MAGNESIUM

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Magnesium is the eighth most abundant element in the Earth's crust and the third most plentiful element dissolved in seawater. Magnesium metal is recovered from seawater and well and lake brines, as well as from such minerals as dolomite, magnesite, and carnallite.

Domestic magnesium production in 1998 declined to its lowest level in 15 years. In November, The Dow Chemical Co., the largest U.S. producer, closed its Freeport, TX, magnesium plant, ending the company's 82-year production history; Dow was the first U.S. firm to extract and produce magnesium commercially. As demand for magnesium continued to increase in the United States, the shortfall in domestic production was replaced by imports, which, in 1998, were at their highest level ever. Canada, China, Russia, and Israel, in descending order, were the principal import sources. Although aluminum alloying remained the largest end use for magnesium, diecasting continued to show strong growth, as automobile manufacturers continued to introduce magnesium components in new models.

Companies continued to examine the potential for new magnesium production facilities around the world, in some cases using novel raw materials as sources of magnesium. New magnesium recovery facilities were proposed in Canada, using asbestos tailings as a raw material; in the Netherlands, using magnesium chloride brines as a raw material; and in Australia, using magnesite as a raw material. If all the proposed plants are constructed, then by 2005, 155,000 metric tons (t) of new capacity in Australia, 58,000 t in Congo (Brazzaville), 108,000 t in Canada, 50,000 t in Iceland; and perhaps 45,000 t in the Netherlands would be available. In addition, expansions of capacity at existing plants could add at least 31,000 t to total world capacity.

Legislation and Government Programs

After an antidumping duty order for magnesium from Ukraine was published by the International Trade Commission (ITC) in 1995, trader Gerald Metals Inc. filed a lawsuit with the Court of International Trade (CIT) challenging the determination. In its first decision, the CIT affirmed the antidumping duty; Gerald Metals, however, appealed that decision to the U.S. Court of Appeals for the Federal Circuit. The appellate court remanded the case back to the CIT, which remanded it back to the ITC. In a vote in June, the ITC said that the United States was not injured by magnesium imported from Ukraine, thus reversing the 1995 decision. In November, the CIT upheld the ITC's decision, which revoked the duty (U.S. Department of Commerce, 1998d).

In a related case, the U.S. magnesium industry and the U.S. Department of Commerce presented oral arguments at the U.S. Court of Appeals for the Federal Circuit in a case involving the 0% antidumping duty on pure magnesium imports from Russia. Currently specific producers and traders have a 0% rate, which was established in 1995, and Magnesium Corp. of America (MagCorp), on behalf of the U.S. magnesium industry, filed a lawsuit to overturn this rate. In 1996, the CIT ruled partially in favor of MagCorp, but the company took the case to the appellate court. The Court of Appeals has no schedule for when its decision is to be made (Platt's Metals Week, 1998e).

In a preliminary ruling from Commerce, the International Trade Administration (ITA) set the antidumping duties for pure magnesium from Norsk Hydro Canada Inc. at 0% ad valorem for the period of August 1, 1996, to July 31, 1997. This is the third review in which the rate has been established at 0%. The ITA, however, did not intend to revoke the antidumping order (which can be done after three consecutive 0% determinations) because it can not be assured that Norsk Hydro will not dump in the future (U.S. Department of Commerce, 1998b). Final duties will be established in March 1999.

In August, the ITA published the final results of the countervailing duty review for calendar year 1996 for pure and alloy magnesium from Canada. The duty was established at 2.78% ad valorem for the specified period for Norsk Hydro Canada (U.S. Department of Commerce, 1998a). The ITA also began its investigation of countervailing duties for pure and alloy magnesium from Canada for calender year 1997 and was investigating antidumping duties on pure magnesium from Canada for the period of August 1, 1996, to July 31, 1997. The antidumping duty investigation was scheduled to be completed by March 31, 1999.

The ITA completed its administrative review of antidumping duties for new shipper, Taiyuan Heavy Machinery Import and Export Corp. of China. The final results indicated that the company was selling primary magnesium in the United States at less-than-fair value and established a dumping margin of 69.53% ad valorem for the period of May 1, 1996, to October 31, 1996. This rate will remain in effect until the next administrative review. The established dumping margin in China rate was 108.26% ad valorem (U.S. Department of Commerce, 1998c).

The U.S. Environmental Protection Agency (EPA) began a collaborative effort with the U.S. magnesium industry to improve manufacturing processes and gas handling practices in an effort to reduce emissions of the greenhouse gas sulfur hexafluoride (SF_6). International concern over global warming has focused attention on the long atmospheric life of SF_6, which

is about 3,000 years, and its high potency as a greenhouse gas, which is about 24,900 times the global warming potential of carbon dioxide. Low concentrations of SF_6 are used as a melt protection by forming a film on molten magnesium and its alloys so that they are not exposed to air, and therefore, do not oxidize (U.S. Environmental Protection Agency, October 1998, New climate protection initiative with U.S. magnesium industry, accessed July 6, 1999, at URL http://www.epa.gov/appdstar/news.html). In addition, the International Magnesium Association (IMA) published a brochure with information to aid the magnesium industry in reducing SF_6 emissions (International Magnesium Association, 1998). Electric utilities also use SF_6 as an insulating material in electrical transmission and distribution equipment, and the EPA also is working with this industry to try to reduce SF_6 emissions.

Production

In 1998, U.S. primary magnesium production declined from that of 1997 (table 1) and was at its lowest level in 15 years. Production in the second half of the year was significantly lower than capacity mostly because of lower production at Dow's 65,000-metric-ton-per-year (t/yr) Freeport, TX, plant. Weather-related problems at the company's plant led Dow to declare a partial force majeure on September 28. The plant was hit by lightning in June and flooded by Hurricane Frances and other rainstorms that hit the Texas coast in August and September (Platt's Metals Week, 1998h). Partially as a result of this damage, Dow announced on November 20 that it was shutting the plant beginning immediately. The company had been producing magnesium since 1916, when it was the first U.S. firm to extract and produce magnesium and had operated the Freeport plant since 1941. With the plant's closure, only two U.S. magnesium producers remained (The Dow Chemical Co., November 20, 1998, Dow to exit magnesium business, accessed November 20, 1998, at URL http://www.dow.com/pr_business/mag.html). Dow had been trying to sell its magnesium operation for about 1 year, but because of the magnesium production plant's integration with other Dow facilities in Freeport, selling the individual operation was difficult.

MagCorp continued a $46 million program to upgrade its electrolytic cell technology and to install a new caster at its Rowley, UT, primary magnesium plant. In addition to reducing operating costs and increasing efficiency, the new electrolytic cells were designed to reduce chlorine emissions. This reduction in chlorine emissions should allow MagCorp to comply with new Clean Air Act standards that are expected to be established in 2000. Because of high emissions of chlorine and hydrochloric acid in the past, MagCorp has ranked high on the EPA's annual Toxics Release Inventory list (Platt's Metals Week, 1998j).

Consumption

Aluminum alloying remained the largest end use for primary and secondary magnesium (tables 3-4). Reported consumption of primary magnesium for aluminum alloying was 48% of the total. Diecasting was the second-largest application, with 19% of the total reported consumption, and desulfurization of iron and steel ranked third, with 11% of the total.

Data for magnesium metal are collected from two voluntary surveys of U.S. operations by the U.S. Geological Survey. Of the 78 companies canvassed for magnesium consumption data, 59% responded, representing 33% of the primary magnesium consumption listed in tables 1 and 3. Data for the 32 nonrespondents were estimated on the basis of prior-year consumption levels and other factors.

Luxfer Group Ltd., the British owner of U.S. firm Reade Manufacturing Co. acquired Hart Metals Inc., another U.S. firm, in April. Hart Metals, which manufactures magnesium powder, will be merged with Reade Manufacturing, which makes magnesium chips, granules, and powders. The new company was expected to concentrate on developing new applications for magnesium particulates in organometallic and flare applications (Luxfer Group Ltd., 1998).

Timminco Ltd. of Canada reportedly entered into an agreement with Dow to acquire its fabricated/extruded products business unit in Aurora, CO, for an undisclosed sum. The transaction was completed in the third quarter. Under the terms of the agreement, Timminco acquired raw materials and finished goods inventory, as well as some trademarks and intellectual property (Platt's Metals Week, 1998n).

With new and expanding applications for magnesium parts, the 1999 models of North American-produced automobiles were expected to average about 3.2 kilograms (kg) of die-cast magnesium per vehicle, a 7% to 8% increase from the 1998 models. Some of the new parts included transfer case castings, and instrument panel and pedal support brackets in General Motors Corp.'s (GM) redesigned Chevrolet Silverado and GMC Sierra pickup trucks, cam cover castings for DaimlerChrysler Corp.'s 4.7-liter, V-8 truck engines, steering column support brackets in GM's Oldsmobile Alero and Pontiac Grand Am cars, cam covers and baffles in the PV-6 engines of GM's Oldsmobile Intrigue cars, steering wheel armatures in Chrysler's LHS and 300M automobiles, and cylinder head covers in 4-cylinder engines, which Toyota Motor Manufacturing USA Inc. will begin manufacturing in its new Buffalo, WV, plant (Wrigley, 1998c).

DaimlerChrysler approved the use of 100% recycled magnesium for die-cast components purchased from its parts suppliers. Ford Motor Co. and GM have used parts made from recycled magnesium for several years. Chrysler approved alloys AZ91D and AM60B, which are processed from die-cast scrap, that the company purchases from MagReTech Inc. in Bellevue, OH. DaimlerChrysler also was evaluating AM60A from the same firm. The use of recycled magnesium can reduce the cost of the final die-cast component (Wrigley, 1998a).

DaimlerChrysler plans to replace steel with magnesium in the mounting brackets for the antilock braking systems in its front-wheel-drive minivans. The material switch will save 0.8 kg per bracket, with the magnesium components weighing 0.4 kg each (American Metal Market, 1998). The company also announced that it would used magnesium alloy cam covers on the new 4.7-liter, V-8 truck engines that are to be installed in

the 1999 models of its Grand Cherokees. Magnesium covers, weighing about 1.4 kg per engine, will be produced from alloy AZ91 by Diemakers Inc., Monroe City, MO. The total quantity of magnesium used for the new covers is estimated to be 600 t/yr (Wrigley, 1998b).

Stocks

Producers' yearend 1998 stocks of primary magnesium increased to 13,500 t from the yearend 1997 level of 13,100 t. Consumer stocks of primary and alloy magnesium increased slightly to 7,990 t at yearend 1998; the 1997 yearend stocks were 7,920 t. Yearend 1998 consumer stocks of secondary magnesium increased to 758 t from the 1997 level of 389 t.

Prices

Quoted magnesium prices declined throughout the year, with a small increase in December. The increase resulted from the announcement of Dow's plant closure. The Metal Bulletin free market price range for pure magnesium started the year at $2,425 to $2,625 per metric ton and declined to $1,900 to $2,150 per ton at yearend. Platt's Metals Week's European free market price decreased from a range of $2,750 to $2,850 per ton at the beginning of the year to $2,300 to $2,450 per ton by yearend. The Platt's Metals Week U.S. spot western price dropped slightly from a range of $1.60 to $1.70 per pound at the beginning of 1998 to $1.52 to $1.62 per pound at yearend. The U.S. spot dealer import price, quoted in Platt's Metals Week, decreased from a range of $1.50 to $1.55 per pound at the beginning of the year to $1.30 to $1.35 per pound by yearend.

Foreign Trade

Total exports of magnesium and its alloys were slightly lower than those in 1997 (table 5). Canada (53%), the Netherlands (25%), and Japan (10%) were the primary destinations. Imports for consumption of magnesium and its alloys were at their highest level ever. Canada (45%), China (19%), Russia (18%), and Israel (11%) were the main sources (table 6). Most of the imports from Canada and China were magnesium alloy, and most of the imports from Israel and Russia were pure magnesium.

World Review

The United States continued to lead the world in production (table 8) and production capacity (table 7) of primary magnesium, with about 29% of the world production and about 30% of total world capacity. Total capacity includes Dow's shuttered plant in Texas.

According to figures published by the IMA, world magnesium shipments in 1998 were 360,000 t, an 8% increase from those of 1997. Aluminum alloying, with 43% of total shipments, was the largest end-use category for magnesium, followed by diecasting with 31%, and desulfurization with 13%. Yearend 1998 world inventories increased by 35%, to 44,300 t representing an estimated 45 days of supply, based on the previous 12 months of shipments (International Magnesium Association, 1999)

The European Commission (EC) imposed provisional antidumping duties on magnesium imported from China, effective May 15. The EC has set a floor price of 2,797 ecu's per ton (about $3,100 per ton). The duty will be the difference between the floor price and the c.i.f. value of magnesium imported under tariff codes 8104.11.00 and 8104.19.00. With this action, the EC set antidumping duties for magnesium imported from China, Russia, and Ukraine (Metal Bulletin, 1998b). China also has imposed a minimum floor price for magnesium for export (Platt's Metals Week, 1998b). India also has proposed antidumping duties on imports of magnesium from China. At a request from Southern Magnesium & Chemicals Ltd., India's Ministry of Commerce has recommended an antidumping duty of Rs 27.5 per kilogram (about $680 per ton), which will take effect when the Ministry of Finance accepts commerce's recommendation (Metal Bulletin, 1998d).

Australia.—Crest Magnesium N.L., a unit of Crest Resources Australia NL, completed a prefeasibility study for a 95,000-t/yr magnesium plant in Tasmania. The results of the study indicate that the project is economically feasible with an operating cost of $0.65 per pound of magnesium produced. Magnesite for the plant will be mined from the nearby Arthur Lyons River deposit, which is estimated to contain about 29 million tons of magnesite, with an average grade of 40% magnesium. A final feasibility study will be conducted by Canada's Hatch Associates Ltd. and Australia's BHP Engineering Ltd., and construction of the proposed plant was expected to begin in the first quarter of 2000 and to be completed in 2003 (Metal Bulletin, 1998h).

Canada.—Construction of Magnola Metallurgy Inc.'s 58,000-t/yr magnesium facility in Asbestos, Quebec, began in April. Final governmental approval was received on April 8, and plant construction began immediately afterward. Commercial production at the plant, which will be using new technology to recover magnesium from asbestos tailings, was expected to begin in 2000 (Metal Bulletin, 1998f). A detailed description of the new magnesium recovery process was published by Brown (1998).

Several other companies were investigating recovering magnesium from asbestos tailings. Minroc Mines Inc. planned to begin a $400 million to $800 million magnesium project in northern British Columbia at the Cassiar chrysotile mine. The plan was in the early stages of investigation (Platt's Metals Week, 1998k). Geo Tech Surveys Inc. submitted a plan to the Newfoundland Government to construct a new plant to extract magnesium from the asbestos tailings at the defunct Baie Verte Mine. If the plan is approved, then Canadian Magnesium Corp., a new firm, planned to complete a feasibility study and to build a pilot plant at the site before a decision on commercial production is made (Platt's Metals Week, 1998l).

Gossan Resources Ltd. completed an agreement with an investment banking firm to help raise $3.5 million to complete a feasibility study of an industrial minerals property in Manitoba. Of the $3.5 million, $300,000 has been targeted to a

feasibility study to produce magnesium metal from dolomite. Gossan Resources announced in 1996 that it completed preliminary studies to construct a 15,000-t/yr plant to produce magnesium; operating costs were projected by the company to be $0.80 per pound of magnesium or less (Platt's Metals Week, 1998i).

The EC cleared Teksid SpA, owned by Italy's Fiat Group and Norway's Norsk Hydro A/S, to acquire the remaining shares of the Canadian firm Meridian Technologies Ltd. Meridian produces aluminum and magnesium diecastings, primarily for the auto industry (Platt's Metals Week, 1998g).

China.—To stabilize the Chinese export market, officials from the China Magnesium Association and the China Chamber of Commerce of Metals, Minerals, and Chemicals established a committee to control export prices. The new National Magnesium Products Export Coordination Committee set minimum export prices for magnesium for the last 2 months of 1998 and for 1999. For the last 2 months of 1998, the f.o.b. floor price was $1,950 per ton; this price rose to $2,320 per ton beginning in 1999. Because of low magnesium prices, however, traders have reported that many suppliers were ignoring the floor price and selling material at less than $1,900 per ton in the export market (Platt's Metals Week, 1998d).

The Wenxi Yinguang Magnesium Industry Group in Shanxi Province announced that it would increase production of magnesium ingot, alloys, and powder in 1998. Ingot production was expected to be increased to 4,500 t in 1998 from 4,000 t in 1997. Magnesium alloy production was expected to be increased by 200%, to 3,000 t, by installing a production line that was imported from the United States. Powder production was expected to be increased by 50%, to 1,500 t. About 90% of the company's production is sold in China (Platt's Metals Week, 1998a). Wenxi Yinguang also has purchased five local plants, thus doubling the company's total capacity to 9,600 t/yr (Platt's Metals Week, 1998o).

In China, the Guangshui Magnesium Metal Plant in Hubei Province announced plans to build a 2,000-t/yr magnesium alloy production line if the company can find outside investors. In 1998, the company had the capacity to produce 2,000 t/yr of pure magnesium (Platt's Metals Week, 1998c).

Congo (Brazzaville).—The Council of Ministers ratified Magnesium Alloy Corp.'s exploration agreement in May, which confirmed the company's right to develop the magnesium salt resources that underlie the Makola and the Youbi licenses. With this agreement, Magnesium Alloy planned to begin the first phase of a prefeasibility study that should be completed by early 1999. If the study results are positive, then a full feasibility study will be conducted within a 1-year period. Costs for the two studies were estimated to be $10 million (Metal Bulletin, 1998e).

Iceland.—In April, Australian Magnesium Corp., which was developing a 90,000-t/yr magnesium plant in Australia, also became a shareholder in the Iceland Magnesium Co. with a 40% stake. Iceland Magnesium almost had completed a feasibility study for a 50,000-t/yr magnesium plant near Reykjanes. Although a decision about plant construction was expected by yearend 1997, the company wanted to find a major shareholder (which it has done with Australian Magnesium) and to decide on which production technology to use—one developed by the Australians or one used by Ukraine (Metal Bulletin, 1998a). Plans were not finalized by yearend.

Israel.—Dead Sea Magnesium Ltd.'s parent company, Israel Chemicals Ltd., agreed to provide an additional $50 million to the plant for debottlenecking work completed in the early part of 1998. The work included improving the equipment that serves the plant's electrolytic cells to increase capacity to 35,000 from 27,000 t/yr (Metal Bulletin, 1998c). Dead Sea Magnesium postponed construction of a magnesium diecasting plant for 1 to 2 years because magnesium output at the Sdom plant would not meet the diecasting plant's long-term raw material needs (Platt's Metals Week, 1998f).

Netherlands.—The Antheus Magnesium Development Programme Delfzijl announced that it would develop a 40,000- to 50,000-t/yr magnesium plant at an estimated capital cost of $400 million. The company would use magnesium chloride brines from the nearby Nedmag magnesia operation as a feedstock. The company was looking for financing to develop the project, and several magnesium production technologies were being evaluated (Metal Bulletin, 1998g).

Russia.—Solikamsk Magnesium Works reportedly was in talks with GM about financing an expansion at its plant. German auto manufacturer Daimler-Benz already has committed to supplying some cash for the upgrade, which was planned to increase magnesium production capacity from 16,800 t/yr to 42,000 t/yr. In return for its investment, Daimler-Benz was seeking a guaranteed source of magnesium (Platt's Metals Week, 1998m).

Outlook

Significant projected increases in magnesium consumption in diecastings for automotive applications continue to fuel announcements of planned magnesium plant construction. If all the proposed plants are built and capacity is expanded at existing plants, then nearly 450,000 t of magnesium production capacity worldwide would be available by 2005. According to IMA shipment figures, 1998 world shipments to the diecasting sector were 110,000 t. The average annual growth rate from 1990 to 1998 was 22% per year (Edgar, 1999). If an annual average growth rate of 20% per year was assumed for diecasting, then by 2005, the additional consumption in this sector would be 284,000 t. Growth rates for the other large end uses for magnesium—aluminum alloying and desulfurization—are not expected to increase as dramatically; the annual average growth rate for aluminum alloying from 1990 to 1998 was 1.9%, and the growth rate for desulfurization was 4.8% (Edgar, 1999). In aluminum alloying, most of the use of magnesium is in aluminum beverage cans, and with postconsumer can-recycling rates of more than 50%, magnesium use in this area is not expected to grow significantly. The only large potential for growth in the use of magnesium for aluminum alloying is if automobile manufacturers make extensive use of aluminum sheet in auto bodies. Desulfurization use of primary magnesium has actually decreased in the past year, so growth in this application may be lower than the average from 1990 to 1998. Many of the North

American steel producers already use magnesium, and because of lower magnesium quality requirement in steel desulfurization, lower cost scrap can be used rather than primary metal. This would limit the growth in pure magnesium use in desulfurization.

Assuming that these projected growth rates are reasonable, if all the new plants are built and capacity expansions are completed, then a significant overcapacity in the magnesium industry will exist. In order for the new plants to be built, the plant owners most likely will need to form long-term agreements with major customers, such as auto manufacturers, to provide a stable market for their product. Because all of the potential plants may not be able to find a long-term agreement for their output, all the proposed plants may not be built. In addition, a substantial quantity of magnesium scrap will be generated with the increased number of die-cast magnesium parts, so this will compete with pure magnesium is some applications. This additional source of supply may reduce the need for new magnesium plants further.

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TABLE 1
SALIENT MAGNESIUM STATISTICS 1/

(Metric tons unless otherwise specified)

	1994	1995	1996	1997	1998
United States:					
Production:					
Primary magnesium	128,000	142,000	133,000	125,000	106,000
Secondary magnesium	62,100	65,100	71,200	77,600 r/	76,400
Exports	45,200	38,300	40,500	40,500	35,400
Imports for consumption	29,100	34,800	46,600	65,100	82,500
Consumption, primary	112,000	109,000	102,000	100,000 r/	103,000
Yearend stocks, producer	11,600	12,100	17,400	13,100	13,500
Price per pound 2/	$1.63	$1.93-2.25	$1.70-1.80	$1.60-1.70	$1.52-1.62
World: Primary production	282,000	395,000	368,000	378,000 r/	369,000 e/

e/ Estimated. r/ Revised.

1/ Data are rounded to three significant digits, except prices.

2/ Source: Platt's Metals Week.

TABLE 2
U.S. MAGNESIUM METAL PRODUCERS, BY LOCATION, RAW MATERIAL,
AND PRODUCTION CAPACITY IN 1998

Company	Plant location	Raw material	Annual capacity (metric tons)
The Dow Chemical Co.	Freeport, TX	Seawater	65,000 1/
Magnesium Corp. of America	Rowley, UT	Lake brines	40,000
Northwest Alloys Inc.	Addy, WA	Dolomite	40,000
Total			145,000

1/ Plant closed in November 1998.

TABLE 3
MAGNESIUM RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES,
BY KIND OF SCRAP AND FORM OF RECOVERY 1/

(Metric tons)

	1997	1998
KIND OF SCRAP		
New scrap:		
Magnesium-base	8,480	7,050
Aluminum-base	38,600 r/	37,500
Total	47,000 r/	44,600
Old scrap:		
Magnesium-base	4,640	7,390
Aluminum-base	25,900	24,400
Total	30,500	31,800
Grand total	77,600 r/	76,400
FORM OF RECOVERY		
Magnesium alloy ingot 2/	W	W
Magnesium alloy castings	3,020	1,860
Magnesium alloy shapes	417	381
Aluminum alloys	64,700 r/	62,400
Zinc and other alloys	10	11
Other 3/	9,440	11,700
Total	77,600 r/	76,400

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."

1/ Data are rounded to 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, as well as data indicated by symbol "W."

TABLE 4
U.S. CONSUMPTION OF PRIMARY MAGNESIUM, BY USE 1/

(Metric tons)

Use	1997	1998
For structural products:		
Castings:		
Die	16,000 r/	19,300
Permanent mold	4,030 r/	5,690
Sand	613	300
Wrought products 2/	6,840	7,100
Total	27,400 r/	32,400
For distributive or sacrificial purposes:		
Aluminum alloys	50,000	49,900
Cathodic protection (anodes)	4,070	3,360
Chemicals	W	W
Iron and steel desulfurization	11,700	11,200
Reducing agent for titanium, zirconium, hafnium, uranium, beryllium	3,120	2,640
Other 3/	4,060	3,710
Total	73,000	70,800
Grand total	100,000 r/	103,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes extrusions, sheet and plate, and forgings.
3/ Includes nodular iron, scavenger, deoxidizer, and powder.

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 (thou-sands)	Quantity (metric tons)	Value (thou-sands)	Quantity (metric tons)	Value (thou-sands)	Quantity (metric tons)	Value (thou-sands)
1997:								
Australia	--	--	1,690	$4,860	--	--	2	$59
Belgium	--	--	65	186	1	$17	179	470
Canada	11,000	$25,100	480	1,700	5,430	19,400	721	3,730
Hong Kong	--	--	292	903	169	830	--	--
Japan	121	299	4,580	12,300	235	971	374	3,280
Mexico	12	55	371	1,150	136	602	521	725
Netherlands	42	89	8,970	22,100	2,540	6,580	447	1,300
Other	26	64	665 r/	4,100 r/	668 r/	4,830 r/	716 r/	5,130 r/
Total	11,200	25,600	17,100	47,300	9,180	33,200	2,960	14,700
1998:								
Australia	--	--	594	1,450	--	--	1	11
Belgium	9	23	8	140	--	--	160	461
Canada	13,100	30,000	525	1,600	5,050	16,800	220	2,140
Hong Kong	--	--	527	1,470	2	21	6	15
Japan	--	--	2,480	6,070	674	1,950	308	2,630
Mexico	7	26	260	726	54	311	441	1,740
Netherlands	--	--	6,330	16,400	2,430	6,200	25	89
Other	22	51	823	3,190	1,010	4,590	308	2,480
Total	13,200	30,100	11,500	31,100	9,230	29,800	1,470	9,560

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

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

Country	Waste and scrap		Metal		Alloys (magnesium content)		Powder, sheets, tubing, ribbons, wire, other forms (magnesium content)	
	Quantity (metric tons)	Value (thou-sands)	Quantity (metric tons)	Value (thou-sands)	Quantity (metric tons)	Value (thou-sands)	Quantity (metric tons)	Value (thou-sands)
1997:								
Brazil	234	$638	579	$1,600	--	--	--	--
Canada	2,220	4,430	1,210	4,930	29,700	$106,000	301	$1,830
China	207	260	2,190	5,330	6,860	17,600	49	140
Israel	19	28	3,360	10,600	--	--	--	--
Mexico	15	18	634	2,580	324	1,130	158	641
Russia	--	--	11,100	28,100	3,410	10,900	--	--
United Kingdom	372	258	9	26	318	3,260	2	274
Other	930	1,070	542	1,530	375	2,390	(2/)	42
Total	3,990	6,700	19,700	54,700	41,000	141,000	510	2,930
1998:								
Brazil	--	--	359	1,100	--	--	--	--
Canada	2,690	4,700	2,300	8,170	32,100	115,000	55	356
China	473	526	2,190	5,310	13,300	34,800	--	--
Israel	38	43	7,990	25,000	100	258	545	1,170
Mexico	--	--	169	557	543	1,850	154	608
Russia	32	31	12,700	33,300	2,160	8,050	--	--
United Kingdom	517	548	48	142	482	3,870	1	134
Other	1,970	2,060	681	2,060	877	3,180	2	24
Total	5,720	7,910	26,500	75,700	49,600	167,000	757	2,290

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 7
WORLD ANNUAL PRIMARY MAGNESIUM
PRODUCTION CAPACITY, DECEMBER 31, 1998,
BY CONTINENT AND COUNTRY 1/ 2/

(Metric tons)

Continent and country	Capacity
North America:	
Canada	60,000
United States	145,000
Total	205,000
South America: Brazil	10,600
Europe:	
France	17,000
Kazakhstan	10,000
Norway	35,000
Russia	40,000
Serbia and Montenegro	5,000
Ukraine	15,000
Total	122,000
Asia:	
China 3/	120,000
India	900
Israel	27,500
Total	148,000
World total	486,000

1/ Includes capacity at operating plants, as well as at plants on standby basis.
2/ Data are rounded to three significant digits; may not add to totals shown.
3/ Total effective capacity, including many small plants at unknown locations.

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

(Metric tons)

Country	1994	1995	1996	1997	1998 e/
Primary production:					
Brazil e/	9,700	9,700	9,000	9,000	9,000
Canada e/ 3/	28,900	48,100	54,000	57,700	77,109 p/
China e/	24,000	93,600	73,100	75,990 r/ 4/	67,000
France	12,280	14,450	14,000 e/	13,740 r/	14,000
Israel	--	--	--	8,000 e/	15,000 4/
Japan	3,412	--	--	--	-- 4/
Kazakhstan	--	9,000 e/	9,000 e/	8,972	9,000
Norway e/	27,635 4/	28,000	28,000	28,000	28,000
Russia e/ 3/	35,400	37,500	35,000	39,500	41,500
Serbia and Montenegro	--	2,560	2,500 e/	2,500 e/	1,500
Ukraine e/	12,000	10,000	10,000	10,000	1,000
United States	128,000	142,000	133,000	125,000	106,000 4/
Total	282,000	395,000	368,000	378,000 r/	369,000
Secondary production:					
Brazil e/	1,600	1,600	1,600	1,600	1,600
Japan	19,009	11,767	21,243	22,797	20,000
U.S.S.R. e/ 5/	5,000	6,000	6,000	NA	NA
United Kingdom e/ 6/	1,000	1,000	1,000	1,000	1,000
United States	62,100	65,100	71,200	77,600 r/	76,400
Total	88,700	85,500	101,000	103,000 r/	99,000

e/ Estimated. p/ Preliminary. r/ Revised. NA Not available.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through July 22, 1999.

3/ Includes secondary.

4/ Reported figure.

5/ Dissolved in December 1991; however, information is inadequate to formulate reliable estimates for individual countries of the former U.S.S.R.

6/ Includes alloys.