USGS
science for a changing world

2018 Minerals Yearbook

MAGNESIUM COMPOUNDS [ADVANCE RELEASE]

U.S. Department of the Interior
U.S. Geological Survey

May 2022

Magnesium Compounds

By Adam M. Merrill

Domestic survey data and tables were prepared by Robin C. Kaiser, statistical assistant.

In 2018, the most used magnesium compound, based on U.S. apparent consumption, was magnesia (MgO). There are three forms of magnesia: caustic-calcined magnesia, dead-burned magnesia, and fused magnesia. Caustic-calcined magnesia was used for agricultural, chemical, and industrial applications. Domestic apparent consumption of caustic-calcined magnesia was unchanged, as were imports for consumption; shipments from domestic producers increased by 3% compared with those in 2017 (table 1). Dead-burned magnesia was used for refractory products by the cement, glass, and steel industries. U.S. imports of dead-burned magnesia for consumption increased by 46% and exports increased by 25%; shipments decreased slightly (table 1). The increase of U.S. imports for consumption of dead-burned magnesia was attributed to the 6% increase in domestic crude steel production, increased exports, and replenishment of stocks consumed in 2017 (World Steel Association, 2018, p. 1; 2019b, p. 1).

In addition to magnesia, the magnesium compounds magnesium chloride ($MgCl_2$), magnesium hydroxide [$Mg(OH)_2$], and magnesium sulfate ($MgSO_4$) were produced in 2018. Magnesium chloride was used for deicing and dust control for roads. Imports for consumption increased by 73% and exports increased by 25% (table 1). Magnesium hydroxide was used in the chemical industry and for environmental and flame-retardant applications. Imports of magnesium hydroxide in 2018 increased by 22% from that in 2017; apparent consumption increased by 5%; and shipments from domestic producers increased by 3%. Exports of magnesium hydroxide decreased by 12% (table 1).

Magnesium sulfate shipments increased by 19% compared with those in 2017 (table 3). Trade data differentiates magnesium sulfate exports as "natural kieserite and epsom salts" and "magnesium sulfate, other;" magnesium sulfate imports are categorized as "natural epsom salts," "natural kieserite," and "magnesium sulfate, other." In 2018, exports of natural kieserite and epsom salts (combined) and magnesium sulfate, other decreased by 39% and 5% respectively, from those in 2017 (table 5). Imports of natural epsom salts and magnesium sulfate, other increased by 21% and 4%, respectively. Imports of natural kieserite decreased by 83% (table 7).

About 73% of magnesium compounds produced domestically came from seawater and well or lake brines (table 8). 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 magnesia, accounting for 70% of caustic-calcined magnesia imports and 68% of dead-burned and fused magnesia imports (table 6).

Legislation and Government Programs

On October 3, 2018, the U.S. Department of Commerce, International Trade Administration (ITA), issued preliminary results of its administrative review of imports of selected magnesia-carbon bricks from China between January 1 and December 31, 2016. The review of the countervailing duty order on certain magnesia carbon bricks was in response to an October 2, 2017, request from the Magnesia Carbon Bricks Fair Trade Committee, an ad hoc association composed of three U.S. producers of magnesia carbon brick. The three companies subject to the review were Fedmet Resources Corporation; Fengchi Imp. and Exp. Co., Ltd. of Haicheng City, Fengchi Mining Co., Ltd. of Haicheng City, and Fengchi Refractories Co., of Haicheng City (collectively, Fengchi); and RHI Refractories Liaoning Co., Ltd. The ITA preliminarily found that that there were no shipments of magnesia carbon bricks by any of the three companies. As a result, the ITA preliminarily rescinded the review (U.S. Department of Commerce, International Trade Administration, 2018).

Production

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 reported in table 3. Data for the four nonrespondents were estimated on the basis of prior-year production levels.

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 2018, 194,000 metric tons (t) of caustic-calcined magnesia and 204,000 t of magnesium hydroxide were shipped by domestic producers in the United States (tables 1, 3). Quantity and value of shipments and apparent consumption for dead-burned magnesia and magnesium chloride were withheld to avoid disclosing company proprietary data. Fused magnesia production in the United States stopped in June 2013.

Compass Minerals International Inc. (Overland Park, KS) is the leading U.S. producer of magnesium chloride. Compass sold magnesium chloride mainly for deicing, dust control, and unpaved road surface stabilization. Compass produced magnesium chloride, potassium sulfate, and salt from the Great Salt Lake. In 2017, Compass completed building new solar evaporation ponds on the west side of the Great Salt Lake

for its plant near Ogden, UT. The expansion project increased the Utah plant's production capacity to 680,000 metric tons per year (t/yr) of magnesium chloride (Compass Minerals International Inc., 2019, p. 7, 11).

Giles Chemical, a division of Premier Magnesia, LLC, expanded its Greendale, IN, facility to produce epsom salt (magnesium sulfate heptahydrate). Prior to the expansion, the plant only produced liquid magnesium sulfate (Perleberg, 2018). Magnesium oxide consumed by the plant was mined at Premier Magnesia's mine in Gabbs, NV (Giles Chemical Corp., 2020).

Consumption

USGS's voluntary surveys are used to determine end uses of magnesium compounds. In 2018, the domestic end uses by tonnage of caustic-calcined magnesia were chemical intermediates, accounting for 36% of the total use; environmental applications (water treatment and stack gas scrubbing), 30%; agriculture (animal feed and fertilizers), 27%; 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 by 6% in the United States in 2018 owing to increased domestic steel production.

Magnesium hydroxide was used for chemical, environmental, and flame-retardant applications. Magnesium sulfate was used for chemicals, fertilizer, pharmaceuticals, pulp and paper, rubber, and other applications. Magnesium chloride was used primarily for deicing, and magnesium chloride brines were used for deicing and to control road dust.

Prices

In 2018, the average unit value of imports for caustic-calcined magnesia increased by 7% to $259 per metric ton from $242 per metric ton in 2017 (table 6). Dead-burned and fused magnesia imports increased by 39% to $1,093 per metric ton in 2018 from $788 per metric ton in 2017 (table 6). Magnesium hydroxide imports decreased by 15% to $1,451 per metric ton in 2018 from $1,700 per metric ton in 2017 (table 7). Crude magnesite imports decreased by 61% to $148 per metric ton in 2018 from $379 per metric ton in 2017 (table 6).

In 2018, the average unit value of caustic-calcined magnesia exports decreased by 10% to $718 per metric ton in 2018 from $797 per metric ton in 2017 (table 4). Dead-burned and fused magnesia exports increased by 10% to $694 per metric ton in 2018 from $630 per metric ton in 2017 (table 4). Crude magnesite exports increased by 5% to $1,298 per metric ton in 2018 from $1,232 per metric ton in 2017 (table 4). Magnesium hydroxide and peroxide exports decreased by 8% to $819 per metric ton in 2018 from $886 per metric ton in 2017 (table 5).

Average annual unit values for all types of magnesia exports from China increased markedly from that in 2017; however, unit values for global exports from China of dead-burned magnesia and fused magnesia decreased in the second half of the year compared with those in the first half of the year. The average unit value for dead-burned magnesia exports from China decreased by 24% to $326 per metric ton during the second half of 2018 from $430 per metric ton in the first half; the average annual unit value was $373 per metric ton, 66% more than that in 2017. The average unit value for fused magnesia exports from China decreased by 6% to $836 per metric ton during the second half of 2018 from $892 per metric ton in the first half; the average annual unit value was $866 per metric ton, 53% more than that in 2017. The average unit value for caustic-calcined magnesia exports from China increased by 3% to $180 per metric ton during the second half of 2018 from $175 per metric ton in the first half, and the average annual unit value was $178 per metric ton, 19% more than that in 2017. As in the prior year, an intensified environmental protection inspection regime at magnesia plants and the consolidation of the refractories industry in China contracted magnesia supply leading to an annual average unit value increase for dead-burned and fused magnesia from 2017 (Shi, 2019; Zen Innovations AG, 2020).

Foreign Trade

Imports of caustic-calcined magnesia in 2018 were unchanged from those in 2017. The leading sources of caustic-calcined magnesia imports were China (65%), Canada (20%), and Australia (7%) (table 6). U.S. exports of caustic-calcined magnesia in 2018 were 76% more than those in 2017. The leading destinations were China (49%), Russia (9%), and Germany (8%) (table 4). Imports of dead-burned and fused magnesia in 2018 were 46% more than those in 2017 (table 6). Imports of dead-burned and fused magnesia were largely supplied by China (66%), Brazil (12%), and Turkey (6%). Dead-burned and fused magnesia imports increased from Brazil (by 407% or 21,800 t), China (by 39% or 41,300 t), and Turkey (by 4% or 440 t) compared with those in 2017. United States exports of dead-burned and fused magnesia increased by 24%, with South Africa and Canada receiving 81% and 7% of exports, respectively (table 4). Imports of crude magnesite in 2018 were a tenfold increase from those in 2017, of which 94% originated from China. Imports from China increased to 68,700 t in 2018 from 6,180 t in 2017 (table 6). Exports of crude magnesite decreased by 9% compared with those in 2017, The leading destinations were Brazil (34%), Canada (28%), and Mexico (14%) (table 4).

World Industry Structure

Production.—World production of crude salable magnesite ($MgCO_3$), excluding U.S. production, decreased slightly to 27.1 million metric tons (Mt) in 2018 compared with the revised total of 27.6 Mt in 2017 (table 9). In descending order, China, Turkey, Brazil, and Russia were the leading producers of magnesite, accounting for 87% of total world production. China accounted for 68% of world production. Production increases in Turkey (106,000 t), Australia (55,000 t), and Pakistan (28,300 t) did not offset declines in China (500,000 t) and North Korea (310,000 t) compared with production in 2017 (table 9). The countries with the leading magnesite-processing capacities were China, Russia, and Turkey, in descending order, and combined accounted for 83% of world production capacity of magnesia from magnesite in 2018, with China accounting for 68% of the

total (table 8). The United States, the Netherlands, Japan, and Norway together accounted for 65% of the world's magnesia production capacity from seawater or brines (table 8). At yearend 2018, 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 was mined in several countries and localities, 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 localities, and some producers may not have mined olivine in 2018 but instead supplied stockpiled olivine to customers. Domestically, olivine was processed at a single plant in Bellingham, WA. In 2018, olivine was processed at the Bellingham plant for foundries and other consumers from previously mined, stockpiled olivine.

Mergers, Acquisitions, and Divestitures.—In April, TIMAB Magnesium (a subsidiary of Groupe Roullier) became the sole owner of Magnesitas Navarras S.A. (Magna), which had been jointly owned by Grecian Magnesite S.A. and TIMAB since 2000. Magna operated two magnesite mines in Azcarate and Borobia, Spain, and had production capacity exceeding 240,000 t/yr of caustic and dead-burned magnesia (Ghilotti, 2018; Grecian Magnesite S.A., 2018).

In June, Afarak Group Plc. purchased Magnohrom d.o.o., a Serbian-based sinter magnesite refractory material company. The purchase included production facilities and mines with reported reserves in excess of 4 Mt of ore. The company expected to upgrade the beneficiation plant with plans to fully commence operations in 2019 (Afarak Group Plc., 2019, p. 11, 19).

In August, RHI Magnesita N.V. (Austria) proposed the merger of its three Indian subsidiaries: RHI India, RHI Clasil, and Orient Refractories. Upon completion, the merged companies were to be renamed RHI Magnesita India. Each company served distinct roles within India's refractory industry. Simplifying the corporate structure and consolidating RHI Magnesita's operating entities in India were cited as reasons for the merger (RHI Magnesita N.V., 2018b; 2019, p. 32).

World Review

Australia.—Archer Exploration Ltd. announced the sale of the Leigh Creek magnesite project for $2 million to Australian Consolidated Venture Capital Pty., Ltd. (Archer Exploration Ltd., 2019, p. 9, 79). The project is located approximately 500 kilometers north of Adelaide, South Australia. Archer had sought to produce dead-burned and caustic-calcined magnesia from magnesite ore, but its inability to secure long-term access to a kiln was cited as the reason to sell the property (Archer Exploration Ltd., 2019, p. 25).

Canada.—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. In June 2017, West High Yield submitted the Project Description for the Record Ridge project, which initiated the permitting and review process with the British Columbia Ministry of Energy Mines and Petroleum Resources (West High Yield Resources Inc., 2013, 2018).

China.—The enforcement of environmental regulations by the Government of China in 2017 brought about the temporary closure of 80% to 90% of magnesia production capacity in China's major magnesia-producing region (O'Driscoll, 2018a). In 2018, enforcement continued to affect production of magnesite particularly within the Liaoning Province (O'Driscoll, 2018b). Environmental and safety inspections persisted throughout 2018, causing production delays and supply shortages of magnesite ores. During the third quarter of 2018, nearly all production of high-purity magnesia in Liaoning had ceased and all magnesite mining in the Anshan and Dashiqiao area had shut down (O'Driscoll, 2018a–c).

The government of Haicheng, within Liaoning Province, took ownership and consolidated 42 magnesia companies into the Liaoning Magnesite Mining Company. The newly formed company controlled government permits and activities including mining, processing, sales, and trade. The consolidation provided the local government with the means to direct sustainable growth for the magnesia market within the region (Shi, 2018).

RHI Magnesita planned to invest $24 million[1] in its Chizhou plant located in Anhui Province. The plant included a dolomite mine and production facilities. The brick plant and mine were expected to begin production in 2019. Improving competitiveness and supply security were given as reasons for the investment (RHI Magnesita N.V., 2018a).

Haicheng Guotian Mining Co., Ltd., Refratechnik Holding GmbH, and Yingkou Jinlong Refractories Group Co., Ltd. formed a joint venture to produce high-grade caustic-calcined magnesia and dead-burned magnesia. New construction for a plant in Pailou town, Haicheng, was to begin in 2019. Production capacity was expected to be 100,000 t/yr of caustic-calcined magnesia and 100,000 t/yr of dead-burned magnesia (Refratechnik Holding GmbH, 2018).

China's exports of dead-burned magnesia in the first half of 2018 were 446,000 t, a 13% decrease from those in the same period of 2017, but a 21% increase over the second half of 2017. The unit value of dead-burned magnesia increased to $430 per metric ton in the first half of 2018, a 135% increase from the same period in 2017, and a 51% increase over the second half of 2017. Full-year exports of dead-burned magnesia were 989,000 t in 2018, 12% more than those in 2017. The average export unit value was $373 per metric ton in 2018, 66% more than that in 2017. The total value of exports increased by 85% compared with those in 2017 (Zen Innovations AG, 2020).

China's exports of caustic-calcined magnesia in the first half of 2018 were 363,000 t, a 26% increase compared with those in the same period of 2017, and essentially unchanged from the second half of 2017. The unit value of caustic-calcined magnesia increased to $175 per metric ton in the first half of 2018, a 30% increase from the same period in 2017, and a 10% increase from the second half of 2017. Full-year exports of caustic calcined magnesia were 747,000 t, 14% more than those in 2017. The average export unit value for caustic-calcined magnesia was $178 per metric ton, 19% more than that in 2017.

[1]Where necessary, values have been converted from EUR at the annual average exchange rate of 0.85=US$1.00, for 2018.

The total value of exports increased by 37% compared with those in 2017 (Zen Innovations AG, 2020).

China's exports of fused magnesia in the first half of 2018 were 282,000 t, a 30% increase compared with exports in the same period of 2017, and a 34% increase compared with those in the second half of 2017. The unit value of fused magnesia increased to $892 per metric ton in the first half of 2018, a 114% increase from the same period in 2017, and a 24% increase compared with that in the second half of 2017. Full-year exports of fused magnesia were 524,000 t, 22% more than those in 2017. The average export unit value for caustic-calcined magnesia was $866 per metric ton, 53% more than that in 2017. The total value of exports increased by 87% compared with those in 2017 (Zen Innovations AG, 2020).

Outlook

Consumption of magnesia products is expected to closely follow production trends in the steel industry. World crude steel production increased to 1.8 billion metric tons in 2018, an increase of 4.6% compared with production in 2017. U.S. production of crude steel increased to 86.7 Mt, an increase of 6% from 81.6 Mt in 2017. China produced 51.3% of the world's steel, an increase from 50.3% in 2017 (World Steel Association, 2019a).

China's production of refractory minerals, including dead-burned magnesia and fused magnesia, is expected to decrease in 2019 owing to closure of illegal mines, enforcement of pollution controls, explosives restrictions, increased audit controls, and increased inspections. The resultant supply shortages are expected to result in increased prices in 2019. Industry's response has been to upgrade existing plants, invest in China, and promote new and alternative worldwide sources (O'Driscoll, 2018c).

Consumption of caustic-calcined magnesia is expected to increase in construction and environmental applications. Magboard, composed of caustic-calcined magnesia, is an alternative to gypsum and cement fiber products and is increasingly used because of its lower construction and maintenance costs and better fire resistance, mold resistance, and insulating properties. Sorel cement, a nonhydraulic magnesia-based cement, is used increasingly in industrial flooring and boards because of its mechanical and insulating properties. Consumption of caustic-calcined magnesia for treatment of wastewater and industrial effluent continues to grow in the United States and Japan. For agricultural applications, caustic-calcined magnesia continues to be consumed primarily as a feed supplement and as a fertilizer additive (Roskill Information Services Ltd., 2018, p. 85–86).

Consumption of magnesium sulfate is expected to mirror fertilizer consumption particularly for the cultivation of palm oils. Health awareness continues to drive consumption of magnesium sulfate for use as a mineral supplement. Consumption of magnesium chloride as a deicer is dependent on weather conditions which are difficult to predict. Magnesium hydroxide consumption is expected to follow growth in the flame retardant and environmental sectors as safety and environmental regulations are issued and enforced (Roskill Information Services Ltd., 2018, p. 87–88).

References Cited

Afarak Group Plc., 2019, Annual report 2018: Helsinki, Finland, Afarak Group Plc., 172 p. (Accessed April 2, 2020, at http://www.afarak.com/site_media/media/cms_page_media/97/Afarak_AR%202018%20EN.pdf.)

Archer Exploration Ltd., 2019, Annual report 2019: Wayville, South Australia, Australia, Archer Exploration Ltd., 94 p. (Accessed April 1, 2020, at https://archerx.com.au//src/uploads/2019/09/20190917_Annual-Report-2019-ASX-Release.pdf.)

Compass Minerals International Inc., 2019, 2018 annual report: Overland Park, KS, Compass Minerals International Inc., 96 p. (Accessed April 21, 2020, at https://s22.q4cdn.com/834578860/files/doc_financials/annual/2018/Compass-Minerals-2018-Annual-Report.pdf.)

Giles Chemical Corp., 2020, About Giles: Waynesville, NC, Giles Chemical Corp. (Accessed April 21, 2020, at http://www.gileschemical.com/about-giles/.)

Ghilotti, Davide, 2018, Timab Magnesium becomes sole owner of Spain's Magnesitas Navarras: London, United Kingdom, Fastmarkets-IM, April 18. (Accessed May 5, 2020, via https://www.indmin.com.)

Grecian Magnesite S.A., 2018, Grecian Magnesite announces the sale of its 40% interest in Spanish producer Magnesitas Navarras S.A.: Athens, Greece, Grecian Magnesite S.A. press release, April 27. (Accessed May 21, 2018, at http://www.grecianmagnesite.com/news/gm-announces-sale-its-interest-magnesitas-navarras-sa.)

O'Driscoll, Mike, 2018a, Basic instinct—Magnesia supply to the refractories industry: Refractories Worldforum, v. 10, no. 1, January, 4 p. (Accessed March 26, 2020, at http://imformed.com/download/9132/.)

O'Driscoll, Mike, 2018b, China minerals meltdown 2—Long hot summer of discontent smoulders on: Imformed Industrial Mineral Forums & Research Ltd., July 30. (Accessed March 25, 2020, at http://imformed.com/china-minerals-meltdown-2-long-hot-summer-of-discontent-smoulders-on/.)

O'Driscoll, Mike, 2018c, China's refractory mineral supply—A new world—Review & outlook: Imformed Industrial Mineral Forums & Research Ltd., December 18. (Accessed March 25, 2020, at http://imformed.com/chinas-refractory-mineral-supply-a-new-world-review-outlook/.)

Perleberg, Mike, 2018, Expanding Greendale company now producing epsom salts: Eagle Country Online [Lawrenceburg, IN], October 10. (Accessed April 21, 2020, at https://www.eaglecountryonline.com/news/local-news/expanding-greendale-company-now-producing-epsom-salts/.)

Refratechnik Holding GmbH, 2018, Magnesia JV in China signed: Ismaning, Germany, Refratechnik Holding GmbH press release, October 18. (Accessed April 6, 2020, at https://www.refra.com/en/Info-center/?art=68.)

RHI Magnesita N.V., 2018a, RHI Magnesita—Major investment in China to strengthen market position and address global supply shortages: Vienna, Austria, RHI Magnesita N.V. press release, June 26. (Accessed April 6, 2020, at https://www.rhimagnesita.com/major-investment-in-china/.)

RHI Magnesita N.V., 2018b, RHI Magnesita—Proposed merger of Indian subsidiaries: Vienna, Austria, RHI Magnesita N.V. press release, August 1. (Accessed March 30, 2020, at https://www.rhimagnesita.com/rhi-magnesita-proposed-merger-of-indian-subsidiaries/.)

RHI Magnesita N.V., 2019, Annual report 2018: Vienna, Austria, RHI Magnesita N.V., 32 p. (Accessed March 30, 2018, at https://ir.rhimagnesita.com/wp-content/uploads/2019/04/rhim_annual_report_2018.pdf.)

Roskill Information Services Ltd., 2018, Magnesium compounds—Global industry, markets & outlook 2018 (13th ed.): London, United Kingdom, Roskill Information Services Ltd., 443 p.

Shi, Carrie, 2018, China's DBM price edges up on magnesia industry consolidation in Haicheng: London, United Kingdom, Fastmarkets-IM, October 9. (Accessed April 10, 2020, via https://www.indmin.com/.)

Shi, Carrie, 2019, Chinese magnesia exports up in 2018, prices firm on mining restrictions: London, United Kingdom, FastMarkets-IM, January 30. (Accessed April 24, 2020, via https://www.indmin.com/.)

U.S. Department of Commerce, International Trade Administration, 2018, Decision memorandum for the preliminary results of the administrative review of the countervailing duty order on certain magnesia carbon bricks from the People's Republic of China, 2016: Washington, DC, U.S. Department of Commerce, International Trade Administration, October 3, 5 p. (Accessed March 3, 2022, via https://access.trade.gov/.)

West High Yield Resources Inc., 2013, West High Yield announces results of preliminary economic assessment: Calgary, Alberta, Canada, West High Yield Resources Inc. press release, June 4, 9 p. (Accessed August 10, 2018, at http://whyresources.com/_resources/news/nr_2013_06_04.pdf.)

West High Yield Resources Inc., 2018, West High Yield announces initiation of the Record Ridge industrial mineral mine permitting process: Calgary, Alberta, Canada, West High Yield Resources Inc. press release, May 29, 2 p. (Accessed April 1, 2020, at http://www.whyresources.com/_resources/news/nr_2018_05_29.pdf.)
World Steel Association, 2018, Steel statistical yearbook 2018: Brussels, Belgium, World Steel Association, November, 126 p. (Accessed April 17, 2020, at https://www.worldsteel.org/en/dam/jcr:e5a8eda5-4b46-4892-856b-00908b5ab492/SSY_2018.pdf.)
World Steel Association, 2019a, Global crude steel output increases by 4.6% in 2018: Brussels, Belgium, World Steel Association, January 25. (Accessed May 18, 2020, at https://www.worldsteel.org/media-centre/press-releases/2019/Global-crude-steel-output-increases-by-4.6--in-2018.html.)
World Steel Association, 2019b, Steel statistical yearbook 2019: Brussels, Belgium, World Steel Association, November, 46 p. (Accessed April 17, 2020, at https://www.worldsteel.org/en/dam/jcr:7aa2a95d-448d-4c56-b62b-b2457f067cd9/SSY19%2520concise%2520version.pdf.)
Zen Innovations AG, 2020, Global trade tracker: Kehrsatz, Switzerland, Zen Innovations AG. (Accessed April 7, 2020, via https://www.globaltradetracker.com/.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Historical Statistics for Mineral and Material Commodities in the United States. Data Series 140.
Magnesian Refractories. Ch. in United States Mineral Resources, Professional Paper 820, 1973.
Magnesium Compounds. Ch. in Mineral Commodity Summaries, annual.
Magnesium, Its Alloys and Compounds. Open-File Report 01–341, 2001.
Mapping the Mineral Resource Base for Mineral Carbon-Dioxide Sequestration in the Conterminous United States. Data Series 414, 2009.

Other

Magnesium. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
Magnesium and Magnesite in the CIS in 1996. Roskill Information Services Ltd., 1996.
Magnesium Compounds and Chemicals (13th ed.). Roskill Information Services Ltd., 2018.
Magnesium Minerals and Compounds. Ch. in Industrial Minerals and Rocks (7th ed.), Society for Mining, Metallurgy, and Exploration, Inc., 2006.

TABLE 1
SALIENT MAGNESIUM COMPOUND STATISTICS[1]

(Thousand metric tons and thousand dollars)

	2014	2015	2016	2017	2018
United States:					
Caustic-calcined and specified magnesias:[2]					
Shipped by producers:[3]					
Quantity	152	156	171	189	194
Value	57,700	59,300	67,400	73,700 r	76,800
Exports[4]	3	6	8	6	11
Imports for consumption[4]	151	183	158	180	180
Apparent consumption[5]	300	333	321	363	363
Dead-burned and fused magnesia:					
Shipped by producers:					
Quantity	W	W	W	W	W
Value	W	W	W	W	W
Exports	21	25	48	55	69
Imports for consumption	241	282	149	155	226
Apparent consumption[5]	W	W	W	W	W
Magnesium chloride:					
Shipped by producers:					
Quantity	W	W	W	W	W
Value	W	W	W	W	W
Exports	10	16	8	8	10
Imports for consumption	118	92	92	55	95
Apparent consumption[5]	W	W	W	W	W
Magnesium hydroxide:					
Shipped by producers:					
Quantity	187	183	188	199	204
Value	88,900	86,500	111,000	87,200 r	88,400
Exports	27	24	21	26	23
Imports for consumption	7	7	8	9	11
Apparent consumption[5]	167	166	175	182	192
World, production of magnesite	25,000 r	28,100	28,700 r	27,600 r	27,100

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through August 27, 2020. 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.
[3]Includes magnesia used by producers.
[4]Caustic-calcined magnesia only.
[5]Shipments 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 2018[1]

(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	288,000	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		795,000	

[1]Table includes data available through August 27, 2020. Data are rounded to no more than three significant digits; may not add to total shown.

TABLE 3
U.S. MAGNESIUM COMPOUNDS SHIPPED BY PRODUCERS[1]

	2017		2018	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined and specified (U.S. Pharmacopeia and technical) magnesias[2]	189,000	$73,700 r	194,000	$76,800
Magnesium chloride	W	W	W	W
Magnesium hydroxide [100% $Mg(OH)_2$][2]	199,000	87,200 r	204,000	88,400
Magnesium sulfate, anhydrous and hydrous	52,800	23,800 r	63,000	28,800
Dead-burned and fused magnesia	W	W	W	W

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through August 27, 2020. 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
U.S. EXPORTS OF MAGNESIA AND CRUDE MAGNESITE, BY COUNTRY OR LOCALITY[1]

	2017		2018	
Material and country or locality	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined magnesia:				
China	1,020	685	5,220	3,580
France	454	369	156	136
Germany	1,510	1,380	891	844
India	147	132	288	262
Italy	60	73	100	123
Netherlands	326	216	96	49
Poland	287	278	557	381
Russia	705	360	944	482
Spain	174	177	204	167
Taiwan	359	274	193	162
Other	1,000	873	1,970	1,440
Total	6,040	4,810	10,600	7,620
Dead-burned and fused magnesia:				
Canada	4,940 r	2,700 r	4,610	4,330
China	278	287	681	837
France	196	139	634	506
Germany	284	305	383	262
Mexico	2,590	1,440	1,480	960
Netherlands	252	340	1,350	1,290
South Africa	43,100	25,300	55,600	34,800
Taiwan	2,080	1,950	2,280	2,490
United Arab Emirates	962	1,430	651	996
Other	672 r	952 r	1,170	1,260
Total	55,300	34,900 r	68,900	47,800
Other magnesia:				
Canada	4,320	3,150	4,990	3,720
China	2,940	2,880	1,540	1,560
France	502 r	395 r	444	468
Germany	332	336	667	561
India	557	480	190	213
Italy	275	588	430	875
Japan	475	412	1,430	1,420
Korea, Republic of	719	799	610	977
Mexico	1,310	1,370	507	1,100
Norway	402	252	504	358
United Arab Emirates	214	295	271	383
United Kingdom	128	188	82	48
Other	2,340	2,840	1,370	2,140
Total	14,500	14,000	13,000	13,800
Crude magnesite:				
Brazil	161	242	264	216
Canada	458 r	350 r	216	146
Germany	17	120	64	213
Mexico	100	134	108	211
Panama	58	116	20	78
Trinidad and Tobago	25	38	11	18
Other	42	61	102	137
Total	861 r	1,060	785	1,020

rRevised. -- Zero.
[1]Table includes data available through August 27, 2020. 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 COMPOUNDS[1]

Material	2017 Quantity (metric tons)	2017 Value (thousands)	2018 Quantity (metric tons)	2018 Value (thousands)	Principal destinations in 2018 based on quantity
Magnesium chloride, anhydrous and other	8,170	$6,200	9,890	$6,260	Canada, 82%; Italy, 6%.
Magnesium hydroxide and peroxide	25,700 r	22,700	22,700	18,600	Canada, 50%; Sweden, 22%; Mexico, 6%.
Magnesium sulfate, natural kieserite, and epsom salts	613	599	375	543	Canada, 64%; United Kingdom, 16%; Malaysia, 6%.
Magnesium sulfate, other	15,100 r	6,970 r	14,200	7,160	Canada, 91%; Mexico, 6%.

rRevised.
[1]Table includes data available through August 27, 2020. 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 LOCALITY[1]

Material and country or locality	2017 Quantity (metric tons)	2017 Value (thousands)	2018 Quantity (metric tons)	2018 Value (thousands)
Caustic-calcined magnesia:				
Australia	10,500	$2,240	12,100	$2,960
Canada	35,600	14,500	35,100	14,400
China	106,000	18,200	117,000	21,900
Hong Kong	17,700	3,690	7,750	1,580
Israel	8,160	1,630	4,730	945
Japan	2,150	3,210	2,300	4,690
Other	62	61	232	83
Total	180,000	43,500	180,000	46,500
Dead-burned and fused magnesia:				
Australia	200	148	--	--
Brazil	5,360	26,900	27,100	23,300
China	107,000	58,900	149,000	174,000
France	141	1,170	161	1,380
Germany	223	302 r	851	2,690
Greece	706	282	496	273
Hong Kong	5,310	1,660	6,090	4,620
Israel	2,230	7,160	2,420	8,580
Japan	1,830	4,910	1,240	3,260
Mexico	6,930	3,920	9,540	5,700
Netherlands	6,470	3,640	9,270	6,390
Russia	724	868	--	--
Spain	3,700	1,350	3,590	1,300
Turkey	12,100	9,290	12,500	13,500
United Kingdom	892	1,290	671	961
Other	1,000 r	478 r	3,200	1,230
Total	155,000	122,000	226,000	247,000
Other magnesia:				
Brazil	51,000	12,000	40,600	19,200
Canada	21	84	24	88
China	2,860	1,180	975	770
France	311	1,050	282	1,300
Israel	2,240	5,820	2,130	5,740
Japan	1,060	2,520	1,210	2,930
Mexico	4,510	4,790	4,580	5,360
Russia	--	--	38	63
Slovakia	814	367	1,060	527
Turkey	3,030	1,390	3,630	1,780
Other	5,240	4,000 r	683	1,140
Total	71,000	33,200	55,200	38,800
Crude magnesite:				
Brazil	208	351	90	156
China	6,180	1,050	68,700	9,290
Germany	121	46	583	158
Greece	104	46	127	46
Japan	298	932	356	638
Other	417 r	354 r	3,240	529
Total	7,320	2,780	73,100	10,800

rRevised. -- Zero.
[1]Table includes data available through August 27, 2020. 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 COMPOUNDS[1]

Material	2017 Quantity (metric tons)	2017 Value (thousands)	2018 Quantity (metric tons)	2018 Value (thousands)	Principal sources in 2018 based on quantity
Magnesium chloride, anhydrous and other	55,500	$22,100	94,800	$28,200	Israel, 57%; Netherlands, 33%.
Magnesium hydroxide and peroxide	9,360	15,900	11,200	16,200	Mexico, 58%; Netherlands, 16%; Israel, 10%.
Magnesium sulfate, natural epsom salts	3,580 r	2,350 r	4,330	3,950	China, 91%; Germany, 8%.
Magnesium sulfate, natural kieserite	5,820	1,070	980	208	Germany, 59%; China, 39%.
Magnesium sulfate, other	35,400 r	15,000 r	36,800	18,100	China, 64%; India, 12%; Germany, 10%.

rRevised.
[1]Table includes data available through August 27, 2020. Data are rounded to no more than three significant digits.

Source: U.S. Census Bureau.

TABLE 8
WORLD MAGNESIA ANNUAL PRODUCTION CAPACITY, DECEMBER 31, 2018[1, 2]

(Thousand metric tons)

Country or locality	Raw material: Magnesite: Caustic-calcined	Magnesite: Dead-burned	Magnesite: Fused magnesia	Seawater or brines: Caustic-calcined	Seawater or brines: Dead-burned	Seawater or brines: Fused magnesia	Total
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.
[1]Table includes data available through August 27, 2020. 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.

TABLE 9
MAGNESITE: WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1, 2]

(Metric tons)

Country or locality	2014	2015	2016	2017	2018
Australia[e, 3]	630,000 [r]	570,000 [r]	340,000 [r]	210,000 [r]	265,000
Austria	754,096 [r]	702,504 [r]	645,593 [r]	730,482 [r]	750,000 [e]
Brazil, beneficiated	1,423,210	1,621,425 [r]	1,700,000 [e]	1,700,000 [r, e]	1,700,000 [e]
Canada[e]	150,000	100,000 [r]	150,000	150,000	150,000
China	16,000,000	18,400,000	18,600,000 [e]	19,000,000 [e]	18,500,000 [e]
Greece, crude ore	360,270	383,230	397,940 [r]	442,680 [r]	450,000 [e]
Guatemala	24,300 [e]	20,000	23,954	16,298 [r]	20,000 [e]
India	195,105	251,737	317,084	187,974	175,000 [e]
Iran[4]	165,886	165,000 [e]	151,881 [r]	155,916 [r]	150,000 [e]
Korea, North[e]	400,000	320,000	350,000	380,000	70,000
Mexico[e]	101,000 [r]	101,000 [r]	101,000 [r]	101,000 [r]	100,000
Pakistan[5]	4,457	24,271	22,581	19,808 [r]	48,108
Poland	116,000	111,077	97,868	127,613 [r]	117,478
Russia	1,300,000 [e]	1,493,000	1,342,000	1,500,000 [e]	1,500,000 [e]
Saudi Arabia[4]	100,800	103,200	75,000	90,000	90,000 [e]
Serbia[e]	75,000	75,000	75,000	75,000	75,000
Slovakia	557,100	501,200	430,900	450,000 [e]	475,000 [e]
South Africa	12,335	40,000 [e]	60,000 [e]	80,000 [e]	90,000 [e]
Spain[4]	275,000	275,000	583,698 [r]	530,191 [r]	550,000 [e]
Turkey	2,377,157	2,800,000	3,258,445	1,694,071 [r]	1,800,000 [e]
United States	W	W	W	W	W
Total	25,000,000 [r]	28,100,000	28,700,000 [r]	27,600,000 [r]	27,100,000

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

[1]Table includes data available through September 3, 2019. 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.

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

[3]Estimates 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.

[4]Estimate based on reported production of caustic-calcined or dead-burned magnesite, unless denoted as reported.

[5]Magnesite, dolomite, and brucite.