



2017 Minerals Yearbook

MAGNESIUM COMPOUNDS [ADVANCE RELEASE]

MAGNESIUM COMPOUNDS

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In 2017, the leading magnesium compounds were, in descending order of U.S. apparent consumption, magnesia (MgO), magnesium hydroxide [Mg(OH)₂], magnesium sulfate (MgSO₄), and magnesium chloride (MgCl₂). 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 quantity—the chemical industry, environmental applications, and agricultural supplements. Domestic apparent consumption of caustic-calcined magnesia increased by 13%, shipments from domestic producers increased by 11% compared with those in 2016, and imports for consumption increased by 14% (table 1). The second-leading commercial magnesium compound was magnesium hydroxide, which was used for—in descending order by quantity—environmental applications, the chemical industry, and flame-retardant applications. Apparent consumption of magnesium hydroxide in 2017 increased by 5% from that in 2016. Shipments from domestic producers increased by 6% from those in 2016, exports increased by 19%, 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 of quantity—the steel, cement, and glass industries. U.S. production of dead-burned magnesia in 2017 increased by 22% from that in 2016, shipments declined slightly, imports for consumption increased by 4%, and exports increased by 14%. The increased production of dead-burned magnesia was attributed to the 4% increase in domestic crude steel production, increased exports, and replenishment of stocks consumed in 2016 (World Steel Association, 2017, 2018). Magnesium sulfate shipments increased by 10% (table 3). About 55% 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; China (including Hong Kong) was the leading supplier of magnesium compounds, accounting for 69% of imports of caustic-calcined, dead-burned, and fused magnesia (table 6).

Legislation and Government Programs

In January, the U.S. Department of Commerce, International Trade Administration (ITA) initiated an administrative review of imports of selected magnesia-carbon bricks from China between January 1 and December 31, 2015. No determination was reached by yearend (U.S. Department of Commerce, International Trade Administration, 2017).

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 2017, 189,000 metric tons (t) of caustic-calcined magnesia and 199,000 t of magnesium hydroxide were shipped by domestic producers in the United States (tables 1, 3). Quantity and value of shipments for dead-burned magnesia were withheld to avoid disclosing company proprietary data. Fused magnesia production in the United States stopped in June 2013. Olivine Corp. processed olivine for use as foundry sand at a plant in Bellingham, WA, using stockpiled material mined in the previous year. No other company mined or processed olivine in the United States in 2017. 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 facilities 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) completed building new solar evaporation ponds on the west side of the Great Salt Lake for its plant near Ogden, UT. Compass produced magnesium chloride, potassium sulfate, and salt from the Great Salt Lake. The project increased the production capacity of Compass's primary product, potassium sulfate, by 230,000 metric tons per year (t/yr), 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., 2018, p. 11, 41).

Consumption

In 2017, the domestic end uses by tonnage for caustic-calcined magnesia were chemical intermediates, accounting for 43% of the total use; agriculture (animal feed and fertilizers), 22%; environmental applications (water treatment and stack gas scrubbing), 28%; and other uses, 7%. Dead-burned magnesia and fused magnesia were used for refractory products, with the steel industry being the leading domestic end user. The cement and glass industries also used refractory products made from dead-burned and fused magnesia. Consumption of dead-burned

and fused magnesia increased slightly in the United States in 2017 because of more domestic steel production.

Magnesium hydroxide was used for—in descending order of quantity—chemical industry, environmental applications such as water treatment, and agricultural supplements. Magnesium sulfate was used for—in descending order of quantity—chemicals, fertilizer, rubber, pulp and paper, pharmaceuticals, and other applications. Magnesium chloride was primarily used for deicing, and magnesium chloride brines were used for deicing and to control road dust.

Prices

In 2017, the average unit value of imports of caustic-calcined magnesia decreased by 13% to \$242 per metric ton from \$277 per metric ton. The average unit value of caustic-calcined magnesia exports increased by 17% to \$797 per metric ton in 2017 from \$681 per metric ton in 2016. In 2017, the average unit value for dead-burned and fused magnesia imports increased by 33% to \$789 per metric ton from \$595 per metric ton in 2016. The average unit value for dead-burned and fused magnesia exports increased slightly to \$630 per metric ton in 2017 from \$627 per metric ton in 2016. In 2017, the average unit value for magnesite imports decreased by 76% to \$379 per metric ton from \$1,560 per metric ton in 2016. The average unit value for magnesite exports increased by 3% to \$1,220 per metric ton in 2017 from \$1,190 per metric ton in 2016 (fig. 1; tables 4, 6). In 2017, the average unit value for magnesium hydroxide imports increased slightly to \$1,700 per metric ton from \$1,671 per metric ton in 2016. The average unit value for exports of magnesium hydroxide increased by 10% to \$885 per metric ton in 2017 from \$803 per metric ton in 2016 (fig. 1; tables 5, 7).

Global exports from China of dead-burned magnesia and fused magnesia had significant price increases in the second half of the year compared with those in the first half of the year. The average price for dead-burned magnesia exports from China increased by 17% to \$284 per metric ton during the second half of 2017 from \$183 per metric ton in the first half, but the average annual price was \$225 per metric ton, 7% less than that in 2016. The average price for fused magnesia exports from China increased by 47% to \$720 per metric ton during the second half of 2017 from \$416 per metric ton in the first half, and the average annual price was \$566 per metric ton, 13% more than that in 2016. However, the average price for caustic-calcined magnesia exports from China decreased by 18% to \$159 per metric ton during the second half of 2017 from \$135 per metric ton in the first half, and the average annual price was \$149 per metric ton, 25% less than that in 2016. Magnesia supply scarcity in China owing to more stringent environmental protection inspections at magnesia plants and consolidation of the refractories industry has been the impetus of the price increases for dead-burned and fused magnesia since the end of 2016 (Li, 2016; Lismore-Scott, 2016; IHS Markit Inc., 2018).

Foreign Trade

Imports of caustic-calcined magnesia in 2017 were 14% more than those in 2016. The leading sources of caustic-calcined

magnesia imports were China (59%), Canada (20%), and Hong Kong (10%). Exports of caustic-calcined magnesia in 2017 were 25% less than those in 2016. The leading destinations were Germany (25%), China (17%), and Russia (12%). Imports of dead-burned and fused magnesia in 2017 were 4% more than those in 2016. China and Turkey supplied 69% and 8%, respectively, of imports of dead-burned and fused magnesia. Dead-burned and fused magnesia imports decreased from Brazil (by 69% or 11,800 t), Australia (by 97% or 5,800 t), Turkey (14% or 2,010 t), and Greece (23% or 210 t) compared with those in 2016. Imports of crude magnesite from China were 6,180 t compared with 155 t in 2016 and accounted for crude magnesite imports increasing by 476% compared with those in 2016. Exports of dead-burned and fused magnesia increased by 14%, with South Africa receiving 78% of exports (tables 4, 6).

World Industry Structure

Production.—World production of crude salable magnesite (MgCO_3) increased slightly to 29.1 million metric tons (Mt) in 2017 compared with the revised total in 2016 of 28.5 Mt (table 9). In descending order, China, Turkey, Brazil, and Russia were the leading producers of magnesite, accounting for 88% of total world production. China accounted for 65% of world production. Production increases in China (400,000 t), Russia (158,000 t), and Brazil (100,000 t) were partially offset by declines in India (129,000 t) and Greece (60,000 t) compared with production in 2016 (table 9). The leading magnesite-processing-capacity countries were China, Russia, and Turkey, in descending order, and combined accounted for 64% of world production capacity of magnesia from magnesite in 2017, with China accounting for 35% 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 2017, world production capacity for caustic-calcined magnesia was 12.8 million metric tons per year (Mt/yr), and capacity for dead-burned magnesia was 11.4 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, and Turkey. Production and trade data were not available for many of these countries, and some producers may not have mined olivine in 2017 but instead supplied stockpiled olivine to customers. Olivine was processed in 2017 for foundries and other consumers at a plant in Bellingham, WA, from stockpiled olivine mined in prior years.

Mergers, Acquisitions, and Divestitures.—In June, RHI AG (Austria) completed its acquisition of Magnesita Refratários S.A. (Brazil) from its controlling shareholders, GP Investments and Rhône Group, that was announced in 2016. The combined company became RHI Magnesita AG, headquartered in the Netherlands. Magnesita produced magnesia and dolomite-based refractories from its 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 (Ghilotti, 2016; RHI Magnesita AG, 2018).

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 tested bulk samples from the Mount Hutton deposit in the first half of 2017, and the bulk sample work produced salable products of dead-burned and caustic-calcined magnesia. Archer was seeking a partner to be a kiln operator (Archer Exploration Ltd., 2017, p. 8–9).

Canada.—Karnalyte Resources Inc. continued to advance its Wynyard potash-magnesium mine project at a carnallite-sylvite mineral deposit near Wynyard, Saskatchewan. In June 2016, Karnalyte completed a technical report for the project. Potash would be the principle commodity. Therefore, the decision to begin construction of the project would be contingent on the potash market, and the magnesium compounds facility would be built only after completion of the potash facility. 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. In 2017, the Saskatchewan Research Council verified Karnalyte's process to produce hydromagnesite (Karnalyte Resources Inc., 2013a, b, 2017; 2018, p. 18, 22–29).

Mag One Products Inc. began construction on a processing plant with the capability to extract magnesium compounds from serpentine tailings at Asbestos, Quebec. The plant would have an initial capacity to produce 18,000 t/yr of magnesia. Mag One planned to focus on providing materials to serve the building and construction industry (Industrial Minerals, 2017).

West High Yield Resources Inc. continued an environmental study and a mine permit application for its proposed Record Ridge project in British Columbia. The company planned to build a mine and processing facility to produce magnesia from a serpentine deposit. A June 2013 preliminary economic assessment indicated an 80% recovery rate for the magnesia. However, in June 2017, West High Yield presented the results of a micro-plant test prepared by Drinkard Metalox, Inc. (Charlotte, NC). Drinkard Metalox developed a nitric acid leach extraction process that would increase the recovery rate by as much as 18% and allow the production of additional salable products such as magnesium nitrate, nickel hydroxide, and high-grade magnesia (West High Yield Resources Inc., 2013, 2017).

China.—At the end of 2016, China eliminated its quotas on magnesia exports. A small amount of production capacity closed at magnesia plants in China during the first part of 2017. However, stronger enforcement of environmental regulations by the Government of China resulted in more shutdowns in the second half of the year, but employment concerns limited shutdowns at the Provincial level in China. Notably, the magnesia industry in Liaoning Province (the leading magnesia-producing Province) was still generally composed of companies with small capacities and obsolete equipment (Lismore-Scott, 2017).

The elimination of quotas and taxes on magnesia exports by the Government of China at the end of 2016 led to decreasing prices in early 2017. However, as the year progressed, prices began to rise owing to the environmental legislation by the Government of China. Since 2015, China has increased the stringency of its environmental regulations on refractory product producers to reduce pollution and conserve energy. Since 2015, hundreds of magnesia kilns have been shut down for failing to meet emission standards. Consolidation of the refractories industry has also contributed to cuts in magnesia capacity and production (Lismore-Scott, 2016).

China's exports of dead-burned magnesia in the first half of 2017 were 514,000 t, a 104% increase from those in the same period of 2016. However, because prices declined to \$183 per metric ton in the first half of 2017 from about \$240 per metric ton in the same period of 2016, the value of exports in the first half of the year was only 56% more than that of the same period in 2016. Full-year exports of dead-burned magnesia were 884,000 t in 2017, 63% greater from those in 2016. The average export price for dead-burned magnesia was \$225 per metric ton in 2017, 7% less than that in 2016. Exports of caustic-calcined magnesia increased by 91% compared with those in the first half of 2016, to 288,000 t. Prices declined to \$135 per metric ton in the first half of 2017 from \$202 per metric ton in the first half of 2016, and the value of exports declined by 29% compared with that of the same period in 2016. Full-year exports of caustic-calcined magnesia were 654,000 t, 94% more than those in 2016. The average export price for caustic-calcined magnesia was \$149 per metric ton, 24% less than that in 2016. Fused magnesia exports in the first half of 2017 increased by 38% compared with those in the first half of 2016 to 217,000 t from 157,000 t, but the value decreased by 20% as prices declined to \$416 per metric ton from \$517 per metric ton during the first half of each year. For the full year, exports of fused magnesia were 428,000 t, an increase of 31% compared with those in 2016. The average export price for fused magnesia was \$566 per metric ton, 13% more than that in 2016 (IHS Markit Inc., 2018).

Greece.—In 2016, Terna Mag S.A., a mining subsidiary of Gek Terna Group S.A., began an investment program of \$117 million to construct a multiple hearth furnace to produce dead-burned magnesia at its Mantoudi plant that would increase the capacity of the plant to 90,000 t/yr from 60,000 t/yr. The plant also had 30,000 t/yr of caustic-calcined magnesia capacity (Perks, 2017). As of June 30, Terna Mag had invested \$34 million, with the goal to complete the program by yearend 2020 (Gek Terna S.A., 2017, p. 12).

Saudi Arabia.—Saudi Arabian Mining Co. Ltd. started production from a new vertical kiln shaft to produce dead-burned magnesia. The capacity of the plant for dead-burned magnesia was 32,000 t/yr. The plant was expected to reach full capacity in 2018 (Saudi Arabian Mining Co. Ltd., 2018, p. 97–98).

Outlook

The global production of magnesia and magnesium compounds is expected to be sufficient for anticipated consumption for many years. The goal of the steel industry in China is to reduce unit consumption of dead-burned magnesia by 2018 to 15 kilograms per metric ton (kg/t) of steel produced

from 23 kg/t of steel produced, the rate in 2014 (Moore, 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 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 grow 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, 2016).

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TABLE 1
SALIENT MAGNESIUM COMPOUND STATISTICS¹

(Thousand metric tons and thousand dollars)

	2013	2014	2015	2016	2017
United States:					
Caustic-calcined and specified magnesia: ²					
Shipped by producers: ³					
Quantity	155	152	156	171	189
Value	47,700	57,700	59,300	67,400	74,300
Exports ⁴	1	3	6	8	6
Imports for consumption ⁴	133	151	183	158	180
Apparent consumption ⁵	287	300	333	321	363
Dead-burned and fused magnesia:					
Shipped by producers:					
Quantity	W	W	W	W	W
Value	W	W	W	W	W
Exports	19	21	25	48	55
Imports for consumption	215	241	282 ^r	149	155
Magnesium hydroxide:					
Shipped by producers:					
Quantity	182	187	183	188	199
Value	86,600	88,900	86,500	111,000	118,000
Exports	22	27	24	21	26
Imports for consumption	6	7	7	8	9
Magnesium chloride:					
Shipped by producers:					
Quantity	W	W	W	W	W
Value	W	W	W	W	W
Exports	9	10	16	8	8
Imports for consumption	48	118	92	92	55
World, production of magnesite	25,900 ^r	24,800 ^r	28,100 ^r	28,500 ^r	29,100

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

¹Table includes data available through October 3, 2018. 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.

⁵Shipments 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 2017¹

(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 October 3, 2018. 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

Material	2016		2017	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined and specified (USP and technical) magnesia ²	171,000	\$67,400	189,000	\$74,300
Magnesium chloride	W	W	W	W
Magnesium hydroxide [100% Mg(OH) ₂] ²	188,000 ^r	111,000 ^r	199,000	118,000
Magnesium sulfate, anhydrous and hydrous	48,200 ^r	22,900	52,800	23,900
Dead-burned and fused magnesia	W	W	W	W

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

¹Table includes data available through October 3, 2018. 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	2016		2017	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined magnesia:				
China	782	\$484	1,020	\$685
France	1,350	940	454	369
Germany	999	721	1,510	1,380
India	188	185	147	132
Italy	371	257	60	73
Netherlands	1,980	1,160	326	216
Poland	272	272	287	278
Russia	677	356	705	360
Spain	172	183	174	177
Taiwan	329	241	359	274
Other	941 ^r	688 ^r	1,000	873
Total	8,060	5,490	6,040	4,810
Dead-burned and fused magnesia:				
Belgium	167	202	--	--
Canada	3,510	2,810	4,890	2,670
China	128	190	278	287
Germany	135	167	284	305
Mexico	1,220	900	2,590	1,440
Netherlands	119	167	252	340
South Africa	39,900	22,000	43,100	25,300
Taiwan	1,830	1,780	2,080	1,950
United Arab Emirates	606	888 ^r	962	1,430
Other	735 ^r	1,210 ^r	868	1,090
Total	48,400	30,300	55,300	34,800
Other magnesia:				
Canada	4,260	3,050 ^r	4,320	3,150
China	294	443	2,940	2,880
France	--	--	499	386
Germany	285	293	332	336
India	667	559	557	480
Italy	225	432	275	588
Japan	112	108	475	412
Korea, Republic of	941	1,360	719	799
Mexico	578	866	1,310	1,370
Norway	499	314	402	252
United Arab Emirates	155	241	214	295
United Kingdom	250	304	128	188
Other	1,110 ^r	1,850 ^r	2,340	2,840
Total	9,370	9,820	14,500	14,000
Crude magnesite:				
Brazil	125	170	161	242
Canada	119	93	459	344
Germany	11	11	17	120
Mexico	79	42	100	134
Panama	78	155	58	116
Trinidad and Tobago	39	69	25	38
United Arab Emirates	17	16	--	--
Other	55	64	42	61
Total	523	620	862	1,060

^rRevised. -- Zero.

¹Table includes data available through October 3, 2018. 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	2016		2017		Principal destinations in 2017 based on quantity
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	
Magnesium chloride, anhydrous and other	7,970	\$6,070	8,170	\$6,200	Canada, 87%; Italy, 5%.
Magnesium hydroxide and peroxide	21,500 ^r	17,300 ^r	25,600	22,700	Canada, 44%; Sweden, 17%; Finland, 6%.
Magnesium sulfate, natural kieserite and epsom salts	308	372	613	599	Canada, 75%; United Kingdom, 10%; Japan, 6%.
Magnesium sulfate, other	11,900	6,010	15,000	6,960	Canada, 93%; Mexico, 4%.

^rRevised.

¹Table includes data available through October 3, 2018. 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	2016		2017	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined magnesia:				
Australia	11,500	\$2,950	10,500	\$2,240
Brazil	17	7	--	--
Canada	35,800	14,900	35,600	14,500
China	96,200	19,400	106,000	18,200
Hong Kong	--	--	17,700	3,690
Israel	2,050	392	8,160	1,630
Japan	2,460	3,410	2,150	3,210
Russia	9,460	2,460	--	--
Other	127	48	62	61
Total	158,000	43,600	180,000	43,500
Dead-burned and fused magnesia:				
Australia	6,000	3,340	200	148
Brazil	17,100	15,900	5,360	26,900
China	100,000	48,400	107,000	58,900
France	100	807	141	1,170
Germany	42	100	223	304
Greece	916	400	706	282
Israel	1,810	5,890	2,230	7,160
Japan	1,000	2,780	1,830	4,910
Mexico	1,910	1,580	6,930	3,920
Netherlands	707 ^r	409 ^r	6,470	3,640
Russia	--	--	724	868
Spain	3,230	1,040	3,700	1,350
Turkey	14,100	4,360	12,100	9,290
United Kingdom	788	3,060	892	1,290
Other	878	463	6,310	2,140
Total	149,000	88,500 ^r	155,000	122,000
Other magnesia:				
Brazil	21,000	5,120	51,000	12,000
Canada	2,340	1,300	21	84
China	7,410	1,530	2,860	1,180
France	289	1,100	311	1,050
Israel	2,320	6,540	2,240	5,820
Japan	1,090	3,010	1,060	2,520
Mexico	3,520	3,890	4,510	4,790
Russia	177	65	--	--
Slovakia	974	301	814	367
Turkey	314	124	3,030	1,390
Other	334 ^r	609 ^r	5,240	4,010
Total	39,800	23,600	71,000	33,200
Crude magnesite:				
Brazil	514	574	208	351
China	155	256	6,180	1,050
Greece	132	48	104	46
Japan	328	935	298	932
Other	143 ^r	165 ^r	538	400
Total	1,270	1,980	7,320	2,780

^rRevised. -- Zero.

¹Table includes data available through October 3, 2018. 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	2016		2017		Principal destinations in 2017 based on quantity
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	
Magnesium chloride, anhydrous and other	91,700	\$29,300 ^r	55,500	\$22,100	Israel, 66%; Netherlands, 18%; China, 6%.
Magnesium hydroxide and peroxide	7,830	13,100	9,360	15,900	Mexico, 46%; Netherlands, 17%, Israel, 15%.
Magnesium sulfate, natural epsom salts	4,400	1,360	4,190	2,470	China, 91%; Germany, 6%.
Magnesium sulfate, natural kieserite	10,100	2,050	5,820	1,070	Germany, 60%; China, 40%.
Magnesium sulfate, other	31,600	16,200 ^r	34,800	14,900	China, 52%; Germany, 14%; Canada, 8%.

^rRevised.

¹Table includes data available through October 3, 2018. 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, 2017^{1,2}

(Thousand metric tons, MgO equivalent)

Country or locality	Raw material						Total
	Magnesite			Seawater or brines			
	Caustic-calcined	Dead-burned	Fused	Caustic-calcined	Dead-burned	Fused	
Australia	178	135	30	--	--	--	343
Austria	100	290	--	--	--	--	390
Brazil	310	410	50	12	--	--	782
Canada	120	--	--	--	--	--	120
China	10,000	5,000	1,900	--	--	--	16,900
France	--	--	--	30	--	--	30
Greece	210	110	--	--	--	--	320
India	110	250	--	--	--	--	360
Iran	170	52	9	--	--	--	231
Ireland	--	--	--	15	70	--	85
Israel	--	--	--	10	60	--	70
Italy	25	--	--	--	--	--	25
Japan	--	--	--	30	160	--	190
Jordan	--	--	--	10	50	--	60
Korea, North	170	60	25	--	--	--	255
Korea, Republic of	--	--	20	--	60	--	80
Mexico	--	--	--	20	70	10	100
Netherlands	--	--	--	10	205	--	215
Norway	--	--	--	90	--	85	175
Pakistan	25	50	--	--	--	--	75
Poland	--	50	--	--	--	--	50
Russia	380	2,500	--	--	--	--	2,880
Saudi Arabia	60	32	--	--	--	--	92
Serbia	--	40	--	--	--	--	40
Slovakia	--	465	--	--	--	--	465
South Africa	50	--	10	--	--	--	60
Spain	150	70	--	--	--	--	220
Turkey	175	760	40	--	--	--	975
Ukraine	--	170	--	20	80	--	270
United States	140	--	--	191	195	--	526
Total	12,400	10,400	2,080	438	950	95	26,400

-- Zero.

¹Table includes data available through October 3, 2018. 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	2013	2014	2015	2016	2017
Australia ³	450,000	500,000 ^e	660,000 ^{r,e}	470,000 ^{r,e}	470,000 ^e
Austria	714,422	754,000	703,000	565,892 ^r	600,000 ^e
Brazil, beneficiated	1,388,866 ^r	1,423,210 ^r	1,620,000 ^{r,e}	1,700,000 ^{r,e}	1,800,000 ^e
Canada ^{e,4}	150,000 ^r	150,000 ^r	150,000 ^r	150,000 ^r	150,000
China	17,000,000	16,000,000	18,400,000	18,600,000 ^e	19,000,000
Greece, crude ore	314,770	360,270	383,230	460,000 ^r	400,000 ^e
Guatemala	17,196	24,300 ^{r,e}	20,000 ^e	23,954 ^r	25,000 ^e
India	213,000 ^e	195,105	251,737	317,084	187,974
Iran ⁵	171,000 ^{r,e}	165,886 ^r	165,000 ^r	150,000 ^{r,e}	150,000 ^e
Korea, North ^c	350,000 ^r	400,000 ^r	320,000 ^r	350,000 ^r	380,000
Mexico ⁴	45,281	46,942	47,210	50,000	50,000 ^e
Pakistan ⁴	4,457 ^r	4,457	24,271 ^r	22,581 ^r	25,000 ^e
Poland	116,274 ^r	116,000	111,077 ^r	97,868 ^r	100,000 ^e
Russia	1,300,000 ^{r,e}	1,300,000 ^e	1,493,000 ^r	1,342,000 ^r	1,500,000 ^e
Saudi Arabia ⁵	82,300	100,800 ^r	103,200 ^r	75,000 ^r	90,000
Serbia ^c	80,000	75,000	75,000	75,000	75,000
Slovakia	583,800 ^r	557,100	501,200 ^r	430,900 ^r	450,000 ^e
South Africa	8,219	12,335	40,000 ^{r,e}	60,000 ^{r,e}	80,000 ^e
Spain ⁵	275,000	275,000	275,000	300,000	300,000 ^e
Turkey	2,597,465	2,377,157	2,800,000	3,258,445 ^r	3,300,000 ^e
United States	W	W	W	W	W
Total	25,900,000 ^r	24,800,000 ^r	28,100,000 ^r	28,500,000 ^r	29,100,000

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

¹Table includes data available through August 8, 2018. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than 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.

³Estimates are based on reported data for the calendar year by the Department of State Development, South Australia, and for the fiscal year by the Queensland Department of Natural Resources and Mines.

⁴Magnesite, dolomite, and brucite.

⁵Magnesite-consumption estimate based on reported production of caustic-calcined or dead-burned magnesite, unless denoted as reported. Consumption may have been from stockpiled magnesite.

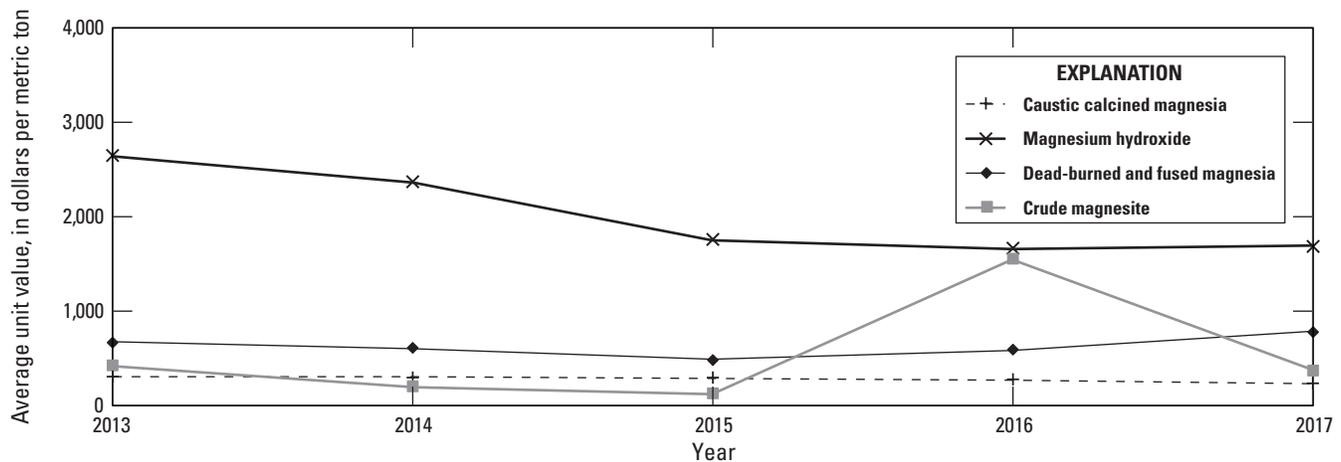


Figure 1. The annual average customs unit value for crude magnesite and magnesium compound imports for consumption from 2013 through 2017. Source: U.S. Census Bureau.