MAGNESIUM COMPOUNDS

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U.S. production of magnesium compounds in 1999 increased from that in 1998, but apparent consumption remained about the same. The increase in production was offset by a decline in the total quantity of imports. Domestic production of caustic-calcined magnesia increased in response to continued growth in water-treatment applications. Production of refractory magnesia in 1999 was about the same as that in 1998, but imports decreased by about 8%. This indicates that the effects of the Asian economic crisis were still being felt by the U.S. steel industry, leading to lower production levels, and, consequently decreased use of refractories. Of the total U.S. magnesium compounds production, about 62% came from seawater and well and lake brines. The remainder was recovered from magnesite, dolomite, olivine, and brucite. About 65% of the total consumption of magnesium compounds was for refractory applications. The remaining 35% was use in environmental, chemical, and other applications.

Production

Domestic production of caustic-calcined magnesia increased slightly from that of 1998. This increase was mainly the result of continued growth in water treatment applications. U.S. production of dead-burned magnesia was about the same as that in 1998, and magnesium hydroxide production declined by about 3% (table 3).

Data for magnesium compounds were collected by the U.S. Geological Survey from one voluntary survey of U.S. operations. Of the 20 operations canvassed, 85% responded, representing 67% of the magnesium compounds shipped and used (table 3). Data for the three nonrespondents were estimated on the basis of prior year consumption levels and other factors.

In February, Rohm and Haas Co. announced that it would purchase Morton International Inc. in a $4.9 billion cash and stock transaction. This merger was estimated to be the largest specialty chemical merger in the 1990's and will create a specialty chemicals manufacturer with global sales of about $6.5 billion annually. The merger was completed on June 21 and includes Morton's magnesium compounds operation in Michigan (Chang, 1999).

Several consolidations occurred in the refractories industry in 1999. In July, the Austrian firm Radex Heraklith Industriebeteilgungs AG (RHI) announced that it would acquire Global Industrial Technologies Inc., the parent company of Harbison-Walker Refractories Inc. for $500 million (Industrial Minerals, 1999j). After the acquisition was completed in January 2000, RHI combined Harbison-Walker with its other refractory businesses in North America—North American Refractories Co., VRD-Canada Inc., Tri-Star Refractories Inc., Intertec Inc., and Zircoa Inc.—to operate under the name RHI Refractories America Inc. RHI America is required to divest some refractory product lines and manufacturing facilities to comply with regulatory requirements in Europe and the United States, however, specific facilities have not been announced yet (RHI Refractories America Inc., January 7, 2000, RHI AG completes acquisition of Global Industrial Technologies, accessed February 18, 2000, at URL http://www.hwr.com/news/index.asp?54). Also in July, National Refractories & Minerals Corp. purchased CFB Industries Inc. for an undisclosed sum. CFB Industries owns two firms that produce clay and alumina refractories for the foundry industry. The acquisition will enable National Refractories to broaden its product line from the magnesia refractories that it currently produces (North American Minerals News, 1999b).

Applied Chemical Magnesias Corp. (ACM) completed a $2 million, 40,000-metric-ton-per-year (t/yr) milling facility in Bullhead City, AZ, in July. The facility is designed to process brucite from the company's nearby mine into specialized grades of magnesium hydroxide and magnesium oxide. The products are targeted toward the water treatment market (North American Minerals News, 1999a). ACM also plans to build a 30,000-t/yr magnesium hydroxide facility at its mine site in west Texas to produce a 90% magnesium hydroxide for the flame retardant market. Construction is scheduled to begin in February 2000, and initial production is scheduled for the summer (Industrial Minerals, 1999b).

Two companies in the United States produced olivine—Unimin Corp. and Olivine Corp. Unimin operated two mines, one in North Carolina and one in Washington, and processing plants in Indiana, North Carolina, and Washington; Olivine operated one mine and one processing plant in Washington. Fused magnesia is produced by two companies in the United States—English China Clays International Ltd. with a plant in Midway, TN, and Universal Ceramic Materials PLC (UCM) of the United Kingdom, which operates a plant in Cherokee, AL, through its Muscle Shoals Minerals Inc. subsidiary. Because of an expansion in UCM's fused zirconia capacity at its Greeneville, TN, plant during the first half of 1999, the company's fused magnesia production was concentrated at its Alabama location. The equipment that was used to produce fused magnesia in Tennessee will be converted to fused zirconia production (North American Minerals News, 1999c).

The largest magnesite production facilities in the world are in China, North Korea, and Russia. Together, these three countries account for 59% of the world magnesite production

capacity. Japan and the United States account for 56% of the world's magnesium compounds production capacity from seawater or brines. Fused magnesia is produced in Australia, Brazil, Canada, China, France, Israel, Japan, the Republic of Korea, Mexico, the United Kingdom, and the United States.

Norway is the world's principal producer and supplier of olivine. Other producers include Australia, Italy, Japan, Mexico, Pakistan, Spain, and the United States.

Consumption

In 1999, environmental applications (water treatment and stack gas scrubbing, in declining order) were the dominant use for caustic-calcined magnesia, accounting for 37% of U.S. shipments. The following categories, with the individual components in parentheses in declining order of consumption, were the other end-use sectors for caustic-calcined magnesia—chemical, 26%; agriculture (animal feed and fertilizers), 20%; construction (oxychloride and oxysulfate cements and insulation) and refractories, 8%; manufacturing (electrical, rubber, fuel additives, and pulp and paper), 7%; pharmaceuticals and nutrition (sugar, cosmetics, and medicine and pharmaceuticals), 1%; and unspecified uses, 1%.

Magnesium carbonate was used principally as a chemical intermediate, in rubber processing, in medicines and pharmaceuticals, and in cosmetics (uses are detailed in descending order of quantity). Magnesium hydroxide was used mainly in the chemical industries and for water treatment. Magnesium sulfate was used mostly for animal feed, pulp and paper, chemical, electrical, and pharmaceutical applications. Magnesium chloride was used mainly as a chemical intermediate and in pharmaceuticals. Magnesium chloride brines were used principally for road dust and ice control and as a chemical intermediate.

Foundry uses remained the largest application for olivine in the United States, accounting for 84% of consumption of domestically produced material. Refractory applications accounted for 10% of U.S. consumption, sandblasting and other abrasive uses accounted for 4%, and soil conditioners accounted for 2%.

Prices

Yearend 1999 prices for magnesium compounds quoted in Chemical Market Reporter remained the same as those for 1998, with the exception of magnesium sulfate, which increased from $0.18 per pound to a range of $0.18 to $0.195 per pound (table 4). Press reports indicated that magnesium sulfate and magnesium hydroxide producers planned to increase prices during 1999. Magnesium hydroxide producers were attempting to increase prices by $20 per short dry ton, and magnesium sulfate heptahydrate (epsom salt) producers were increasing prices by $12 per ton (Brown, 1999a, b).

U.S. olivine prices, quoted in Industrial Minerals, were $60 to $110 per metric ton for foundry grade and $50 to $78 per metric ton for aggregate material at yearend 1999. Although the price range for foundry-grade material widened slightly from that at yearend 1998, this change was insignificant. All prices were quoted f.o.b. mine or plant.

Foreign Trade

Imports continued to supply a significant share of U.S. consumption of caustic-calcined and dead-burned magnesias (table 7). China was the dominant supplier of caustic-calcined and dead-burned magnesias with 58% and 70%, respectively, of the totals.

Trade data for olivine are not available separately from the U.S. Bureau of the Census; however, The Journal of Commerce Port Import/Export Reporting Service (PIERS) provides data on material that travels by ship. PIERS data indicate that in 1999 the United States exported 617 metric tons (t) of olivine; Venezuela (61%), Australia (17%), and Guatemala (13%) were the principal destinations. U.S. olivine imports totaled 117,000 t, 97% from Norway and 3% from China.

World Review

Australia.—With the heightened interest in magnesium metal because of an anticipated increase in demand for its use in the automotive industry, several firms are investigating magnesite resources in Australia as raw materials for magnesium metal production. Pima Mining Co.'s 80%-owned subsidiary, Samag, upgraded the magnesite resources it holds in the Willouran Range (Leigh Creek) deposit in South Australia. The company indicated that the total measured, indicated, and inferred resources were 516 million metric tons (Mt) of magnesite grading 42% MgO (Platt's Metals Week, 1999c). A feasibility study completed for construction of a 52,000-t/yr magnesium metal plant indicated that capital costs for the plant would be $375 million, and the cash cost of production would be $0.60 per pound. The company plans to use technology it licensed from Dow Chemical Co. to produce magnesium from magnesite, with funding and offtake agreements completed by June 2000, and initial production scheduled for 2003 (Metal Bulletin, 1999).

Mt. Grace Resources Ltd. announced that it would continue developing its Batchelor magnesite mine in the Northern Territory following an agreement to license Magnesium Development International's Heggie production technology. Mt. Grace plans to develop the project in stages, beginning in June 2000, and reach full capacity of 50,000 t/yr by 2004. Inferred magnesite resources for the project are 20.7 Mt, grading 42% MgO, but the company plans further drilling to upgrade the material in the deposit to a measured or indicated status (Platt's Metals Week, 1999b).

Crest Magnesium NL was scheduled to construct and begin operating a magnesium metal plant in Tasmania by 2003, but after financing agreements fell through, Crest Magnesium has postponed its plans. The plant was originally expected to use magnesite from the Lyons River and Arthur River deposits as feed. Inferred resources at the Lyons River deposit were estimated at 100 Mt of magnesite grading 40% MgO, and the inferred resources at the Arthur River deposit were estimated to be 80 Mt, grading 40% MgO (Gomez, 1999; Crest Magnesium NL, 1999, Profile, accessed March 10, 2000, at URL

http://www.crestmagnesium.com.au/profile.html).

Anaconda Nickel Co. announced that it is considering plans to invest $646 million in magnesite resources that it has in Western Australia, with the eventual goal of constructing a magnesium metal plant. The magnesite resources are near the company's Murrin Murrin nickel-cobalt project that Anaconda is commissioning. A preliminary study indicated that a plant with the capacity to produce 100,000 t/yr of magnesium could be economically feasible, if current energy costs can be reduced. Kaiser Engineers Inc. has been retained to carry out a preliminary study of available process options and their economics (Platt's Metals Week, 1999a).

Australian Bulk Minerals (ABM) began feasibility studies for the production of magnesite from a deposit adjacent to the company's Savage River iron ore mine in Tasmania. Because the magnesite must be removed as part of the company's normal iron ore production, ABM expects that mining costs could be minimized. Estimates of resources at the deposit are 100 Mt of magnesite. ABM also is planning to build a magnesite processing plant in Tasmania, but expects that most of the magnesite will be sold to steel works, magnesium producers, and chemical plants worldwide (Industrial Minerals, 1999a).

China.—Two rounds of bidding for export licenses for magnesite were held at the end of January and the beginning of March under a new set of rules that affected the ratio of open (public) bidding to closed bidding, the number of bidding rounds to be held during the year, and increased the amount of the licencing fee that was to be paid immediately. These bidding rounds, however, were declared invalid in March in response to pressure from the Chinese magnesite producers. China's Ministry of Foreign Trade and Economic Co-operation (MOFTEC) then reevaluated the entire licensing process for magnesite. As a result of this reevaluation, MOFTEC announced that a total of 1.5 Mt of magnesite licenses will be distributed among all mines and companies, with a set licensing fee of about $42.30 per metric ton, only $3.60 higher than the 1998 fee (Industrial Minerals, 1999g).

After a investigation by the European Commission (EC), the European Union decided to retain the antidumping duty on caustic-calcined magnesia from China that had been in place since 1993. The duty to be imposed will be the difference between $114 per ton and the free-at-Community-frontier price before Customs clearance. From its investigation, the EC determined that the potential existed for China to eliminate its export licensing fee system, which could lead to a price drop of about $38 per ton; this was the rationale used for retaining the duty (Industrial Minerals, 1999d).

The Qinghai Provincial Department for Heavy Industries was looking for an investment of $13 million from a foreign partner to reopen and expand a plant to produce high-purity magnesia from brines. The Golmud High Purity Magnesia Works had operated a 5,000-t/yr pilot plant, but suspended production because of operational and financial difficulties. With the investment and some additional technical expertise, the company hopes to produce about 50,000 t of fused magnesia annually, although the plant's remote location may discourage potential investors (Industrial Minerals, 1999e).

India.—After only slightly more than 1 year of operation, Indian Rayon Industries Ltd. stopped production at its 50,000-t/yr seawater magnesia operation in Andhra Pradesh and is evaluating the sale of the plant. The plant began operation in December 1997, but never was commercially successful. Production was expected to satisfy increased demand for magnesia refractories in the country's steel plants, but this increase never materialized. A decrease in product prices, a slump in India's steel industry, imports of low-cost steel from other Asian countries, and competition from low-cost magnesia from China were cited as factors in the decision to close the plant (Industrial Minerals, 1999f).

Japan.—Tateho Chemical Industries Co. Ltd. and Tosoh Corp. planned to set up a joint-venture firm to manufacture magnesium hydroxide flame retardants. The new company will be called TMG Corp., and the new flame retardant plant will be constructed at Tosoh's existing manufacturing complex in Nanyo. Construction of the 12,000-t/yr plant began in February, with completion scheduled for March 2000 (Industrial Minerals, 1999h).

Jordan.—A partnership between a Canadian firm, AGRA Monenco Inc., and a Turkish firm, Attila Dogan Construction and Installation Co. Inc., was awarded an $80 million contract to construct Jordan Magnesia Co. Ltd.'s 60,000-t/yr magnesia plant. Construction of the plant began in October and is expected to take 22 months. Initial startup for the plant, which will have the capacity to produce 50,000 t/yr of dead-burned magnesia and 10,000 t/yr of specialty magnesium compounds, is scheduled for the beginning of 2001. Magnesium chloride-rich brine from Arab Potash Co.'s existing solar ponds will supply the plant's feedstock (Industrial Minerals, 1999c).

Current Research and Technology

Israel's Dead Sea Periclase Ltd. developed new coated magnesium hydroxide flame retardants in which the coatings are compatible with organic polymers. Surface modifications are applied, depending upon the type of polymer in which the flame retardant will be used. The new products not only absorb heat, but they dilute the flammable gases. In addition, the magnesium oxide that is formed during combustion acts as a protective insulating barrier. Dead Sea also is developing a new surface treatment for flame retardants for the wire and cable and nylon markets (Industrial Minerals, 1999i).

U.S. steel manufacturer, USX Corp., conducted trials to reduce the usage of burnt lime and dolomitic lime as steelmaking fluxes by substituting magnesia for part of the lime or dolomitic lime used. In the trials, the researchers found that by adding 227 kilograms of dead-burned magnesia to its basic oxygen furnaces, the quantity of lime or dolomitic lime can used can be reduced by 2,227 kilograms without jeopardizing slag refining ability or furnace lining life (Zhang and others, 1999).

Outlook

The refractories industry, the largest consumer of magnesium compounds, continues to be characterized by contraction in

demand. To cut production costs, refractories users are demanding higher quality materials that have a longer usable life in the furnace. In addition, they are requiring more specialized products for specific applications. The U.S. refractories industry was hurt by the downturn in the Asian economy in 1997 and 1998. Competition from imports of lower priced steel into the United States from this region caused a drop in U.S. steel production, which, in turn, caused a decline in refractories usage. Because the Asian economy has improved, steel producers from that area are expected to return to selling their products in their traditional markets, thus lowering the quantity of imports into the U.S. market. This may lead to an upturn in U.S. steel production and consequently, a slight increase in refractories demand.

Markets for caustic-calcined magnesia are not expected to grow significantly; most of the applications are mature, with the exception of water-treatment applications. Magnesium hydroxide, however, is expected to continue to penetrate the acid neutralization market, although competition with other lower cost materials may limit its growth.

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[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT MAGNESIUM COMPOUND STATISTICS 1/

(Thousand metric tons, unless otherwise specified)

		1995	1996	1997	1998	1999
United States:						
Caustic-calcined and specified magnesias: 2/						
Shipped by producers: 3/						
Quantity		141	158	160	177 r/	179
Value	thousands	$37,900	$47,600	$52,600	$76,700 r/	$77,000
Exports 4/		2	20	5	5	3
Imports for consumption 4/		139	114	133	127	123
Refractory magnesia:						
Shipped by producers: 3/						
Quantity		234	269	283	215 r/	216
Value	thousands	$83,800	$96,800	$97,500	$75,000 r/	$75,300
Exports		75	73	66	63	67
Imports for consumption		393	271	279	427	392
World production (magnesite)		10,600 r/	11,000 r/	10,400 r/	11,700 r/	10,700 e/

e/ Estimated. r/ Revised.

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

2/ Excludes caustic-calcined magnesia used in the production of refractory magnesia.

3/ Includes magnesia used by producers.

4/ Caustic-calcined magnesia only.

TABLE 2
U.S. MAGNESIUM COMPOUND PRODUCERS, BY RAW MATERIAL
SOURCE, LOCATION, AND PRODUCTION CAPACITY, IN 1999

Raw material source and producing company	Location	Capacity (metric tons of MgO equivalent) 1/	Products
Brucite: Applied Chemical Magnesias Corp.	Van Horn, TX, and Bullhead City, AZ	25,000	Magnesium hydroxide.
Magnesite: Premier Services Inc.	Gabbs, NV	100,000	Caustic-calcined and dead-burned magnesia.
Lake brines:			
IMC Kalium Ogden Corp.	Ogden, UT	106,000	Magnesium chloride and magnesium chloride brines.
Reilly Industries Inc.	Wendover, UT	45,000	Magnesium chloride brines.
Well brines:			
The Dow Chemical Co. 2/	Ludington, MI	214,000	Magnesium hydroxide.
Martin Marietta Magnesia Specialties Inc. 3/	Manistee, MI	297,000	Caustic-calcined and dead-burned magnesia.
Rohm and Haas Co.	do.	10,000	Magnesium carbonate, magnesium hydroxide, and caustic-calcined magnesia.
Seawater:			
Barcroft Co.	Lewes, DE	5,000	Magnesium hydroxide.
National Refractories & Minerals Corp.	Moss Landing, CA	165,000	Magnesium hydroxide and caustic-calcined and dead-burned magnesia.
Premier Services Inc.	Port St. Joe, FL	50,000	Caustic-calcined magnesia and magnesium hydroxide.
Western Salt Co.	Chula Vista, CA	3,000	Magnesium chloride brines.
Total		1,020,000	

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

2/ Most of Dow's production is shipped to RHI Refractories America Inc. in Ludington, MI, where it is converted to dead-burned magnesia at a 200,000-metric-ton-per-year plant.

3/ In addition to its Michigan plant, Martin Marietta owns a 30,000-metric-ton-per-year magnesium hydroxide plant in Pittsburgh, PA, and a 15,000-metric-ton-per-year magnesium hydroxide plant in Lenoir City, TN, which use imported magnesite as a raw material.

TABLE 3
U.S. MAGNESIUM COMPOUNDS SHIPPED AND USED 1/

	1998		1999	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined and specified (USP and technical) magnesias 2/	177,000 r/	$76,700 r/	179,000	$77,000
Magnesium hydroxide [100% $Mg(OH)_2$] 2/	241,000 r/	43,300 r/	233,000	44,100
Magnesium sulfate (anhydrous and hydrous)	57,500	24,100	47,100	14,500
Precipitated magnesium carbonate 2/	2,170	4,710	2,190	4,890
Refractory magnesia	215,000 r/	75,000 r/	216,000	75,300

r/ Revised.

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

2/ Excludes material produced as an intermediate step in the manufacture of other magnesium compounds.

TABLE 4
YEAREND 1999 MAGNESIUM COMPOUND PRICES

Material		Price
Magnesia, natural, technical, heavy, 85%, f.o.b. Nevada	per short ton	$232-$265
Magnesia, natural, technical, heavy, 90%, f.o.b. Nevada	do.	265
Magnesia, dead-burned	do.	350
Magnesia, synthetic, technical	do.	385
Magnesium chloride, hydrous, 99%, flake	do.	290
Magnesium carbonate, light, technical, freight equalized	per pound	.73-.78
Magnesium hydroxide	do.	.45
Magnesium sulfate, technical, epsom salts	do.	.18-.195

Source: Chemical Market Reporter.

TABLE 5
U.S. EXPORTS OF CRUDE AND PROCESSED MAGNESITE, BY COUNTRY 1/

Material and country	1998 Quantity (metric tons)	1998 Value (thousands)	1999 Quantity (metric tons)	1999 Value (thousands)
Caustic-calcined magnesia:				
Colombia	1,270	$238	161	$87
France	794	515	95	42
Germany	972	555	689	339
Mexico	925	356	1,220	613
Netherlands	752	472	573	294
Other	717	278	453	304
Total	5,430	2,410	3,190	1,680
Dead-burned and fused magnesia:				
Canada	45,500	14,700	51,800	15,700
Mexico	3,760	1,370	690	339
Netherlands	3,230	1,010	6,460	2,100
Philippines	--	--	2,000	600
United Kingdom	830	1,870	1,380	3,140
Venezuela	4,020	1,210	4	4
Other	5,880 r/	3,610 r/	4,440	3,380
Total	63,200	23,700	66,700	25,200
Other magnesia:				
Canada	4,660	1,750	5,180	2,040
Hong Kong	1,370	1,690	1,580	1,900
Mexico	2,720	2,800	4,790	4,590
Spain	1,180	1,410	961	1,080
Taiwan	575	298	454	254
Other	2,790 r/	3,690 r/	2,800	3,470
Total	13,300	11,600	15,800	13,300
Crude magnesite:				
Brazil	1,090	117	1,140	129
Canada	1,040	207	3,490	540
Germany	31,700	3,500	6,520	796
Korea, Republic of	5,870	646	4,500	512
Mexico	4,960	579	6,140	699
Venezuela	3,040	324	2,950	323
Other	5,600 r/	658 r/	4,130	523
Total	53,300	6,030	28,900	3,520

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

Source: Bureau of the Census.

TABLE 6
U.S. EXPORTS OF MAGNESIUM COMPOUNDS 1/

Material	1998 Quantity (metric tons)	1998 Value (thousands)	1999 Quantity (metric tons)	1999 Value (thousands)
Magnesium chloride, anhydrous and other	4,130	$3,690	4,420	$2,310
Magnesium hydroxide and peroxide	17,700	8,770	18,900	7,540
Magnesium sulfate, natural kieserite and epsom salts	69	101	393	210
Magnesium sulfate, other	5,910	2,190	5,140	2,260

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

Source: Bureau of the Census.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF CRUDE AND PROCESSED MAGNESITE, BY COUNTRY 1/

Material and country	1998 Quantity (metric tons)	1998 Value (thousands)	1999 Quantity (metric tons)	1999 Value (thousands)
Caustic-calcined magnesia:				
Canada	35,700	$6,700	43,100	$7,630
China	78,500	7,710	71,500	7,650
Greece	9,100	2,320	5,080	1,220
Other	3,300	2,580	2,950	2,590
Total	127,000	19,300	123,000	19,100
Dead-burned and fused magnesia:				
Australia	53,200	13,100	45,400	11,900
Austria	21,200	10,400	19,800	11,400
Brazil	10,000	1,190	15,500	2,790
China	292,000	31,900	275,000	34,900
Greece	9,620	1,620	7,740	1,340
Hong Kong	10,700	1,130	4,000	368
Israel	13,000	8,800	3,400	4,000
Other	17,300	8,200	21,400	8,360
Total	427,000	76,300	392,000	75,000
Other magnesia:				
Canada	4,400	1,180	4,550	925
China	805	392	1,670	832
Israel	3,710	5,610	4,330	7,190
Japan	1,500	2,590	1,670	2,880
Mexico	3,740	2,110	3,440	1,930
Other	2,890	2,430	2,230	1,100
Total	17,000	14,300	17,900	14,900
Crude magnesite:				
Austria	1,010	466	--	--
China	582	375	4,080	708
Japan	--	--	962	212
Netherlands	2,580	831	245	90
United Kingdom	--	--	1,210	291
Other	415	168	1,400	418
Total	4,590	1,840	7,900	1,720

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

Source: Bureau of the Census.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF MAGNESIUM COMPOUNDS 1/

	1998 Quantity (metric tons)	1998 Value (thousands)	1999 Quantity (metric tons)	1999 Value (thousands)
Magnesium chloride, anhydrous and other	12,000	$3,720	24,500	$5,600
Magnesium hydroxide and peroxide	6,140	10,100	7,440	12,600
Magnesium sulfate, natural epsom salts	288	103	82	64
Magnesium sulfate, natural kieserite	26,000	1,870	23,800	595
Magnesium sulfate, other	21,900	4,330	26,700	5,170

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

Source: Bureau of the Census.

TABLE 9
WORLD MAGNESIUM COMPOUNDS ANNUAL PRODUCTION CAPACITY 1/ 2/
DECEMBER 31, 1999

(Thousand metric tons, MgO equivalent)

Country	Raw material				Total
	Magnesite		Seawater or brines		
	Caustic-calcined	Dead-burned	Caustic-calcined	Dead-burned	
North America:					
Canada	100	--	--	--	100
Mexico	--	--	15	95	110
United States	NA	NA	NA	NA	1,020 3/
Total	100	NA	15	95	1,230
South America: Brazil	88	291	--	--	379
Europe:					
Austria	90	486	--	--	576
France	--	--	30	--	30
Greece	120	80	--	--	200
Ireland	--	--	--	100	100
Italy	25	--	15	130	170
Netherlands	--	--	--	130	130
Norway	--	--	25	--	25
Poland	--	10	--	--	10
Russia	--	2,020	--	--	2,020
Serbia and Montenegro	40	200	--	--	240
Slovakia	30	275	--	--	305
Spain	140	65	--	--	205
Turkey	50	359	--	--	409
Ukraine	--	120	20	80	220
United Kingdom	--	--	70	80	150
Total	495	3,620	160	520	4,790
Africa:					
Kenya	NA	NA	--	--	170
South Africa	7	--	--	--	7
Total	7	NA	--	--	177
Asia:					
China	200	1,770	--	10	1,980
India	25	292	--	--	317
Iran	--	30	--	--	30
Israel	--	--	10	60	70
Japan	--	--	65	265	330
Korea, North	--	500	--	--	500
Korea, Republic of	--	--	--	50	50
Total	225	2,590	75	385	3,270
Oceania: Australia	50	107	--	--	157
Grand total	965	6,600	250	1,000	10,000

NA Not available. -- Zero.

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

2/ Includes capacity at operating plants, as well as at plants on standby basis.

3/ Includes capacity for production of magnesium chloride, magnesium chloride brines, magnesium carbonate, magnesium hydroxide, and caustic-calcined and dead-burned magnesias.

TABLE 10
MAGNESITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1995	1996	1997	1998	1999 e/
Australia	263,249	237,707	245,192 r/	360,113 r/	195,000
Austria	784,000	624,000	650,000 e/	650,000 e/	650,000
Brazil (beneficiated) 3/	315,978	305,737	294,629	308,300 r/	310,000
Canada e/ 4/	180,000	180,000	180,000	180,000	180,000
China e/	2,050,000	2,100,000	2,400,000	2,400,000	2,450,000
Colombia e/	10,500	10,500	10,500	10,500	10,500
Greece	565,720	682,346	623,050 r/	650,000 e/	650,000
India	335,189	373,306	362,929 r/	355,033 r/	360,000
Iran e/ 5/	40,000	40,000	40,000	40,000	40,000
Korea, North e/	1,600,000	1,600,000	1,600,000	1,600,000	1,000,000
Mexico	250	200	231	274 r/	275
Pakistan	16,891	3,202	4,057 r/	3,157 r/	3,000
Philippines e/	700	700	700	700	700
Poland	21,500	19,300	6,403 r/	5,745 r/	6,000
Russia e/	1,000,000	1,000,000	1,040,000	851,845 6/	900,000
Serbia and Montenegro	75,000 e/	89,000	95,000	100,000 e/	30,000
Slovakia	814,500 r/	824,800 r/	863,600 r/	877,840 r/	850,000
South Africa	84,639	71,358	76,669	74,300 r/	75,000
Spain	491,397	483,726 r/	500,000 r/ e/	500,000 e/	500,000
Turkey (run of mine)	1,928,064	2,339,138	1,409,768	2,703,343 r/	2,500,000
United States	W	W	W	W	W
Zimbabwe	5,597	10,659	13,050 r/	4,321 r/	4,000
Total	10,600,000 r/	11,000,000 r/	10,400,000 r/	11,700,000 r/	10,700,000

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total."

1/ World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

2/ Figures represent crude salable magnesite. In addition to the countries listed, Bulgaria produced magnesite, but output is not reported quantitatively, and available information is inadequate for formulation of reliable estimates of output levels. Table includes data available through May 19, 2000.

3/ Series reflect output of marketable concentrates. Production of crude ore was as follows, in tons: 1995--1,210,617; 1996--1,268,265; 1997--1,030,171; and 1998-99--1,050,000 (estimated).

4/ Magnesitic dolomite and brucite. Figures are estimated on the basis of reported tonnage dollar value.

5/ Year beginning March 21 of that stated.

6/ Reported figure.