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MAGNESIUM

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MAGNESIUM

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Primary magnesium was produced by one company in the United States, and much of the U.S. demand was met by imports. Canada, Israel, and Russia were the principal sources of imported magnesium. Diecasting, aluminum alloying, and iron and steel desulfurization, in descending order, were the principal end-use applications for magnesium in the United States in 2005. China continued to dominate world production of primary magnesium, accounting for 75% of the total.

Legislation and Government Programs

Final antidumping duty orders on magnesium from China and Russia were published in April. For China, the final duties for magnesium alloy were 49.66% ad valorem for Tianjin Magnesium International Co. and Beijing Guangling Jinghua Science & Technology Co. Ltd. and 141.49% ad valorem for the China-wide rate. Magnesium covered under this order is classified under Harmonized Tariff Schedule (HTS) codes 8104.19.00 and 8104.30.00. The U.S. International Trade Commission (ITC) also determined that critical circumstances did not exist. As a result of this determination, antidumping duties were assessed on any material that entered the United States from China after October 4, 2004, which was the date that the preliminary duties were published. Material that entered between July 6, 2004, and October 4, 2004, was not subject to antidumping duties because of the negative critical circumstances finding (U.S. Department of Commerce, International Trade Administration, 2005b). An antidumping duty order was established on magnesium ingot from China in 1995 (108.26% ad valorem), and a separate antidumping duty order was established on granular magnesium from China in 2001 (24.67% and 305.56% ad valorem).

For Russia, the antidumping duties were 21.71% ad valorem for JSC Avisma Titanium-Magnesium Works, 18.65% ad valorem for Solikamsk Magnesium Works, and 21.01% for all others. The material covered under this order is classifiable under HTS codes 8104.11.00, 8104.19.00, 8104.30.00, and 8104.90.00 (U.S. Department of Commerce, International Trade Administration, 2005c).

In May, JSC Avisma filed an appeal of the ITC ruling that resulted in antidumping duties being established for magnesium imported from Russia with the U.S. Court of International Trade. In addition, one of the leading U.S. consumers of magnesium and a former U.S. magnesium producer, Alcoa Inc., filed a similar appeal, but Alcoa's appeal was directed against antidumping duties on magnesium imported from China (Brooks, 2005a).

In August, U.S. Magnesium LLC filed a "scope ruling request" with the U.S. Department of Commerce, International Trade Administration (ITA) alleging that Timminco Ltd. of Canada and Pechiney of France evaded United States antidumping duties by remelting ingots or pure magnesium pieces from China and Russia and exporting them to the United States as Canadian- or French-origin magnesium. Although Timminco and Pechiney were targeted by the filing, the scope was not limited to these two firms; it would apply to any company that had been importing Chinese- or Russian-origin magnesium that had been slightly modified (Peterson and McBeth, 2005).

The ITC also began a second 5-year review of antidumping duties on imports of pure magnesium from China. (A duty of 305.56% ad valorem had been established in 1995, except for one company for which the duty was 24.67% ad valorem.) A continuation of the antidumping duties was established after the first 5-year review in 2000 (U.S. International Trade Commission, 2005b).

Final countervailing duty determinations for calendar year 2003 for pure and alloy magnesium from Canada were announced in September 2005 by the ITA. For pure magnesium, the duty was 1.21% ad valorem for Norsk Hydro Canada Inc., and for alloy magnesium, the rates were 1.21% ad valorem for Norsk Hydro Canada and 5.40% ad valorem for Magnola Metallurgy Inc. (U.S. Department of Commerce, International Trade Administration, 2005d). In July, the ITC began its second 5-year review of countervailing duties on pure and alloy magnesium imported into the United States from Canada. The original duties were established in 1992, and a 5-year review was conducted in 2000 (U.S. International Trade Commission, 2005a).

The Government of Quebec and Magnola Metallurgy had appealed the ITA's decision on countervailing duties on magnesium to a North American Free-Trade Agreement binational panel. (A 7% ad valorem countervailing duty for alloy magnesium from Magnola Metallurgy was originally established in a new shipper review in 2003.) The binational panel upheld the ITA's original determination (U.S. Department of Commerce, International Trade Administration, 2005a).

Production

U.S. Magnesium Corp. announced that it would delay the startup of its planned expansion of 11,000 metric tons per year (t/yr). The company cited unfavorable market conditions that did not exist when the expansion plans were announced in 2004 as the main reason for its decision to delay the expansion. U.S. Magnesium did not announce a new date to bring the additional capacity online (Blamey and McBeth, 2005).

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) has resulted in a call for voluntary reductions in its emissions. In 1999, the U.S. magnesium industry, the International Magnesium Association, and the U.S. Environmental Protection Agency (EPA) began a voluntary partnership to understand and reduce emissions of SF_6. The major processes that require SF_6 melt protection are primary production; secondary production; die, permanent mold, and sand casting; wrought products; and anode production. According to the EPA, emissions from primary magnesium production and magnesium casting have halved between 1990 and 2004, and emissions in 2004 were 10% lower than those in 2003 despite processing additional magnesium. The most significant decrease has taken place since 1999, mainly because of a decline in the quantity of magnesium diecast and the closure of a U.S. primary magnesium production facility (U.S. Environmental Protection Agency, 2006§[1]).

In May, the U.S. Department of Justice, acting at the request of the EPA, filed a suit alleging that waste and dust from U.S. Magnesium's plant had elevated levels of polychlorinated biphenyls (PCBs). The PCB levels were estimated to be as high as 600 parts per million (ppm). PCB wastes are generally regulated for disposal under the Toxic Substance Control Act at concentrations greater than 50 ppm (Brooks, 2005b). U.S. Magnesium was already involved in a lawsuit that was brought in 2001 regarding dioxin releases at the plant.

Consumption

Data for magnesium metal are collected from two voluntary surveys of U.S. operations by the U.S. Geological Survey. Of the 80 companies canvassed for magnesium consumption data, 55% responded, representing 71% of the magnesium-base scrap consumption listed in table 2 and the primary magnesium consumption listed in table 3. Data for the 36 nonrespondents were estimated on the basis of prior-year consumption levels and other factors.

Reported primary magnesium consumption in 2005 was slightly lower than that in 2004 (table 3). Consumption of primary magnesium for diecasting applications increased by 8% from that in 2004. Diecasting remained the leading use for primary magnesium, accounting for 52% of the total, followed by aluminum alloying with 30% and iron and steel desulfurization with 7%.

On January 14, a fire started at a warehouse at the Advanced Magnesium Alloys Corp. (AMACOR) magnesium recycling plant in Anderson, IN, destroying about 25% of the facility. After an investigation by local, State, and Federal investigators, it was determined that the fire was intentionally set, and a reward was offered for information leading to the arson suspect (McCann, 2005; McFeely, 2005§). AMACOR restarted production at its plant at the end of May. A former employee was arrested and charged with arson (Platts Metals Week, 2005a).

A fire broke out on August 7 at Remacor Inc.'s magnesium grinding plant in West Pittsburgh, PA. Remacor produced magnesium-base desulfurization reagents for the iron and steel industry. Several drums of magnesium stored in one of the manufacturing buildings caught fire and exploded, and the fire spread to several smaller buildings at the site. The fire was allowed to burn until it burned out, which took several days. The cause of the fire was not determined (Lash, 2005§).

A new firm, MagPro LLC, planned to begin a magnesium recycling operation in 2006 in Camden, TN. One of the owners of the company was the former owner of bankrupt Halaco Engineering Inc., a magnesium recycler in Oxnard, CA, that closed in 2004 (Platts Metals Week, 2005c).

Stocks

Producers' yearend 2005 stocks of primary magnesium increased from those at yearend 2004; producer stock data were withheld to avoid disclosing company proprietary data. Consumer stocks of primary and alloy magnesium were 5,800 metric tons (t) at yearend 2005, a 28% decrease from the yearend 2004 level of 8,020 t (revised). Secondary magnesium stocks of 2,270 t at yearend 2005 were essentially the same as those at yearend 2004 of 2,260 t.

Prices

With the exception of a slight increase at the beginning of the year in anticipation of antidumping duties being established for magnesium imported from China and Russia, United States magnesium prices fell throughout 2005. The yearend 2005 U.S. magnesium price range was 30 to 40 cents per pound lower than that at yearend 2004 (table 4). Several reasons were suggested for the downturn in prices, particularly in the latter part of the year. Oversupply of magnesium, particularly from Russian producers, was cited as one reason for the drop in prices. Competition from recycled magnesium, which has a lower price, was cited as another reason. In addition, the phasing out of one of General Motors Corp.'s (GM) most comprehensive truck and sport utility vehicle redesign programs, which had been incorporating magnesium parts, contributed to the price decline (McBeth, 2005).

Contract prices among the magnesium producers and large consuming companies for 2006 were reported to be between \$1.25 and \$1.32 per pound, which was less than the 2005 contract level of about \$1.40 to \$1.50 per pound (Carroll, 2005).

Foreign Trade

Total magnesium exports for 2005 were about 18% less than those in 2004 (table 5). Canada (63%) and Mexico (19%) were the principal destinations. Imports for consumption in 2005 were 14% lower than those in 2004, reflecting a sharp decline in imports from China because of the antidumping duties assessed (table 6). China's share of total United States imports fell to 2% in 2005 from 19% in 2004. Of the total quantity of magnesium imported into the United States, Canada (46%), Israel (17%), and Russia (15%) were the principal sources in 2005. Nearly one-half the magnesium imported in 2005 was as alloy, and about one-third was in the form of pure metal. Canada supplied 61% of the magnesium alloy imports, and Russia and Israel together provided 72% of the pure magnesium imports in 2005.

World Review

Australia.—Despite the competition from magnesium produced in China, three companies were in the preliminary stages of initiating magnesium metal production in Australia,

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

attempting to revive plants that were originally proposed in the late 1990s. All the companies were seeking additional financing before proceeding with definitive production plans.

A new Australian company, Minemakers Australia NL, agreed to acquire the Lyons River and Arthur River, Tasmania, magnesite deposits that were owned by Crest Magnesium NL (now Australian Ethanol Ltd.). Australian Ethanol holds the deposits under its Tasmania Magnesite NL subsidiary. Plans to construct a 95,000-t/yr magnesium plant were shelved in 2001. Minemakers Australia would like to use the carbothermic technology that was being developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to recover magnesium, but this process has not been commercialized yet. In addition, Minemakers Australia was investigating the possibility of a 500,000-t/yr magnesia plant using the magnesite resources as a raw material. This would generate cash to develop the magnesium metal project (Forster, 2005).

Korab Resources Ltd. was investigating magnesium recovery from the Batchelor magnesite deposit in New South Wales. The project was a joint venture with New World Alloys Ltd. (formerly Mt. Grace Resources Ltd.), which had originally tried to develop a magnesium metal production plant from the deposit in 1999. The resource at the deposit was estimated to be 16.6 million metric tons containing 43% magnesium (Korab Resources Ltd., 2005§).

International Minerals Corp. Pty. Ltd. (Imcor) was investigating magnesium recovery from a waste silica-magnesia tailings pile in New South Wales. This was the same project that Pacific Magnesium Ltd. (formerly Golden Triangle Resources Ltd.) had been trying to develop since 1998. Pacific Magnesium was a shareholder in Imcor. Imcor planned to use Russian technology to recover the magnesium and produce silica as a coproduct. The company was seeking funding for detailed test work and a feasibility study that was scheduled to be completed in 2006 (Magnesium.com, 2005c§).

Brazil.—In October, the Brazilian Government expanded its antidumping duties on magnesium imported from China. In 2004, the country had imposed antidumping duties on imports with a magnesium content of 99.8% or greater. A new resolution imposed a duty of $1.18 per kilogram on imports from China with a magnesium content less than 99.8%. This duty will be in effect until October 2009 (Magnesium.com, 2005a§).

Canada.—Hydro Magnesium Inc. announced that it would increase production capacity at its magnesium plant in Becancour, Quebec, by 7,000 t/yr, with construction beginning in the first quarter of 2005. The company will improve its dehydration process and add four electrolytic cells to bring the total capacity at the plant to 58,000 t/yr by the third quarter of 2006 (Hydro Magnesium Inc., 2005b§).

On June 30, Falconbridge Ltd. and Noranda Inc. completed their merger. The merged company will continue to operate under the name Falconbridge Ltd. (Falconbridge Ltd., 2005b§). Noranda's 80% ownership of the closed 63,000-t/yr Magnola magnesium plant in Quebec was transferred to Falconbridge with the merger. On October 11, however, Inco Ltd. announced a friendly takeover bid for all outstanding shares of Falconbridge. This acquisition was pending at yearend (Falconbridge Ltd., 2005a§).

Leader Mining International Inc. established a wholly owned subsidiary, North Pacific Alloys Ltd. (NPAL), to conduct activities related to the company's Cogburn Magnesium Project. The Cogburn project was designed to extract magnesium from a magnesium silicate deposit in British Columbia. NPAL signed a 15-year operating agreement with Emil Anderson Construction Inc. for quarrying, ore transportation, and residue management of the magnesium silicate deposit. NPAL also signed an agreement with BC Hydro for providing 250 megawatts of electrical energy capacity to the project. The company's 2003 feasibility study for a 150,000-t/yr magnesium plant determined that the project was technically feasible and economically viable at a magnesium price of $1.27 per pound (Leader Mining International Inc., 2005§).

Automotive component supplier Magna International Inc. (Aurora, Ontario, Canada) expanded its business to include magnesium Thixomolding® and formed a special division dedicated to the process. Magna modified an injection molding machine from Husky Injection Molding Systems Inc. for the Thixomolding® process because it anticipated processing components with 2- to 3-millimeter wall thickness. Magna was awarded a contract from its subsidiary Intier Automotive Inc. for an integrated bracket for a closure (Metals Place, 2005§). Magna also purchased New Venture Gear Inc. from DaimlerChrysler Corp. in September 2004. New Venture Gear was a leading supplier of magnesium transfer cases in North America.

China.—China's National Bureau of Statistics reported that the country produced about 469,000 t of pure magnesium in 2005, an 8% increase from that in 2004. Exports of pure magnesium totaled 182,000 t, and exports of magnesium alloys were 93,000 t (Beijing Antaike Information Development Co., Ltd., 2006).

Forty small magnesium plants reportedly closed in the second quarter because of falling prices and environmental concerns. Each of the closed plants was estimated to have a capacity less than 1,000 t/yr of magnesium ingot. The China Magnesium Association expected that an additional 40 plants would be closed by the end of 2005. In addition, some of the larger firms have delayed expansion plans because of low magnesium prices (Mok, 2005).

Minhe Magnesium Co. announced that it shelved plans to expand magnesium alloy production at its facility in Qinghai Province. The company originally had planned to increase alloy capacity to 20,000 t/yr by mid-2005 from 4,000 t/yr, but because of unfavorable market conditions and weak prices, the expansion was delayed indefinitely (Platts Metals Week, 2005e).

In Inner Mongolia, Weixin Magnesium Co. Ltd. began construction of a 20,000-t/yr magnesium facility in March in the Urad Front Banner industrial zone. The plant, which will recover magnesium by the Pidgeon process, was scheduled to be completed by the end of 2005 (Beijing Antaike Information Development Co., Ltd., 2005).

Five new magnesium plants were scheduled to come onstream in 2005 (Interfax China Ltd., 2005). In Shanxi Province, Meijing Group Magnesium Industry Co. Ltd. opened a 10,000-t/yr primary magnesium plant in August, and Datuhe Magnesium Plant opened at 10,000-t/yr plant in March. Meijing was scheduled to add 10,000 t/yr of capacity in 2006, and Datuhe was scheduled to increase its capacity by 5,000 t/yr in 2006. In Inner Mongolia, Zhongrun Magnesium Co. Ltd. opened a 10,000-t/yr primary magnesium plant in December, with a capacity increase of 10,000 t/yr scheduled to be added in 2006. In Qinghai Province, Fengrui Magnesium Co. Ltd. opened a 4,000-t/yr primary magnesium plant in October, and Qinghai Drive Machine Manufacturing Co. Ltd. opened a 3,500-t/yr plant in July. Both companies were expected to increase plant capacity in 2006—Fengrui by 6,000 t/yr and Qinghai by 16,500 t/yr

Hydro Magnesium increased its magnesium alloy remelting and recycling capacity to 15,000 t/yr at its plant in Xi'an in August. The plant was originally opened in 2002 with a capacity of 10,000 t/yr, producing AZ- and AM-series alloys from remelted pure magnesium from China (Platts Metals Week, 2005b).

In September, Meridian Technologies Inc. opened a new magnesium diecasting plant named Shanghai Meridian Magnesium Products Co. Ltd. in Shanghai. The new facility, with a capacity of 3,500 t/yr, will produce transmission cases and covers, steering column housings and supports, seat frames, instrument panel reinforcements, and other parts for domestic consumption and export. The plant's customers include Shanghai General Motors Co. Ltd., Shanghai Volkswagen Co. Ltd., DaimlerChrysler AG, and Delphi Corp. (Meridian Technologies Inc., 2005§).

Beginning on January 1, 2006, China will reduce the export tax rebates on many of its commodities including magnesium metal. The Government announced that it would cut the magnesium export rebate to 5% from 13% in an attempt to control exports. Analysts expected that prices for magnesium exports from China would increase in response to the rebate cut (Mok and McBeth, 2005).

Congo (Brazzaville).—MagIndustries Corp. inaugurated its first commercial-scale brine well in October near Point-Noire. The brine mine field initially will include five commercial-scale production wells within a 5-square-kilometer area near the village of Mengo. Each well will be completed to a target depth of about 600 meters where it will intersect the carnallite mineralization. After additional plants are constructed, the brine solution initially will be sent to a plant for the extraction of potassium salts, which will be upgraded into several grades of potash fertilizer. After removing the potassium, the magnesium-enriched brine will be sent to the company's proposed 60,000-t/yr magnesium smelter, for which construction was scheduled to begin in 2007. A final bankable feasibility study for a 40,000-t/yr potash plant was scheduled for completion in the second quarter of 2006 (MagIndustries Corp., 2005§).

Egypt.—During the second quarter of 2005, Egyptian Magnesium Co. (EMAG) [jointly owned by Magnesium International Ltd. (MIL) and Amiral Overseas Magnesium Ltd.] decided to base its bankable feasibility study on magnesite feedstock from Myrtle Springs, South Australia. EMAG, however, had been evaluating four additional deposits—two each in Saudi Arabia and Egypt. The principal deposit that EMAG was investigating is the Sul Hamed deposit in southern Egypt, where a small magnesite mining operation already exists. The deposit is held by El Nasr Mining Co. (a wholly owned subsidiary of the Egyptian Government). EMAG planned to negotiate an agreement with El Nasr to complete a resource evaluation and potential mining arrangements. Parallel evaluation of the other deposits, owned by Ma'aden in Saudi Arabia and El Nasr in Egypt, was expected to continue in the next two quarters (Platts Metals Week, 2005d).

EMAG expected that the total construction cost of the first module (43,000 t/yr) of its proposed 88,000-t/yr magnesium plant in Port Sokhna, Egypt, will be higher than had been forecast in the company's internal feasibility study. EMAG cited the high level of global demand for equipment and services, high raw material prices, including steel and copper, both of which are major components, and the relatively high European content of some materials for the project as reasons for the high construction costs. Because of the higher than anticipated costs, EMAG planned to delay construction until it can reduce capital costs. In addition, funding for EMAG will need to be resolved between MIL and Amiral and before the project progresses further (Magnesium International Ltd., 2005§).

MIL also signed an exclusive option to license CSIRO's magnesium sheet production process. The CSIRO technology is based on the application of the twin roll casting technique, which is used extensively in the aluminum industry, to the production of magnesium alloy sheet. Magnesium alloy strip can be produced directly from the melt with a thickness at or close to the final required shape, thereby reducing operational costs (Magnesium.com, 2005b§).

Netherlands.—United States-based Aleris International Inc. purchased the bankrupt Dutch firm Remag Alloys BV Delfzijl. The Dutch firm, which operated a 10,000-t/yr magnesium recycling facility in Delfzijl, filed for bankruptcy in June because of falling magnesium prices and competition from Chinese magnesium. Remag Alloys had been operating only since November 2003 and produced recycled magnesium mainly for the European automotive market. The plant restarted in November (Mason, 2005).

Russia.—RUSAL Ltd. announced that it would construct a 40,000-t/yr magnesium plant in the Volgograd region using locally mined bischofite as the raw material. The project was in the early planning stages (Magnesium.com, 2005d§).

Ukraine.—After Kalush Magniy was privatized in 2004, a $25 million investment to reconstruct the plant began, and production was restarted in January 2005. The plant had been closed since the late 1990s. Kalush expected to produce 6,000 t of magnesium in 2005, with plant capacity expanding to 10,000 t/yr in 2006 and 20,000 t/yr by 2007 (Kalush Magniy, undated §).

Current Research and Technology

In July, DaimlerChrysler, Ford Motor Co., and GM, as members of the United States Council for Automotive Research (USCAR), signed cooperative research agreements with the U.S. Department of Energy (DOE) to support continued research and development in the areas of lightweight materials and advanced battery technologies for vehicles. The agreements, which included DOE funding and industry cost share, when combined with a $70 million United States Automotive Materials Partnership agreement for lightweight, high-strength materials research, (initially announced in May), represented a total investment potential of $195 million during the next 5 years (United States Council for Automotive Research, 2005b§). As part of USCAR's FreedomCAR initiative, a number of research activities were underway to develop approaches for producing magnesium sheet at the volume and cost levels demanded by automotive applications. In particular, the economics associated with producing magnesium sheet at the volume and cost levels demanded by automotive applications are unclear. As such, in 2005, the Aluminum Consultants Group, in conjunction with Pacific Northwest National Laboratory, prepared a technical cost model for magnesium sheet production alternatives. In addition, the Structural Cast Magnesium Development Project focused on resolving critical issues that previously limited the large-scale application of magnesium castings in automotive components. Major accomplishments in 2005 included successful validation of a magnesium front engine cradle in a 2006 production vehicle (Chevrolet Corvette model). This resulted in a 34% weight savings compared with the 2005 production aluminum engine cradle (United States Council for Automotive Research, 2005a§).

A team of research engineers from CSIRO developed a new permanent-mold magnesium casting technology called T-Mag. This technology can produce magnesium alloy castings that are essentially free of the porosity that has restricted the use of magnesium in the past. T-Mag has several advantages over traditional casting technologies, such as high-pressure casting. For example, with current casting technology 6 to 7 kilograms (kg) of metal is needed to produce a 3.5-kg casting. T-Mag requires only 3.7 kg of alloy for the same weight casting. The T-Mag permanent-mold casting process requires neither high pressure nor a vacuum to fill the die, which fills smoothly from the bottom. This minimizes air entrapment and oxidation and produces castings that are virtually free of defects. T-Mag combines melting and casting in a single unit that is hermetically sealed to protect the magnesium from oxidation and to minimize gas usage. Using the T-Mag process, CSIRO scientists have cast lightweight magnesium alloy engine blocks that are only two-thirds the weight of current aluminum alloy blocks. The new process also may enable casting of magnesium alloy wheels, powertrain components, and other load-critical applications, which are not economically feasible with current casting technologies (Commonwealth Scientific and Industrial Research Organisation, 2005§).

Engineers at BMW AG manufactured a cast magnesium water-cooled engine block. Because magnesium alloys cannot be used as material for cylinder liners, aluminum is used and integrated into the magnesium housing. Magnesium alloy $MgAl_6Sr_2$ is used for the block jacket, and the insert section consists of aluminum alloy $AlSi_{17}Cu_4Mg$. By replacing gray iron with aluminum, the weight was reduced by almost 30%. By using magnesium, the total weight reduction achieved, when compared with the original gray iron product, was almost 50%. The composite block has been on the market in the BMW 630i coupe since autumn 2004. BMW has the capacity to produce more than 500,000 6-cylinder composite blocks per year (Hydro Magnesium Inc., 2005a§).

Magnesium Elektron Ltd. announced that it developed a new wrought alloy, ELEKTRON® 675, which it claims is the world's strongest magnesium alloy at temperatures above 100° C. Applications were expected to be within the temperature range of 100° to 300° C across a broad range of markets, including aerospace, defense, motorsport, specialized automotive, and space. The new alloy's yield and tensile strengths were greater than those of wrought 2000 and 7000 series aluminum at temperatures above 100° C. At 200° C, the yield strength is more than 100% stronger than 2024 series of aluminum, and more than 200% stronger than 7075 series aluminum, both of which are used in aerospace applications (Magnesium Elektron Ltd., 2005§).

Outlook

Although new primary magnesium plants were planned for Australia, Canada, Congo (Brazzaville), and Egypt, it is unlikely that any of these will be constructed in the near future, if at all. Most of the companies that were planning magnesium plant construction continued to seek financing from outside sources. Even if the new plants were constructed, magnesium produced at these plants would have to compete in the world market with low-cost magnesium produced in China.

In contrast with other nonferrous metals (such as aluminum, copper, lead, and zinc), for which prices had increased significantly beginning in 2004, magnesium prices fell during the same period. This potentially could allow magnesium to be price competitive with materials for applications in the automotive industry, making magnesium a more attractive choice in component applications. Although magnesium alloy diecastings might be substituted for aluminum alloys, such as A380, in vehicles during their production cycle, it is more likely that any change would happen when the models are redesigned. In addition, high gasoline prices have led to increased awareness of fuel economy and may result in increased consumer demand for lighter vehicles. Incorporating magnesium alloy components could help to meet this demand.

U.S. titanium sponge producers have added capacity in 2005 and planned to increase total U.S. capacity by nearly 17,000 t by 2008 (Allegheny Technologies Inc., 2006§). This would provide a larger market for magnesium metal, and although most magnesium is recycled by the titanium industry, new magnesium also would be required to replace losses in the sponge production process.

According to a paper presented by Dead Sea Magnesium Ltd. at the 2006 International Magnesium Association conference, the diecasting segment has become the major application for magnesium, representing 35% of total world consumption in 2005. An increase of 8% to 10% in consumption was projected for 2006. The prediction of increased magnesium use in automotive applications was based on the development of new applications in powertrains. Increased use of magnesium in electronics and consumer goods also was predicted for 2006. Consumption of magnesium as an alloying element in aluminum continued to increase in line with the growing demand for aluminum products. The aluminum segment represented about 35% of total consumption of magnesium, and growth of 4% to 5% was forecast in 2006. Use of magnesium in Europe and Asia was growing faster than in North America and South America combined (Shair, 2006).

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TABLE 1
SALIENT MAGNESIUM STATISTICS[1]

(Metric tons unless otherwise specified)

	2001	2002	2003	2004	2005
United States:					
Production:					
Primary magnesium	W	W	W	W	W
Secondary magnesium	65,800	73,600	70,100	72,000 r	72,800
Exports	19,600	25,400	20,400	11,800	9,650
Imports for consumption	68,500	88,000	83,400	98,700	84,700
Consumption, primary	95,700	102,000	103,000	101,000 r	100,000
Yearend stocks, producer	W	W	W	W	W
Price[2] dollars per pound	1.21-1.28	1.10-1.22	1.10-1.17	1.55-1.60	1.15-1.30
World, primary production	420,000 r	440,000 r	485,000 r	595,000 r	626,000 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)

	2004	2005
KIND OF SCRAP		
New scrap:		
Magnesium-base	15,800	16,300
Aluminum-base	35,700 r	37,000
Total	51,500 r	53,300
Old scrap:		
Magnesium-base	822	807
Aluminum-base	19,700	18,600
Total	20,500	19,400
Grand total	72,000 r	72,800
FORM OF RECOVERY		
Magnesium alloy ingot[2]	W	W
Magnesium alloy castings	1,920	1,410
Magnesium alloy shapes	353	439
Aluminum alloys	55,700	56,100
Other[3]	14,100	14,800
Total	72,000 r	72,800

[r]Revised. 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, cathodic protection, and data indicated by symbol W.

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

(Metric tons)

Use	2004	2005
For structural products:		
Castings:		
Die	48,100 r	51,900
Permanent mold	138 r	112
Sand	391	412
Wrought products[2]	2,240	2,880
Total	50,900 r	55,300
For distributive or sacrificial purposes:		
Aluminum alloys	33,900	30,300
Cathodic protection (anodes)	3,520	3,020
Iron and steel desulfurization	8,360	7,410
Reducing agent for titanium, zirconium, hafnium, uranium, beryllium	934	812
Other[3]	3,580	3,540
Total	50,300	45,100
Grand total	101,000 r	100,000

[r]Revised.
[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 chemicals; nodular iron; and scavenger, deoxidizer, and powder.

TABLE 4
YEAREND MAGNESIUM PRICES

Source		2004	2005
Platts Metals Week:			
U.S. spot Western	dollars per pound	1.55-1.60	1.15-1.30
U.S. spot dealer import	do.	1.40-1.55	1.14-1.24
European free market	dollars per metric ton	1,850-1,900	1,560-1,700
Metal Bulletin:			
European free market	do.	1,890-1,940	1,590-1,600
China free market	do.	1,730-1,750	1,500-1,520

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)
2004:								
Brazil	--	--	--	--	2	$36	5	$94
Canada	4,450	$10,400	1,730	$3,690	1,210	3,990	842	4,600
Mexico	151	427	--	--	158	782	2,020	6,980
United Kingdom	--	--	10	28	23	143	359	7,950
Other[r]	196	511	22	104	355	2,830	303	6,200
Total	4,790	11,300	1,760	3,830	1,750	7,780	3,530	25,800
2005:								
Brazil	--	--	--	--	420	1,010	9	246
Canada	4,790	10,800	701	2,340	205	1,730	365	3,800
Mexico	458	1,280	13	45	302	849	1,070	4,760
United Kingdom	24	69	--	--	58	269	244	6,170
Other	360	895	18	87	214	2,020	396	7,460
Total	5,630	13,100	732	2,470	1,200	5,870	2,080	22,400

[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)
2004:								
Canada	10,000	$15,600	1,850	$6,390	22,900	$69,600	892 [r]	$7,410
China	228	429	18	57	18,100	45,900	75	301
Israel	--	--	8,790	24,500	4,140	15,700	--	--
Russia	--	--	20,700	40,500	2,500	5,400	146	972
Other	1,420	1,580	2,890	6,820	3,850	15,200	64 [r]	1,500
Total	11,700	17,600	34,300	78,200	51,500	152,000	1,180 [r]	10,200
2005:								
Canada	8,910	12,400	4,810	15,000	24,500	83,200	833	7,280
China	693	995	19	32	693	2,310	26	276
Israel	--	--	9,040	29,700	5,560	23,300	--	--
Russia	--	--	11,800	27,400	768	1,710	143	599
Other	5,060	9,320	3,090	8,540	8,720	28,100	40	1,910
Total	14,700	22,700	28,700	80,700	40,300	139,000	1,040	10,100

[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 7
WORLD ANNUAL PRIMARY MAGNESIUM
PRODUCTION CAPACITY, DECEMBER 31, 2005[1, 2]

(Metric tons)

Country	Capacity
Brazil	12,000
Canada	123,000 [3]
China	528,000
India	900
Israel	27,500
Kazakhstan	10,000
Russia	46,000
Serbia and Montenegro	5,000
Ukraine	15,000
United States	45,000
Total	812,000

[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]Includes 63,000 metric tons per year of idle capacity.

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

(Metric tons)

Country	2001	2002	2003	2004	2005[e]
Brazil[e]	5,500	6,000	6,000	6,000	6,000
Canada[e, 3]	83,000	88,000	54,000	54,000	54,000
China[e]	200,000	250,000	340,000	442,000 [r]	470,000
France[e]	4,000	--	--	--	--
Israel	34,000 [e]	26,000 [r]	26,000 [r]	28,000	27,600 [4]
Kazakhstan[e]	16,000	18,000	14,000	18,000	20,000
Norway[e]	36,000	10,000	--	--	--
Russia[e, 3]	40,000 [r]	40,000 [r]	43,000 [r]	45,000 [r]	45,000
Serbia and Montenegro[e]	1,630 [4]	1,695 [4]	1,600	1,600	1,500
Ukraine[e]	3	3	3	3	2,000
United States	W	W	W	W	W
Total	420,000 [r]	440,000 [r]	485,000 [r]	595,000 [r]	626,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

[1]World totals 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, 2006.

[3]Includes secondary.

[4]Reported figure.