



2016 Minerals Yearbook

MAGNESIUM COMPOUNDS [ADVANCE RELEASE]

MAGNESIUM COMPOUNDS

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Domestic survey data and tables were prepared by Paula R. Neely, statistical assistant.

In 2016, the leading magnesium compounds were, in descending order of U.S. apparent consumption, magnesia (MgO), magnesium hydroxide [Mg(OH)₂], magnesium chloride (MgCl₂), and magnesium sulfate (MgSO₄). There are three forms of magnesia: caustic-calcined magnesia, dead-burned magnesia, and fused magnesia. The leading commercial magnesium compound was caustic-calcined magnesia, which was used for—in descending order by volume—the chemical industry, environmental applications, and agricultural supplements. Domestic apparent consumption of caustic-calcined magnesia decreased by 4%; shipments from domestic producers increased by 9% compared with those in 2015, but imports for consumption decreased by 14% (table 1). The second-leading commercial magnesium compound was magnesium hydroxide (including magnesium peroxide), which was used for—in descending order by volume—environmental applications, chemicals, and flame retardants. Apparent consumption of magnesium hydroxide in 2016 increased by 5% from that in 2015; shipments from domestic producers increased slightly from those in 2015, exports decreased by 12%, and imports increased by 20% (tables 3, 5, 7). The third-leading commercial magnesium compound was dead-burned magnesia, which was used for refractory products by—in descending order by volume—the steel, cement, and glass industries. U.S. production of dead-burned magnesia in 2016 decreased by 30% from that in 2015, shipments decreased by 13%, and imports for consumption decreased by 42%, but exports increased by 95%. The decrease in production of dead-burned magnesia was attributed to consumption from stocks and a shift in product mix with an increase in production of caustic-calcined magnesia. Magnesium sulfate shipments increased by 8% (table 3). About 70% of magnesium compounds produced domestically came from seawater and well or lake brines. The remainder was recovered from the minerals dolomite, magnesite, and olivine. Imports made up for the production shortfall relative to consumption with China as the main supplier of magnesium compounds, accounting for 61% of imports of caustic-calcined magnesia and 67% of imports of dead-burned magnesia (table 6).

Legislation and Government Programs

China's export restrictions on raw materials, including those on magnesia, were the subject of two complaints filed with the World Trade Organization. On July 13, the United States filed a complaint against China over its export duties on nine raw materials—antimony, cobalt, copper, graphite, lead, magnesia, talc, tantalum, and tin. On July 19, the European Union Trade Commission filed a complaint against China over export restrictions on the same nine raw materials. After its initial filing, the United States expanded the complaint to include China's export duties on chromium and its export quotas on antimony, indium, magnesia, talc, and tin. China defended

its export restrictions on environmental grounds. At yearend, China's Government announced that magnesia export limits would be eliminated in 2017 (Salwan, 2016; Li, 2017a).

The U.S. Department of Commerce, International Trade Administration (ITA) conducted an administrative review of imports of selected magnesia-carbon bricks from China between January 1, 2014, and December 31, 2014. In September, the ITA determined that the companies under review had not shipped magnesia-carbon bricks to the United States during the review period (U.S. Department of Commerce, International Trade Administration, 2016b).

The ITA conducted another administrative review of imports of selected magnesia-carbon bricks from China between September 1, 2014, and August 31, 2015. In September, the ITA determined that the companies under review had not shipped magnesia-carbon bricks to the United States during the review period (U.S. Department of Commerce, International Trade Administration, 2016a).

In April, the U.S. Department of Commerce concluded a review of countervailing duties and antidumping duties on magnesia bricks from China and adopted the preliminary findings for the final determination. As a result, magnesia bricks produced in China by Dalian Mayerton Refractories Co. Ltd. and Liaoning Mayerton Refractories Co. Ltd. were assessed a countervailing duty rate of 253.87%, and the countervailing duty assessed for magnesia bricks produced by all other producers in China was 24.24% (U.S. Department of Commerce, International Trade Administration, 2016c).

Production

Caustic-calcined magnesia was produced from magnesite and well brines. Well brines and seawater were used to produce magnesium hydroxide. Well brines were used to produce dead-burned magnesia (table 2). In 2016, 171,000 metric tons (t) of caustic-calcined magnesia and 187,000 t of magnesium hydroxide were shipped by domestic producers in the United States (tables 1, 3). Production and shipment volumes for dead-burned magnesia were withheld to avoid disclosing company proprietary data. Fused magnesia production stopped in June 2013 in the United States. Olivine Corp. (Bellingham, WA) mined olivine from a deposit near Bellingham, WA, which was processed for use as foundry sand. No other company mined or processed olivine in the United States in 2016. Data for magnesium compounds were collected by the U.S. Geological Survey (USGS) from an annual voluntary survey of U.S. operations. Of the nine operations canvassed, five responded, representing approximately 90% of the magnesium compounds shipped and used, including data for some compounds that were not reportable in table 3. Data for the four nonrespondents were estimated on the basis of prior-year production levels.

Compass Minerals International Inc. (Overland Park, KS) was building new solar evaporation ponds on the west side of the Great Salt Lake to supply its operation near Ogden, UT. Compass produced magnesium chloride, potassium sulfate, and salt from the Great Salt Lake. The project would increase production capacity of Compass's primary product, potassium sulfate, by 35%, and magnesium chloride capacity could be increased if market conditions warranted. Compass sold magnesium chloride, mainly for deicing and dust control applications, but also for agricultural purposes; potassium sulfate for agricultural uses; and salt for deicing and chemicals (Compass Minerals International Inc., 2016, p. 14, 26; 2017, p. 11, 43).

Consumption

In 2016, the domestic end uses by tonnage for caustic-calcined magnesia were chemical intermediates, accounting for 42% of the total use; agriculture (animal feed and fertilizers), 21%; environmental applications (water treatment and stack gas scrubbing), 27%; and other uses, 9%. Dead-burned magnesia and fused magnesia were used for refractory products, with the steel industry being the leading domestic end user. Domestic consumption of magnesia refractories decreased in 2016 as a result of less domestic steel production attributed to increased imports of steel from China. The cement and glass industries also used refractory products made from dead-burned and fused magnesia.

Magnesium hydroxide was used, in descending order of quantity, for water treatment, as a chemical intermediate, and in medicines and pharmaceuticals. Magnesium sulfate was used for, in descending order of quantity, chemicals, fertilizer, rubber, pulp and paper, pharmaceuticals, and other applications. Magnesium chloride was used mainly for deicing, and magnesium chloride brines were used for deicing and to control road dust.

Prices

In 2016, the average value of imports of caustic-calcined magnesia decreased by 6% to \$277 per metric ton from \$295 per metric ton. The average value of caustic-calcined magnesia exports increased slightly to \$681 per metric ton in 2016 from \$670 per metric ton in 2015. In 2016, average values for dead-burned and fused magnesia imports increased by 11% to \$595 per metric ton from \$535 per metric ton in 2015. The average value for exports of dead-burned and fused magnesia decreased by 7% to \$627 per metric ton in 2016 from \$673 per metric ton in 2015. The average value for exports of magnesite decreased by 19% to \$1,190 per metric ton in 2016 from \$1,470 per metric ton in 2015 (tables 4, 6). In 2016, the average value for magnesium hydroxide imports decreased by 5% to \$1,670 per metric ton from \$1,760 per metric ton in 2015. The average value for exports of magnesium hydroxide increased by 6% to \$806 per metric ton in 2016 from \$761 per metric ton in 2015 (tables 5, 7). High stocks of dead-burned magnesia and fused magnesia in China were cited for lower prices for these products in world markets during the first quarter of the year. Only 80% of magnesia-based refractory products produced in

2015 were consumed prior to yearend, resulting in lower order volumes from consumers during the first quarter of the 2016 and lower prices, which persisted throughout the year (Industrial Minerals, 2016).

Foreign Trade

Imports of caustic-calcined magnesia in 2016 were 14% less than those in 2015. The leading sources of caustic-calcined magnesia imports remained China (61%), Canada (23%), and Australia (7%). Exports of caustic-calcined magnesia were 42% more in 2016 than those in 2015. The leading destinations were the Netherlands (25%) and Germany (12%). Imports of dead-burned and fused magnesia in 2016 were 42% less than those in 2015. China, Brazil, and Turkey supplied 67%, 11%, and 9%, respectively, of imports of dead-burned and fused magnesia. Imports of dead-burned and fused magnesia from Brazil and China decreased by 64% and 22%, respectively, compared with those in 2015. Ukraine supplied 50,600 t of dead-burned and fused magnesia in 2015 but did not supply any imports in 2016, accounting for nearly one-half of the decline in imported dead-burned and fused magnesia. Imports of crude magnesite from China decreased by 76,700 t and accounted for crude magnesite imports decreasing by nearly 100% compared with those in 2015. Exports of dead-burned and fused magnesia increased by 95%, with South Africa receiving 83% of exports (tables 4, 6).

World Industry Structure

Production.—World production of crude salable magnesite (MgCO_3) increased slightly to 27.3 million metric tons (Mt) in 2016 compared with the revised total of 27.1 Mt in 2015 (table 9). In descending order, China, Turkey, and Russia were the leading producers of magnesite (table 9). The countries with the leading magnesite processing capacity were China, Russia, and Turkey, in descending order, and combined accounted for 72% of world production capacity of magnesia from magnesite in 2016, with China accounting for 39% of the total. Japan, the Netherlands, and the United States together accounted for about 57% of the world's magnesia production capacity from seawater or brines (table 8). Fused magnesia was produced in Australia, Brazil, China, Iran, Israel, Japan, North Korea, the Republic of Korea, Mexico, Norway, Russia, Turkey, and the United Kingdom. At yearend 2016, world production capacity for caustic-calcined magnesia was 3.32 million metric tons per year (Mt/yr), and capacity for dead-burned magnesia was 8.72 Mt/yr (table 8).

Olivine is mined in several countries including Australia, Austria, Brazil, China, Greece, Italy, Japan, the Republic of Korea, Mexico, Norway, Spain, Taiwan, Turkey, and the United States. Production and trade data were not available for many of these countries, and some producers may not have mined olivine in 2016 but supplied stockpiled olivine to customers. Olivine was mined in Washington in 2016 and processed for foundries and other consumers at a plant in Bellingham, WA.

Mergers, Acquisitions, and Divestitures.—RHI AG (Austria) reached an agreement to acquire Magnesita Refratários S.A. (Brazil) from its controlling shareholders, GP Investments and Rhône Group. The combined company became RHI Magnesita

AG, headquartered in the Netherlands. Magnesita produced magnesia- and dolomite-based refractories from its own deposits, and RHI produced magnesia-based refractories from raw materials that it produced and obtained from suppliers. RHI's assets were mainly in Asia and Europe, whereas Magnesita's assets were mainly in South America. The diverse mix of geographic locations and products, plus the strategic positioning in response to the consolidation of the industry in China, were cited for the merger. The transaction was expected to be completed in 2017, pending regulatory approval (Ghilotti, 2016b; RHI Magnesita AG, 2016).

In October, Compass Minerals completed the acquisition of Produquímica Indústria e Comércio S.A. (Brazil). Produquímica produced minerals for agricultural and chemical uses, including magnesium compounds used in fertilizer and feed supplements in Brazil (Compass Minerals Inc., 2017, p. 41).

World Review

Australia.—Archer Exploration Ltd. conducted exploration work on the Leigh Creek magnesite project, approximately 500 kilometers north of Adelaide, South Australia. Six cryptocrystalline magnesite deposits were identified northwest of Leigh Creek Township, including the Myrtle Springs deposit, which Calix Ltd. mined. Archer planned to conduct testing of bulk samples from the Mount Hutton deposit in the first half of 2017, and if results were favorable, to mine 125,000 metric tons per year (t/yr) of magnesite starting in 2018. Archer would produce dead-burned and caustic-calcined magnesia from the deposit (Archer Exploration Ltd., 2016, p. 15–17; Perks and Flook, 2016).

Canada.—Karnalyte Resources Inc. continued planning a mine at a carnallite-sylvite mineral deposit near Wynyard, Saskatchewan. In July, estimates for construction and operation costs were updated in a technical report. Bench testing of Karnalyte's process would be conducted in 2017. In 2013, the Saskatchewan Ministry of Environment approved Karnalyte's environmental impact statement and notified Karnalyte it could proceed with the construction permitting process. Karnalyte planned to produce 100,000 t/yr of magnesium chloride brine (32% MgCl₂), 104,000 t/yr of hydromagnesite [Mg₅(CO₃)₄(OH)₂·4(H₂O)], and 625,000 t/yr of potash (Karnalyte Resources Inc., 2013a, b, 2017).

China.—Since 2015, China has increased the stringency of its environmental regulations on refractory product producers to reduce pollution and conserve energy. Hundreds of magnesia kilns have been shut down since 2015 for failing to meet emission standards. Consolidation of the refractories industry has been encouraged to close excess capacity and limit production. At the end of the year, the Government announced that quotas limiting magnesia exports would be eliminated in 2017 (Li, 2016b, 2017a; Lismore-Scott, 2016).

Magnesia producers in China delayed or slowed restarting production following China's New Year holiday owing to weak demand and low prices, especially for fused magnesia. Excess refractory production capacity and slightly increased steel production led to lower prices for dead-burned and fused magnesia in China. Production by other refractory-using industries declined in 2015 compared with that in 2014,

including cement (by 4.9%) and flat glass (by 8.6%), also contributing to the supply surplus of magnesia in China. The trend of decreased production by refractory-using industries continued in the early part of 2016, after which production by these industries increased during the remainder of the year. As a result, full-year production by magnesia consumers increased from that of 2015, including steel (by 1.2%), cement (by 2.5%), flat glass (by 5.8%), and nonferrous metals (by 2.5%) (Li, 2016b, 2017b; Li and Syrett, 2016; Lismore-Scott, 2016a; World Steel Association, 2016, 2017).

China's exports of dead-burned magnesia in the first half of 2016 were 252,000 t, slightly more than those in the same period of 2015. However, because prices declined to \$240 per metric ton in the first half of 2016 from about \$273 per metric ton in the same period of 2015, the value of exports in the first half of the year was 10% less than that of the same period in 2015. Full-year exports of dead-burned magnesia were 541,000 t in 2016, essentially unchanged from those in 2015. The average export price for dead-burned magnesia was \$242 per metric ton in 2016, 12.2% less than that in 2015. Exports of caustic-calcined magnesia decreased by 9% compared with those in the first half of 2015 to 151,000 t. Prices declined to \$202 per metric ton in the first half of 2016 from \$218 per metric ton in the first half of 2015, and the value of exports declined by 16% compared with that of the same period in 2015. Full-year exports of caustic-calcined magnesia were 337,000 t, 11.4% less than those in 2015. The average export price for caustic-calcined magnesia was \$197 per metric ton, 8.5% less than that in 2015. Fused magnesia exports in the first half of 2016 increased by 10% compared with those in the first half of 2015 to 26,100 t from 23,800 t, but the value decreased slightly as prices decreased to \$3,100 per metric ton from \$3,460 per metric ton during the first half of each year. For the full year, exports of fused magnesia were 328,000 t, an increase of 8.6% compared with those in 2015. The average export price for fused magnesia was \$560 per metric ton, 3.2% less than that in 2015 (Ghilotti, 2016a; Li, 2017a, b).

Greece.—Terna Mag S.A. continued construction of a multiple hearth furnace to produce dead-burned magnesia at its Mantoudi plant to increase capacity at the plant to 90,000 t/yr from 60,000 t/yr. A construction schedule was not available. The plant also had 30,000 t/yr of caustic-calcined magnesia capacity (Syrett and Li, 2015; Perks, 2017).

Outlook

Consumption of dead-burned and fused magnesia is expected to follow the trend of steel production in 2017. According to the World Steel Association (2016, 2017), world crude steel production, the leading end use for magnesia, was 1.6 billion metric tons in 2016, essentially unchanged from that of 2015. China continued to be the leading steel-producing nation, accounting for 50.2% of global production in 2016.

The global production of magnesia and other magnesium compounds is expected to be sufficient for anticipated global consumption for many years. The elimination of export quotas and taxes on magnesia by the Government of China was expected to decrease prices in 2017. Magnesia exports from China are expected to increase again in 2017 as China's

magnesia production exceeds consumption by the domestic steel and other pyrogenic industries that require refractory products. In China, pressure on producers to close surplus capacities of cement, glass, nonferrous metals, and steel may further the abundance of magnesia in the world market. China claimed that 65 Mt/yr of steel capacity was shut down in 2016 and pledged to close another 50 Mt/yr of capacity in 2017. A slow response by magnesia producers in China to the reduction in steel capacity apparently led to a surge in available dead-burned magnesia, and increased exports from China were reported in early 2017 (Perks, 2017). Also, by 2018, the steel industry in China has a goal to reduce unit consumption of dead-burned magnesia to 15 kilograms per metric ton of steel produced from 23 kilograms per metric ton of steel produced, which was the rate in 2014 (Moores, 2014). If this target is achieved, less demand for magnesia refractory products is expected in the long term.

Magnesia consumption in Europe is expected to increase slowly in the next several years. Development of magnesite deposits in Australia and Canada and the recent expansion of processing capacity in Australia, Brazil, Iran, the Netherlands, Norway, Russia, and Turkey are expected to increase supplies of magnesium compounds outside of China.

Consumption of caustic-calcined magnesia as a feed supplement and fertilizer additive is expected to increase as the nutrient value of magnesium continues to gain attention. By 2020, global consumption of caustic-calcined magnesia in animal feed is expected to increase to 600,000 t/yr from 470,000 t/yr in 2014, a 28% increase. Consumption of magnesium hydroxide for water treatment is expected to increase and remain the leading end use of magnesium hydroxide. Use of magnesium hydroxide for flame retardants is expected to increase owing to concern about the corrosiveness and toxicity of smoke and other emission products from plastics containing halogenated flame retardants. Consumption of other magnesium compounds, including magnesium chloride and magnesium sulfate, is expected to increase in the next several years (Industrial Minerals, 2014; Li, 2016a).

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TABLE 1
 SALIENT MAGNESIUM COMPOUND STATISTICS¹

(Thousand metric tons and thousand dollars)

	2012	2013	2014	2015	2016
United States:					
Caustic-calcined and specified magnesias: ²					
Shipped by producers: ³					
Quantity	152	155	152	156	171
Value	46,000	47,700	57,700	59,300	67,400
Exports ⁴	(5)	1	3	6	8
Imports for consumption ⁴	114	133	151	183	158
Apparent consumption ⁶	271	287	300	333	321
Refractory magnesia:					
Shipped by producers:					
Quantity	W	W	W	W	W
Value	W	W	W	W	W
Exports	16	19	21	25	48
Imports for consumption	292	215	241	259	149
World, production of magnesite	24,400 ^r	25,500 ^r	24,400 ^r	27,100 ^r	27,300

^rRevised. W Withheld to avoid disclosing company proprietary data.

¹Table includes data available through August 7, 2017. Data are rounded to no more than three significant digits.

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

³Includes magnesia used by producers.

⁴Caustic-calcined magnesia only.

⁵Less than ½ unit.

⁶Shipments plus imports minus exports. Does not account for changes in stocks.

TABLE 2
U.S. MAGNESIUM COMPOUND PRODUCERS, BY RAW MATERIAL SOURCE, LOCATION, AND PRODUCTION CAPACITY, IN 2016¹

(Metric tons, MgO equivalent)

Raw material source and producing company	Location	Capacity	Products
Magnesite, Premier Magnesia, LLC	Gabbs, NV	140,000	Caustic-calcined magnesia.
Lake brines:			
Compass Minerals International, Inc.	Ogden, UT	250,000	Magnesium chloride and magnesium chloride brines.
Intrepid Potash, LLC	Wendover, UT	45,000	Magnesium chloride brines.
Well brines, Martin Marietta Magnesia Specialties, LLC	Manistee, MI	314,000	Caustic-calcined magnesia, dead-burned magnesia, and magnesium hydroxide.
Seawater:			
South Bay Salt Works	Chula Vista, CA	3,000	Magnesium chloride brines.
SPI Pharma, Inc.	Lewes, DE	5,000	Magnesium hydroxide.
Total		757,000	

¹Table includes data available through August 7, 2017. Data are rounded to no more than three significant digits; may not add to total shown.

TABLE 3
U.S. MAGNESIUM COMPOUNDS SHIPPED BY PRODUCERS¹

	2015		2016	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined and specified (USP and technical) magnesias ²	156,000	\$59,300	171,000	\$67,400
Magnesium hydroxide [100% Mg(OH) ₂] ²	183,000	86,500	187,000	88,600
Magnesium sulfate, anhydrous and hydrous	44,600	21,100	48,100	22,900
Refractory magnesia	W	W	W	W

W Withheld to avoid disclosing company proprietary data.

¹Table includes data available through August 7, 2017. Data are rounded to no more than three significant digits.

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

TABLE 4
U.S. EXPORTS OF MAGNESIA AND CRUDE MAGNESITE, BY COUNTRY OR LOCALITY¹

Material and country or locality	2015		2016	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined magnesia:				
Canada	114	\$58	--	--
China	670	447	782	\$484
Germany	359	307	999	721
India	206	209	188	185
Netherlands	1,470	882	1,980	1,160
Poland	139	140	272	272
Russia	1,410	720	677	356
Spain	312	310	172	183
Taiwan	348	259	329	241
Other	654 ^r	474 ^r	2,670	1,890
Total	5,680	3,810	8,060	5,490
Dead-burned and fused magnesia:				
Belgium	405	435	167	202
Canada	3,100	2,480	3,510	2,810
China	114	159	128	190
Germany	83	75	135	167
Mexico	2,810	1,260	1,220	900
South Africa	15,600	9,290	39,900	22,000
Taiwan	1,830	1,760	1,830	1,780
Turkey	69	93	20	23
United Arab Emirates	436	603	606	887
Other	326 ^r	519 ^r	835	1,360
Total	24,800	16,700	48,400	30,300
Other magnesia:				
Brazil	108	222	25	80
Canada	4,880	4,060	4,260	3,060
China	226	366	294	443
France	607	474	--	--
Germany	575	515	285	293
India	359	361	667	559
Italy	370	698	225	432
Korea, Republic of	642	845	941	1,360
Mexico	709	1,090	578	866
Netherlands	364	298	41	46
Norway	641	403	499	314
United Kingdom	1,540	1,400	250	304
Other	2,120 ^r	2,740 ^r	1,310	2,070
Total	13,100	13,500	9,370	9,820
Crude magnesite:				
Brazil	37	58	125	170
Canada	43	30	119	93
Germany	17	97	11	11
Mexico	215	214	79	42
Panama	69	155	78	155
Trinidad and Tobago	23	30	39	69
United Arab Emirates	3	6	17	16
Venezuela	32	46	--	--
Other	81 ^r	129 ^r	55	64
Total	520	764	523	620

^rRevised. -- Zero.

¹Table includes data available through August 7, 2017. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 5
U.S. EXPORTS OF MAGNESIUM COMPOUNDS¹

Material	2015		2016		Principal destinations in 2016
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	
Magnesium chloride, anhydrous and other	16,300	\$10,400	7,970	\$6,070	Canada, 84%; Italy, 9%.
Magnesium hydroxide and peroxide	24,500	18,600	21,600	17,400	Canada, 50%; Sweden, 15%; Mexico, 8%.
Magnesium sulfate, natural kieserite and epsom salts	924	735	308	372	Canada, 65%; Mexico, 12%.
Magnesium sulfate, other	10,300	5,370 ^r	11,900	6,010	Canada, 92%; Mexico, 6%.

^rRevised.

¹Table includes data available through August 7, 2017. Data are rounded to no more than three significant digits.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF MAGNESIA AND CRUDE MAGNESITE, BY COUNTRY OR LOCALITY¹

Material and country or locality	2015		2016	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined magnesia:				
Australia	23,000	\$5,170	11,500	\$2,950
Brazil	14,800	3,790	17	7
Canada	35,900	16,200	35,800	14,900
China	101,000	23,000	96,200	19,400
Hong Kong	307	76	--	--
Israel	2,060	375	2,050	392
Japan	2,160 ^r	4,350 ^r	2,460	3,410
Russia	3,040	777	9,460	2,460
Other	132	72	127	48
Total	183,000	53,800 ^r	158,000	43,600
Dead-burned and fused magnesia:				
Australia	4,520	2,990	6,000	3,340
Brazil	47,800	29,600	17,100	15,900
China	128,000	71,500	100,000	48,400
France	181	1,460	100	807
Germany	76	179	42	100
Greece	2,480	1,140	916	400
Israel	2,100 ^r	7,020 ^r	1,810	5,890
Japan	1,230	3,680	1,000	2,780
Mexico	1,490	1,430	1,910	1,580
Netherlands	703	522	745	429
Russia	1,500	626	--	--
Spain	4,040	1,460	3,230	1,040
Turkey	12,600	7,540	14,100	4,360
Ukraine	50,600	7,870	--	--
United Kingdom	680	1,180	788	3,060
Other	674 ^r	310 ^r	878	463
Total	259,000	138,000 ^r	149,000	88,600
Other magnesia:				
Australia	7,080	4,350	--	--
Brazil	11,400	3,500	21,000	5,120
Canada	2,840	1,440	2,340	1,300
China	8,290	2,810	7,410	1,530
France	270 ^r	924 ^r	289	1,100
Israel	1,880	5,320 ^r	2,320	6,540
Japan	905	2,070	1,090	3,010
Mexico	3,760	4,180	3,520	3,890
Russia	12,800	3,540	177	65
Slovakia	654	287	974	301
United Kingdom	508	884	14	70
Other	666 ^r	569 ^r	635	662
Total	51,000	29,900 ^r	39,800	23,600
Crude magnesite:				
Brazil	367	583	514	574
China	76,900	8,630	155	256
Italy	188	50	12	4
Japan	310	916	328	935
Other	198 ^r	240 ^r	263	209
Total	77,900	10,400	1,270	1,980

^rRevised. -- Zero.

¹Table includes data available through August 7, 2017. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF MAGNESIUM COMPOUNDS¹

Material	2015		2016		Principal sources in 2016
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	
Magnesium chloride, anhydrous and other	92,400 ^r	\$29,400	91,700	\$29,400	Israel, 60%; Netherlands, 31%.
Magnesium hydroxide and peroxide	6,500 ^r	11,500 ^r	7,830	13,100	Mexico, 47%; Israel, 18%; Netherlands, 13%.
Magnesium sulfate, natural epsom salts	5,170	1,510	4,400	1,360	China, 96%.
Magnesium sulfate, natural kieserite	45,500 ^r	3,970	10,100	2,050	Germany, 99%.
Magnesium sulfate, other	31,800 ^r	13,000 ^r	31,600	14,400	China, 52%; Germany, 18%; Canada, 11%.

^rRevised.

¹Table includes data available through August 7, 2017. Data are rounded to no more than three significant digits.

Source: U.S. Census Bureau.

TABLE 8
WORLD MAGNESIUM COMPOUNDS ANNUAL PRODUCTION CAPACITY,
DECEMBER 31, 2016^{1,2}

(Thousand metric tons, MgO equivalent)

Country or locality	Raw material				Total
	Magnesite		Seawater or brines		
	Caustic- calcined	Dead- burned	Caustic- calcined	Dead- burned	
Australia	218	110	--	--	328
Austria	76	325	--	--	401
Brazil	96	380	12	--	488
Canada	100	--	--	--	100
China	1,440	2,740	--	--	4,180
France	--	--	30	--	30
Greece	90	110	--	--	200
India	20	202	--	--	222
Iran	25	40	--	--	65
Ireland	--	--	--	90	90
Israel	--	--	10	60	70
Italy	25	--	--	--	25
Japan	--	--	50	70	120
Jordan	--	--	10	50	60
Korea, North	25	100	--	--	125
Korea, Republic of	--	--	--	40	40
Mexico	--	--	15	95	110
Netherlands	--	--	10	205	215
Norway	--	--	30	--	30
Poland	--	10	--	--	10
Russia	380	2,500	--	--	2,880
Saudi Arabia	39	32	--	--	71
Serbia	--	35	--	--	35
Slovakia	--	465	--	--	465
South Africa	12	--	--	--	12
Spain	150	70	--	--	220
Turkey	106	544	--	--	650
Ukraine	--	170	20	80	270
United States	140	--	191	195	526
Total	2,940	7,830 ^r	378	885	12,000

^rRevised. -- Zero.

¹Table includes data available through August 7, 2017. Data are rounded to no more than three significant digits; may not add to totals shown.

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

TABLE 9
MAGNESITE: WORLD PRODUCTION, BY COUNTRY OR LOCALITY^{1,2}

(Metric tons)

Country or locality	2012	2013	2014	2015	2016
Australia	587,000	450,000	500,000 ^e	420,000 ^e	425,000 ^e
Austria	778,810	714,422	754,000 ^r	703,000 ^r	710,000 ^e
Brazil	479,304	557,431	600,000	550,000	560,000 ^e
Canada ^{e,3}	220,000 ^r	220,000 ^r	220,000 ^r	220,000 ^r	220,000
China	16,000,000	17,000,000	16,000,000 ^r	18,400,000 ^r	18,600,000
Greece	360,080 ^r	314,770 ^r	360,270 ^r	383,230 ^r	400,000
Guatemala	27,132	17,196	24,268 ^r	20,000 ^e	20,000 ^e
India	224,000 ^e	213,000 ^e	195,105 ^r	251,737 ^r	317,084
Iran ⁴	170,000 ^e	170,741 ^r	170,000 ^e	170,000 ^e	170,000 ^e
Korea, North ^e	500,000 ^r	700,000 ^r	700,000 ^r	700,000 ^r	700,000
Mexico ³	44,700	45,281	46,942	47,210 ^r	50,000
Pakistan ³	5,440 ^r	4,400 ^r	4,457 ^r	2,136 ^r	2,000 ^e
Poland	129,641	116,275 ^r	116,000 ^{r,e,4}	120,000 ^{r,e,4}	125,000 ^{e,4}
Russia	1,300,000 ^e	1,370,000 ^e	1,300,000 ^r	1,300,000	1,300,000 ^e
Saudi Arabia ^{e,4}	89,800 ^r	82,300 ^r	101,000 ^r	103,000 ^r	100,000
Serbia	80,000 ^{r,e}	80,000 ^{r,e}	75,000 ^{r,e}	75,000 ^r	75,000 ^e
Slovakia	618,400	584,000 ^{r,e}	557,100 ^r	557,000 ^r	560,000 ^e
South Africa	12,878 ^r	8,219 ^r	12,335 ^r	12,000 ^r	12,000 ^e
Spain	274,551 ^r	275,000 ^{r,e,4}	275,000 ^{r,e,4}	275,000 ^{r,e,4}	300,000 ^{e,4}
Turkey	2,475,828	2,597,465 ^r	2,377,157 ^r	2,800,000	2,700,000 ^e
United States	W	W	W	W	W
Total	24,400,000 ^r	25,500,000 ^r	24,400,000 ^r	27,100,000 ^r	27,300,000

^eEstimated. ^rRevised. W Withheld to avoid disclosing company proprietary data; not included in "Total."

¹Table includes data available through May 1, 2017. Totals and estimated data are rounded to three significant digits; may not add to totals shown.

²Figures represent crude salable magnesite. In addition to the countries and (or) localities listed, Bulgaria produced magnesite, but output was not reported quantitatively and available information was inadequate to make reliable estimates of output.

³Magnesite, dolomite, and brucite.

⁴Magnesite-consumption estimate based on reported production of caustic-calcined or dead-burned magnesite. Consumption may have been from stockpiled magnesite.