negotiated method for purchasing lead beginning in June 2002. As a result of the BOA sales and the delivery of previously committed inventory, lead disposal from stockpile inventory during 2003 totaled about 60,300 t (66,500 short tons). The Defense National Stockpile Center's (DNSC) Annual Materials Plan (AMP) approved by the U.S. Congress for fiscal year 2003 included a maximum sales authority for lead of 54,400 t (60,000 short tons) (Defense National Stockpile Center, 2002). Under this authority, disposal of lead from the NDS inventory during the first 9 months of calendar year 2003 was 48,800 t (53,800 short tons). The AMP approved by the U.S. Congress for fiscal year 2004 also included a maximum sales authority for lead of 54,400 t (Defense National Stockpile Center, 2003a). Under the fiscal year 2004 authority, disposal of lead from the NDS inventory during the final 3 months of calendar year 2003 amounted to 11,500 t (12,700 short tons), leaving about 112,000 t (123,000 short tons) of lead at yearend. Announcements were made by the DNSC in February 2003 and November 2003 awarding the sale of lead from the NDS in negotiated long-term contracts extending for a contract period of 360 calendar days (Defense National Stockpile Center, 2003b, c). The long-term sales included several grades of lead totaling about 21,600 t (23,800 short tons).

During 2003, U.S. Government agencies issued proposed and final rules on matters affecting the lead industry, announced funding availability for eliminating lead hazards, revised the priority list of hazardous substances that will be the subject of toxicological profiles, and proposed the inclusion of lead and lead compounds in a report on carcinogens. In mid-April, the Consumer Product Safety Commission (CPSC), under the authority of the Federal Hazardous Substances Act, issued a final rule banning the use of lead-containing metal-cored candlewicks and candles with such wicks. Under the CPSC ruling, wicks containing more than 0.06% lead by weight are prohibited. The metal cores are used to provide structural rigidity to the wick during candle production and to provide an upright wick during burning of the candle. The CPSC's concerns with the wicks focused on the potential hazards associated with excessive emissions of lead into the air during burning. Cautionary labeling was deemed to be an inadequate measure to protect public health and safety; thus the CPSC removed the wicks as a commercial good. The final rule applied to all candlewick material and candles subject to the ban that were either manufactured or imported on or after October 15, 2003. Prior to this date, existing stocks were commercially depleted (U.S. Consumer Product Safety Commission, 2003).

In late October, the U.S. Environmental Protection Agency (EPA) proposed revisions to the definition of solid waste and its regulation under subtitle C of the Resource Conservation and Recovery Act (RCRA). In the proposed rule, the EPA attempted to identify certain recyclable waste materials and their related industries, wherein the materials have been generated and reclaimed in a continuous process within the respective industries. As such, these materials then would not be subject to regulation under the RCRA. Excluded from the EPA's proposed list of nonregulated recyclable materials were those processed by "Waste Management and Remediation Services"—an industry group that, as defined by the EPA, includes secondary lead smelters. Currently, the spent lead-acid batteries recycled at these smelters are classified as having been "discarded" by the entity from which the smelters acquired the spent battery, thereby making the batteries subject to RCRA

regulations. However, included in the EPA's proposed revisions was a request for industry comments on an optional, broader regulatory exclusion for legitimate recycling, with specific reference to lead recycling. This option could be included by the EPA in its final rule and likely would encourage further recycling and reuse while maintaining protection of human health and the environment (U.S. Environmental Protection Agency, 2003b).

In its request to the Office of Management and Budget for renewal of information collection approval pertaining to toxic chemical releases, the EPA included downward adjustments to the estimated total number of respondents. Specifically, the EPA overestimated by about 30% the number of respondents impacted by the agency's final rule, which effectively lowered the reporting thresholds for lead and lead compounds (U.S. Environmental Protection Agency, 2001). As a result, the EPA decreased the estimated total annual hourly burden for toxic chemical release reporting of lead and lead compounds by about 218,000 hours (U.S. Environmental Protection Agency, 2003d).

The EPA solicited grant proposals from Native American tribes to support tribal outreach and educational awareness programs on lead and to conduct baseline assessments of the existing exposure and risk of exposure to lead in tribal children. Grants totaling about $1.4 million will be awarded to conduct such activities (U.S. Environmental Protection Agency, 2003a).

The EPA issued a solicitation to States, Territories, Native American tribes, intertribal consortia, and the District of Columbia for entry into cooperative agreements with the agency in support of their respective lead-based paint abatement programs. Funds made available by the EPA for these agreements totaled $12.5 million. The lead-based paint programs and the financial assistance offered under the cooperative agreements are authorized under section 404 of the Toxic Substance Control Act. The local programs are conducted in lieu of the corresponding Federal programs. They are intended to ensure that individuals conducting lead-based paint activities are properly trained and certified and that renovation contractors provide appropriate lead information to building owners and residents (U.S. Environmental Protection Agency, 2003c).

Late in the year, the U.S. Department of Health and Human Services (HHS) included lead and lead compounds in its nominations proposed for listing in the Report on Carcinogens (11th ed.) (previously known as the Annual Report on Carcinogens), which is a congressionally mandated listing of known human carcinogens and reasonably anticipated human carcinogens to which a significant number of persons residing in the United States are exposed. Its preparation is delegated to the National Toxicology Program (NTP) by the Secretary of the HHS. Nominations for inclusion in the report were reviewed by three scientific committees, two comprising Federal agencies and interagency working groups and one comprising of peers, nongovernmental reviewers that served as a board of scientific counselors to the NTP. The board of scientific counselors voted to reject the NTP staff recommendation to classify lead as a known human carcinogen. However, based on existing animal evidence, the counselors voted to classify lead and lead compounds as a reasonably anticipated human carcinogen. This classification is defined as having limited evidence of carcinogenicity from studies in humans, which indicates that causal interpretation is credible, but that alternative explanations, such as chance, bias, or confounding factors, could not adequately be excluded. Final public comments on the proposed listing were to be submitted to the NTP by January 6, 2004 (Environmental Update, 2003a; U.S. Department of Health and Human Services, 2003b).

In other action, the HHS, through its Agency for Toxic Substances and Disease Registry (ATSDR), issued notice of a revised priority list of hazardous substances that will be the subject of ATSDR toxicological profiles. Lead has been ranked second behind arsenic on the revised priority list. Revision of the priorities list is required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) as amended by the Superfund Amendments and Reauthorization Act. The list includes substances most commonly found at or near CERCLA hazardous waste sites that, based upon most recent information available, have been determined to be of greatest concern to public health (U.S. Department of Health and Human Services, 2003c).

The Centers for Disease Control and Prevention of the HHS announced the availability of funds in fiscal year 2003 for cooperative agreements directed toward childhood lead poisoning prevention programs. The purpose of this funding is to assist State and local partners in the elimination of childhood health hazards associated with lead. The programs are intended to focus on reducing blood lead levels in children under the age of 6, with special emphasis on children under the age of 3. Priority will be given to jurisdictions that have the highest estimated number of children with elevated blood lead levels. Approximately $31 million will be available for such programs in fiscal year 2003 through the awarding of an estimated 40 grants, averaging $775,000 per grant (U.S. Department of Health and Human Services, 2003a).

The U.S. Department of Housing and Urban Development (HUD) issued its fiscal year 2003 notice of funding availability for the Lead Hazard Reduction Demonstration Grant Program. The distribution of funds is intended to assist local government units in carrying out specific programs pertaining to abatement, inspections, risk assessments, temporary relocations, and interim control of lead-based paint hazards. The awarded funds are directed toward eligible privately owned, single-family housing units and multifamily buildings occupied by low-income families. Individual States and Native American tribes may apply for funding on behalf of a local government unit (for example, a city or county within their jurisdiction). Approximately $50 million in grants will be made available under the HUD program. The Lead Hazard Reduction Demonstration Program is authorized under section 1011 of the Residential Lead-Based Paint Hazard Reduction Act, title X of the Housing and Community Development Act of 1992 (U.S. Department of Housing and Urban Development, 2003f).

The HUD also announced funding awards under four separate lead programs administered by the agency. A total of about $75 million was awarded to 30 grantees under the fiscal year 2003 Lead-Based Paint Hazard Control Program. This program assists States, Native American tribes, and local governments in identifying and controlling lead-based paint hazards in eligible

privately owned housing (U.S. Department of Housing and Urban Development, 2003b). Nearly $50 million also was distributed to 20 recipients under the fiscal year 2003 Lead Hazard Reduction Demonstration Program. These funds are intended to assist local governments in carrying out specific programs pertaining to abatement, inspections, risk assessments, temporary relocations, and interim control of lead-based paint hazards. The awarded funds are directed toward eligible privately owned, single-family housing units and multifamily buildings occupied by low-income families (U.S. Department of Housing and Urban Development, 2003c). Another $5 million was distributed to eight grantees under the Healthy Homes and Lead Technical Studies Program (U.S. Department of Housing and Urban Development, 2003a). In addition, a total of about $2.5 million was awarded to six recipients under the Lead Outreach Program (U.S. Department of Housing and Urban Development, 2003d).

In July, the Secretary of HUD delegated to the Director of the Office of Healthy Homes and Lead Hazard Control all authority of the Secretary in accordance with the following acts and rules: the Lead-based Paint Poisoning Prevention Act; the Residential Lead-based Paint Hazard Reduction Act; sections 501 and 502 of the Housing and Urban Development Act that pertain to healthy homes; the lead disclosure rule; and the lead safe housing rule. The transfer of authority became effective June 24, 2003. It does not include the authority to issue or waive regulations or to enter into matters of a legal nature (U.S. Department of Housing and Urban Development, 2003e).

The U.S. Department of the Interior's Fish and Wildlife Service issued a final rule approving gun shot formulated of 65% tungsten, 21.8% tin, 10.4% iron, and 2.8% nickel as a virtually nonlead form of ammunition for hunting waterfowl. Under authority contained in the Migratory Bird Treaty Act of 1918, the Fish and Wildlife Service controls the hunting of migratory game birds and, since the mid-1970s, has sought to identify shot that does not pose a significant toxicity hazard in feeding areas of migratory birds or other wildlife. Currently bismuth-tin, steel, tungsten-iron, tungsten matrix, tungsten-nickel-iron, and tungsten polymer shot are approved for permanent use as environmentally acceptable forms of shot. The maximum environmentally acceptable level of residual lead in these forms of shot is 1% (U.S. Department of the Interior, 2003).

Production

Primary.—In 2003, domestic mine production of lead increased by about 9,000 t, or 2%, compared with that of 2002. The major share of the U.S. mine output of lead continued to be derived from production in Alaska and Missouri. Appreciable lead mine production also was reported in Idaho and Montana. Domestic mine production data were collected by the U.S. Geological Survey (USGS) from a base-metal voluntary survey on lode-mine production of copper, lead, and zinc. All lead-producing mines responded to the survey. The lead concentrates produced from the mined ore were processed into primary metal at two smelter-refineries in Missouri (tables 1-4).

Doe Run Resources Corp., St. Louis, MO, produced primary lead at two smelter-refinery facilities in Missouri. Concentrates for the smelter-refineries were provided mainly from four Doe Run mills that were supplied with ore mined from five production shafts along the Viburnum Trend in southeastern Missouri. Some concentrates also were purchased in the open market to supplement those provided from the four mills. Doe Run suspended operations at its Glover, MO, smelter-refinery in November 2003 in response to a declining domestic market. The company planned to sell concentrate on the open market that was produced in excess of the quantity required to maintain operations at its Herculaneum, MO, smelter-refinery. In early January 2004, Doe Run announced that it would close permanently its Viburnum number 28 lead mine. The final supply of lead ore was removed from the mine in late November 2003. The mine operated for 41 years. Mine closure activities were expected to be completed in 2004 and would include equipment removal and permanent sealing of the mineshaft (Doe Run Resources Corp., 2004b). As of October 31, 2003, Doe Run's proven and probable U.S. ore reserves were about 44 Mt, containing an estimated 2.40 Mt of lead, 0.54 Mt of zinc, and 0.13 Mt of copper (Doe Run Resources Corp., 2004a, p. 3-27).

Teck Cominco Alaska Inc. (a wholly owned subsidiary of Teck Cominco Ltd., Vancouver, British Colombia, Canada) operated the Red Dog zinc-lead mine in northwestern Alaska under a leasing agreement with NANA Regional Corp., the sole owner of the property. NANA is a corporation organized under the provisions of the Alaska Native Claims Settlement Act. During 2003, production of lead in concentrate at Red Dog increased by 16% to 124,900 t compared with 107,900 t in 2002. The average mill recovery of lead at Red Dog was 63.8% in 2003 compared with 60.2% in 2002. Proven ore reserves at Red Dog, as of December 31, 2003, were estimated to be 25.6 Mt grading 21.3% zinc and 5.7% lead. Probable reserves at the nearby Aqqaluk deposit, as of December 31, 2003, were estimated to be 56.0 Mt grading 16.5% zinc and 4.1% lead. An improvement in operational efficiency as well as a significant increase in profitability was achieved at Red Dog in 2003. However, lead production in 2004 was expected to be about 10% lower compared with that of 2003 as the ore grades and recovery rates for lead were expected to decrease (Teck Cominco Ltd., 2004, p. 21, 62, and 63).

Construction at Teck Cominco's Pend Oreille zinc-lead mine near Metaline Falls, WA, was completed on time and on budget at the end of 2003. Production was to begin in early 2004, with anticipated production rates of 83,000 metric tons per year (t/yr) of zinc concentrates and 15,000 t/yr of lead concentrates. Pend Oreille, an underground room and pillar operation, was expected to have a mine life of about 8 years. Probable ore reserves at Pend Oreille, as of December 31, 2003, were estimated to be 5.7 Mt grading 7.7% zinc and 1.4% lead (Teck Cominco Ltd., 2004, p. 21, 62, and 63).

Hecla Mining Company, Coeur d'Alene, ID, operated the Lucky Friday Mine in Mullan, ID, throughout 2003. Lucky Friday is an underground silver-lead mine 100% owned by Hecla that has been a producing mine since 1958. Production at Lucky Friday since the end of 2001 has been at about 30% of full production as a result of declining metal prices. In 2003, lead production was increased by about 28% compared with that of 2002 to a level of 11,700 t but was still well below

the 29,000 t produced in 2000. Hecla continued to estimate that, with minimal additional development, the mine could continue to be operated at the lower production levels through 2004, provided the cost of operating was less than the cost of placing the property on care-and-maintenance status. In December 2003, Hecla's management approved the additional expenditures necessary to further develop the adjacent mining area known as the Gold Hunter deposit. It was anticipated that the time required to complete the development would be about 18 months, at which time mine production would be resumed at or near capacity. Ore was processed during the year in a conventional flotation mill with a capacity of about 1,000 metric tons per day (t/d). In 2003, ore was processed at a rate of about 380 t/d. Silver-lead and zinc concentrates were produced at the mill, with 94% of the silver, 94% of the lead, and 76% of the zinc being recovered. All silver, lead, and zinc concentrate production from the Lucky Friday operation was shipped to Teck Cominco's smelter in Trail, British Columbia, Canada, in 2003. Proven and probable ore reserves at Lucky Friday were estimated to be about 0.6 Mt grading 8.4% lead at yearend 2003 (Hecla Mining Company, 2004, p. 3-22).

Hecla Mining also held a 29.7% interest in the Greens Creek Mine on Admiralty Island near Juneau, AK, through a joint-venture arrangement with Kennecott Greens Creek Mining Co. (the manager of the mine) and Kennecott Juneau Mining Company; both are wholly owned subsidiaries of Kennecott Minerals. Greens Creek lies within the Admiralty Island Monument area and includes 17 patented lode claims and 1 patented millsite claim. In addition, it includes property leased from the U.S. Department of Agriculture's Forest Service and has title to mineral rights on 7,500 acres of Federal land adjacent to the mine properties. The mineral rights were acquired pursuant to a 1996 land exchange agreement whereby the Greens Creek joint venture transferred private property valued at $1.0 million to the Forest Service in exchange for access to the potential resources within the acquired Federal land. Production from new ore discoveries on the exchanged lands will be subject to Federal royalties included in the land exchange agreement. In 2003, about 2,000 t/d of ore was mined from the underground 200 South, Southwest, and West ore zones at Greens Creek and milled onsite to yield lead, zinc, and bulk concentrates as well as a gold-silver dore. Total production of lead in concentrate was about 25,300 t in 2003 compared with about 25,000 t in 2002. Estimated reserves at the Greens Creek Mine at yearend 2003 were 6.8 Mt grading 4.0% lead compared with 6.4 Mt grading 4.2% lead in 2002 (Hecla Mining Company, 2004, p. 3-22).

Apollo Gold Corporation resumed full production in early April at its Montana Tunnels polymetallic mine near Helena, MT. The mine had been scheduled for closure as a result of the depletion of developed ore reserves prior to Apollo's acquisition of the mine in April 2002. After the acquisition, Apollo immediately began a three-phase waste stripping program designed to redevelop the mine. Approximately 18 Mt of waste was moved, allowing the mill to be restarted in October 2002 with the processing of development ore from the stripped area of the mine. A second stripping phase was completed at the end of 2003. Proven and probable reserves at Montana Tunnels were estimated to be about 17 Mt grading about 0.20% lead, 0.56% zinc, 0.45 grams per metric ton (g/t) gold, and 5.1 g/t silver (Apollo Gold Corporation, 2003; CRU International Ltd., 2003b).

Secondary.—Domestic secondary production increased by about 3% in 2003. Secondary lead accounted for 82% of domestic lead refinery production compared with 81% in 2002. Lead-acid batteries continued to be the dominant source of recoverable lead scrap, accounting for 92% of all lead produced from secondary sources. The domestic secondary statistics were derived by the USGS from a combined secondary producer and consumer survey that included data from monthly and annual surveys. All of the 11 companies producing secondary lead, exclusive of that produced from copper-based scrap, were surveyed; 9 responded, representing about 99% of the total production of secondary lead. Of the total lead recycled in 2003, about 99% was produced by 7 companies operating 15 plants in Alabama, California, Florida, Indiana, Louisiana, Minnesota, Missouri, New York, Pennsylvania, Tennessee, and Texas. Production and consumption for the nonrespondents were estimated by using prior-year levels as a basis (tables 1, 5-9).

In March 2003, Doe Run and East Penn Manufacturing Company, Inc., Lyon Station, PA, reported ongoing plans to increase secondary lead production at their respective facilities. According to a company report, Doe Run applied to the State of Missouri for an air permit that would allow the company to increase secondary lead production at its Boss, MO, smelter by 25%. Further study was underway at East Penn to establish an appropriate configuration of additional furnaces for increasing the secondary lead output (Platts Metals Week, 2003b).

The lead-acid battery industry recycled 97.1% of the available lead scrap from spent lead-acid batteries during the period 1997 through 2001, according to a report issued by the Chicago, IL-based Battery Council International (BCI) in mid-2003. Lead-acid batteries remained the United States most highly recycled consumer product. Historically, the recycling rate of battery lead has consistently ranked higher than other recyclable materials (Platts Metals Week, 2003e). The BCI report tracked the lead recycling rate from spent automotive, garden tractor, marine, motorcycle, truck, and miscellaneous lead-acid batteries.

Exide Technologies, Inc., Princeton, NJ, a major producer of secondary lead and a manufacturer of lead acid batteries, began its emergence from Chapter 11 bankruptcy protection in mid-2003. Under a reorganization plan filed during July with the U.S. Bankruptcy Court in Delaware, debt would be exchanged for equity, all existing common stock would be canceled, and a seven-member board would be established. Final court approval of the plan was to be granted contingent upon the backing of certain shareholders. The company continued negotiations with lenders to acquire the necessary financing to exit Chapter 11. There were no plans to sell any additional assets (American Metal Market, 2003b).

Environment

The U.S. paint industry and most of the Nation's State attorneys general announced an agreement in mid-May aimed at reducing the hazard from lead-containing paint. The agreement will require uniform stickers or labels on new paint cans warning consumers of the dangers associated with dust from

old paint that may be disturbed during home renovations. The agreement also will fund a national training program to instruct individuals on safe methods for eliminating lead paint in old homes and to provide discounts on the cost of certain equipment used in the removal of old paint (Kaufman, 2003).

The Ad Hoc Metals Coalition of the U.S. metals sector was briefed by the U.S. Department of Commerce and several European metal industry representatives on a draft of a new policy issued by the European Commission outlining the manner in which chemicals, including metals, are assessed in the European Union (EU). The core of the policy, known as the REACH system, reverses the burden of proof about the safety of chemicals from regulators to industry. The responsibility for establishing this proof of safety extends to all metals, metal compounds, and metal-bearing products and wastes. The REACH system will apply to all chemicals and metals manufactured in or imported by EU countries. Metal products were to be included in the first phase of registrations required under the REACH system. At the briefing, the U.S. metals sector participants were urged by the European industry to submit comments emphasizing, in part, the need to exclude minerals, ores, and concentrates from the REACH system and the importance of simplifying procedures for importing secondary (recyclable) raw materials under the system (Environmental Updates, 2003b).

The California Air Resources Board (CARB) recently approved modifications to the State's zero-emission vehicle program. Under the program, automakers will be allowed to meet emission requirements through the manufacture of an adjusted mix of battery-driven electric, clean conventional, hybrid-electric, and natural-gas-powered vehicles. Alternatively, automakers can meet program requirements by the manufacture of an adjusted mix of clean conventional, hybrid, and natural gas vehicles provided they produce the required market-weighted share of fuel cell vehicles. Total production of fuel cell vehicles by all manufacturers combined must total 250 by 2008; 2,500 by 2011; 25,000 by 2014; and 50,000 by 2017. Automakers will be allowed to meet 50% of their fuel cell requirements through the manufacture of battery-driven electric vehicles (Advanced Battery Technology, 2003).

The European Commission adopted a proposal in December for a new battery directive, which will require the collection and recycling of all batteries placed on the EU market. The proposal was intended to prevent spent batteries from being discarded in incinerators and landfills, thereby effectively increasing the recovery of the various metals used in batteries as well as addressing environmental concerns associated with these metals. The proposal would include a ban on the landfilling and incineration of automotive and industrial type batteries and aimed to create an EU-wide framework for national battery collection and recycling schemes (Platts Metals Week, 2003c).

Consumption

Reported U.S. consumption of lead decreased by about 3% in 2003 as the demand for lead slowed in many end-use sectors. A continuing lackluster demand for industrial-type sealed lead-acid batteries in backup power systems was evident as telecommunications companies scaled down investment plans significantly. In addition, the demand for original equipment automotive batteries declined slightly as a result of slow growth in the U.S. economy. Contributing to the declining demand for lead in the United States was the relocation of some lead-consuming industries to other areas of the world. The demand for replacement automotive batteries was moderately stronger in 2003 but insufficient to counter lower demand in the other battery sectors. Replacement battery demand is related principally to seasonal temperature extremes that effectively increase the rate of automotive battery failures. Consumption of lead in SLI- and industrial-type lead-acid storage batteries represented 84% of the total reported consumption of lead. Industrial-type batteries included stationary batteries (such as those used in uninterruptible power-supply equipment for computer and telecommunications networks, hospitals, and load-leveling equipment for commercial electrical power systems) as well as traction batteries (such as those used in airline ground equipment, industrial forklifts, and mining vehicles). Of the 95 consuming companies to which a USGS survey request was sent, 70 responded, representing about 98% of the total reported U.S. lead consumption.

Total North American SLI battery shipments were 107.2 million units in 2003 (Amistadi, 2004). The total included original equipment and replacement automotive-type batteries. Using an estimate of 10.6 kilograms (kg) (23.3 pounds) of lead per unit, SLI shipments in 2003 accounted for about 1.148 Mt of lead. SLI batteries included those used for automobiles, buses, general utility vehicles, golf cars, marine craft, motorcycles, tractors, and trucks (tables 6-13).

World Industry Structure

World mine production of lead increased in 2003 by about 70,000 t to 2.95 Mt, or a 2.4% increase when compared with production in 2002. Of the 41 countries in which lead was mined, the top 6 accounted for 82% of the world's total production. Australia was the largest producer, with 24% of the world total, followed by China, 22%; the United States, 16%; Peru, 10%; Canada, 5%; and Mexico 5%.

Worldwide reserves of lead contained in demonstrated resources in producing and nonproducing deposits at yearend were estimated to be 67 Mt by the USGS (Smith, 2004). Reserves for the three largest producers in the world, Australia, China, and the United States, were about 15 Mt, 11 Mt, and 8.1 Mt of contained lead, respectively. The reserve base (reserves plus measured and indicated resources that are marginally economic and some of those that are currently subeconomic) for Australia and China was 28 Mt and 36 Mt, respectively. The reserve base for the United States was 20 Mt. The total world reserve base at the end of 2003 was estimated to be 140 Mt.

World production of refined lead increased to 6.82 Mt in 2003 from 6.63 Mt in 2002. Other statistics for 2003, as reported by the International Lead and Zinc Study Group, are as follows: world consumption increased to 6.83 Mt from 6.65 Mt in 2002; commercial stocks of refined lead in industrialized countries were 391,000 t, or 4 weeks of consumption, at yearend 2003 compared with 481,000 t at yearend 2002 and 435,000 t at yearend 2001; and

significant exports of refined lead to industrialized countries from developing Asian countries, notably China, continued during 2003, increasing by about 2% to 492,000 t compared with those of 2002 (International Lead and Zinc Study Group, 2004, p. 6-21).

LME lead prices increased sharply during the last half of the year, attributed mostly to strong speculative fund commodity buying. The average LME and North American Producer prices were up in 2003 by $0.028 per pound and $0.002 per pound, respectively, from the average prices of $0.205 per pound and $0.436 per pound, respectively, in 2002.

The structure of the lead mining and refining industries was affected by a number of changes, including the opening and development of new facilities as well as the closing, reopening, expanding, selling, restructuring, and modernizing of existing facilities (tables 14, 15).

World Review

Australia.—Australia's Perth-based Kagara Zinc Ltd. received final drill results from its Balcooma polymetallic deposit, part of the Mount Garnet project in Queensland. Lead concentrations ranging from 4.3% to 10.5% were reported. The data, acquired from the final drillings, were included in a revised resource estimate for Balcooma. Earlier drill results had revealed lead concentrations ranging from 6.6% to 8.7% (Mining Journal, 2003a).

Ivernia West Inc., Toronto, Ontario, Canada, received new reserve estimates at the end of the year for the Cano lead deposit, part of its 60%-owned Magellan property in Western Australia. The reserve estimates effectively increased the quantity of economically recoverable lead at Cano by 40% to a level of 211,000 t. Total measured and indicated resources at Cano are estimated to be 3.8 Mt grading 5.5% lead. The Cano deposit represents about 25% of the measured and indicated resources at the Magellan project. A mine life of about 12 years is envisioned for the Magellan project with concentrate production beginning in 2005. Construction of a refinery for processing the concentrate onsite is expected to be completed in 2008 (Ivernia West Inc., 2003).

Australian-based Western Metals Ltd. entered into voluntary administration in July, the equivalent of U.S. Chapter 11 bankruptcy protection, after failing to attract new equity and restructure its debt. The company cited depressed metal prices and the strengthening of the Australian dollar as reasons for its financial difficulties. In May, Western announced that it would temporarily suspend operations at its Kapok lead-zinc mine and transfer staff to its Pillara operations, part of the Leonard Shelf lead-zinc deposit. Prior to its closure, the Kapok Mine yielded 24,400 t of zinc and 20,000 t of lead in the 9 months that ended March 31, 2003 (American Metal Market, 2003e). In October, Canada's Teck Cominco Ltd. agreed to purchase the Lennard Shelf zinc-lead mining assets of Western. Finalization of the sale was subject to completion by Western of a program placing the operations on care and maintenance by about the end of November 2003. Teck Cominco will prepare a redevelopment plan for the Lennard Shelf assets, which will include a detailed review of reserves/resources and the generation of an exploration program to further define and expand reserves/resources. A decision to restart the two underground Lennard Shelf mines (Kapok and Pillara) will depend on the results of the redevelopment plan as well as the status of the zinc market and monetary exchange rates. About 176,000 t of zinc and 70,000 t of lead in concentrate were produced, in total, from the mines in the year ended June 30, 2003 (Mining Journal, 2003d).

Swiss-based Xstrata plc completed the takeover of Australia's MIM Holdings Ltd. effective June 24, 2003. The cash offer for the major Australian mining company had been approved by MIM shareholders on June 6. MIM sold 406,000 t of zinc and 274,000 t of lead in 2002 (Platts Metals Week, 2003i).

In Australia, Consolidated Broken Hill Ltd. (CBH) planned to resume production of lead and zinc concentrates following acquisition of the Elura Mine, New South Wales, from Pasminco Ltd. in mid-September. CBH anticipated investing sufficient capital to increase the existing mine life by about 4.5 years, effectively doubling the life of the mine. At current throughput rates, the Elura Mine can yield enough concentrate to produce 73,000 t/yr of zinc and 42,000 t/yr of lead (American Metal Market, 2003a).

Canada.—Canadian Zinc Ltd. received approval from local authorities to proceed with underground development of a polymetallic lead-zinc-copper-silver mine as well as construction of a metallurgical pilot plant at the Prairie Creek project in Canada's Northwest Territories. Prairie Creek (formerly known as the Cadillac property) was financed in the early 1980s, but the collapse of silver prices halted its startup just a few months before its scheduled opening. Overall, Prairie Creek hosted a mineral resource of 11.9 Mt grading 12.5% zinc, 10.1% lead, 0.4% copper, and 161 grams per metric ton of silver (Northern Miner, 2003).

China.—China's Wanyang Lead Group, Henan Province, announced plans to increase primary refined lead production in 2003 to between 45,000 and 50,000 t/yr, up from the 35,000 t/yr produced in 2002. The plant capacity had been increased to 58,000 t/yr from the previous 33,000 t/yr in late 2002. Wanyang also continued with its plans to construct a new 50,000-t/yr primary lead smelter to replace the company's antiquated 30,000-t/yr smelter (Platts Metals Week, 2003h).

In February, China's Yuguang Gold and Lead Group, Henan Province, announced plans to increase primary refined lead production in 2003 to 180,000 t compared with 136,000 t in 2002. Refinery capacity had been increased to 180,000 t/yr as a result of the completion of an expansion project in May 2002. Yuguang potentially could increase its exports of lead by about 15% to a level of 80,000 t/yr as a result of the expansion (Platts Metals Week, 2003k).

Yubei Metal Smelter, Henan Province, increased its primary refined lead output to 130,000 t in 2003 compared with 90,000 t in 2002 as a result of the installation of new smelting furnaces early in the year. With the new furnaces, Yubei effectively increased its production capacity to 150,000 t/yr. Yubei had doubled its lead capacity to 120,000 t/yr in 2002 with the completion of an expansion project in December 2001. However, output was limited in 2002 by a tight supply of concentrate feed (Platts Metals Week, 2003j).

China's Jiyuan Gold Smelter, Henan Province, completed the expansion of its refined lead capacity to 200,000 t/yr from the

previous 150,000 t/yr in June 2003. About 160,000 t of lead was produced in 2003 with full production anticipated in 2004. Exports of refined lead in 2003 were maintained at the 2002 level of 80,000 t (Platts Metals Week, 2003d).

France.—France's Metaleurop Nord (a wholly owned subsidiary of Metaleurop SA) formally placed its Noyelles-Godault lead-zinc smelter in liquidation in early March after efforts to sell the facility were unsuccessful. In mid-January, the parent company had halted further investment in Noyelles-Godault, most notably for the plan to convert the operation from primary to secondary production. Noyelles-Godault has suffered significant financial losses during the past 2 years as a producer of primary metal. The Noyelles-Godault complex consisted of an imperial smelting furnace operation with a production capacity of 90,000 t/yr zinc and 30,000 t/yr lead, a 100,000-t/yr lead blast furnace, and a 130,000-t/yr lead refinery. Reportedly, all lead inventories at Noyelles-Godault were shipped out, following the announcement of liquidation (CRU International Ltd., 2003a).

India.—Australia's Ausmelt, Ltd. signed an agreement with India's Hindustan Zinc, Ltd. (HZL) in mid-April to build a 60,000-t/yr lead smelter at Chanderiya in Rajasthan, India. The new smelter was to be designed to process a mixture of concentrates from HZL's mines as well as residues from the company's existing smelter. Construction of the smelter began in 2003 after the signing of the agreement (Platts Metals Week, 2003a).

Indian Lead Ltd. sold its secondary lead production facilities in January, following more than 18 months of financial difficulties and temporary shutdowns. Reportedly, the new owner planned to shift equipment from Indian Lead's 40,000-t/yr plant at Thane to a site nearby at Wada. Indian Lead's 7,000-t/yr plant at Kolkata was restarted in early 2003 (American Metal Market, 2003c).

Italy.—In Sardinia, all lead and zinc production was halted at the Porto Vesme primary smelting complex, beginning October 1, 2003. Speculation was that the complex would be shut down for at least 6 months. Swiss-based Glencore International AG (the operator of the complex) continued its attempts to resolve the issue of high electric power costs at Porto Vesme, a major factor in the decision to close the smelting complex. The complex included a Kivcet lead smelter with a production capacity of 100,000 t/yr and an imperial smelting furnace with a lead capacity of 40,000 t/yr (Platts Metals Week, 2003f).

Macedonia.—The Macedonian Privatization Agency continued its efforts to sell three of the country's lead-zinc mining operations. The operations are located in northeastern Macedonia near the border with Bulgaria. Each of the mines is currently operating below capacity owing principally to the loss of markets in the Commonwealth of Independent States, and Serbia and Montenegro. The Rudnici Zietovo Mine in the Probistip region has an ore production capacity of 600,000 t/yr; the Sasa Mine in Makedonska Kamenica and the Toranica Mine in Kriva Palanka can produce 750,000 t/yr and 450,000 t/yr, respectively. Measured and indicated resources at Sasa are estimated to be 18.9 Mt grading 4.68% lead and 3.46% zinc; at Rudnici Zietovo, 10 Mt grading 5.79% lead and 2.09% zinc; and at Toranica, 9.9 Mt grading 4.18% lead and 3.14% zinc. The Privatization Agency had set a deadline of February 20, 2004, for receipt of bids on these mines (Mining Journal, 2003b).

Mexico.—Canada's Vancouver-based Western Silver Corp. reported a new, higher grade zone of mineralization from a continued drilling program at its Penasquito polymetallic property in Zacatecas State, Mexico. Lead concentrations ranging from 1.16% to 9.11% were intersected at this new zone, named La Palma. Drilling continued during the year at areas of known mineralization as well as new areas that might extend the mineralization at Penasquito (Mining Journal, 2003c).

In Mexico, the two major owners of the Rey de Plata lead-zinc mine closed the mine permanently at the end of January, citing low metal prices. The mine opened in 1997, supplying lead concentrates to Industrias Peñoles SA de CV (51% owner) and zinc concentrates to Akita Zinc Co. Ltd. (a smelter majority owned by Japan's Dowa Mining Ltd., which also owns a 39% stake in Minera Rey de Plata SA de CV). At its peak, the mine supplied 1,500 metric tons per month (t/mo) of lead concentrate to Peñoles and 4,500 t/mo of zinc concentrate to Akita. The mine had been idled in December 2001 in hopes that metal prices would improve sufficiently to permit its restart. Japan's Sumitomo Metal Mining Co. Ltd. owned the remaining 10% of Minera Rey de Plata (American Metal Market, 2003d).

Pakistan.—MCC Resources Development Co., Beijing, China, accelerated its commitment in Pakistan, with plans to embark on a new lead-zinc project in Balochistan Province. MCC expected to mine the first ore at the Duddar underground lead-zinc mine by 2005, following a construction period of about 18 months. The company secured the mining rights to Duddar from Pakistan's Government in early November. The mine, located in Kanraj Valley, is anticipated to yield 32,500 t/yr of lead concentrate (54% lead) and 100,000 t/yr of zinc concentrate (65% zinc). Duddar was expected to have a mine life of about 14 years (Metal Bulletin, 2003b).

Serbia and Montenegro.—The Trepca lead-zinc mining and smelting complex in Kosovo would restart mining activities in some of the open pit mining areas by the end of 2003. The resumption of mining was necessary in order to generate sufficient revenue to begin extensive modernization of the complex. A transitional production period of up to 3 years was likely to be required to gather production and processing data, since the data generated prior to the closure of Trepca were not considered to be of appropriate standard to satisfy potential foreign investment in the complex. Trepca was closed in 2000 following the conflict in what was the former Yugoslavia (Mining Journal, 2003e).

Thailand.—Thailand's Bergsoe Metals (a producer of secondary lead) planned to increase its capacity by between 50% and 67% in early 2004. Bergsoe's production capacity was between 900 and 1,000 t/mo of refined secondary lead (Platts Metals Week, 2003g).

United Kingdom.—Britannia Recycling Ltd., United Kingdom, closed its Wakefield, West Yorkshire County, secondary lead refinery at the beginning of the year, citing poor market conditions for lead. Production capacity at Wakefield was about 20,000 t/yr but prior to closing was producing at a rate of only 12,000 t/yr. Secondary lead production was expected to continue at Britannia's sister company Britannia

Refined Metals Ltd. in Northfleet, Kent County. Secondary production at Northfleet was about 40,000 t/yr. The Britannia companies are subsidiaries of Australia's MIM Holdings Ltd. Northfleet also refined lead bullion produced at MIM's Mt. Isa smelter in Australia. Total production of lead and lead alloys at Northfleet in fiscal year 2001-02 was about 250,000 t (Metal Bulletin, 2003a).

Outlook

World usage of refined lead is forecast to rise by 2.4% in 2004. It is anticipated that European consumption of lead will rise by 2.5% in 2004. Demand in the United States is expected to decline by 2.3% in 2004. Some of this decline is attributed to the rising number of imports of finished automotive batteries as well as to the increased longevity of automotive batteries. In China, further increases in the vehicle fleet, increased exports of automotive batteries, and ongoing investment in the telecommunications and information technology sectors are expected to result in a demand growth of 10.5% in 2004. On the supply side, global lead mine production is expected to rise by 2.8% in 2004. The increase is attributed to the cumulative effect of small increases in production in several countries, including Australia, China, India, Ireland, Mexico, and Peru. Global output of refined lead is forecast to fall by about 0.5% in 2004, despite production increases in Asia. The global fall in production is mainly the consequence of the loss of smelting and refining capacity through closures in Australia, Europe, and the United States. A supply deficit of about 130,000 t is anticipated in the Western World market in 2004 (International Lead and Zinc Study Group, 2003).

Mine production in the United States is expected to decline by about 5% in 2004 as a result of additional temporary production cutbacks at several of the larger facilities. Refined lead production from primary refineries will decline by nearly 40% as a result of the temporary closure of one of the two remaining refineries. Secondary production of lead is expected to remain at a level comparable with that of 2003 but could rise slightly should weather-related temperature extremes increase the demand for replacement automotive-type batteries.

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TABLE 1
SALIENT LEAD STATISTICS[1]

(Metric tons unless otherwise specified)

		1999	2000	2001	2002	2003
United States:						
Production:						
Mine, recoverable lead content:[2]						
Quantity		503,000	449,000	454,000	440,000	449,000
Value	thousands	$485,000	$431,000	$437,000	$423,000	$433,000
Primary lead, refined, lead content:						
Domestic ores and base bullion		350,000	341,000	290,000	262,000	245,000
Foreign ores and base bullion		W	W	W	W	W
Secondary lead, lead content		1,110,000	1,130,000	1,100,000	1,120,000	1,150,000
Exports, lead content:						
Lead ore and concentrates		93,500	117,000	181,000	241,000	253,000
Lead materials, excluding scrap		103,000	92,000	52,400	43,400	123,000
Imports for consumption, lead content:						
Lead in ore and concentrates		12,300	31,200	2,240	6	--
Lead in base bullion		90	65	--	--	--
Lead in pigs, bars, and reclaimed scrap		311,000	356,000	271,000	210,000	175,000
Stocks, December 31, lead content:						
Primary lead		12,300	18,600	W [3]	W [3]	W
At consumers and secondary smelters		78,700	106,000	100,000	111,000 [r]	107,000
Consumption of metal, primary and secondary, lead content		1,680,000	1,720,000	1,550,000	1,440,000	1,390,000
Price, North American Producer average, delivered[4]	cents per pound	43.72	43.57	43.64	43.56	43.76
World:						
Production, gross weight:						
Mine	thousands metric tons	3,060 [r]	3,170 [r]	3,090 [r]	2,880 [r]	2,950 [e]
Refinery[5]	do.	3,320	3,590 [r]	3,570	3,520 [r]	3,710 [e]
Secondary refinery	do.	2,970 [r]	3,060 [r]	3,000 [r]	3,110 [r]	3,110 [e]
Price, London Metal Exchange, pure lead, cash average[4]	cents per pound	22.78	20.57	21.58	20.52	23.34

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Primary lead, refined, domestic ores and base bullion." -- Zero.
[1]Data are rounded to no more than three significant digits, except prices.
[2]Lead recoverable after smelting and refining. Number in table 14 represents lead in concentrate.
[3]Included with stocks at consumers and secondary smelters.
[4]Platts Metals Week.
[5]Primary metal production only; includes secondary metal production, where inseparable.

TABLE 2
MINE PRODUCTION OF RECOVERABLE LEAD IN THE UNITED STATES, BY STATE[1]

(Metric tons, lead content)

State	2002	2003
Alaska and Missouri	428,000	432,000
Other States[2]	12,300	17,200
Total	440,000	449,000

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Idaho, Montana, and Nevada.

TABLE 3
LEADING LEAD-PRODUCING MINES IN THE UNITED STATES IN 2003, IN ORDER OF OUTPUT[1]

Rank	Mine	County and State	Operator	Source of lead
1	Red Dog	Northwest Arctic, AK	Teck Cominco Alaska Inc.	Lead-zinc ore.
2	Brushy Creek	Reynolds, MO	Doe Run Resources Corp.	Lead ore.
3	Fletcher	do.	do.	Do.
4	Buick	Iron, MO	do.	Do.
5	Sweetwater	Reynolds, MO	do.	Do.
6	Greens Creek	Juneau, AK	Kennecott Greens Creek Mining Co.	Zinc ore.
7	Casteel	Iron, MO	Doe Run Resources Corp.	Lead ore.
8	Lucky Friday	Shoshone, ID	Hecla Mining Company	Silver ore.
9	Montana Tunnels	Jefferson, MT	Montana Tunnels Mining, Inc.	Gold ore.
10	Viburnum #28	Iron, MO	Doe Run Resources Corp.	Lead ore.

TABLE 4
REFINED LEAD PRODUCED AT PRIMARY REFINERIES IN THE UNITED STATES, BY SOURCE MATERIAL[1]

(Metric tons, lead content, unless otherwise specified)

Source material		2002	2003
Refined lead:			
Domestic ores and base bullion		262,000	245,000
Foreign ores and base bullion		W	W
Total		262,000	245,000
Calculated value of primary refined lead[2]	thousands	$252,000	$236,000

W Withheld to avoid disclosing company proprietary data; included with "Refined lead, domestic ores and base bullion."
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Value based on average quoted price.

TABLE 5
LEAD RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES,
BY KIND OF SCRAP AND FORM OF RECOVERY[1]

(Metric tons, lead content, unless otherwise specified)

		2002	2003
Kind of scrap:			
New scrap:			
Lead-base		34,800	33,900
Copper-base		7,960 r	7,010
Total		42,800 r	40,900
Old scrap:			
Battery-lead		1,010,000	1,060,000
All other lead-base		53,100	44,600
Copper-base		6,400 r	4,370
Total		1,070,000	1,110,000
Grand total		1,120,000	1,150,000
Form of recovery:			
As soft lead		754,000	829,000
In antimonial lead		289,000	303,000
In other lead alloys		58,400	4,230
In copper-base alloys		14,400 r	11,400
Total:			
Quantity		1,120,000	1,150,000
Value[2]	thousands	1,070,000	1,110,000

rRevised.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Value based on average quoted price of common lead.

TABLE 6
U.S. CONSUMPTION OF LEAD, BY PRODUCT[1]

(Metric tons, lead content)

SIC code	Product	2002	2003
	Metal products:		
3482	Ammunition, shot and bullets	57,600	48,800
	Bearing metals:		
35	Machinery except electrical	W	W
36	Electrical and electronic equipment	W	W
371	Motor vehicles and equipment[2]	374	357
37	Other transportation equipment	W	W
	Total	406	406
3351	Brass and bronze, billets and ingots	2,730	2,810
36	Cable covering, power and communication	W	W
15	Calking lead, building construction	1,060	822
	Casting metals:		
36	Electrical machinery and equipment	W	W
371	Motor vehicles and equipment	29,400	27,500
37	Other transportation equipment	W	W
3443	Nuclear radiation shielding	1,290	227
	Total	34,800	31,700
	Pipes, traps, other extruded products:		
15	Building construction	2,250	1,670
3443	Storage tanks, process vessels, etc.	(3)	(3)
	Total	2,250	1,670
	Sheet lead:		
15	Building construction	18,100	16,900
3443	Storage tanks, process vessels, etc.	(3)	(3)
3693	Medical radiation shielding	7,550	7,370
	Total	25,600	24,200
	Solder:		
15	Building construction	1,320	1,480
	Metal cans and shipping containers	W	W
367	Electronic components, accessories and other electrical equipment	3,970	3,670
371	Motor vehicles and equipment	W	W
	Total	6,450	6,310
	Storage batteries:		
3691	Storage battery grids, post, etc.	554,000	523,000
3691	Storage battery oxides	641,000	642,000
	Total storage batteries	1,190,000	1,170,000
371	Terne metal, motor vehicles and equipment	(4)	(4)
27	Type metal, printing and allied industries	(5)	(5)
34	Other metal products[6]	24,200	22,800
	Total	1,350,000	1,310,000
	Other oxides:		
285	Paint	W	W
32	Glass and ceramics products	W	W
28	Other pigments and chemicals	W	W
	Total	51,900	35,700
	Miscellaneous uses	34,200	42,600
	Grand total	1,440,000	1,390,000

W Withheld to avoid disclosing company proprietary data; included in appropriate totals.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes "Metal products: Storage batteries: Terne metal, motor vehicles and equipment."
[3]Included with "Metal products: Sheet lead: Building construction" to avoid disclosing company proprietary data.
[4]Included with "Metal products: Bearing metals: Motor vehicles and equipment."
[5]Included with "Metal products: Storage batteries: Other metal products" to avoid disclosing company proprietary data.
[6]Includes lead consumed in foil, collapsible tubes, annealing, galvanizing, plating, electrowinning, and fishing weights.

TABLE 7
U.S. CONSUMPTION OF LEAD IN 2003, BY STATE[1, 2]

(Metric tons, lead content)

State	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
California and Washington	25,700	26,500	2,710	--	54,900
Florida and Georgia	18	677	35,900	--	36,600
Illinois	5,030	19,700	10,800	--	35,500
Iowa, Michigan, Missouri	1,390	3,400	4	--	4,800
Ohio and Pennsylvania	75,500	43,500	57,900	550	177,000
Arkansas and Texas	38,700	15,200	9,640	--	63,500
Alabama, Louisiana, Oklahoma	107,000	2,040	--	--	109,000
Colorado, Indiana, Kansas, Kentucky, Minnesota, Nebraska, Tennessee, Wisconsin	179,000	72,300	47,200	133	298,000
Connecticut, Maryland, New Jersey, New York, North Carolina, South Carolina	27,200	8,850	15,900	--	51,900
Various States	295,000	183,000	77,800	--	556,000
Total	753,000	375,000	258,000	683	1,390,000

-- Zero.

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

[2]Includes lead that went directly from scrap to fabricated products.

TABLE 8
U.S. CONSUMPTION OF LEAD IN 2003, BY CLASS OF PRODUCT[1, 2]

(Metric tons, lead content)

Product	Soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
Metal products	59,200	74,000	9,690	683	144,000
Storage batteries	647,000	301,000	218,000	--	1,170,000
Other oxides	W	--	--	--	W
Miscellaneous	47,500	153	30,600	--	78,300
Total	753,000	375,000	258,000	683	1,390,000

W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous." -- Zero.

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

[2]Includes lead that went directly from scrap to fabricated products.

TABLE 9
STOCKS OF LEAD AT CONSUMERS AND SECONDARY SMELTERS
IN THE UNITED STATES, DECEMBER 31[1, 2]

(Metric tons, lead content)

Year	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
2002	59,300 [r]	31,200	20,000 [r]	154	111,000 [r]
2003	60,100	31,300	15,400	151	107,000

[r]Revised.

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

[2]Includes stocks at primary refineries.

TABLE 10
PRODUCTION AND SHIPMENTS OF LEAD PIGMENTS AND OXIDES IN THE UNITED STATES[1, 2]

(Metric tons and dollars)

	2002				2003			
	Production		Shipments		Production		Shipments	
Product	Gross weight	Lead content	Quantity (lead content)	Value[3]	Gross weight	Lead content	Quantity (lead content)	Value[3]
Litharge, red lead and white lead, dry	758	636	20,400	13,500,000	1,290	1,170	14,800	9,600,000
Leady oxide	661,000	628,000	NA	NA	649,000	616,000	NA	NA
Total	662,000	628,000	NA	NA	650,000	618,000	NA	NA

NA Not available.

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

[2]Excludes basic lead sulfate to avoid disclosing company proprietary data.

[3]At plant, exclusive of container.

TABLE 11
U.S. IMPORTS FOR CONSUMPTION OF LEAD PIGMENTS AND COMPOUNDS, BY KIND[1]

Kind	Quantity (metric tons, lead content)	Value (thousands)
2002:		
White lead carbonate	--	--
Red and orange lead	15	$106
Chrome yellow, molybdenum orange pigments, lead-zinc chromates	8,040	20,600
Litharge	3,820	2,030
Glass frits (undifferentiated)	21,400	21,400
Total	33,300	44,200
2003:		
White lead carbonate	1	2
Red and orange lead	40	317
Chrome yellow, molybdenum orange pigments, lead-zinc chromates	6,700	17,600
Litharge	2,180	1,200
Glass frits (undifferentiated)	27,100	31,000
Total	36,000	50,100

-- Zero.

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

Source: U.S. Census Bureau.

TABLE 12
U.S. EXPORTS OF LEAD, BY COUNTRY[1]

	2002		2003	
Country	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Ore and concentrates, lead content:				
Bahamas, The	20,900	$952	--	--
Belgium	22,500	4,930	5,500	$1,250
Canada	10,800	7,110	17,600	11,500
China	2,700	534	72,000	25,700
France	--	--	6,320	3,330
Germany	477	148	11,500	4,360
Italy	27,400	13,300	7,000	1,490
Japan	44,500	10,200	49,200	18,600

See footnotes at end of table.

TABLE 12--Continued
U.S. EXPORTS OF LEAD, BY COUNTRY[1]

Country	2002 Quantity (metric tons)	2002 Value (thousands)	2003 Quantity (metric tons)	2003 Value (thousands)
Ore and concentrates, lead content--Continued:				
Korea, Republic of	42,200	$13,400	39,500	$14,300
Mexico	52,800	32,600	43,600	16,400
Netherlands	16,100	3,610	--	--
Other	310	315	1,080	841
Total	241,000	87,200	253,000	97,700
Base bullion, lead content:				
Belgium	243	260	556	488
Other	13	127	37	397
Total	256	387	593	885
Unwrought lead and lead alloys, lead content:				
Belgium	10	17	1,900	1,210
Canada	1,430	940	910	691
France	240	113	3,620	2,270
Germany	9	61	437	543
Ireland	1	15	2,090	1,250
Israel	661	2,260	63	848
Italy	245	60	30,600	18,900
Korea, Republic of	101	99	1	11
Mexico	22,100	12,800	33,600	22,200
Netherlands	2	22	14,200	6,930
Spain	2	23	1,290	692
United Kingdom	6,040	2,620	1,590	1,050
Other	525	653	1,830	1,940
Total	31,400	19,700	92,100	58,500
Wrought lead and lead alloys, lead content:				
Canada	3,190	4,870	2,540	4,950
China	1,110	1,060	793	779
France	272	390	16	230
Germany	2,960	2,610	1,700	1,960
Hong Kong	414	1,920	1,020	2,270
Ireland	22	216	1,030	640
Korea, Republic of	859	706	1,970	1,760
Mexico	1,170	5,320	820	2,420
Netherlands	191	320	49	103
Poland	--	--	5,850	3,630
Saudi Arabia	149	1,720	14	73
Singapore	398	520	1,270	996
South Africa	28	207	59	661
Switzerland	2	12	10,800	6,730
United Kingdom	310	836	498	998
Other	659	3,580	2,000	6,300
Total	11,700	24,300	30,500	34,500
Scrap, gross weight:				
Canada	40,900	4,700	40,900	4,930
China	53,500	14,300	40,800	13,000
Dominican Republic	318	456	1,270	1,580
France	33	9	--	--
Haiti	--	--	--	--
India	1,450	770	2,080	1,190
Japan	26	269	1	24
Korea, Republic of	5,540	1,170	6,770	1,610
Mexico	3,040	924	189	178
Spain	640	141	--	--

See footnotes at end of table.

TABLE 12--Continued
U.S. EXPORTS OF LEAD, BY COUNTRY[1]

Country	2002 Quantity (metric tons)	2002 Value (thousands)	2003 Quantity (metric tons)	2003 Value (thousands)
Scrap, gross weight--Continued:				
Taiwan	--	--	58	$34
Other	508	$592	671	704
Total	106,000	23,300	92,800	23,300

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

Source: U.S. Census Bureau.

TABLE 13
U.S. IMPORTS FOR CONSUMPTION OF LEAD, BY COUNTRY[1]

Country	2002 Quantity (metric tons)	2002 Value (thousands)	2003 Quantity (metric tons)	2003 Value (thousands)
Ore and concentrates, other, lead content:[2]	6	$8	--	--
Pigs and bars, lead content:				
Australia	2,630	1,290	107	$61
Belgium	82	60	4	21
Canada	172,000	89,100	167,000	88,600
China	28,200	12,100	1	7
Mexico	7,460	3,530	8,270	3,520
Other	197	549	255	179
Total	210,000	107,000	175,000	92,400
Reclaimed scrap, including ash and residues, lead content:				
Canada	300	228	673	394
Colombia	1,580	611	3,070	1,250
Mexico	622	834	406	720
Other	71	66	--	--
Total	2,570	1,740	4,150	2,360
Wrought lead, all forms, including wire and powders, gross weight:				
Australia	18	87	--	--
Belgium	4	26	--	--
Canada	4,300	5,250	4,310	6,560
China	597	1,810	716	2,220
France	15	206	37	173
Germany	1,000	2,710	964	3,060
Guatemala	--	--	--	--
Hong Kong	3	42	--	--
Italy	45	306	4	19
Japan	50	557	81	795
Mexico	61	168	109	126
Netherlands	625	1,470	319	1,160
New Zealand	41	321	34	350
Peru	50	27	16	17
Taiwan	226	642	197	679
United Kingdom	490	1,360	659	1,410
Other	464	1,200	335	1,250
Total	7,990	16,200	7,780	17,800

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Also includes other lead-bearing materials containing more than 5 troy ounces per short ton of gold or more than 100 troy ounces per short ton of total precious metals.

Source: U.S. Census Bureau.

TABLE 14

LEAD: WORLD MINE PRODUCTION OF LEAD IN CONCENTRATE, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	1999	2000	2001	2002	2003[e]
Algeria	1,215	818	991 [r]	1,105 [r]	1,108 [4]
Argentina	15,256	14,115	12,334	12,011	12,079 [4]
Australia	681,000	739,000	714,000	683,000	694,000 [4]
Bolivia	10,153	9,523	8,857	9,893 [r]	9,740 [p]
Bosnia and Herzegovina[e]	200	200	200	200	200
Brazil	10,281	8,832	9,754	9,253 [r]	10,000
Bulgaria	17,000	10,500	18,500 [r]	19,600 [r]	20,000
Burma[e]	1,800	1,200	1,300	1,200	1,200
Canada	162,180	148,765 [r]	153,932 [r]	99,100 [r]	150,000
Chile	608 [r]	785	1,193	2,895 [r]	2,900
China[e]	549,000	660,000	676,000	641,000 [r]	660,000
Colombia	166	226	225 [e]	225 [e]	225
Ecuador[e]	200	200	200	200	200
Georgia[e]	400 [r]	200	350 [r]	400 [r]	400
Greece[e]	16,000	18,235 [4]	27,700	29,300	2,000
Honduras	3,764	4,805	6,750	8,128	8,200
India	32,100	28,900	25,600 [r]	28,600 [r, e]	33,100 [4]
Iran[e, 5]	11,000	15,000	12,000 [r]	9,000 [r]	8,000
Ireland	43,831	57,825	44,500 [e]	32,000 [r, e]	50,000
Italy[e]	6,000	2,000	1,000	1,000	1,000
Japan	6,074	8,835	4,997	5,723	5,660 [4]
Kazakhstan	34,100 [e]	40,000	37,700	40,000 [e]	40,000
Korea, North[e]	60,000	60,000	60,000	60,000	60,000
Korea, Republic of	1,822	2,724	988	28 [r]	--
Macedonia	12,300 [r]	16,200 [r]	9,700 [r]	3,500 [r]	5,000
Mexico	125,656	137,975	118,247 [r]	138,707 [r]	140,000
Morocco	79,900	81,208	76,747	62,000 [r, e]	38,000
Namibia	9,885	11,114	13,025	13,190 [r]	18,782 [4]
Peru	271,782	270,576	289,546	297,704 [r]	307,755 [4]
Poland	62,900	51,200	52,600	56,600 [r, e]	55,000
Romania	20,484	18,750	19,676	19,000 [r, e]	20,000
Russia	13,000	13,300	12,300 [e]	13,500 [e]	14,500
Saudi Arabia[e]	50	50	60	60	60
Serbia and Montenegro	8,000 [r]	10,500 [r]	7,500 [r]	4,600 [r]	5,100
South Africa	80,191	75,262	50,771	49,444	39,941 [4]
Spain	41,800	40,300	36,000 [r]	6,000 [r]	2,000
Sweden	116,300	106,584	85,975	43,000 [r, e]	50,400
Tajikistan[e]	800	800	800	800	800
Thailand	11,900	15,600	500 [r]	3,200 [r]	-- [4]
Tunisia	6,599	6,602	6,820 [r]	5,081 [r]	5,000
Turkey	14,225	17,270	17,923 [r]	17,352 [r]	17,500
United Kingdom[e]	1,000	1,000	1,000	1,000	--
United States	520,000	465,000	466,000	451,000	460,000 [4]
Vietnam[e]	1,000	1,000	1,000	1,000	1,000
Total	3,060,000 [r]	3,170,000 [r]	3,090,000 [r]	2,880,000 [r]	2,950,000

[e]Estimated. [p]Preliminary. [r]Revised. -- Zero.

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

[2]Table includes data available through July 1, 2004.

[3]In addition to the countries listed, lead is also produced in Nigeria, but information is inadequate to formulate reliable estimates of output levels.

[4]Reported figure.

[5]Year beginning March 21 of that stated.

TABLE 15
LEAD: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	1999	2000	2001	2002	2003[e]
Algeria:[e]					
Primary	900	900	900	1,100 [r]	1,100
Secondary	4,800	5,200	5,100	5,000 [r]	5,000
Total	5,700	6,100	6,000	6,100 [r]	6,100
Argentina:					
Primary	495 [e]	8,665	9,473	10,567	11,011 [p]
Secondary	25,195	27,000	25,960	33,000 [r]	30,300 [p]
Total	25,690	35,665	35,433	43,567 [r]	41,311 [p]
Australia:					
Primary	240,000	223,366	270,000	181,000	310,000 [4]
Secondary	32,828	28,430	33,000	30,000 [e]	40,000 [4]
Total	272,828	251,796	303,000	211,000 [e]	350,000 [4]
Austria, secondary[e]	24,000	24,000	22,000	21,000 [r]	20,000
Belgium:[e]					
Primary[5]	82,900	98,000	76,000	68,000 [r]	45,000
Secondary	20,300 [4]	20,000	20,000	20,000	20,000
Total	103,200 [4]	118,000	96,000	88,000 [r]	65,000
Bolivia	--	--	--	--	1
Brazil, secondary[6]	52,000	50,000	50,000	50,000 [e]	50,000
Bulgaria:					
Primary[e]	71,600	74,100	75,000	75,000	60,000
Secondary[e]	10,000	10,000	13,600	10,000	6,000
Total	81,600	84,100	88,600	85,000	66,000
Burma, primary	1,666	1,054	1,005	1,000 [e]	1,000
Canada:					
Primary	137,172	159,192	127,007	133,815	152,000
Secondary	129,243	125,641	103,921	117,449	120,000
Total	266,415	284,833	230,928	251,264	272,000
China:[e]					
Primary	821,000	998,000	984,000	1,100,000	1,330,000
Secondary	97,000	102,000	211,000	230,000 [r]	250,000
Total	918,000	1,100,000	1,200,000	1,330,000 [r]	1,580,000
Colombia, secondary[e]	12,000	12,000	12,000	12,000	12,000
Czech Republic, secondary[e]	15,000	15,000	15,000	15,000	15,000
France:[e]					
Primary	124,000 [4]	100,000	96,000	76,000	20,000
Secondary	155,000 [4]	158,000	142,000	128,000	80,000
Total	279,000 [4]	258,000	238,000	204,000	100,000
Germany:[e]					
Primary	169,557 [4]	210,000	232,000	240,000	207,000
Secondary	204,000 [4]	205,000	142,000	150,000	150,000
Total	373,557 [4]	415,000	374,000	390,000	357,000
India:[e]					
Primary	72,000	57,400 [r]	74,400 [r]	64,200 [r]	61,500
Secondary	20,000	20,500 [r]	22,000 [r]	25,000 [r]	24,800
Total	92,000	77,900 [r]	96,400 [r]	89,200 [r]	86,300
Iran:[e]					
Primary	12,000	15,000	12,000	12,000	12,000
Secondary	38,000	38,000	38,000	38,000	38,000
Total	50,000	53,000	50,000	50,000	50,000
Ireland, secondary[e]	12,000	12,000	13,000	7,000 [r]	8,000
Israel, secondary	13,000	13,000	20,000	22,000 [e]	25,000
Italy:[e]					
Primary	66,954 [4]	75,000	82,000	75,000	70,000
Secondary	148,354 [4]	160,000	121,000	130,000	144,000
Total	215,308 [4]	235,000	203,000	205,000	214,000

See footnotes at end of table.

TABLE 15--Continued
LEAD: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	1999	2000	2001	2002	2003[e]
Japan:					
Primary	125,514	129,469	127,358	107,744	105,462 [4]
Secondary	167,915	182,209	175,088	178,016 [r]	189,831 [4]
Total	293,429	311,678	302,446	285,760 [r]	295,293 [4]
Kazakhstan, primary and secondary	160,000 [e]	185,800	158,700	161,800	140,700 [4]
Kenya, secondary	1,000	1,000	1,000	1,000	1,000
Korea, North, primary and secondary[e]	75,000	75,000	75,000	75,000	75,000
Korea, Republic of:					
Primary	140,317	170,704	161,000	178,722 [r]	180,000
Secondary	10,000	10,000	10,000	10,000	10,000
Total	150,317	180,704	171,000	188,722 [r]	190,000
Macedonia:[e]					
Primary	19,000	19,000	19,000	19,000	19,000
Secondary	738	1,000	1,000	1,000	800
Total	19,738 [4]	20,000	20,000	20,000	19,800
Malaysia, secondary[e]	33,000	35,300	42,000	40,000	40,000
Mexico:					
Primary[7]	111,136	143,223	143,523	128,241 [r]	140,000
Secondary	110,000 [r]	110,000 [r]	110,000 [r]	110,000 [r]	110,000
Total	221,136 [r]	253,223 [r]	253,523 [r]	238,241 [r]	250,000
Morocco:					
Primary	65,209	66,812	58,178	71,840 [r]	61,473 [4]
Secondary	3,000	3,000	3,000	3,000	3,000
Total	68,209	69,812	61,178	74,840 [r]	64,473 [4]
Netherlands, secondary[e]	19,900 [4]	20,000	24,000	25,000	20,000
New Zealand, secondary[e]	6,000	10,000	10,000	10,000	10,000
Nigeria, secondary[e]	5,000	5,000	5,000	5,000	5,000
Pakistan, secondary[e]	2,000	2,000	3,000	2,000	3,000
Peru, primary	111,276	116,412	121,181	119,588 [r]	112,289 [4]
Philippines, secondary	12,389	16,218	24,000 [e]	24,000 [e]	24,000
Poland:					
Primary[e]	50,000	35,412 [4]	45,000	29,000 [r]	30,000
Secondary[e]	13,985 [4]	20,000	20,000	40,000 [r]	40,000
Total	63,985	55,412	65,000 [e]	69,000 [r, e]	70,000
Portugal, secondary[e]	6,000	6,000	6,000	4,000 [r]	4,000
Romania:[e]					
Primary	13,000	25,000	24,000	26,000 [r]	25,000
Secondary	3,000	3,000	3,000	3,000	3,000
Total	16,000	28,000	27,000	29,000 [r]	28,000
Russia, primary and secondary[e]	62,000	59,000	67,500	60,350 [4]	60,500
Serbia and Montenegro, primary	3,690	1,242	-- [e]	170 [e]	--
Slovenia, secondary[e]	14,000	15,300	15,000	15,000	15,000
South Africa, secondary	52,000 [r]	46,000 [r]	55,000 [r]	61,000 [r]	62,000
Spain, secondary[e]	96,000 [4]	120,000	98,000	116,000 [r]	102,000
Sweden:					
Primary	38,000 [e]	30,604	31,322	30,000 [e]	24,200
Secondary	48,000 [e]	47,255	44,056	39,700 [e]	52,000
Total	86,000 [e]	77,859	75,378	69,700 [e]	76,200
Switzerland, secondary[e]	7,000	8,000	9,000	9,000	8,000
Thailand:					
Primary	3,025	3,390	3,300	3,300 [e]	3,000
Secondary	23,741	23,803	26,700 [r]	40,000 [r, e]	40,000
Total	26,766	27,193	30,000 [r]	43,300 [r, e]	43,000
Trinidad and Tobago, secondary[e]	1,600	1,600	1,600	1,600	1,600

See footnotes at end of table.

TABLE 15--Continued
LEAD: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	1999	2000	2001	2002	2003[e]
Turkey:[e]					
Primary	4,000	4,000	4,000	4,000	4,000
Secondary	4,000	2,000	2,000	2,000	2,000
Total	8,000	6,000	6,000	6,000	6,000
Ukraine, secondary	9,902	15,034	12,000 [e]	12,000 [e]	12,000
United Kingdom:					
Primary	185,422	166,411	203,000 [e]	205,000 [e]	200,000
Secondary	162,651	170,740	163,000 [e]	165,000 [e]	140,000
Total	348,073	337,151	366,000 [e]	370,000 [e]	340,000
United States:					
Primary	350,000	341,000	290,000	262,000	245,000 [4]
Secondary	1,110,000	1,130,000	1,100,000	1,120,000	1,150,000 [4]
Total	1,460,000	1,470,000	1,390,000	1,380,000	1,390,000 [4]
Venezuela, secondary[e]	25,000	30,000	30,000	30,000	30,000
Grand total:	6,280,000 [r]	6,660,000 [r]	6,580,000 [r]	6,630,000 [r]	6,820,000
Of which					
Primary	3,020,000	3,270,000 [r]	3,270,000	3,220,000 [r]	3,430,000
Secondary	2,970,000 [r]	3,060,000 [r]	3,000,000 [r]	3,110,000 [r]	3,110,000
Undifferentiated	297,000	320,000	301,000	297,000	276,000

[e]Estimated. [p]Preliminary. [r]Revised. -- Zero.

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

[2]Table includes data available through July 1, 2004. Data included represent the total output of refined lead by each country, whether derived from ores and concentrates (primary) or scrap (secondary), and include the lead content of antimonial lead but exclude, to the extent possible, simple remelting of scrap.

[3]In addition to the countries listed, Egypt and Iraq produced secondary lead, but output is not officially reported; available general information is inadequate for the formulation of reliable estimates of output levels.

[4]Reported figure.

[5]Derived by calculating reported total lead output plus exports of lead bullion minus imports of lead bullion.

[6]Source: Lead and Zinc Statistics, Monthly Bulletin of the International Lead and Zinc Study Group, v. 42, no. 6, June 2002.

[7]Includes lead content in antimonial lead.