

MAGNESIUM COMPOUNDS

By Deborah A. Kramer

Domestic production of magnesium compounds from all sources declined by 10% from that of 1993, but apparent consumption remained about the same. Refractory applications accounted for about 67% of total U.S. demand for magnesium compounds, the same as in 1993. Imports of dead-burned magnesia, particularly from China, made up for the shortfall in domestic production. U.S. magnesium compounds producers continued to target acid neutralization as a growth application for magnesium hydroxide [Mg(OH)₂] and magnesia.

Production

Production of refractory magnesia and Mg(OH)₂ decreased in 1994, continuing declines begun in 1989 and 1991, respectively. Although total Mg(OH)₂ production declined, the portion of the total that was consumed for water neutralization applications increased significantly. The overall drop in Mg(OH)₂ production was a result of lower demand for domestically produced magnesia for refractories.

In February, Clearwater Inc. announced the start-up of a new 30,000-ton-per-year Mg(OH)₂ production facility in Neville Island, PA. The plant produced Mg(OH)₂ by pressure hydrating magnesium oxide, most of which was imported from China. Magnesium hydroxide produced at this location was expected to be used for acid neutralization and heavy metals removal.¹ By the end of 1994, Martin Marietta Magnesia Specialties Inc. had purchased the Magneclear Div. of Clearwater. This purchase, combined with Martin Marietta's existing Mg(OH)₂ operations in Michigan, increases the company's total Mg(OH)₂ slurry production capacity to about 100,000 tons per year. Earlier in 1994, the company had expanded its merchant Mg(OH)₂ capacity to between 45,000 and 64,000 tons per year.²

Morton International Inc. purchased the trademarks, trade names, rights, and technology to manufacture magnesium compounds previously made by Marine Magnesium Co. in California. Marine Magnesium's facility closed at the end of 1993 when the company's lease ran out. Morton planned to produce Marine Magnesium's products at Morton's plant in Manistee, MI. Morton acquired products

servicing the pharmaceutical, food, cosmetic, and paper markets in the transaction.³ (See tables 1 and 2.)

Data for magnesium compounds were collected from one voluntary survey of U.S. operations. Of the 18 operations canvassed, 67% responded, representing 35% of the magnesium compounds shipped and used shown in table 3. Data for the six nonrespondents were estimated based on prior-year consumption levels and other factors.

Two companies in the United States produced olivine—Unimin Corp., which purchased the operations of Applied Industrial Materials Corp. in April 1994, 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.

The largest magnesite production facilities in the world are in China, North Korea, and Russia. Together, these three countries account for 61% of the world magnesite production capacity. Japan and the United States account for 61% of the world's magnesium compounds production capacity from seawater or brines. Fused magnesia is produced in Australia, Canada, France, Israel, Japan, Mexico, the United Kingdom, and the United States.

Norway, the world's principal producer of olivine, supplies its domestic needs and is a major world supplier of olivine. Countries with smaller output include Austria, Italy, Japan, Mexico, Spain, Sweden, and the United States.

Consumption

Dead-burned magnesia refractories for use in metal, cement, and glass production furnaces continued to be the primary application for magnesium compounds in the United States, representing about 67% of the total U.S. demand for magnesium compounds.

In 1994, agricultural applications (animal feed and fertilizer) were the dominant use for caustic-calcined magnesia, accounting for 28% of U.S. shipments. The following categories, with the individual components in parentheses in declining order, were the other end-use sectors for caustic-calcined magnesia: metallurgical (water treatment, refractories, and electrical), 26%; chemical, 22%;

manufacturing (rayon, fuel additives, rubber, pulp and paper, fluxes, and foundry), 17%; construction (oxychloride and oxysulfate cements and general construction), 3%; pharmaceuticals and nutrition (medicinal and pharmaceutical, sugar, and candy), 1%; and unspecified uses, 2%.

Magnesium carbonate was used principally as a chemical intermediate and in rubber processing. Magnesium hydroxide was used mainly in the chemical industries. Magnesium sulfate was used mostly in pharmaceuticals and animal feed.

Magnesium chloride was used mainly as a chemical intermediate. Magnesium chloride brines were used principally for road dust and ice control.

Foundry uses remained the largest application for olivine in the United States, accounting for 78% of consumption of domestically produced material. Refractory applications accounted for 9% of U.S. demand, sandblasting and other abrasive uses consumed 7%, and slag control accounted for 6%. (See table 3.)

AP Green Industries Inc. signed a letter of intent to acquire the assets of General Refractories Co., U.S. Refractories Div. According to General Refractories, the company is being sold because the owner intended to retire from the business. General Refractories' nine plants throughout the United States, which all are included in the sale, produce a range of refractory materials including magnesium-carbon and chrome-magnesia products.⁴

A review of the magnesia industry was published that discussed the varied end uses for caustic-calcined magnesia and Mg(OH)₂.⁵

Prices

Yearend magnesium compounds prices quoted in Chemical Marketing Reporter did not change from those at yearend 1993. However, the publication ceased citing a Mg(OH)₂ price.

U.S. olivine prices, quoted in Industrial Minerals, were \$62 to \$109 per ton for foundry grade and \$50 to \$78 per ton for aggregate material. All prices were quoted f.o.b. mine or plant. (See table 4.)

Foreign Trade

Olivine trade data are not reported separately by the Bureau of the Census, but some trade information is available from the Journal of Commerce Port Import/Export Reporting Service (PIERS). This service only reports material that travels by ship. According to PIERS, 175,000 tons of olivine was imported into the United States from Norway. A total of 813 tons of olivine was exported in 1994. Chile (64%) and Peru (15%) were the principal destinations. (See tables 5, 6, 7, and 8.)

World Review

Australia.—Queensland Metals Corp. Ltd. (QMC) continued to expand its operations, both in scope and in size. The company announced that it would form a joint venture with the French firm Mines de la Lucette S.A. (MDL) to develop and market QMC's magnesium hydroxide flame retardants. Under the joint venture, QMC (Flamemag) Pty. Ltd., a wholly owned subsidiary of QMC, and MDL each will hold 50% interest. MDL already is involved in the antimony-base flame retardant market in France.⁶ QMC also announced plans to increase its fused magnesia production capacity from 15,000 tons per year to 22,600 tons per year by early 1995.⁷

Devex Ltd. planned to nearly double its caustic-calcined magnesia capacity at Young, New South Wales, by installing a kiln from its closed Fifield facility. After kiln installation, the company's total annual caustic-calcined production capacity was estimated to be between 17,000 and 20,000 tons.⁸

China.—The Chinese Government reportedly instituted a new export licensing system for several minerals including magnesite, beginning April 1, 1994. Under the new system, companies wishing to export these minerals were invited to present bids for export licenses and for export tonnage quotas. The export licenses essentially consisted of a fee paid to export material. Two rounds of bidding were held in 1994, one for the 6-month period of April to September and the second for the next 3-month period. The export licensing system has the effect of raising prices of Chinese materials on the world market.⁹

Israel.—Dead Sea Periclase Ltd. (DSP) and Dead Sea Bromine Group, both of which are part of Israel Chemicals Ltd., announced the formation of a joint venture to develop a new range of Mg(OH)₂ flame retardants. A new 6,000-ton-per-year plant began operation at DSP's Mishor Rotem location producing surface-treated Mg(OH)₂ flame retardants for use in polymer applications such as polyvinyl

chloride, polyethylene, and copolymers for wire and cable.¹⁰ This joint-venture company reportedly signed a sales agreement with Kyowa Chemical Industry Co. of Japan to promote the sales of its fire retardants under the Kyowa trademark in Japan, the Republic of Korea, and Taiwan.¹¹

South Africa, Republic of.—As part of the Government's effort to reduce unemployment, generate income, and replace imports, Venmag began operating a small-scale magnesite mine in Transvaal. The plant, established with the assistance of Mintek, began operating in late 1993, but was officially commissioned in March 1994. Initial plant capacity was 300 tons per month of caustic-calcined magnesia and 120 tons per month of crude magnesite. Crude magnesite production capacity was being increased to 500 tons per month to meet domestic demand in the chemical and fertilizer markets. The caustic-calcined magnesia was being marketed to water treatment, fertilizer, and pharmaceutical applications. Venmag also planned to start production of a wall covering material from magnesite fines to supply the local construction market.¹² (See tables 9 and 10.)

Outlook

Magnesium compounds consumption was expected to remain relatively constant over the next few years. Refractory magnesia demand, the bulk of total U.S. demand, was expected to decrease slightly, but this decrease would be offset by an increase in environmental applications of Mg(OH)₂. Even with the additional cost of the export licensing requirements, magnesia from China was expected to continue to supply a significant portion of U.S. demand.

¹Chemical Week. V. 154, No. 7, Feb. 23, 1994, p. 43.

²Industrial Minerals (London). No. 326, Nov. 1994, pp. 13-14.

³_____. No. 322, July 1994, pp. 13-14.

⁴_____. No. 321, June 1994, p. 15.

⁵ODriscoll, M. Caustic Magnesia Markets. Ind. Miner. (London), No. 318, Mar. 1994, pp. 23-45.

⁶Industrial Minerals (London). No. 320, May 1994, p. 13.

⁷Mining Journal (London). V. 323, No. 8285, July 22, 1994, p. 57.

⁸Page 8 of work cited in footnote 5.

⁹Industrial Minerals (London). No. 325, Oct. 1994, p. 9.

¹⁰_____. No. 316, Jan. 1994, p. 13.

¹¹_____. No. 323, Aug. 1994, p. 13.

¹²_____. No. 324, Sept. 1994, p. 23.

OTHER SOURCES OF INFORMATION

U.S. Bureau of Mines Publications

Magnesium Compounds. Ch. in Mineral Commodity Summaries, annual.

Other Sources

Industrial Minerals (London), monthly.

Roskill Information Services Ltd. Magnesium Compounds 1992, 7th ed.

Roskill Information Services Ltd. Olivine 1990, 2d ed.

TABLE 1
SALIENT MAGNESIUM COMPOUND STATISTICS 1/

(Thousand metric tons and thousand dollars)

	1990	1991	1992	1993	1994
United States:					
Caustic-calcined and specified magnesia: 2/					
Shipped by producers: 3/					
Quantity	135	154	130	131	135
Value	\$37,900	\$48,100	\$36,800	\$39,500	\$39,300
Exports, quantity 4/	2	4	5	4	3
Imports for consumption, quantity 4/	84	108	83	141	125
Refractory magnesia:					
Shipped by producers: 3/					
Quantity	335	296	291	268	243
Value	\$95,000	\$85,300	\$80,800	\$77,700	\$67,800
Exports, quantity	59	66	57	60	60
Imports for consumption, quantity	155	147	210	279	342
Dead-burned dolomite:					
Sold and used by producers:					
Quantity	342	308	302	315	300
Value	\$27,000	\$25,700	\$25,200	\$26,200	\$25,000
World production (magnesite)	10,500 r/	9,790 r/	9,990 r/	8,310 r/	8,520 e/

e/ Estimated. r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to 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 1994

Raw material source and producing company	Location	Capacity (metric tons of MgO equivalent)	Products
Magnesite: Premier Services Inc.	Gabbs, NV	100,000	Caustic-calcined and dead-burned magnesia.
Lake brines:			
Great Salt Lake Minerals Corp.	Ogden, UT	90,000	Magnesium chloride and magnesium chloride brines.
Reilly Industries Inc.	Wendover, UT	45,000	Magnesium chloride brines.
Well brines:			
The Dow Chemical Co.	Ludington, MI	214,000	Magnesium hydroxide.
Martin Marietta Magnesia Specialties Inc.	Manistee, MI	275,000	Caustic-calcined and dead-burned magnesia.
Morton International	do.	10,000	Magnesium carbonate, magnesium hydroxide, and caustic-calcined magnesia.
Seawater:			
Barcroft Co.	Lewes, DE	5,000	Magnesium hydroxide.
The Dow Chemical Co.	Freeport, TX	20,000	Magnesium chloride.
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 and dead-burned magnesia.
Total		974,000	

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

	1993		1994	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined 2/ and specified (USP and technical) magnesias	131,000	\$39,500	135,000	\$39,300
Magnesium hydroxide [100% Mg(OH) 2] 2/	252,000	61,600	240,000	65,700
Magnesium sulfate (anhydrous and hydrous)	42,700	14,000	44,600	15,100
Precipitated magnesium carbonate 2/	3,010	672	2,470	534
Refractory magnesia	268,000	77,700	243,000	67,800

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits.

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

TABLE 4
YEAREND 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. 330
Magnesia, synthetic, technical	do. 366
Magnesium chloride, hydrous, 99%, flake	do. 290
Magnesium carbonate, light, technical (freight equalized)	per pound .73- .78
Magnesium sulfate, technical (epsom salts)	do. .16

Source: Chemical Marketing Reporter.

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

Material and country	1993		1994	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined magnesia:				
Germany	495	\$404	458	\$304
Mexico	543	243	574	258
Netherlands	865	573	984	572
Venezuela	1,670	477	146	76
Other	559 r/	762 r/	1,080	573
Total	4,450	2,460	3,240	1,780
Dead-burned and fused magnesia:				
Canada	40,700	14,300	42,100	15,700
Germany	2,160	689	1,140	402
Israel	906	524	1,080	675
Venezuela	10,300	3,770	7,750	2,530
Other	5,770 r/	2,560 r/	7,750	3,520
Total	59,800	21,800	59,800	22,800
Other magnesia:				
Canada	6,510	2,570	5,160	2,130
France	2,660	710	97	119
Mexico	7,380	3,590	927	788
Venezuela	1,350	513	1,660	561
Other	4,110 r/	3,770 r/	4,820	5,060
Total	22,000	11,100	12,700	8,660
Crude magnesite:				
Canada	791	245	1,200	129
China	237	105	730	78
Korea, Republic of	819	231	3,830	410
Mexico	818	321	1,480	159
Netherlands	993	641	143	34
Other	3,730 r/	1,460 r/	1,180	177
Total	7,390	3,010 r/	8,570	987

r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 6
U.S. EXPORTS OF MAGNESIUM COMPOUNDS1/

Material	1993		1994	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Magnesium chloride (anhydrous and other)	3,140	\$2,640	4,400	\$2,520
Magnesium hydroxide and peroxide	2,540	3,580	10,100	5,330
Magnesium sulfate (natural kieserite and epsom salts)	69	52	2,250	365
Magnesium sulfate (other)	4,140	1,670	4,160	2,210

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to 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	1993		1994	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined magnesia:				
Canada	42,800	\$8,560	41,700	\$8,600
China	83,100	4,700	72,500	4,420
Greece	9,880	1,470	6,200	1,290
Other	4,850 r/	986 r/	4,770	1,770
Total	141,000	15,700	125,000	16,100
Dead-burned and fused magnesia:				
Australia	1,330	583	12,000	3,330
Austria	13,600	6,070	21,300	9,660
China	196,000	15,900	264,000	20,900
Israel	16,200	6,880	10,600	5,060
Other	51,700 r/	19,200 r/	34,600	12,900
Total	279,000	48,700	342,000	51,800
Other magnesia:				
China	1,330	238	228	82
Israel	856	1,450	1,310	2,300
Japan	1,830	3,640	1,850	3,540
Mexico	--	--	3,070	1,150
Other	1,110 r/	936 r/	1,430	1,430
Total	5,120	6,270	7,890	8,500
Crude magnesite:				
Austria	--	--	92	33
China	109	43	53	26
Japan	144	167	99	20
Other	79 r/	41 r/	82	54
Total	332	251	326	133

r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to 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/

Material	1993		1994	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Magnesium chloride (anhydrous and other)	5,320	\$1,740	23,100	\$5,820
Magnesium hydroxide and peroxide	1,770	1,830	2,790	4,700
Magnesium sulfate (natural kieserite)	20,200	1,040	19,600	1,080
Magnesium sulfate (natural epsom salts)	138	154	192	136
Magnesium sulfate (other)	6,650	1,380	9,790	1,940

1/ Previously published data and 1994 are rounded by the U.S. Bureau of Mines to three significant digits.

Source: Bureau of the Census.

TABLE 9
WORLD MAGNESIUM COMPOUNDS ANNUAL PRODUCTION CAPACITY 1/ 2/
DECEMBER 31, 1994

(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	145	160
United States	NA	NA	NA	NA	974 3/
Total	100	NA	15	145	1,230
South America: Brazil	45	146	--	--	191
Europe:					
Austria	90	575	--	--	665
France	--	--	30	--	30
Greece	100	140	--	--	240
Ireland	--	--	NA	NA	100
Italy	25	--	5	125	155
Netherlands	--	--	--	100	100
Norway	--	--	25	--	25
Poland	--	10	--	--	10
Russia	--	2,200	--	--	2,200
Serbia and Montenegro	40	200	--	--	240
Slovakia	30	700	--	--	730
Spain	135	70	--	--	205
Turkey	50	224	--	--	274
Ukraine	--	--	20	80	100
United Kingdom	--	--	NA	NA	200
Total	470	4,120	80	305	5,270
Africa:					
Kenya	NA	NA	--	--	170
South Africa, Republic of	9	--	--	--	9
Zimbabwe	NA	NA	--	--	2
Total	9	--	--	--	181
Asia:					
China	200	850	--	10	1,060
India	25	228	--	--	253
Israel	--	--	10	60	70
Japan	--	--	570	65	635
Korea, North	NA	NA	--	--	2,100
Korea, Republic of	--	--	--	50	50
Nepal	--	50	--	--	50
Total	225	1,130	580	185	4,220
Oceania: Australia	167	40	--	--	207
Grand total	1,020	5,430	675	635	11,300

NA Not available.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to 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 magnesia.

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

(Metric tons)

Country	1990	1991	1992	1993	1994 e/
Australia e/	60,000	100,000	262,000 r/	261,000 r/	275,000
Austria	1,180,000	961,000	995,000	649,000 r/	600,000
Brazil 3/ (beneficiated)	257,000	242,000	273,000 r/	232,000 r/	250,000
Canada e/ 4/	150,000 5/	180,000	180,000	180,000	180,000
China e/	2,170,000	1,650,000	1,510,000	1,500,000	1,500,000
Colombia	19,300	18,800	18,800	9,820 r/	9,500
Czechoslovakia 6/ 7/	561,000	328,000	XX	XX	XX
Greece	697,000	590,000	250,000 e/	250,000 e/	200,000
India	544,000	539,000 e/	603,000 r/	409,000 r/	500,000
Iran 8/	1,410	29,300	36,200	40,000 e/	40,000
Korea, North e/	1,500,000	1,600,000	1,600,000	1,600,000	1,600,000
Mexico	579	600 r/ e/	--	1,530 r/	1,500
Nepal	-- r/	-- r/	-- r/	-- r/	--
Pakistan	4,270	5,190	6,480	4,160 r/	4,000
Philippines e/	700	700	700	700	700
Poland	23,300	8,100	12,900	13,000 r/	13,000
Russia e/ 9/	XX	XX	1,100,000	800,000	600,000
Serbia and Montenegro 10/	XX	XX	185,000	55,000 r/	68,000 5/
Slovakia 6/	XX	XX	1,270,000	1,200,000 e/	1,200,000
South Africa, Republic of	114,000	92,600	60,100	67,400 r/	69,700 5/
Spain e/	444,000 5/	445,000	400,000	400,000	400,000
Turkey (run of mine)	845,000	1,370,000	1,220,000	629,000 r/	1,000,000
U.S.S.R. e/ 9/ 11/	1,600,000	1,400,000	XX	XX	XX
United States	W	W	W	W	W
Yugoslavia 10/ 12/	252,000	210,000	XX	XX	XX
Zimbabwe	32,600	23,300	8,970	6,280 r/	6,000
Total	10,500,000	9,790,000 r/	9,990,000 r/	8,310,000 r/	8,520,000

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

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to 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, 1995.

3/ Series reflects output of marketable concentrates. Production of crude ore was as follows, in metric tons: 1990--1,430,000; 1991--879,000; 1992--1,000,000 (revised); 1993--974,000 (revised); and 1994--1,000,000 (estimated).

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

5/ Reported figure.

6/ All production in Czechoslovakia from 1990-92 came from Slovakia.

7/ Dissolved on Dec. 31, 1992.

8/ Year beginning Mar. 21 of that stated. Figures for 1990 are for magnesite; figures for 1991 and 1992 include 3,340 tons and 220 tons of huntite (Mg₃Ca(CO₃)₄), white clay, respectively.

9/ All production in U.S.S.R. for 1990 and 1991 came from Russia.

10/ All production in Yugoslavia for 1990 and 1991 came from Serbia and Montenegro.

11/ Dissolved in Dec. 1991.

12/ Dissolved in Apr. 1992.