MAGNESIUM

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The U.S. magnesium industry dwindled to one primary producer by the end of 2001, with total production capacity of about 45,000 metric tons per year (t/yr). Because of high production costs and competition from lower priced imports, Alcoa Inc. closed its 43,000-t/yr primary production facility in Washington in October. This left Magnesium Corp. of America (Magcorp) as the sole primary producer in the United States, although Magcorp's parent company filed for bankruptcy protection in August.

Domestic magnesium (primary and secondary) consumption fell in 2001, affected by high energy costs at the beginning of the year and the general economic downturn. The principal uses for magnesium in the United States were aluminum alloying, die-casting, and iron and steel desulfurization. Consumption of magnesium in aluminum alloying, traditionally its largest end use, declined significantly. U.S. primary aluminum production in 2001 decreased by about 28% because of smelter production cutbacks caused by increased energy costs and reduced energy supply in the Pacific Northwest. As a result of the drop in consumption for aluminum alloying and the inclusion of new respondents to the annual magnesium canvas, die-casting became the largest use for magnesium in 2001. An upswing in motor vehicle sales in the last quarter of 2001 as a result of no-interest loans offered by manufacturers, along with an increased number of parts manufactured from magnesium alloys, led to an increase in magnesium consumption for die-casting applications. The use of magnesium in iron and steel desulfurization fell in response to a drop in U.S. steel production of 11.5% in 2001.

Although total imports of magnesium decreased by 24% from those in 2000, the United States relied on imports to supply an increasing share of demand. Canada, Russia, China, and Israel, in declining order, were the principal sources in 2001. More than one-half of magnesium imports in 2001 was as alloy, and about one-third was in the form of pure metal. Canada and China together supplied nearly three-quarters of the magnesium alloy imports, and Russia provided more the one-half of the pure magnesium imports in 2001.

Legislation and Government Programs

The International Trade Administration (ITA) finalized its antidumping and countervailing duties on magnesium from China, Israel, and Russia in September. For China, the antidumping duty for granular magnesium was set at 24.67% ad valorem for Minmetals Precious & Rare Metals Import and Export (China National Nonferrous Metals Industry Trading Group Corp.) and at 305.56% ad valorem as the China-wide rate. This dumping suit was initiated in October 2000 by Magcorp and the United Steelworkers of America, and the suit was joined by the employees of Northwest Alloys Inc. on April 20, 2001 (U.S. Department of Commerce, International Trade Administration, 2001d). Although China already has an antidumping duty of 108.26% established for pure magnesium, the original duty did not cover granular magnesium. The original duty also covered magnesium alloy.

For Israel, the ITA set an antidumping duty for pure magnesium of 28.14% ad valorem and a countervailing duty of 16.52% (U.S. Department of Commerce, International Trade Administration, 2001a, c). In a vote by the commissioners, however, the U.S. International Trade Commission (ITC) agreed with the ITA that imports of granular magnesium from China materially injured a U.S. industry but disagreed that imports from Israel injured a U.S. industry. The ITC found that imports of granular magnesium from Israel were negligible (defined as less than 3% of the total imported during a year). As a result, the ITC directed the ITA to impose no duty on granular magnesium imported from Israel (U.S. International Trade Commission, 2001§[1]). For Russia, the antidumping duty was set at 0% ad valorem (U.S. Department of Commerce, International Trade Administration, 2001e).

In addition, the ITA received requests to conduct administrative reviews of the antidumping duty on pure magnesium and the countervailing duties on pure and alloy magnesium from Canada. Although the reviews have been done each year since the duties were instituted, these reviews will include Magnola Metallurgy Inc. for the first time (U.S. Department of Commerce, International Trade Administration, 2001b). For the antidumping duty, the period under review was August 1, 2000, to July 31, 2001, and the period for the countervailing duty reviews was calendar year 2000.

The ITA also finalized the countervailing duty for pure and alloy magnesium from Canada for calendar year 1999. The duty was set at 1.21% ad valorem for Norsk Hydro Canada Inc. (U.S. Department of Commerce, International Trade Administration, 2001f).

The U.S. Department of Justice filed a lawsuit against Magcorp alleging that the company was mishandling hazardous waste at its primary magnesium facility in Rowley, UT. The suit, which was brought on behalf of the U.S. Environmental Protection Agency (EPA), charged that Magcorp violated Resource Conservation and Recovery Act standards by disposing of thousands of gallons of liquid and solid wastes in unlined ditches and ponds on its property without proper treatment. In a separate action, the U.S. Government also moved to expand a 1998 lawsuit that sued Magcorp for trespass and conversion of minerals contained in brines located on Federal lands in the west desert of Utah. This lawsuit seeks to

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

recover the value of the magnesium chloride and other minerals allegedly taken (U.S. Department of Justice, 2001§).

The EPA completed a report that projected the emissions of global-warming-potential gases from several industries, including sulfur hexafluoride (SF_6) from the magnesium industry. The report has three objectives—it presents the EPA's current forecasts of U.S. high-global-warming-potential gas emissions through 2010 under a scenario that assumes no further actions are taken to reduce emissions; it uses available cost and technical data to describe those technologies and practices that can reduce these emissions from the major emission sources, some of which are expected to be voluntarily adopted by industry; and it estimates the costs of reducing high-global-warming-potential gas emissions for each major source. According to the EPA, under a business-as-usual scenario, by 2010 the United States could emit 5.5 million metric tons (Mt) of carbon equivalent of SF_6 from magnesium production and processing, but actual emissions are expected to be lower as a result of voluntary industry actions. Of the options that the EPA presented for reducing emissions, it estimated costs for three of them—replacing SF_6 with sulfur dioxide (SO_2), good housekeeping, and recycling or recapturing SF_6. The EPA assumed that 60% of SF_6 emissions could be reduced by SO_2 replacement in 2010 at a cost of about $0.25 per metric ton of carbon equivalent. Good housekeeping could reduce SF_6 emissions by a further 0.7 Mt of carbon equivalent or 12% of 2010 baseline emissions at savings of $1.91 per ton of carbon equivalent. The EPA's cost analysis showed that the capture and recycling of SF_6 could reduce 1.5 Mt of carbon equivalent or 27% of baseline emissions at savings of about $0.90 per ton of carbon equivalnent. The EPA has a partnership with the magnesium industry that was begun in 1999 to work together to reduce emissions of SF_6. This partnership works together to review and evaluate emission reduction strategies and technologies, promote technical information sharing by preparing annual reports and hosting technical conferences; the EPA is responsible for recording and verifying the partners' progress, and providing positive public recognition for the partners' achievements (U.S. Environmental Protection Agency, 2001§).

Production

On June 22, Alcoa announced that it would close its Northwest Alloys 45,000-t/yr magnesium plant in Addy, WA, on October 1. High production costs and unfavorable market conditions were cited as the reasons for the closure (Alcoa Inc., 2001§). This closure leaves the United States with only one primary magnesium producer—Magcorp, with its 45,000-t/yr plant in Rowley, UT.

Renco Metals Co. (the parent company of Magcorp) filed for chapter 11 bankruptcy in August saying that price pressures from imports have prevented Magcorp from generating enough profits to service its long-term debt. The company received approval of a debtor-in-possession financing on a interim basis until the final bankruptcy hearing (Platts Metals Week, 2001d).

Magcorp reported that it had cut its overall operating costs by 20% following the installation of some new electrolytic cells. The company has reached 20,000 t/yr of capacity with its new cells, which are larger than the ones they replaced. Cost savings have been made in energy, labor, and maintenance. The cost of developing and installing the new cells was estimated to be $1,000 per ton of capacity, compared to estimated costs for greenfield development of $3,000 to $15,000 per ton. Magcorp also claimed that the new cells reduced thermal emissions by 30% and captured 99.9% of chlorine emissions (Platts Metals Week, 2001f; Thayer and Neelameggham, 2001).

Consumption and Uses

Consumption of primary and secondary magnesium fell in 2001 from the levels in 2000 (tables 2, 3). Die-casting applications represented 45% of the total reported primary consumption, aluminum alloying was 37%, and desulfurization of iron and steel was 9%. In addition to primary magnesium, significant quantities of secondary magnesium are used in aluminum alloying and iron and steel desulfurization applications. The total primary magnesium consumed in the United States in 2001 declined by 8% from that in 2000; much of this decline was recorded in the aluminum alloying sector. Consumption of primary and secondary magnesium for aluminum alloying declined significantly as aluminum producers closed capacity in the Pacific Northwest in response to high electric power costs at the beginning of 2001; total primary aluminum production in 2001 was 28% lower than that in 2000 (Plunkert, 2002b).

Although consumption of magnesium for die-casting applications appears to have more than doubled, the reported increase resulted mainly from the addition of new respondents to the annual canvass. Without the additional respondents, consumption for this end use would have increased by about 20%. An upswing in motor vehicle sales in the last quarter of 2001, as a result of no-interest loans offered by manufacturers along with an increased number of parts manufactured from magnesium alloys, led to the increase in die-casting consumption.

Magnesium consumption in iron and steel desulfurization declined because of lower U.S. steel production. According to preliminary data from the American Iron and Steel Institute ([undated]§), U.S. steel mill shipments in 2001 were 8.8% lower than those in 2000, and the U.S. steel industry's capability utilization rate through December was 75.6%, down from 84.4% in 2000. Total steel production in 2001 declined by 11.5% from that of 2000. Falling prices and rising imports have left only a few U.S. steel producers making profits, and 31 have filed for bankruptcy protection over the last 4 years, including Bethlehem Steel Corp., LTV Steel Corp., Republic Technologies International LLC, and Wheeling-Pittsburgh Steel Corp., which filed for bankruptcy in 2001.

Data for magnesium metal are collected from two voluntary surveys of U.S. operations by the U.S. Geological Survey. Of the 84 companies canvassed for magnesium consumption data, 64% responded, representing 62% of the primary magnesium consumption listed in tables 1 and 3. Data for the 30 nonrespondents were estimated on the basis of prior-year consumption levels and other factors. One large aluminum producer accounted for 65% of the nonresponse total quantity.

Reactive Metals & Alloys Corp. (Remacor), a magnesium

desulfurization reagent producer, filed for chapter 11 bankruptcy in March. The company sought court authority to sell nearly all its assets to Rossborough Manufacturing Co., another magnesium desulfurization reagent producer. Rossborough created a separate unit, Rossborough-Remacor LLC, for Remacor to transfer its assets; at the same time, Rossborough transferred its assets to the newly formed company. Remacor said that the reason for its bankruptcy declaration was because of bankruptcy filings by several of its steel-producing customers (Platts Metals Week, 2001j). The sale was completed on July 31.

Allegheny Technologies Inc. idled its titanium sponge production plant in Albany, OR, in the second quarter of 2001 as part of its overall cost-reduction plan (Allegheny Technologies Inc., 2001§). This leaves only one Kroll-process titanium sponge producer in the United States, reducing the need for magnesium for this application.

Xstrata Magnesium Corp. opened its new magnesium scrap recycling facility in Anderson, IN, in the third quarter. The plant has an initial capacity of 25,000 t/yr of magnesium alloy from two lines that can process class I and class II scrap generated during the die-casting process. The company began shipping product in December; however, only one of the two lines was operating at yearend. Xstrata hoped to have the second line operating by late 2002, if demand was sufficient (Platts Metals Week, 2002).

With the introduction of the new 2002 model cars, industry executives estimated that the average magnesium content in the car would increase to 4.1 kilograms (kg) (9 pounds) compared with 3.9 kg (8.5 pounds) for the 2001 model year. The largest new applications for magnesium in the 2002 models were the instrument panel support beams in the Ford Explorer and Mercury Mountaineer sport-utility vehicles (SUVs). Other new magnesium applications include driver-side instrument panel support castings and steering wheel armatures in the Chevrolet Trailblazer and GMC Envoy SUVs; cam covers in some of DaimlerChrysler AG's 3.7-liter (L), V-6 truck engines; and steering column jackets, steering column/pedal bracket supports, steering wheel armatures, and alternator brackets in the Chevrolet Avalanche and Cadillac Escalade SUVs (Wrigley, 2001a).

General Motors Corp. (GM) planned to use magnesium instrument support beams in its next generation of full-size Chevrolet and GMC vans that are due out in late 2002. This decision continues the use of the magnesium parts from when they were introduced in the vans in 1995. If 150,000 to 200,000 vans are built each year, then this application will consume up to 2,450 t/yr of magnesium alloy (Wrigley, 2001g). In addition to its use of magnesium alloy for the instrument panel support beams and transfer case housings in its redesigned 2002 Ford Explorer and Mercury Mountaineer SUVs, Ford Motor Co. also was introducing magnesium valve covers in its 5.4-L Triton V-8 engines, which were due out in the spring of 2002. These engines will be used in several standard-size and heavy-duty pickup trucks and in some SUVs. Magnesium consumption for this application was expected to be between 1,900 and 2,100 t/yr. Spartan Light Metal Products Inc., Sparta, IL, will manufacture the valve covers (Wrigley, 2001e).

DaimlerChrysler planned to convert the rear seat frames in its V-class Mercedes models from steel to a combination of aluminum and magnesium components. This change will reduce the seat frame weight by about 11 kg (24 pounds) (American Metal Market, 2001a). DaimlerChrysler also announced that it would introduce the first dash panels made from magnesium in the 2003 model of its Dodge Viper sports car. The one-piece dash panel, made from magnesium alloy AM60, will replace several steel components and require less assembly. With the dash panel and other magnesium parts, the redesigned Viper was expected to have almost five times the magnesium content of the average North American automobile (Wrigley, 2001j).

Engineers at Ford were beginning to develop a front-end module for use in supporting some components in the 2006 model Ford Explorer. Magnesium would replace steel in this application, and although the design has not been completed, Ford estimated that the new component could weigh about 4.5 kg (10 pounds). These new units could require about 7,500 t/yr of magnesium die-casting alloy (Wrigley, 2001c). In addition, Ford is developing a magnesium frame for the liftgate for standard-size SUVs. This frame could support inner and outer aluminum or plastic panels, with an estimated weight savings of 50% compared to the currently used steel assembly. Ford also is working on a front-end radiator-support module made entirely of magnesium for use in Ford Explorer SUVs. Neither product has been approved for production use yet (Wrigley, 2001d).

Recycled magnesium alloy produced by Spectrulite Consortium Inc. was approved for use in automotive applications. The company said that its class I scrap-derived alloys—AM60B, AM50A, and AZ91D—were approved by GM and DaimlerChrysler. Spectrulite has the capacity to recycle 30,000 t/yr of magnesium scrap (Regan, 2001).

Stocks

Producers' yearend 2001 stocks of primary magnesium declined significantly from those at yearend 2000 mainly because inventories at Northwest Alloys' plant were liquidated when the plant closed in October. Producer stock data cannot be reported to avoid disclosing company proprietary data. Consumer stocks of primary and alloy magnesium decreased to 6,040 metric tons (t) at yearend 2001 from 7,390 t (revised) at yearend 2000. Yearend 2001 consumer stocks of secondary magnesium decreased slightly to 2,340 t from the 2000 level of 2,360 t.

Prices

Quoted magnesium prices continued to decline during 2001 (table 4), reflecting the oversupply of magnesium in the world market and the weak economy. Yearend 2001 free market prices were about $100 per ton lower than those at yearend 2000. The U.S. spot western price fell by about 2 cents per pound during 2001.

Foreign Trade

Total magnesium exports for 2001 were about 18% lower than those in 2000 (table 5). Canada (69%) and Mexico (16%) were the main destinations. Imports for consumption in 2001 were

24% lower than those in 2000 (table 6), reflecting the decline in magnesium usage in the aluminum industry and for die-castings. Of the total quantity of magnesium imported into the United States, Canada (39%), Russia (17%), China (17%), and Israel (11%) were the principal sources in 2001 (table 6). More than one-half the magnesium imports in 2001 was as alloy, and about one-third was in the form of pure metal. Canada and China together supplied nearly three-quarters of the magnesium alloy imports, and Russia provided more the one-half the pure magnesium imports in 2001.

World Review

According to data from the International Magnesium Association (2002§), 2001 magnesium shipments of 330,000 t were about 10% less than shipments in 2000. The shipment figures include estimates of shipments from China and Russia. Not surprisingly, North America (42%) and Europe (34%) were the principal geographic areas of consumption. Aluminum alloying, with 43% of the total, remained the largest use for magnesium around the world. Die-casting, with 34%, and iron and steel desulfurization, with 13%, were the other large applications for magnesium.

Australia.—In February, Australian Magnesium Corp. Ltd. (AMC) acquired full ownership of the Stanwell magnesium project with its purchase of Fluor Australia Pty. Ltd.'s 5% interest; AMC already owned the remaining 95%. In April, AMC signed an agreement with Ford to supply it with 45,000 t/yr of magnesium. AMC already had a 5-year agreement with Ford in place; the new agreement doubles the length of the contract to 10 years. Under the revised agreement, the price paid by Ford will be fixed for 5 years in Australian dollars. In the second 5-year period, the price will be calculated with reference to then-prevailing market prices (Australian Magnesium Corp. Ltd., 2001b§).

AMC opened a A$680 million share offering on June 25 to fund the development of the plant. The offer was scheduled to close on July 19, and on July 20, AMC withdrew the offering because it did not receive sufficient funding. The company announced that it would pursue alternative means of funding (Australian Magnesium Corp. Ltd., 2001a§). On August 9, the Australian Government announced that it would act as a guarantor for a A$100 million loan to reduce the amount of equity that needs to be raised by AMC. The Government cited the number of jobs that the new plant would create in its engineering, construction, and operating phases as one of the reasons for the loan. In addition, this loan from the Government would help ensure that AMC's technology, of which the Government owns 50%, would be commercialized (Department of Industry, Tourism and Resources, 2001§).

After receiving the loan guarantee from the Federal Government, a A$100 million commitment from the Queensland State government, and a commitment to purchase an additional A$100 million in shares from its major shareholder Normandy Mining Ltd., AMC filed a prospectus to raise A$525 million to develop its proposed magnesium plant in October. The offer was scheduled to close on November 16 and, if fully subscribed, would provide enough financing to complete the plant by 2004. After Normandy Mining offered to purchase the additional shares, AMC filed the prospectus in October (Australian Magnesium Corp. Ltd., 2001c§).

At the end of November, AMC was given formal approval by its board of directors to begin construction of a 97,000-t/yr magnesium plant in Stanwell, Queensland. Construction was scheduled to begin in February 2002, with first metal production by the fourth quarter of 2004 (Australian Magnesium Corp. Ltd., 2001d§).

Mt. Grace Resources NL announced that it had signed a memorandum of understanding (MOU) with the German firm Frank & Schulte Group to purchase at least 10,000 t/yr of magnesium metal for at least 10 years. The magnesium will be purchased at a price to be determined by a preagreed formula that will enable successful debt-equity financing of the proposed magnesium plant (Mt. Grace Resources NL, 2001c§). According to a feasibility study prepared for Mt. Grace Resources by Bateman Multiplex JV (a joint venture between Bateman Engineering Pty. Ltd. and Multiplex Constructions Pty. Ltd.) the optimum capacity for the initial stage of a magnesium plant would be 12,500 t/yr, and the total capital cost for a plant that size (including the mine and additional infrastructure) located 85 kilometers (km) south of Darwin, Northern Territory, would be $38 million (Metal Bulletin, 2001c.).

The Minister for Industry, Science and Resources, announced that Mt. Grace Resources has been granted major project facilitation status for its Batchelor magnesium project. The purpose of this was to achieve timely and efficient approvals for the proposed development. Through this process, the Department of Industry, Science and Resources will ensure that information on government approvals is provided promptly to Mt. Grace; all relevant Government processes would be coordinated so that, as far as possible, they occur simultaneously and without duplication; the Government would respond promptly to issues raised by the company; and assistance in identifying and accessing Government support programs would be provided. Mt. Grace plans to complete a 50,000-t/yr magnesium plant in Northern Territory by 2003 (Mt. Grace Resources NL, 2001a§).

In October, Mt. Grace Resources announced that it negotiated an option agreement to purchase the Princhester magnesite deposit, located 95 km north of Rockhampton in central Queensland. Resource definition work completed by previous owners delineated 5.4 Mt of high-grade magnesite (46.8% MgO) with a low silica content (1.8% SiO_2). The deposit occurs as a near-surface horizontal sheet with an average thickness of about 12 meters. Mt. Grace was in the final stages of awarding a contract to undertake a bankable feasibility study for its Batchelor project (Mt. Grace Resources NL, 2001b§).

Pima Mining NL's SAMAG Ltd. subsidiary began a feasibility study for the construction of a magnesium plant in New Zealand. SAMAG was evaluating several possible sites where appropriate infrastructure and competitive energy prices were available, including Hawkes Bay, Taranaki, and Southland. The company proposed that the magnesite feedstock would be shipped from its deposit near Leigh Creek, South Australia. Initial studies suggested that the additional cost of transportation would be more than offset by the competitive energy costs, construction costs, and labor costs available in New Zealand. SAMAG proposed to establish a New Zealand-based company

for the project, which would be extended a sublicense to use Dow Chemical Co.'s magnesium process technology. SAMAG's off-take agreement with ThyssenKrupp Metallurgie GmbH also would be extended to encompass the proposed New Zealand operation. SAMAG has nearly completed the feasibility study for its planned 52,500-t/yr magnesium plant based at Port Pirie, South Australia (Pima Mining NL, 2001e§).

In May, SAMAG acquired fluidized bed driers from Dow's closed plant in Freeport, TX. The driers can dry enough magnesium chloride brine into prills to produce 100,000 t/yr of magnesium metal. SAMAG estimated that acquisition of the driers and engineering design improvements would significantly reduce its estimated capital cost for the plant (Pima Mining NL, 2001c§). The company also signed a power agreement with Australian National Power (ANP) to provide power and gas to the Port Pirie plant site. Under the agreement, ANP would build a 230-megawatt (MW) power station adjacent to the plant, of which 170 MW would be dedicated to the plant. ANP also would convert gas supplied to SAMAG into electricity under a 20-year tolling agreement (Pima Mining NL, 2001b§). After the power agreement was signed, SAMAG announced that it would increase the capacity of its proposed plant to 65,000 t/yr from the originally planned capacity of 52,500 t/yr. In July, the company was granted environmental approval for the larger plant by the South Australian government. With this approval, the company planned to begin plant construction in 2002 (Pima Mining NL, 2001d§).

In December, Pima Mining announced that the South Australian Government has planned to commit up to A$25 million toward improving industrial infrastructure in the Port Pirie area. Key areas under consideration for improvement include gas, electricity, and water supplies into the region (Pima Mining NL, 2001a§).

Golden Triangle Resources NL received shareholder approval to change its name to Pacific Magnesium Corp. Ltd. in June. Pacific Magnesium planned to build an 80,000-t/yr magnesium plant in New South Wales by 2006.

In the first quarter of 2001, Crest Magnesium NL made a complete change in its management and recapitalized the company so it had 100% ownership of its TasMag project. In 1999, Crest Magnesium's financing arrangement had collapsed, and its construction partner had withdrawn from the company's proposed 95,000-t/yr magnesium plant in Bell Bay, Tasmania. Crest Magnesium also changed the company's name to Indcor Ltd. (Indcor Ltd., 2001a§). By the end of the second quarter, the company was looking for a partner for the TasMag operation and had extended its existing technology option with the Ukrainian National Research and Design Titanium Institute and the Russian National Aluminum-Magnesium Institute for an exclusive license for their magnesium production technology through December 31, 2001. By September, however, Indcor announced that it was unable to secure an investment in its TasMag project, and as a result, the project had been put on hold, with the company citing low magnesium prices and plant closure announcements as reasons that it could not find investors (Indcor Ltd., 2001b§).

In November, Australia's Rambora Technologies Ltd. announced that it would begin a 6-month prefeasibility study into extracting and processing magnesium from brown coal ash in Victoria's Latrobe Valley. Rambora entered into an agreement with Magnesium Investments Pty. Ltd. and Hazelwood Power to undertake the study. Ash currently being produced would be combined with ash contained in Hazelwood Power's tailings dams. A feasibility study will evaluate the potential to build a 100,000-t/yr magnesium metal plant. Recent studies conducted by HRL Technology have verified the feasibility of extracting magnesium from the Latrobe Valley ash. Initial magnesium extraction tests used a standard acid leach process, followed by purification of the magnesium chloride solution. The company anticipated that this process could be followed by electrolysis using established Alcan Inc. cell technology to produce magnesium metal. The Hazelwood tailings ponds are currently estimated to contain more than 5 Mt of ash that contain between 8% and 12% magnesium. In addition, the power station produces approximately 200,000 t/yr of ash. An initial review undertaken by Magnesium Investments estimated that the capital cost of a 100,000-t/yr plant would be about $800 million, and the projected operating costs would be between $0.75 and $0.80 per pound of magnesium metal (Australian Mining, 2001§).

Canada.—By February, Magnola Metallurgy Inc. was operating 10 of its 24 magnesium electrolytic cells at its new 63,000-t/yr plant in Quebec. By yearend, the company was operating a total of 16 cells, which were producing at approximately 65% of their rated power capacity. Magnola reported that the plant produced 9,340 t of pure magnesium and magnesium alloy in 2001 (Canada Newswire, 2002§).

Timminco Ltd. restarted production of magnesium alloy billet on May 14. The casthouse had been closed for 5½ months after a fire in November 2000 had caused extensive damage to two induction furnaces. The cost of the casthouse reconstruction combined with additional modifications to the equipment was estimated to be $4 million, most of which was covered by a property insurance policy (Platts Metals Week, 2001l).

In December, Timminco announced that it had entered into a forbearance agreement with its principal lender Bank of Nova Scotia. Under this agreement, the bank will not enforce its rights arising from certain defaults under the loan agreement while Timminco pursues alternatives to maximize shareholder value, which may include a direct investment, strategic alliance, refinancing, or a sale of all or a part of its operations. The forbearance agreement was scheduled to remain in effect until April 30, 2002. A special committee of the board of directors of Timminco was established on April 26, 2001. This committee was formed mainly to consider all alternative financing proposals from third parties and solicit and review offers for purchase of the company's assets. Timminco operates a 6,000-t/yr primary magnesium plant in Haley, Ontario, which primarily serves high-end product lines, and a magnesium extrusion facility in Aurora, CO (Platts Metals Week, 2001k).

Hydro Magnesium (a division of Norsk Hydro ASA) idled one of its four production lines at its magnesium recycling facility in Becancour in August. The closure reduced the capacity at the plant by 2,500 t/yr to 7,500 t/yr. This closure was attributed to a shortage of die-cast scrap and high inventory levels at the plant. The company had not made a decision on the length of time the line would be closed (Metal Bulletin, 2001a).

Globex Mining Enterprises Inc. received a scoping study from

Hatch Associates Inc. that indicated that construction of a mine and mill to process a magnesite-talc ore and a 90,000-t/yr magnesium plant would be economically feasible. The project scenario studied by Hatch consists of a mine-mill complex located near Timmins, Ontario, and a smelter complex located west of Rouyn-Noranda, Quebec. The entire complex would cost $966 million, including a $153 million contingency. The next step in the process would be a proposed prefeasibility study consisting of mine drilling and test work, metallurgical test work, preliminary engineering, environmental baseline data collection, environmental test work, market studies, and off-take agreement discussions. The projected cost of this study is $9 million and, upon completion, would generate a bankable feasibility report. Subject to financing, the prefeasibility study was expected to take about 18 months (Globex Mining Enterprises Inc., 2001§).

In October, Hatch conducted test work on material from Leader Mining International Inc.'s Cogburn magnesium project, about 29 km west of Hope, British Columbia, and concluded that the magnesium silicate mineral could be efficiently leached to a pure magnesium chloride brine suitable for subsequent dehydration and fused-salt electrolysis to magnesium metal. The Cogburn deposit is an ultramafic complex that covers almost 20 square kilometers. Surface sampling suggested fairly uniform magnesium distribution with values consistently greater than 25%. Boron, calcium, and sulfur, considered impurities in magnesium metal production, showed low values in large areas of the deposit. Leader Mining was continuing drilling to define the total resource and to obtain bulk metallurgical test material as part of a feasibility study (Leader Mining International Inc., 2001§).

China.—Zunyi Titanium Works in Guizhou Province, China, started up a 5,000-t/yr electrolytic magnesium plant in February. By April, the plant was producing at a 2,000-t/yr rate, and the company planned to reach full capacity by August (Platts Metals Week, 2001o). Ningxia Zhongning Aluminium Co. planned to complete a 12,000-t/yr magnesium plant by February 2002. If the plant is completed, it would be China's largest individual magnesium plant; construction of the plant has already begun (Platts Metals Week, 2001g). Tongxiang Magnesium Co. began production at a new 3,500-t/yr magnesium ingot line in November, which is part of the first phase of a 13,000-t/yr expansion project (Platts Metals Week, 2001m).

Jishan Huayu Enterprises Group planned to complete a 10,000-t/yr expansion at its plant in Shanxi Province by September 2002. Total capacity will be about 20,000 t/yr when the expansion is complete. In addition to magnesium ingot, Jishan Huayu has the capacity to produce 400 metric tons per month (t/mo) of magnesium granules. The company planned to expand this capacity to 8,000 t/yr by September 2002. The company also began producing magnesium powder in January, with a capacity of 400 t/mo, and planned to increase capacity for this product to 10,000 t/yr in October. One-half the company's products are exported to customers in Japan and the Republic of Korea under long-term contracts (Platts Metals Week, 2001c).

China also was adding magnesium alloy production capacity. Xindi Magnesium Industries Co. planned to double its magnesium alloy capacity to 4,800 t/yr by August, once a plant upgrade is completed (Platts Metals Week, 2001n). The first metal from Hydro Magnesium's 10,000-t/yr magnesium alloy plant in Xi'an was produced on November 29; however, there were some problems with the induction furnaces. The first of the furnaces was modified in December, and after operator training was completed, commercial production at the plant was expected to begin in early 2002 (Hydro Magnesium, 2002§). Jinghua Magnesium Industry Group announced that it would build a new 10,000-t/yr magnesium alloy line by the end of 2002. The company, which has about 17,000 t/yr of magnesium powder production capacity, planned to spend $6 million on the expansion, and construction was estimated to take about 6 months (Platts Metals Week, 2001e). Three new magnesium alloy plants, with a total output capacity between 30,000 and 40,000 t/yr, were expected to be completed by the fourth quarter of 2001. All three plants are in the Shanxi Province—one each in Jincheng, Linyi, and Wuxiang. Production at these new plants was expected to be targeted to the export market (Platts Metals Week, 2001a).

A new plant in Qingdao Province, which was expected to be operational by mid-2001, would have the capability to produce 16,000 die-castings per year, which were expected to be used mainly in mobile phones and the electronics industry (Platts Metals Week, 2001b).

Ningxia Wanhui Magnesium Works in Ningxia Autonomous Region began producing magnesium powder in October from a 3,000-t/yr line and announced plans to expand this capacity to 5,000 t/yr by June 2002. The company also has the capability to produce 3,000 t/yr of magnesium ingot and 2,000 t/yr of magnesium alloy. All the company's ingot and alloy were exported, and Ningxia Wanhui planned to export almost all its powder (Platts Metals Week, 2001h).

Congo (Brazzaville).—In May, Magnesium Alloy Corp. (MagAlloy) announced that it had signed a memorandum of understanding with the German firm Siemens AG that addressed power supply and distribution issues that were needed to develop the Kouilou magnesium project. Initial investigations by both firms suggested that power could be supplied to the proposed 60,000-t/yr magnesium plant from the Inga hydroelectric facility on the Congo River (Magnesium Alloy Corp., 2001a§). In addition, a presidential decree was signed in June by President Sassou-Nguesso appointing a steering committee to assist in the implementation of the project. The steering committee would report directly to the President and was expected to fast-track development of the project (Magnesium Alloy Corp., 2001b§).

Czech Republic.—Magnesium Elektron (a subsidiary of Luxfer Group) began production at its new magnesium recycling plant in the Czech Republic in mid-October. Enough equipment was available at the plant to produce at a level of 7,000 t/yr by January 2002. Additional equipment was expected to be installed to increase capacity to 10,000 t/yr by mid-2002. Magnesium Elektron also operates a 10,000-t/yr magnesium recycling plant in the United Kingdom (Metal Bulletin, 2001b).

France.—After determining that there was no economic feasibility in operating its plant as a scrap recycling plant, Pechiney Group announced that it would close its 17,000-t/yr Marignac magnesium plant permanently. The plant had been closed since June while studies were done to see if the plant could operate economically as a secondary facility (Platts

Metals Week, 2001i). This plant was the only plant operating in the European Union (EU), and its closure, combined with the closure of Norsk Hydro's Norway plant, left Western Europe without any primary magnesium production capacity. In addition, the fate of the EU antidumping duty on magnesium from China was unknown. The duty was assessed to protect EU magnesium producers, but when Pechiney's plant permanently closes, there would be no domestic industry to protect.

Germany.—ThyssenKrupp AG announced that it would set up a new company to research and develop magnesium sheet for automotive applications. The new company is called Magnesium Flachproduckte GmbH, and the Saxony State Ministry for Economics and Labour was expected to fund the research project. ThyssenKrupp signed an long-term sales agreement with SAMAG in November 2000 for all the output of magnesium metal and alloys from its proposed plant in Australia (Metal Bulletin, 2001d).

Hungary.—U.S.-based Gibbs Die Casting Corp. planned to construct a new die-casting facility in Hungary by 2003 to meet the needs of its European die-casting customers. The new facility would produce both aluminum and magnesium die castings from two 850-t verti-cast presses (North American Die Casting Association, 2001b§).

Norway.—On October 12, Hydro Magnesium announced that it would close its 42,000-t/yr primary magnesium plant in Porsgrunn by April 2002, citing competition from imports of low-cost magnesium from China into Europe. Hydro Magnesium planned to continue to operate its 44,000-t/yr primary magnesium plant in Becancour, Quebec, Canada, and to increase capacity there to 48,000 t/yr by 2002 through debottlenecking. In addition, the company planned to continue to operate its existing casthouse in Norway, where ingot and scrap are remelted for magnesium alloy production (Hydro Magnesium, 2001§).

Russia.—High energy costs were affecting magnesium plants in Russia. Solikamsk Magnesium Works was negotiating with the state power supplier Unified Energy Systems regarding a sharp increase in energy prices. Additional tariffs that were implemented on July 10 resulted in a 32% increase in Solikamsk's electricity costs. Russia's other magnesium producer, Avisma, said that its electricity costs had increased by 65% and that it would have to abandon plans to implement new magnesium technology that was expected to double its magnesium production capacity to 40,000 t/yr (American Metal Market, 2001b).

Ukraine.—A new company, Magnii LLC, was established to run the Kalush Potassium and Magnesium Works in Ukraine, which has been closed since January 1999. The company is owned by Oriana (25%) and ESKO-Pivnich (75%), which were awarded the plant in a tender offer by the Government. Magnii estimated that it will take 8 to 10 months to complete the upgrades necessary to get the plant running again. When the plant is operational, it is expected to have the capacity to produce 17,000 t/yr of magnesium (Interfax Mining & Metals Report, 2001).

Current Research and Technology

GM developed a new family of creep-resistant magnesium alloys that may have the potential to replace aluminum and iron in some large powertrain components, such as engine blocks and transmission cases. The new alloys, named ACX alloys, have 40% greater tensile resistance and 25% greater compressive creep resistance than alloy AE42, and unlike AE42, they do not contain rare earths, which increase the cost of the alloy. The new alloys contain 4% to 6% aluminum, 1.5% to 3.5% calcium, and small quantities of strontium and/or silicon. The ACX alloys also demonstrated corrosion resistance equal to that of AZ91D, one of the most common alloys used in current automotive applications, but which is not suited for the higher temperatures found in powertrain applications (Wrigley, 2001f). Israeli magnesium producer Dead Sea Magnesium Ltd. also reported the development of creep-resistant alloys named MRI 15X. The company said that die-casting tests for these alloys would begin in May. Although no specific composition was given, the new family of alloys contains aluminum, some alkaline earth elements, and very little rare earths (Wrigley, 2001h).

A consortium of the "Big Three" automakers—Chrysler Group of DaimlerChrysler, Ford, and GM—their suppliers, and the U.S. Department of Energy planned to begin a 4-year project to develop magnesium-intensive automobile engines. The project, conducted by the U.S. Automotive Materials Partnership, will use newly developed creep-resistant magnesium alloys to produce such components as cylinder blocks, engine covers, oil pans, and transmission cases and determine the alloys' suitability for these types of applications. The new project will complement a project started in 2000 that is investigating the potential for magnesium components in the structural undercarriage of automobiles (Wrigley, 2001b).

Chicago White Metal Casting Inc. and Tektronix Inc. developed a new case for a new portable fiber-optic cable testing system that combines a magnesium die-cast case with an elastomer overmold. At almost the same weight as molded plastic, the magnesium-elastomer combination provided impact strength and dent resistance superior to plastic. Magnesium also provided ruggedness for a variety of tests, including surviving a 4-foot drop to concrete. Magnesium's added torsional rigidity protected the unit's glass touch-screen display. Magnesium also did a better job meeting the unit's thermal requirements and provided built-in electromagnetic and radio-frequency shielding integrity without the need for expensive coatings or gasketing materials, as would be required for a plastic design. Part consolidation and process simplification made possible with the new unit generated up to a 20% cost savings compared to a comparable plastic design, in spite of the cost of separate casting and molding tooling (North American Die Casting Association, 2001a§).

In February, Sumitomo Metals (Naoetsu) Ltd. announced that it had developed a new process that allowed magnesium alloys to be hot- and cold-rolled into wide and thin sheet. The company had produced magnesium alloy AZ31 sheet in a width of 600 millimeters (mm) at a thickness of 0.5 mm. Sumitomo Metals had adapted techniques that it used to produce aluminum-clad stainless steel by induction heating to the magnesium rolling process. Sumitomo Metals planned to begin commercial production of rolled magnesium sheet as soon as possible and planned to test the rolling process on other magnesium alloys (Furukawa, 2001).

Energy Conversion Devices Inc. was testing powder magnesium metal hydride storage systems for hydrogen, which could be used in fuel-cell-powered vehicles. The storage systems have successfully undergone more than 2,000 fill-and-release cycles, equivalent to several hundred thousand kilometers in a car, according to a company representative. The powder magnesium-based system is designed to store hydrogen as a solid and has an advantage compared to cryogenic tanks designed to store hydrogen as a supercooled liquid at high pressure in that it can store more hydrogen per liter of volume. The magnesium-based storage system also eliminates the need for costly tanks that can hold hydrogen either as a chilled liquid or as a gas. Energy Conversion Devices was working to improve the system's total efficiency and improve the metal hydride's hydrogen uptake and release rates (Wrigley, 2001i).

The publication in January of the discovery that magnesium diboride (MgB_2) becomes superconducting at 40 K has led to an explosion of research activities designed to reveal its basic properties and to process the material for applications. Researchers at Aoyama-Gakuin University in Tokyo were characterizing materials when they unexpectedly discovered that MgB_2 loses electrical resistance at 40 K. This is significantly higher than the previous record transition temperature of simple intermetallic compounds that was previously held by niobium germanium at 23.2 K. Many groups are now trying to grow single crystals for more detailed scientific studies. These groups also are attempting to produce thin films and superconducting junctions for device applications and wires and tapes for superconducting magnets and power applications (Gough, 2001§).

Outlook

Domestic consumption of magnesium in the short-term will be dependent on its three principal end uses, aluminum alloying, die-casting, and iron and steel desulfurization. Through April 2002, U.S. primary aluminum production was about 10% lower than production in the same period of 2001, and production in 2001 was significantly lower than normal because of the shutdown of many smelters in the Pacific Northwest (Plunkert, 2002a). Therefore, based on the aluminum production figures, consumption of magnesium for aluminum alloying does not appear to be returning to normal levels in 2002. Magnesium consumption for die-casting applications, however, may continue to increase in 2002. North American vehicle production through June 2002 was 5.2% greater than that in 2001 (WardsAuto.com, 2002§). In addition, in July, DaimlerChrysler, Ford, and GM began offering no-interest loans on most of their models to new car buyers; this spurred auto sales in 2001, and it may increase sales again in 2002.

In March 2002, the President imposed tariffs of up to 30% on imports of most steel products (Allen and Pearlstein, 2002). Under the decision, steel imported from Canada and Mexico would be exempt from the duties because of these countries' status under the North American Free Trade Agreement, as would imports from developing countries, such as Argentina, Thailand, and Turkey, because they account for less than 3% of all total imports. The decision was expected to help increase the U.S. steel industry's sales, and if that occurs, then it could lead to an increase in consumption of magnesium for steel desulfurization.

Closures of plants in Europe and the United States leave Canada and China as the largest producers in the world, and potential new plants are expected to be constructed in Australia, Canada, and perhaps Congo (Brazzaville). As a result, the United States is expected to continue to be import dependent, and this import dependence is expected to increase as consumption begins to grow and no additional production capacity is planned for the United States. It does appear that the United States will continue to have a magnesium-metal-producing plant because the sale of Magcorp to newly formed U.S. Magnesium LLC was finalized in June 2002, and U.S. Magnesium indicated that it would continue operating and continue the modernization program already underway (Mas, 2002).

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TABLE 1
SALIENT MAGNESIUM STATISTICS 1/

(Metric tons unless otherwise specified)

	1997	1998	1999	2000	2001
United States:					
Production:					
Primary magnesium	125,000	106,000	W	W	W
Secondary magnesium	80,200	77,100	86,100	82,300	65,800
Exports	40,500	35,400	29,100	23,800	19,600
Imports for consumption	65,100	82,500	90,700	91,400	69,100
Consumption, primary	100,000	107,000	131,000	104,000	95,700
Yearend stocks, producer	13,100	13,500	W	W	W
Price per pound 2/	$1.60-$1.70	$1.52-$1.62	$1.40-$1.55	$1.23-$1.30	$1.21-$1.28
World, primary production	384,000 r/	396,000 r/	341,000 r/	428,000 r/	426,000 e/

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.
1/ Data are rounded to no more than three significant digits.
2/ Source: Platts Metals Week.

TABLE 2
MAGNESIUM RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES, BY KIND OF SCRAP AND FORM OF RECOVERY 1/

(Metric tons)

	2000	2001
KIND OF SCRAP		
New scrap:		
Magnesium-base	12,800	5,200
Aluminum-base	39,400	33,400
Total	52,200	38,600
Old scrap:		
Magnesium-base	7,300	6,880
Aluminum-base	22,800	20,300
Total	30,100	27,200
Grand total	82,300	65,800
FORM OF RECOVERY		
Magnesium alloy ingot 2/	W	W
Magnesium alloy castings	6,870	2,540
Magnesium alloy shapes	196	231
Aluminum alloys	62,400	54,000
Other 3/	12,800	9,060
Total	82,300	65,800

W Withheld to avoid disclosing company proprietary data; included with "Other."
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes secondary magnesium content of secondary and primary alloy ingot.
3/ Includes chemical and other dissipative uses and cathodic protection, and data indicated by symbol W.

TABLE 3
U.S. CONSUMPTION OF PRIMARY MAGNESIUM, BY USE 1/

(Metric tons)

Use	2000	2001
For structural products:		
Castings:		
Die	23,500	42,900
Permanent mold	5,430	1,280
Sand	527	532
Wrought products 2/	2,120	3,280
Total	31,600	48,000
For distributive or sacrificial purposes:		
Aluminum alloys	55,400	35,000
Cathodic protection (anodes)	98	104
Chemicals	W	W
Iron and steel desulfurization	12,200	8,150
Reducing agent for titanium, zirconium, hafnium, uranium, beryllium	1,520	1,040
Other 3/	3,570	3,400
Total	72,800	47,700
Grand total	104,000	95,700

W Withheld to avoid disclosing company proprietary data; included with "Other."
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes extrusions, sheet and plate, and forgings.
3/ Includes nodular iron, scavenger, deoxidizer, powder, and data indicated by symbol W.

TABLE 4
YEAREND MAGNESIUM PRICES

Source		2000	2001
Platts Metals Week:			
U.S. spot western	dollars per pound	$1.23-$1.30	$1.21-$1.28
U.S. spot dealer import	do.	$1.05-$1.15	$1.03-$1.09
European free market	dollars per metric ton	$1,800-$2,000	$1,700-$1,900
Metal Bulletin:			
European free market	do.	$1,900-$2,000	$1,775-$1,875
China free market	do.	$1,300-$1,310	$1,220-$1,240

TABLE 5
U.S. EXPORTS OF MAGNESIUM, BY COUNTRY 1/

Country	Waste and scrap Quantity (metric tons)	Waste and scrap Value (thousands)	Metal Quantity (metric tons)	Metal Value (thousands)	Alloys (gross weight) Quantity (metric tons)	Alloys (gross weight) Value (thousands)	Powder, sheets, tubing, ribbons, wire, other forms (gross weight) Quantity (metric tons)	Powder, sheets, tubing, ribbons, wire, other forms (gross weight) Value (thousands)
2000:								
Canada	6,290	$17,100	2,700	$7,680	4,930	$16,400	957	$6,310
Japan	--	--	537	1,740	233	1,520	200	3,400
Mexico	57	142	31	106	118	686	1,710	5,540
Netherlands	6	14	2,650	7,000	78	166	162	970
United Kingdom	--	--	99	391	29	775	407	1,740
Other	46	195	1,280 r/	3,290 r/	632 r/	3,810 r/	625 r/	6,050 r/
Total	6,400	17,500	7,300	20,200	6,020	23,300	4,060	24,000
2001:								
Canada	6,780	17,900	2,700	6,930	3,130	10,200	938	5,160
Japan	15	39	172	1,450	6	111	50	542
Mexico	25	81	839	2,960	166	735	2,120	6,630
Netherlands	10	24	879	2,970	1	13	113	1,480
United Kingdom	--	--	105	293	91	863	78	955
Other	117	555	170	676	469	3,120	589	8,950
Total	6,950	18,600	4,870	15,300	3,860	15,100	3,890	23,700

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

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF MAGNESIUM, BY COUNTRY 1/

Country	Waste and scrap Quantity (metric tons)	Waste and scrap Value (thousands)	Metal Quantity (metric tons)	Metal Value (thousands)	Alloys (magnesium content) Quantity (metric tons)	Alloys (magnesium content) Value (thousands)	Powder, sheets, tubing, ribbons, wire, other forms (magnesium content) Quantity (metric tons)	Powder, sheets, tubing, ribbons, wire, other forms (magnesium content) Value (thousands)
2000:								
Brazil	--	--	450	$1,040	(2/)	$9	--	--
Canada	6,450	$12,800	3,100	10,100	25,700	82,100	1,740	$6,710
China	508	548	244	322	21,100	41,800	106	351
Israel	13	6	6,320	18,900	2,110	11,900	--	--
Kazakhstan	--	--	1,340	3,390	--	--	--	--
Mexico	27	50	100	199	328	1,080	431	1,240
Norway	164	402	37	101	2,550	8,060	(2/)	3
Russia	10	10	10,800	23,200	2,610	8,720	(2/)	3
United Kingdom	145	192	(2/)	3	954	5,920	3	237
Other r/	2,570	2,390	495	1,490	999	443	21	131
Total	9,890	16,400	22,900	58,700	56,300	160,000	2,300	8,670
2001:								
Brazil	--	--	1,050	2,190	3	7	--	--
Canada	8,600	17,400	1,520	4,900	14,200	44,000	2,460	12,600
China	212	215	137	199	11,700	22,100	49	148
Israel	18	6	2,820	8,080	4,780	15,700	--	--
Kazakhstan	--	--	1,380	3,030	--	--	--	--
Mexico	68	87	121	173	111	312	310	1,000
Norway	--	--	877	2,140	2,040	5,980	--	--
Russia	19	12	11,300	19,800	603	1,370	--	--
United Kingdom	245	210	(2/)	3	952	6,310	6	243
Other	1,810	1,270	961	2,740	822	4,370	36	93
Total	11,000	19,200	20,100	43,200	35,100	100,000	2,870	14,100

r/ Revised. -- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 7
WORLD ANNUAL PRIMARY MAGNESIUM
PRODUCTION CAPACITY, DECEMBER 31, 2001 1/ 2/

(Metric tons)

Country	Capacity
Brazil	12,000
Canada	117,000
China	270,000 3/
France	17,000 4/
India	900
Israel	27,500
Kazakhstan	10,000
Norway	42,000 5/
Russia	40,000
Serbia and Montenegro	5,000
Ukraine	15,000 4/
United States	45,000
Total	601,000

1/ Includes capacity at operating plants as well as at plants on standby basis.
2/ Data are rounded to no more than three significant digits; may not add to total shown.
3/ Total effective capacity, including an estimate for many small plants at unknown locations.
4/ Standby capacity as of December 31, 2001.
5/ All primary magnesium production capacity was scheduled to shut down in April 2002.

TABLE 8
WORLD PRODUCTION OF MAGNESIUM, BY COUNTRY 1/ 2/

(Metric tons)

Country	1997	1998	1999	2000	2001 e/
Primary production:					
Brazil e/	9,000	9,000	8,000 r/	5,700 r/	5,500
Canada e/ 3/	57,700	77,100	73,700 r/	85,700 r/	83,400
China e/	75,990 4/	70,500	120,000	190,000 r/	200,000
France e/	13,740 4/	14,000	16,200 r/	16,500 r/	4,000
Israel	7,400 r/	24,500 r/	24,800 r/	31,700 r/	31,700
Kazakhstan	8,972	9,000 e/	11,031 r/	10,380 r/	16,000
Norway	34,200	35,400	40,800 r/	41,400 r/	36,000
Russia e/ 3/	39,500	41,500	45,000	45,000	48,000
Serbia and Montenegro e/	2,500	3,965 4/	1,203 4/	1,200	1,200
Ukraine	10,000 e/	5,043	3	3 e/	3
United States	125,000	106,000	W	W	W
Total	384,000 r/	396,000 r/	341,000 r/	428,000 r/	426,000
Secondary production:					
Brazil e/	1,600	1,600	1,600	1,600	1,600
Japan	10,934	7,807	7,732 r/	7,900 r/ e/	7,800
United Kingdom e/ 5/	1,000	1,000	500	500	500
United States	77,600 r/	77,100	86,100	82,300	65,800 4/
Total	91,100	87,500	96,000	92,300 r/	75,700

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total."
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 20, 2002.
3/ Includes secondary.
4/ Reported figure.
5/ Includes alloys.