MAGNESIUM

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U.S. primary magnesium consumption increased slightly in 2002. Diecasting was the largest magnesium-consuming application, accounting for nearly one-half of domestic consumption. Magnesium consumption in this application increased by 6% from that in 2001 mainly because of the introduction of magnesium alloy diecastings into more vehicle models.

With only one U.S. magnesium producer, imports continued to supply a significant portion of U.S. magnesium demand. Imports for consumption in 2002 increased by 28% from those in 2001. Of the total quantity of magnesium imported into the United States, Canada (50%), Russia (19%), China (13%), and Israel (9%) were the principal sources in 2002. Almost one-half the magnesium imported in 2002 was as alloy, and about one-third was in the form of pure metal.

Primary magnesium plants in France and Norway were permanently closed in 2002; some of the capacity was converted to recycling and reprocessing magnesium scrap. These two closures left the European Union (EU) with no primary magnesium production capacity. This continued the trend of shifting magnesium capacity from areas with relatively high electric power costs, such as Europe and the United States, to areas such as China, where fuel costs are cheaper and labor costs are generally lower. Progress continued on new magnesium recovery plants in Australia, Canada, China, and Congo (Brazzaville). In addition to conversion of primary capacity to recycling capacity in France and Norway, new magnesium recycling plants were opened in China, the Czech Republic, and the United States, and additional capacity was planned for the Netherlands.

Legislation and Government Programs

In March, the North American Free Trade Agreement (NATFA) Secretariat issued its decision on the review of the sunset duties (countervailing and antidumping) on pure and alloy magnesium from Canada that were published in the Federal Register in July 2000. The review was requested in August 2000 by the Government of Quebec. The Secretariat remanded the countervailing duty decision back to the International Trade Administration (ITA) of the U.S. Department of Commerce for it to reconsider the determination to use the results of the sixth review to establish the subsidy rate, the basis for the "all others" rate, and the reasons for the failure to investigate subsidies that were allegedly received by Magnola Metallurgy Inc. The antidumping duty decision was remanded to the ITA for it to consider the Quebec Government's claims regarding good cause under the standards of the statute and the determination to report the investigation rate as the margin of dumping likely to occur if the order was revoked (U.S. Department of Commerce, International Trade Administration, 2002b, c). The dumping margin was set at 21% ad valorem in the sunset orders, and the countervailing duty rate was set at 1.84% for Norsk Hydro Canada Inc., the investigated company, and for all others, at 7.34%.

The ITA issued its remand determination on May 28, and on July 15, the Government of Quebec filed a rule 73(2)(b) challenge that contended that the ITA improperly interpreted the good cause requirement of the statute, failed to consider changes in the magnesium market that made recurrence or continuation of dumping unlikely, refused to enter into the record information relevant to the likelihood determination, and wrongfully reported the investigation rate to the International Trade Commission. As a result, the NAFTA panel remanded the antidumping duty investigation again to the ITA to consider these factors (Organization of American States, 2002a§[1]). The ITA had until January 28, 2003, to complete its remand investigation.

In the countervailing duty investigation, the panel concluded that, in this case, the ITA's reporting of an "all others" subsidy rate was neither supported by substantial evidence nor in accordance with law and required that it amend its determination to exclude an "all others" subsidy rate. The panel also agreed with the ITA that there was no good cause to investigate alleged subsidies received by Magnola because there was no indication that the company had produced magnesium (Organization of American States, 2002b§).

In April 2002, the ITA began a new shipper review for Magnola for the countervailing duty determinations on pure and alloy magnesium from Canada, which was scheduled to be completed within 180 days from the date of publication of the notice. The period of review for Magnola was calendar year 2001 (U.S. Department of Commerce, International Trade Administration, 2002d). In September, the ITA extended the time limit for the new shipper review. At the beginning of August, U.S. Magnesium LLC had requested that the ITA include an alleged labor subsidy that was not originally included in the investigation. Although Magnola objected to the reconsideration, this subsidy allegation was included in the review, and the ITA extended the time limit for review until no later than January 21, 2003 (U.S. Department of Commerce, International Trade Administration, 2002a).

In January 2002, the ITA made a preliminary determination that imports of pure magnesium in granular form from Canada or any other country that were produced from magnesium of Chinese origin were subject to the antidumping duties that were established for granular magnesium from China (American Metal Market, 2002b).

The ITA published the final results of its countervailing duty review for pure and alloy magnesium from Canada. For

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

calendar year 2000, the countervailing duty for Norsk Hydro Canada was determined to be 1.59% ad valorem. Based on information submitted by Magnola, the ITA rescinded the review for that company (U.S. Department of Commerce, International Trade Administration, 2002e). The ITA also established a 0% preliminary antidumping duty for magnesium from Norsk Hydro Canada for August 1, 2000, to July 31, 2001. The ITA also found that because no sales were made in commercial quantities during at least 1 of the 3 years cited by Norsk Hydro Canada in its request for revocation, the company did not qualify for revocation of the duty (U.S. Department of Commerce, International Trade Administration, 2002f). The ITA began investigations of countervailing and antidumping duties for alloy magnesium from Magnola for calendar year 2001 and for August 1, 2001, to July 31, 2002, respectively. In addition, the ITA initiated countervailing and antidumping duty investigations for pure and alloy magnesium from Norsk Hydro Canada for the same periods.

The Federal Government planned to leave the corporate average fuel economy (CAFE) standards at 20.7 miles per gallon for light trucks [including minivans and sport utility vehicles (SUVs)] for model year 2004, according to its final rule announced on April 1, 2002. One of the reasons for maintaining the standard was because, after a 6-year prohibition was lifted by Congress, the National Highway Traffic Safety Administration (NHTSA) did not have enough time to analyze any changes. The NHTSA was developing proposals for CAFE standards for light trucks, beginning with the 2005 model year, and had also requested comments through May 8, 2002, for changes to the CAFE requirements for passenger cars (Platts Metals Week, 2002e). Higher CAFE requirements could lead to increased use of magnesium because of its light weight.

Production

On June 4, a U.S. bankruptcy court gave final approval for the sale of Magnesium Corp. of America (Magcorp) to an affiliate of Renco Group for $24 million. Magcorp had been operating under Chapter 11 bankruptcy protection since its parent company Renco Metals Inc. filed in August 2001. Renco Metals was the owner of the Magcorp plant, and the principal individual owner of Renco Group was the principal owner of the new company U.S. Magnesium (Platts Metals Week, 2002g). After the sale was announced, the U.S. Department of Justice (DOJ) attempted to block the sale because it allowed U.S. Magnesium to assume the postbankruptcy petition liabilities of Magcorp rather than paying the purchase price into Magcorp's estate. The sale also would release U.S. Magnesium from tax and successor liabilities. The bankruptcy court dismissed the DOJ's suit, and the DOJ did not file an appeal in the allowable timeframe, so the sale became final at the end of June (Mas, 2002).

U.S. Magnesium announced that it would continue the modernization and expansion plan that was begun by Magcorp. The plan involved installing new electrolytic cells that are larger, more energy efficient, and generate fewer emissions. Installation of these cells would increase the plant's capacity to 60,000 metric tons per year (t/yr) from its current level of 45,000 t/yr. No timetable was set for completion of the modernization (Platts Metals Week, 2002k).

Environment

The cover gas sulfur hexafluoride (SF_6) that is used to protect molten magnesium from oxidation has been implicated as a potential factor in global warming. Although studies on its effect continue, its long atmospheric life (about 3,000 years) and high potential as a greenhouse gas (23,900 times the global warming potential of carbon dioxide) have resulted in a call for voluntary reductions in its emissions. The U.S. Environmental Protection Agency (EPA) began a voluntary partnership with U.S. industries that produce SF_6 emissions, including the magnesium industry, in 1999. The goal of the partnership was to monitor and reduce emissions, and through 2002, SF_6 emissions from the magnesium industry have been reduced by 42%. The International Magnesium Association (IMA), with the EPA's support, initiated a study in mid-2000 to identify and evaluate protective cover gas alternatives to SF_6.

Several alternatives have shown promise as substitutes. These included the hydrofluorocarbon (HFC) HFC-134a, the refrigerant adopted in the 1980s as a replacement for the ozone-depleting chlorofluorocarbon (CFC) Freon-12, and three compounds proposed as candidates by 3M Co. Two of these were hydrofluoroethers (HFE) HFE-7100 and HFE-7200 and the third a perfluoroketone, a new patented compound tradenamed Novec-612, under development at 3M for its reduced environmental impact in an unrelated application. All four of these compounds were found to provide competitive performance when compared with SF_6 mixtures for the protection of magnesium melts from oxidation. They are also attractive candidates because they are of low toxicity, nonflammable, non-ozone-depleting, of short atmospheric lifetime, and possess a much-reduced global warming potential. Commercial development trials of both HFC-134a and Novec 612 began in 2002 and were expected to be completed by 2003 (Hillis, 2002§).

Consumption

Reported primary and secondary magnesium consumption in 2002 increased from those in 2001 (tables 2, 3). Diecasting, with a 6% increase, was the sector with the largest growth in primary consumption from 2001 to 2002. This increase in magnesium consumption reflects an increase of 7.6% in U.S. light vehicle production from 2001 to 2002 (WardsAuto.com, 2003§). Diecasting remained the largest use for primary magnesium, accounting for 47% of the total, followed by aluminum alloying with 36% and iron and steel desulfurization with 9%. Use of magnesium for iron and steel desulfurization also increased, most likely reflecting an increase of 2.4% in U.S. steel production from that in 2001.

Data for magnesium metal are collected from two voluntary surveys of U.S. operations by the U.S. Geological Survey. Of the 79 companies canvassed for magnesium consumption data, 58% responded, representing 60% of the magnesium consumption listed in tables 2 and 3. Data for the 33 nonrespondents were estimated on the basis of prior-year consumption levels and other factors. One large aluminum producer accounted for 57% of the nonresponse total quantity.

Xstrata Magnesium Corp. began shipping magnesium from its new magnesium recycling plant in Anderson, IN, in December

2001. Plant capacity is about 25,000 t/yr; 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, 2002l).

Chrysler Group of DaimlerChrysler AG planned to install additional magnesium components on its 2003 model year Dodge Viper to give the car a total magnesium content of about 18 kilograms (kg) (40 pounds). This would be the highest magnesium content for any North American-produced car. The new parts included the dash panel; the instrument support panel; and several small parts in the steering system, powertrain, and mounting brackets. The dash panels will weigh between 9.5 and 11.3 kg (21 to 25 pounds) each, and the instrument panel support beams will weigh about 5.4 kg (12 pounds) each. The single-piece magnesium dash panel will replace a 51-piece assembly of steel stampings weighing about 25.4 kg (56 pounds) (Wrigley, 2002b).

General Motors Corp. (GM) chose Intermet Corp., Troy, MI, to supply the magnesium alloy instrument panel support beam for its new Cadillac SRX crossover vehicle for which production is beginning in 2003. The beams, which weigh from 6.4 to 13.6 kg (14 to 30 pounds) each, will be cast in two pieces, then joined with adhesive bonding. Casting the part in two pieces allows the use of conventional medium-size die-casting machines rather than requiring the large costlier machines if the beams were to be cast in one piece (Wrigley, 2002h).

In addition, GM completed plans to install magnesium alloy instrument panel support beams on all of its North American-built automobiles designed on the Epsilon platform, which include the Chevrolet Malibu and Pontiac Trans Am. All of the instrument panel support beams that will be installed in these redesigned models beginning in 2004 will be one-piece die castings and will be supplied by three different manufacturers. These manufacturers are Lunt Manufacturing Co. Inc., Hampshire, IL; Meridian Technologies, Strathroy, Ontario, Canada; and the TriMag unit of Société de Développement du Magnésium s.e.c., Boisbriand, Quebec, Canada. The support beams, which will weigh between 4.5 and 12.2 kilograms (10 and 27 pounds) will be manufactured from the AM series of alloys. GM estimated that about 900,000 beams would be used annually, accounting for a magnesium consumption of more than 9,000 t/yr (Wrigley, 2002c).

GM announced plans to use magnesium alloys for the retractable hardtop roofs for its Cadillac XLR sports cars and for its Pontiac Grand Am models. The Cadillac model will debut in 2004, and the Grand Am, in 2006. The retractable hardtop, which is nearly nonexistent in currently produced automobiles in the United States, is expected to become popular because of its durability and perceived safety advantages over soft tops (Wrigley, 2002i, j).

GM was considering using magnesium alloys for floor-mounted shift towers and console covers in its light- and medium-duty pickup trucks, vans, and SUVs. The company had begun using an AZ91 magnesium alloy shift tower in the 2002 model of its Saturn Vue SUV; however, engineers need to investigate its floor adherence and service life before it is incorporated into more vehicles. The shift tower took several years to develop partially because it was difficult to find an economical way to attach the magnesium tower to the steel floor of the vehicle and have the tower remain in place for the vehicle's service life. A new thread-forming fastening system was designed that compresses the threads into the magnesium while the fasteners are being installed. This eliminates the need to drill and tap the threads after the magnesium parts were cast. If the shift towers prove to be suitable, production could number in the hundreds of thousands to millions of components annually, according to GM. The manufacturer for the Saturn Vue shift tower component is Lunt Manufacturing. The one-piece magnesium shift towers weigh between 0.9 and 2.3 kg (2 to 5 pounds) and replace a multipiece steel assembly (Wrigley, 2002a).

GM also was considering using magnesium sheet for vehicle body components in some limited-volume vehicles. This would be the first use of magnesium body components in consumer vehicles. GM has tested commercially available magnesium wrought alloys from at least two suppliers and, from these, has produced two prototype magnesium components by superplastic- and warm-forming techniques. GM determined that these production techniques could be used at a reasonable level of cost effectiveness to produce moderately complex components, although not in high volumes (Wrigley, 2002g).

Ford Motor Co. announced that it would use single-piece magnesium alloy die-casting front-end supports in its redesigned F-150 pickup trucks beginning in the 2004 model year. The 1-piece AM50 diecastings would replace a 15-piece steel assembly and were expected to be produced by Magnesium Products of America Inc. at its Eaton Rapids, MI, die-casting facility. This represents the first use of this particular component in a North American-produced vehicle (Wrigley, 2002d). In addition to the pickup truck application, Ford subsidiaries Jaguar Plc and Volvo Car Corp. were working to develop more than 40 magnesium alloy components for their European luxury cars.

Ford continued its plans to install magnesium cam covers on its Triton V-8 and V-10 engines during the next 2 years. Ford, which had been hesitant to replace the plastic covers with magnesium in North American-produced vehicles because of the cost of magnesium, decided the quality and durability benefits of magnesium in certain areas outweighed its cost. The new magnesium parts, which will be phased in by engine type, are expected to consume more than 3,000 t/yr of magnesium. The supplier for the AZ91 die-cast covers for the V-8 engines will be Spartan Light Metal Products, Sparta, IL, and other suppliers may be added as applications increase (Wrigley, 2002f).

Because of its cost-cutting program, Ford was considering switching some magnesium components in its lower priced vehicles from magnesium to aluminum or steel. Ford already has decided not to use magnesium cam covers on its new V-6 truck engine that will be introduced in 2004. It also canceled plans to use magnesium instrument panel beams in another new vehicle planned for the future. According to Ford, in 1999, the company was projecting that by 2004 the total quantity of magnesium that would be used in North American-produced vehicles would be 100,000 t/yr; based on current information, this projection has dropped to 35,000 t (Wrigley, 2002e).

Stocks

Producers' yearend 2002 stocks of primary magnesium fell slightly from those at yearend 2001; producer stock data cannot be reported to avoid disclosing company proprietary data. Consumer stocks of primary and alloy magnesium were 5,940 metric tons (t) at yearend 2002, the same as the yearend 2001 level of 5,940 t (revised); the ratio of magnesium to magnesium alloys, however, was different. Yearend 2001 consumer stocks of secondary magnesium fell to 2,720 t from the 2001 level of 3,040 t (revised).

Prices

Quoted magnesium price trends were mixed in 2002 (table 4). The U.S. prices fell, and the European and Chinese prices increased. With the shutdown of the European magnesium production facilities in mid-2002 and the subsequent expectation of the removal of the antidumping duty on imports of magnesium from China, European and Chinese prices rose most significantly during the third quarter and then fell slightly by yearend.

Foreign Trade

Total magnesium exports for 2002 were about 30% higher than those in 2001 (table 5). Canada (70%), Mexico (14%), and the Netherlands (11%) were the main destinations. Imports for consumption in 2002 increased by 28% from those in 2001 (table 6). Of the total quantity of magnesium imported into the United States, Canada (50%), Russia (19%), China (13%), and Israel (9%) were the principal sources in 2002. Almost one-half the magnesium imported in 2002 was as alloy, and about one-third was in the form of pure metal. Canada and China together supplied 87% of the magnesium alloy imports, and Russia provided about one-half the pure magnesium imports in 2002.

World Review

According to data reported to the IMA, aluminum alloying remained the largest end use for magnesium in the world, with almost 40% of the total shipments. Diecasting, with 35% of the total, was second, followed by iron and steel desulfurization with 16%. The largest consuming region for magnesium was North America, with 44% of the total, followed by Western Europe with 33%. Magnesium shipments of 365,000 t in 2002 were 11% higher than those in 2001; Western World magnesium production of 130,000 t, however, was 28% lower than that in 2001. This decrease in production reflects closure of plants in Europe and the shift in production to China and Russia (International Magnesium Association, 2003§).

A notice concerning the review of the antidumping measures on Chinese magnesium was finally published by the European Commission (EC) on September 27. The notice gave interested parties 40 days to appeal against the removal of the duties. The duty review had been expected since Pechiney officially closed its primary magnesium plant in France in June. Reviews were scheduled to be completed by January 2003, with the duty expected to be removed (Nordic Magnesium Cluster, 2002§).

Australia.—Australian Magnesium Corp. Ltd. (AMC) continued to develop its 97,000-t/yr magnesium plant in Queensland. In March, the company chose to use 40 Alcan Ex2 electrolytic cells rather than the 64 Alcan MKIII cells that had originally been chosen. AMC cited improved cell efficiency, lower operating costs, and lower capital costs as the main reasons for the switch (Australian Magnesium Corp. Ltd., 2002c§). The company also signed an engineering, procurement, and construction contract with Leighton Contractors Pty. Ltd. for an estimated $1 billion. AMC began site clearing in June and expected to begin magnesium production by the end of 2004 and reach its full production capacity by the end of 2005 (Australian Magnesium Corp. Ltd., 2002a§).

In the fourth quarter, AMC completed a sales agreement for 15,000 t/yr of magnesium with a European metals company for a 3-year period, formed an alliance with Hong Kong-based Lee Kee Group Inc. to develop markets for its magnesium products in China, and signed an agreement with European component manufacturer Wagon plc to develop magnesium automotive applications (Australian Magnesium Corp. Ltd., 2003b§).

Pima Mining NL, which changed its name to Magnesium International Ltd. in July, completed its feasibility study on the SAMAG magnesium project in August. The feasibility study recommended a 71,000-t/yr plant, which would have a capital cost of A$761 million and an operating cost of A$1.06 per pound (US$0.59 per pound). Construction of the proposed plant, based on Dow's magnesium technology, could be completed in 28 months. Based on the result of the feasibility study, the company planned a project financing in the range of A$250 million to A$300 million (Magnesium International Ltd., 2002b§). Magnesium International also signed a 15-year power supply contract with NRG Flinders Pty. Ltd. in October that allows for a 2% power interruptibility at NRG's request. The Dow process that will be used to produce magnesium allows for instantaneous power interruptibility, which will be useful for the power company to maintain supplies in peak summer electricity demand periods. Magnesium International had originally planned to build its own power station for the SAMAG plant and retained the right to develop a power station in the future if the magnesium plant's capacity is expanded (Magnesium International Ltd., 2002a§).

Magnesium International and Thiess Ltd. announced that they have agreed on an A$751.5 million price for the engineering, procurement, and construction of the 71,000-t/yr SAMAG magnesium smelter to be built at Port Pirie in South Australia. Construction was expected to begin by mid-2003, with operations to start by the end of 2005 (Hagopian and Francis-Grey, 2002).

In April, Rambora Technologies Ltd. entered a conditional agreement to buy all the shares in Magnesium Investments Pty. Ltd., which holds 100% of the Latrobe magnesium project. The Latrobe magnesium project is centered on the production of magnesium from fly ash produced by power stations in the La Trobe Valley in Victoria. The project's assets include the fly ash in Hazelwood Power's tailings ponds, the fly ash to be produced at the Hazelwood power station in the future, an area of leased land adjacent to the Hazelwood power station, and the right to use existing tailings system facilities at Hazelwood (Platts Metals Week, 2002i). In June, Rambora announced that it would take an option to licence Alcan International Ltd.'s magnesium dehydration technology for its planned magnesium plant (Australia Mining, 2002§). In addition, Rambora changed its name to Latrobe Magnesium Ltd. in June and, in August, released the results of its feasibility study to construct a 100,000-t/yr plant to recover magnesium from coal fly ash. The capital cost of the plant was estimated to be A$857 million, and the direct operating cost would be A$0.705 per pound. This project was estimated to have a lower operating cost than some others because the raw material does not need to be mined (MineBox, 2002§).

Canada.—Hydro Magnesium increased production capacity at its Becancour, Quebec, plant to 45,000 t/yr from 40,000 t/yr through debottlenecking operations that have taken place during the past few years. During a maintenance shutdown in April, the plant's capacity was increased further to 48,000 t/yr by increasing the quantity of energy available to the dehydration trains (Hydro Magnesium, 2002a§).

By the end of the first quarter of 2002, Magnola had brought additional electrolytic cells online at its new plant in Quebec; 20 of the plant's 24 cells were operating at about 65% of their designed power rate. Magnola expected to reach 60% of its 63,000-t/yr production capacity by the end of the third quarter. In 2001, the plant produced 9,340 t of magnesium and magnesium alloy (Platts Metals Week, 2002h).

Leader Mining International Inc. signed a technology transfer agreement with the State Research and Design Titanium Institute of Zaprozhye, Ukraine, and the joint stock company VAMI of Russia to use their production technology to recover magnesium from magnesium silicate at its Cogburn magnesium project in British Columbia. The company also selected Hatch Associates Ltd. to complete a feasibility study by mid-December 2002 for a quarry and integrated processing plant to recover 120,000 t/yr of magnesium metal (Leader Mining International Ltd., 2002a§, b§).

Globex Mining Enterprises Inc. received a conditional offer from the Quebec Government to finance part of a feasibility study for its Timmins magnesite-talc project. An initial scoping study by Hatch Associates Ltd. had proposed a Can$1.5 billion complex in two locations, with the capacity to produce 90,000 t/yr of magnesium metal. The Quebec Government would finance 25% of the Can$17.7 million study if the Federal Government financed 25% and Globex financed the remaining 50% (Globex Mining Enterprises Inc., 2002§).

China.—China continued to plan new magnesium capacity at several of its plants. Shanxi Qizhen Magnesium Co. announced that it would build a new plant with the capacity to produce 20,000 t/yr of magnesium metal and 5,000 t/yr of magnesium die-casting alloy in 2002. Most of the company's current production is exported to Southeast Asian countries (China Metal Market, 2002). Guangling Jinghua Magnesium Co. Ltd. planned to start up its 10,000-t/yr alloy line by the end of March. Hebi Jianghai Smelting Co. expanded its magnesium alloy production capacity to 6,000 t/yr from 2,000 t/yr. The company exported most of its magnesium to the United States and Europe. Shanxi Electric Power Import and Export Corp. announced that it would complete a 2,400-t/yr magnesium plant by the fourth quarter of 2002, with production mainly for export to Southeast Asian countries (Platts Metals Week, 2002j).

Dongfang Metallurgy Enterprises Co. Ltd. planned to form a joint venture with a foreign partner by the third quarter of 2002 to increase its magnesium production capacity to 30,000 t/yr from its current level of 11,000 t/yr. The company was negotiating with potential partners in Germany, Japan, and the United Kingdom (Platts Metals Week, 2002c). Jishan Huayu Enterprises Group planned to complete a 20,000-t/yr expansion to its primary magnesium plant by yearend 2002 to bring the plant's total capacity to 32,000 t/yr (Platts Metals Week, 2002f). Shanxi Wenxi Baiyu Magnesium Industry Co. Ltd. planned to double its magnesium ingot capacity to 9,600 t/yr by August 2002 (Platts Metals Week, 2002a). Many of the planned expansions in China are in response to the expectation that the EC antidumping duty on magnesium imported from China would be revoked.

Ningxia Zhongning Aluminium Co. began operating its 12,000-t/yr magnesium plant at the end of September. About 80% of the plant's output of magnesium ingot will be targeted to U.S. and Japanese markets, with the remaining 20% to be used in the company's aluminum alloying plant (Platts Metals Week, 2002b).

Hydro Magnesium also began operations at its new 10,000-t/yr magnesium alloy plant in Xi'an on November 29, 2001, but there were some problems with the induction furnaces. After furnace modification was completed, the plant began commercial operations in the first quarter of 2002. Hydro Magnesium expected to add a third shift in July and begin 7-day-per-week, 24-hour-per-day operations at the end of August, at which time the plant would be operating at full capacity. Metal produced at the new plant was expected to be shipped to customers in the Pacific rim (Hydro Magnesium, 2002b§).

Congo (Brazzaville).—Magnesium Alloy Corp. (MagAlloy) signed a memorandum of understanding with Eskom Enterprises (Pty.) Ltd. of Johannesburg, South Africa. This agreement would establish a long-term power contract for the delivery of low-cost electrical energy to MagAlloy's planned 60,000-t/yr Kouilou magnesium project. Under the first phase of the agreement, existing transmission and production facilities would be rehabilitated, if necessary, and new routes that link Congo (Brazzaville) to the southern Africa power pool would be built (Magnesium Alloy Corp., 2002a§). MagAlloy also signed an offtake agreement with Stinnes Metall GmbH whereby Stinnes Metall would market up to 100% of the magnesium and magnesium alloys produced at the plant (Magnesium Alloy Corp., 2002b§).

Czech Republic.—Production at Magnesium Elektron's new 10,000-t/yr magnesium recycling plant in the Czech Republic began in May. The plant recycles magnesium from the die-casting industry to produce high-quality alloys. Most of the plant's customers were within 350 kilometers of the plant (Cooper, 2002).

France.—Pechiney officially closed the primary production portion of its Marignac plant on July 2; the company had not produced any magnesium since June 2001. This closure left the EU with no primary magnesium production and was expected to lead to removal of the European antidumping duty on imports of magnesium from China that was established in 1997 by the EC. Pechiney began converting the Marignac plant into a 5,000-t/yr magnesium recycling operation, which would produce niche products including turnings and granules. Pechiney was expected to source the scrap feedstock from France, Italy, and Spain (Platts Metals Week, 2002d).

Netherlands.—Remag Alloys BV planned to construct a 10,000-t/yr magnesium recycling plant in Delfzijl, with production to start about October 2003. Raw material for the plant will be sourced mainly from European diecasters. The recycling plant was expected to be the forerunner of a project proposed by Antheus Magnesium to build a primary magnesium plant that will produce 50,000 t/yr of magnesium using magnesium chloride as a raw material; the primary plant was not expected until 2006 (American Metal Market, 2002a).

Norway.—Hydro Magnesium, operating as Hydro Magnesium Alloys a.s., planned to continue to operate its casthouse in Porsgrunn after the primary magnesium plant closed in April. The casthouse began operating as a remelting plant on March 18 and produced its first metal on March 20. The casthouse has a capacity of 20,000 t/yr and was operating on imported pure metal from China and returned scrap from customers in Europe (Hydro Magnesium, 2002c§).

Russia.—Because investors have shown no interest in financing the project, a proposal to construct a plant to recover magnesium from asbestos tailings in Russia has been indefinitely postponed. Plans to construct a 50,000-t/yr magnesium plant were originally proposed in 2000 (Metal Bulletin, 2002b).

Ukraine.—Magnesium production was expected to restart by the end of 2002 at the Kalush plant in Ukraine. Esko-Pivnich, the plant's holding company, planned to produce 500 t of magnesium in December and 10,000 t in 2003. The plant has been closed since 1999 (Metal Bulletin, 2002a).

Current Research and Technology

Sumitomo Electric Industries Ltd. announced that it developed a magnesium alloy wire that is 20% stronger than extruded magnesium alloy bar and can be bent and coiled at room temperature. Because of the alloy's flexibility, strength, and light weight, its potential applications include electronic devices, leisure and sporting goods, and automotive parts. In addition, the alloy can shield against electromagnetic interference and can be easily recycled, making it ideal for use in portable electronic equipment such as cellular phones, notebook computers, and portable disc players. Sumitomo Electric also expects that the alloy could be used as a substitute for resins and aluminum alloys (Sumitomo Electric Industries Ltd., 2002§).

AMC announced that it had developed a new patented magnesium alloy that was featured in a prototype 3-cylinder Volkswagen engine at a trade exhibition in Europe. The engine block, sand-cast out of alloy AMC-SC1, weighed 14 kilograms, about 25% less than an aluminum engine block currently in use (Australian Magnesium Corp. Ltd., 2002b§).

Outlook

The magnesium industry is in transition. Although consumers in developed parts of the world continue to specify magnesium for new components in applications in the auto industry and in such consumer goods as laptop and notebook computers, cameras, bicycles, and hand tools, the magnesium production capacity has shifted to areas where production costs are lower, specifically China. In addition, some of the proposed new facilities that were expected to produce magnesium within the next several years have had financial problems. In Australia, construction on the most advanced of the new magnesium plants—AMC's Stanwell project—was halted in mid-2003, the engineering contract was canceled, and the project was put on care and maintenance until a new business plan is developed. Cost overruns in the construction of the plant, which had begun in 2002, were responsible for the decision to halt construction (Australian Magnesium Corp. Ltd., 2003a§). Magnesium International did not raise sufficient funds though a stock offering to proceed with development of its SAMAG project, and the South Australian Government plans to review the project (Magnesium International Ltd., 2003§). Also, the Magnola plant in Canada that had begun operating in 2000 closed indefinitely in April 2003. Competition from magnesium imports from China and technical problems at the plant were cited as the principal reasons for the closure (American Metal Market, 2003).

In addition, some large magnesium consumers in the United States have had financial difficulties as well. Spectrulite Consortium Inc., one of the largest magnesium extrusion plants in the United States, filed for Chapter 11 bankruptcy in early 2003 and was required to sell its assets. Rossborough-Remacor LLC, one of the largest desulfurization reagent producers in the United States, filed for Chapter 11 bankruptcy in June because of bankruptcy filings by its steel-producing customers.

The projections of rapidly growing magnesium use in automotive applications led to the announcement of new primary magnesium plants throughout the world; however, these projections may have proven to be too optimistic. Although still growing, the use of magnesium for die-cast auto components did not increase as rapidly as originally projected, so the total capacity that was forecast to be added through new plant construction may have been too great. In addition, some of the technology that was expected to be used in these plants had not been proven on a commercial scale, and implementation of the new technology took longer than expected, proved costlier than expected, or had technical difficulties in scaleup.

One of the reasons for not using magnesium in some applications, cited by potential users in the past, was the limited number of suppliers of the metal. Although this may have been addressed if new capacity had come onstream, the number of suppliers has actually decreased, and much of the capacity that is producing is in China. Some consumers may be reluctant to rely on China as their principal supply source, and this could slow the continued penetration of magnesium into automotive applications. As an example, Ford had signed a 45,000-t/yr magnesium supply agreement with AMC in 1997, soon after the plant was proposed. The proposed plant's financial difficulties may jeopardize Ford's willingness to use magnesium in new applications.

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TABLE 1
SALIENT MAGNESIUM STATISTICS[1]

(Metric tons unless otherwise specified)

	1998	1999	2000	2001	2002
United States:					
Production:					
Primary magnesium	106,000	W	W	W	W
Secondary magnesium	77,100	86,100	82,300	65,800	73,600
Exports	35,400	29,100	23,800	19,600	25,400
Imports for consumption	82,500	90,700	91,400	68,500 r	88,000
Consumption, primary	107,000	131,000	104,000	95,700	96,100
Yearend stocks, producer	13,500	W	W	W	W
Price[2] dollars per pound	1.52-1.62	1.40-1.55	1.23-1.30	1.21-1.28	1.10-1.22
World, primary production	396,000	341,000	428,000	428,000 r	429,000 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)

	2001	2002
KIND OF SCRAP		
New scrap:		
Magnesium-base	5,200	13,400
Aluminum-base	33,400	33,700
Total	38,600	47,100
Old scrap:		
Magnesium-base	6,880	6,880
Aluminum-base	20,300	19,600
Total	27,200	26,400
Grand total	65,800	73,600
FORM OF RECOVERY		
Magnesium alloy ingot[2]	W	W
Magnesium alloy castings	2,540	929
Magnesium alloy shapes	231	247
Aluminum alloys	54,000	53,500
Other[3]	9,060	18,900
Total	65,800	73,600

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes secondary magnesium content of both 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	2001	2002
For structural products:		
Castings:		
Die	42,900	45,600
Permanent mold	1,280	270
Sand	532	492
Wrought products[2]	3,280	1,940
Total	48,000	48,300
For distributive or sacrificial purposes:		
Aluminum alloys	35,000	34,900
Cathodic protection, anodes	104	104
Chemicals	W	W
Iron and steel desulfurization	8,150	8,510
Reducing agent for titanium, zirconium, hafnium, uranium, beryllium	1,040	867
Other[3]	3,400	3,380
Total	47,700	47,800
Grand total	95,700	96,100

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

TABLE 4
YEAREND MAGNESIUM PRICES

Source		2001	2002
Platts Metals Week:			
U.S. spot Western	dollars per pound	1.21-1.28	1.10-1.22
U.S. spot dealer import	do.	1.03-1.09	1.02-1.07
European free market	dollars per metric ton	1,700-1,900	1,800-1,900
Metal Bulletin:			
European free market	do.	1,775-1,875	1,880-1,980
China free market	do.	1,220-1,240	1,360-1,380

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

	Waste and scrap		Metal		Alloys (gross weight)		Powder, sheets, tubing, ribbons, wire, other forms (gross weight)	
Country	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
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
2002:								
Canada	5,790	14,400	6,990	11,200	3,750	11,300	1,180	4,760
Japan	12	186	27	62	13	179	202	1,520
Mexico	18	46	1,550	5,060	76	539	1,920	8,460
Netherlands	--	--	2,570	4,980	10	19	96	616
United Kingdom	(2)	5	146	313	21	170	104	2,090
Other	27	70	54	204	349	1,830	516	9,990
Total	5,850	14,700	11,300	21,800	4,210	14,000	4,010	27,400

-- 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 6

U.S. IMPORTS FOR CONSUMPTION OF MAGNESIUM, BY COUNTRY[1]

	Waste and scrap		Metal		Alloy (magnesium content)		Powder, sheets, tubing, ribbons, wire, other forms (magnesium content)	
Country	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
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	11,000 r, 2	17,800 r, 2	49	146 r, 2
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	(3)	3	952	6,310	3 r	243
Other	1,810	1,270	961	2,740	819 r, 2	3,860 r, 2	36	87 r, 2
Total	11,000	19,200	20,100	43,200	34,500 r	95,400 r	2,860 r	14,100
2002:								
Brazil	--	--	1,220	2,810	6	20	--	--
Canada	10,200	15,600	6,810	18,300	25,200	72,900	1,940	11,000 2
China	116	132	91	152	11,000 2	17,800 2	1	29
Israel	39	33	5,850	14,500	2,390	6,860	--	--
Kazakhstan	--	--	994	1,990	--	--	--	--
Mexico	47	60	21	35	296	1,680	114	350
Norway	--	--	201	405	8	26	(3)	8
Russia	--	--	14,600	25,600	1,860	3,870 2	--	--
United Kingdom	211	217	11	31	390	3,620	2	161
Other	3,420	4,860	22	60	710	1,860 2	39	702
Total	14,100	20,900	29,900	63,900	41,900	109,000	2,090	12,200

[r]Revised. -- Zero.

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

[2]Data adjusted by the U.S. Geological Survey.

[3]Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 7
WORLD ANNUAL PRIMARY MAGNESIUM
PRODUCTION CAPACITY, DECEMBER 31, 2002 [1, 2]

(Metric tons)

Country	Capacity
Brazil	12,000
Canada	120,000
China[3]	300,000
India	900
Israel	27,500
Kazakhstan	10,000
Norway	42,000 [4]
Russia	40,000
Serbia and Montenegro	5,000
Ukraine	15,000 [5]
United States	45,000
Total	617,000

[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]Closed in April 2002.
[5]Standby capacity as of December 31, 2002.

TABLE 8
MAGNESIUM: PRIMARY WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country	1998	1999	2000	2001	2002[e]
Brazil[e]	9,000	8,000	5,700	5,500	6,000
Canada[e, 3]	77,100	73,700	85,700	83,400	80,000
China[e]	70,500	120,000	190,000	200,000	230,000
France[e]	14,000	16,200	16,500	4,000	--
Israel	24,500	24,800	31,700	34,000 [r]	34,000
Kazakhstan	9,000 [e]	11,031	10,380	16,000 [e]	18,000
Norway	35,400	40,800	41,400	36,000 [e]	10,000
Russia[e, 3]	41,500	45,000	45,000	48,000	50,000
Serbia and Montenegro	3,965	1,203	1,200 [e]	1,200 [e]	1,200
Ukraine	5,043	3	3 [e]	3 [e]	3
United States	106,000	W	W	W	W
Total	396,000	341,000	428,000	428,000 [r]	429,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- 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 20, 2003.
[3]Includes secondary.