2013 Minerals Yearbook

MAGNESIUM [ADVANCE RELEASE]

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Magnesium

By E. Lee Bray

Domestic survey data and tables were prepared by Paula R. Neely, statistical assistant, and the world production table was prepared by Lisa D. Miller, international data coordinator.

Magnesium is the eighth most abundant element in the Earth's crust and the third most plentiful dissolved element in seawater. Magnesium metal is recovered from seawater, lake brines, and the mineral dolomite. Magnesium's light weight and ease of casting make it desirable for transportation products. Magnesium easily alloys with aluminum to make aluminum products stronger and easier to machine. Magnesium's strong affinity for halides such as chlorine and fluorine make it useful for reducing metal halides such as those of beryllium, hafnium, titanium, uranium, and zirconium. Magnesium's chemical properties also make it useful to remove sulfur from iron and steel.

During 2013, primary magnesium production in the United States continued to increase owing to new capacity installed in 2011 and resulted in a reduction of imports of primary magnesium. Imports provide a significant share of U.S. supply of primary magnesium as there has been only one domestic producer since 2001. Over the past 20 years, the U.S. share of the world's primary magnesium capacity has decreased to 3% from 28% of global capacity. China continued to increase its production in 2013, and accounts for 84% of global capacity.

Domestic prices for magnesium were generally stable during 2013, while prices in China and Europe declined following the repeal of a 10% tax on magnesium exports by the Government of China as required by a World Trade Organization (WTO) ruling. Since the United States imposed antidumping duties on magnesium from China in 2001, imports from China have decreased. The Platts Metals Week annual average magnesium price of $2.17 per pound in 2013 was slightly lower than the 2012 annual average price of $2.20 per pound.

Worldwide, primary magnesium production increased by 11% in 2013 to 877,000 metric tons (t) from 787,000 t in 2012 (table 8). China, with 84% of global capacity and 88% of global production (excluding the United States), accounted for most of the increase. The United States had 3% of the world's primary magnesium capacity. U.S. consumption of primary magnesium decreased to 68,500 t in 2013 from 71,900 t in 2012. Decreased consumption of magnesium by titanium producers was partially offset by increased consumption by aluminum alloy producers. Increased consumption of secondary magnesium offset the decline in consumption of primary magnesium as production of secondary magnesium increased by 2,000 t (3%) in 2013 compared with that in 2012 (table 1).

Consumer inventories of primary magnesium and alloys were 19% less at yearend 2013 than at yearend 2012. Consumer inventories of secondary magnesium and alloys were 27% less at yearend 2013 than at yearend 2012. Primary magnesium was produced by one company in the United States, and much of the U.S. demand was met by imports. Net imports of magnesium decreased by 8% as consumption declined and new capacity installed in 2011 and ramped up in 2012 resulted in increased domestic magnesium production.

Legislation and Government Programs

The U.S. Department of Commerce, International Trade Administration (ITA), imposed an antidumping duty of 339.6% ad valorem on imports of pure magnesium from China by Tianjin Magnesium Metal Co. Ltd. (TMM) and an affiliate, Tianjin Magnesium International Co. Ltd. (TMI), between May 1, 2011, and April 30, 2012. An administrative review of the antidumping orders was initiated in June 2013 by the ITA (McBeth, 2013b; U.S. Department of Commerce, International Trade Administration, 2013).

In 2011, the European Union, Mexico, and the United States filed a complaint with the WTO concerning China's export taxes on several mineral products, including magnesium. The WTO ruled that the export taxes violated international trade agreements, and China appealed the ruling. In 2012, the Appellate Body of the WTO rejected most of China's claims in the appeal, determining that China's export restraints on several raw materials, including magnesium, were inconsistent with China's WTO obligations. On January 1, 2013, in compliance with a WTO ruling, the Government of China removed a 10% export tax on magnesium ingot and alloys (American Metal Market, 2012; World Trade Organization, 2012; Yee, 2013c).

Production

Because there was only one primary magnesium producer operating in the United States, production data were withheld by the U.S. Geological Survey (USGS) to avoid disclosing company proprietary data. U.S. Magnesium LLC (Salt Lake City, UT) was the sole producer of primary magnesium in the United States. The company recovered magnesium electrolytically from brines from the Great Salt Lake in Utah at its 63,500-metric-ton-per-year (t/yr) plant in Rowley, UT. U.S. Magnesium announced plans to expand the magnesium plant's capacity to 76,500 t/yr by yearend 2015 (Cowden, 2014). Secondary metal recovery (table 2) from magnesium and aluminum scrap increased by about 3% in 2013.

Nevada Clean Magnesium Inc.Vancouver, British Columbia, Canada), formerly Molycor Gold Corp., continued planning for the Tami-Mosi magnesium project near Ely, NV. The proposed project would mine 294,000 t/yr of dolomite with an average grade of 12.6% magnesium and includes a 30,000-t/yr magnesium-processing plant (Molycor Gold Corp., 2012; Nevada Clean Magnesium Inc., 2013).

Environment

The cover gas sulfur hexafluoride (SF_6), which is used to protect molten magnesium from oxidation, has been identified as a potential factor in global warming. Although studies on the effects of the gas continued, its long atmospheric life (about 3,000 years) and high potential as a greenhouse gas (GHG) [23,900 times the global warming potential of carbon dioxide (CO_2)] resulted in a call for voluntary reductions in emissions. In 1999, the U.S. magnesium industry, the International Magnesium Association, and the U.S. Environmental Protection Agency (EPA) began a voluntary partnership to reduce emissions of SF_6. The major molten magnesium processes that require SF_6 melt protection are primary production; secondary production; die, permanent mold, and sand casting; wrought products production; and anode production. According to the EPA, the magnesium industry emitted 1.7 teragrams CO_2 equivalent of SF_6 in 2012, representing a decrease of approximately 41% from 2011 emissions. The decrease was attributed to continuing industry efforts to use SF_6 alternatives, such as Novec™612 (dodecafluoro-2-methyl-3-pentanone), and sulfur dioxide (SO_2), as part of the EPA's SF_6 Emission Reduction Partnership for the Magnesium Industry. These alternatives have lower global warming potential than SF_6 and tend to decompose quickly during their exposure to the molten metal (U.S. Environmental Protection Agency, 2014a, p. 4–70 to 4–74).

In January 2011, the U.S. Circuit Court of Appeals for the District of Columbia denied U.S. Magnesium's appeal of the EPA's decision to include the company's Rowley, UT, magnesium production facility as a Superfund site. U.S. Magnesium had challenged the agency's 2008 listing decision and argued that the agency had overestimated the risk of pollutants from the facility entering the air and soil. Designation of the facility as a Superfund site gave the EPA the authority to investigate the site further to determine if a cleanup was necessary. The designated site encompasses 1,830 hectares (4,530 acres) on the southwest edge of the Great Salt Lake. Contaminants at the site include acidic wastewater, dioxins, furans, heavy metals, hexachlorobenzene, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons. A study of the site was underway in 2013 but cleanup activities had not started (Fahys, 2011; U.S. Environmental Protection Agency, 2014b).

Consumption

Data for magnesium metal were collected from two voluntary surveys of U.S. operations by the USGS. Of the 55 companies canvassed for magnesium consumption data, 45% responded, representing 52% of the magnesium-base scrap consumption listed in table 2 and the primary magnesium consumption listed in table 3. Data for the 30 nonrespondents were estimated on the basis of prior-year consumption levels and other factors.

Magnesium's light weight makes it desirable for transportation products, and its chemical properties make it useful in the processing of other metals. The principal applications for magnesium in the United States in 2013 were alloying aluminum (36%); reduction of titanium tetrachloride, zirconium chloride, beryllium fluoride, uranium tetrafluoride, and hafnium chloride to produce metals (28%); die casting (14%); and desulfurization of iron and steel (12%) (table 3). Globally, uses were estimated to be aluminum alloying (33%), diecasting (33%), iron and steel desulfurization (15%), and other uses (19%) (McBeth, 2014).

Primary magnesium consumption in 2013 was about 5% less than that in 2012 (table 3), which was attributed to a 20% decrease in consumption for production of titanium and other metals. Consumption of primary magnesium for diecasting decreased by 3% from that in 2012. Consumption of secondary magnesium in the form of scrap for castings in 2013 increased by 18% to 11,900 t from 10,100 t in 2012 (table 2), offsetting most of the decreased primary magnesium use in castings. Secondary magnesium recovery increased by 3% compared with that in 2012, which was attributed to increased consumption of alloy castings by automobile manufacturers (table 1). Primary magnesium consumption in aluminum alloys increased by 4% even though primary aluminum production decreased by 6% compared with that in 2012 (table 3). Secondary aluminum smelters (whose production increased by 6% compared with that in 2012) cited a shortage of aluminum scrap as the reason for using more primary aluminum and therefore for consuming more magnesium (Cowden, 2013a, c; McBeth, 2013d).

Research and Development

The U.S. Department of Energy's (DOE) Advanced Research Projects Agency-Energy announced the awarding of $2.4 million in funding for a project to develop a method of recovering magnesium from seawater using less energy than current production methods. The 3-year project was to be conducted at DOE's Pacific Northwest National Laboratory (PNNL) in Richland, WA, and would cost $2.7 million. Global Seawater Extraction Technologies, LLC and U.S. Magnesium partnered with PNNL and would contribute an additional $210,000 and $60,000, respectively, to fund the project (White, 2013).

Stocks

Primary magnesium producers' yearend 2013 stock data were withheld to avoid disclosing company proprietary data. Consumer stocks of primary and alloy magnesium were 4,020 t at yearend 2013, 19% less than the yearend 2012 stocks of 4,940 t. Consumer stocks of secondary magnesium were 1,670 t at yearend 2013, 27% less than the 2,280 t at yearend 2012.

Prices

At the beginning of 2013, the Platts Metals Week U.S. spot Western magnesium price range was $2.15 to $2.25 per pound, where it remained until the end of July. The price range decreased to $2.10 to $2.20 per pound in August and then declined slightly to $2.10 to $2.15 per pound in September, where it remained until yearend. The average Platts Metals Week U.S. spot Western magnesium price in 2013 was $2.17 per pound, slightly less than the 2012 average of $2.20 per pound. According to traders and producers, however, spot prices were not representative of the prices paid by magnesium consumers in 2013 as more than 95% of the volume of primary magnesium was purchased through annual contracts

(Cowden, 2013b; McBeth, 2013c). Prices contracted in October 2012 for delivery in 2013 ranged from $1.95 per pound to $2.05 per pound, and the price range for deliveries contracted in November 2012 was $1.90 per pound to $2.00 per pound (McBeth, 2012; Waite, 2012).

Press reports indicated that some magnesium consumers started contract negotiations for their 2014 requirements earlier than normal with some contracts signed in August, about a month earlier than negotiations usually take place. Secondary aluminum smelters needing to secure magnesium during the fourth quarter of 2013 owing to increased demand for aluminum alloys for the automotive industry and low aluminum scrap availability also reportedly sought to negotiate 2014 deliveries at the same time (Cowden, 2013a; McBeth, 2013d).

In January, magnesium prices in China decreased by 10% to $2,855 per metric ton, down from $3,170 per metric ton in December 2012. The price gradually declined to $2,815 per metric ton in March and April, and then it started a sharp decline in May, reaching a low of $2,575 per metric ton in September. The price increased slightly for the remainder of the year, ending the year at $2,615 per metric ton. The price decline in January was attributed to the removal of the 10% export duty following the WTO ruling. Low export demand for magnesium from China was cited for further price declines throughout the third quarter of the year. Increasing prices for ferrosilicon used in the Pigeon process to refine magnesium from dolomite were cited for increasing magnesium prices in China during the latter part of the year (American Metal Market, 2012; McBeth, 2013a; Yee, 2013a; Yee and Watanabe, 2013).

Foreign Trade

Total U.S. magnesium exports for 2013 were 12% less than those in 2012 (table 5). Mexico (34%), Canada (20%), and Singapore (17%) were the principal destinations. However, exports of alloys in 2013 were 13% higher than those in 2012. Magnesium imports for consumption in 2013 were 10% less than those in 2012 (table 6). Israel was the leading source of imported magnesium metal (69%) and alloys (35%). China was the second leading supplier of magnesium alloys (27%). Because of the continued imposition of antidumping duties, the quantity of pure magnesium imported from China to the United States was minimal. Canada accounted for 40% of the scrap imports, which accounted for 38% of total magnesium imports (table 6). Total net imports of magnesium were 8% less than those in 2012; net imports of scrap, semifabricated products, and alloys decreased by 9%, 23% and 24%, respectively, but net imports of metal increased slightly (tables 5, 6). Trade data in this report are from the U.S. Census Bureau. All percentages in the report were computed using unrounded data. Estimates when made were based on previously reported data and other factors.

World Review

Global production of primary magnesium (excluding the United States) was 877,000 t, 11% more than was produced in 2012. Global consumption of primary magnesium was estimated to be 792,000 t in 2013, an increase of 14% from 693,000 t in 2012 (McBeth, 2014).

Australia.—Latrobe Magnesium Ltd. (Sydney, New South Wales) leased a site for its proposed 5,000-t/yr primary magnesium plant in the Latrobe Valley, Victoria. A feasibility study of the proposed plant that would extract magnesium metal from fly ash produced by coal-fired powerplants was expected to be completed by yearend 2014 (Latrobe Magnesium Ltd., 2013).

China.—According to the China Non-Ferrous Metals Industry Association, magnesium production in China in 2013 was 770,000 t, an increase of 10% compared with that in 2012. Production in December 2013, however, was 31.4% less than production in December 2012. The China Magnesium Association reported that consumption of primary magnesium in China in 2013 was 351,500 t, an increase of 13.4% from consumption in 2012. Production of aluminum alloys and titanium was cited as a reason for the increased consumption of magnesium. Exports of unwrought magnesium from China were 212,000 t, 21.5% more than those in 2012. Exports of magnesium alloys in 2013 were 102,000 t, 10.4% more than those in 2012. The increased exports were attributed to the removal of a 10% export duty in January, which the WTO ruled violated trade agreements (American Metal Market, 2012; Shair, 2014a; Yee, 2014b, d). In recent years the Government has ordered several coal mines to shut down citing environmental and safety concerns, resulting in shortages of byproduct coke gas used for fuel at magnesium plants in some areas which forced some magnesium smelters to decrease production (Shair, 2013d). Primary magnesium capacity in China at yearend was estimated to be 1.54 million metric tons per year (table 7).

Chaohu Yunhai Magnesium Co. Ltd. was ramping up its 50,000-t/yr smelter in Anhui Province that was commissioned in October 2012. An expansion to 100,000 t/yr was planned, but a construction schedule was not announced (Shair, 2013a). In March, Wulong Group Ltd. completed and commissioned a 60,000-t/yr magnesium smelter in Yuanqu County, Shanxi Province (Shair, 2013c). In December, production started at Shanxi Wulong Investment Group’s magnesium alloy plant in Yuanqu County, Shanxi Province. The 60,000-t/yr plant was built adjacent to a coke plant that started producing in November and would supply coke gas to power the magnesium plant (Shair, 2014c). Construction of Wenxi Baiyu Magnesium Corp.’s 30,000-t/yr magnesium alloy plant in Wenxi, Shanxi Province, was nearly completed at yearend and production was scheduled to start in January 2014 (Shair, 2014b).

Century Sunshine Group Holdings was expanding the capacity of its smelter in Baishan, Jilin Province, to 25,000 t/yr from 16,000 t/yr. The project was expected to be completed in early 2014. Further expansion to 75,000 t/yr was planned by yearend 2016 (Leung, 2013a, b). Hebi Mingyuan Magnesium Ltd. was constructing a 55,000-t/yr magnesium plant in Hebi, Henan Province. The plant was expected to be completed in the second half of 2014 (Shair, 2012). Qinghai Salt Lake Magnesium Co. Ltd. continued construction of a 100,000-t/yr smelter to produce magnesium from lake brines in Golmud, Qinghai Province. Expansion to 150,000 t/yr was planned. Magontec Ltd. (Sydney, New South Wales, Australia) continued construction of a 56,000-t/yr foundry in Golmud to be supplied with molten magnesium from the adjacent smelter. A schedule for either project was not available (Magontec Ltd., 2013).

Malaysia.—CVM Minerals Ltd. (Hong Kong) continued to delay the ramp up of its smelter in Perak, which was expanded in 2011 to 15,000 t/yr but experienced technical problems in 2012 during startup. Maintenance work was completed in the third quarter of 2012, but the only production through 2013 was from trial runs and only 150 t of magnesium ingot was sold during the first half of 2013. Financial issues and weak markets were cited for the delay (Shair, 2013b; Yee, 2013b).

Outlook

U.S. magnesium consumption is expected to be dependent upon the production of metal alloys containing magnesium, the production of metals that consume magnesium during their production process, and the demand for magnesium die-cast products. A significant portion of U.S. demand for magnesium will depend on its use in aluminum alloys and primary aluminum production. One primary aluminum smelter in New York shut down 84,000 t/yr of capacity in January 2014, which was likely to result in decreased domestic magnesium use in aluminum alloying (Alcoa Inc., 2014). Use of magnesium in the Kroll process of titanium production is expected to increase as the use of titanium in aerospace applications increases. The Boeing Co. doubled the production rate of the 787 Dreamliner passenger jet, which contains a significant amount of titanium, at the beginning of 2014 from that of yearend 2012 (Boeing Co., The, 2014). Consumption of magnesium for desulfurization of iron and steel is expected to increase slightly because domestic steel production during the first half of 2014 was slightly more than that in the first half of 2013 (World Steel Association, 2013; 2014).

Most of the growth in the use of magnesium in the past two decades resulted from its increased use in automotive applications because of its light weight, and any increase in automobile manufacturing would be expected to result in an increase in the use of magnesium. The use of magnesium in diecasting is expected to increase with increased automobile production and increased intensity of use. Domestic automobile production during the first half of 2014 increased by 4.7% compared with production in the first half of 2013 (Ward's Automotive Group, 2014). Magnesium content in automobiles is expected to increase as manufacturers replace steel automotive body parts with lighter materials to increase fuel efficiency. Some manufacturers are switching additional automotive parts to die-cast magnesium and aluminum-magnesium alloys. However, historically, because of the limited number of magnesium producers outside of China, domestic automotive manufacturers were somewhat reluctant to choose magnesium over other lightweight materials, such as aluminum or plastic. Because Chinese producers account for 84% of global primary magnesium capacity, and antidumping duties assessed on magnesium imported from China deter imports from China, some automotive manufacturers continue to be cautious about switching to magnesium, thereby limiting the growth of magnesium consumption.

Analysts projected that global primary magnesium consumption would increase by 7.7% per year from 2014 through 2019 and would average 7.8% per year from 2014 through 2024 (McBeth, 2014). China's production was forecast to increase by 10% in 2014 (Yee, 2014c). Although some expansion projects are being constructed in China, additional capacity expansions in China are expected to be limited, as production has been only about half of capacity in recent years. Some older high-cost capacity is expected to be permanently shut down in China. However, the overcapacity in China is expected to limit the growth of new capacity in other parts of the world, as the risk of oversupply may deter investors from building new primary magnesium plants.

Exports of magnesium from China are expected to increase slightly during 2014 compared with exports in 2013. Exports of unwrought magnesium through the end of May 2014 increased by 3.7% compared with those of the same period in 2013 (Yee, 2014a). Export growth, however, is expected to be limited by continued weak demand from overseas markets. Consumption of magnesium in China is expected to continue to increase as magnesium diecasters expand and aluminum production continues to increase. Primary aluminum production in China through May 2014 was 8% greater than that of the same period in 2013 (China Metal Market—Alumina and Aluminum, 2014).

References Cited

Alcoa Inc., 2014, Alcoa to permanently close remaining potlines at Massena East smelter: New York, NY, Alcoa Inc. press release, January 15. (Accessed January 22, 2014, at http://www.alcoa.com/global/en/news/news_detail.asp?pageID=20140115000185en&newsYear=2014.)

American Metal Market, 2012, Asian giant nixes export taxes targeted in WTO case: American Metal Market, v. 119, no. 51–3, December 19, p. 11.

Boeing Co., The, 2014, Boeing rolls out first 787 Dreamliner at increased production rate: Everett, WA, The Boeing Co., January 24, 1 p. (Accessed March 6, 2014, at http://boeing.mediaroom.com/2014-01-24-Boeing-Rolls-Out-First-787-Dreamliner-at-Increased-Production-Rate.)

China Metal Market—Alumina and Aluminum, 2014, Statistics: China Metal Market—Alumina and Aluminum, no. 211, July 1, p. 22–23.

Cowden, Michael, 2013a, Magnesium demand boosts spot prices: American Metal Market, v. 121, no. 37–4, September 12, p. 3.

Cowden, Michael, 2013b, Magnesium prices steady in quiet market: American Metal Market, v. 121, no. 10–2, March 5, p. 5.

Cowden, Michael, 2013c, Magnesium spot prices inch higher in thin market: American Metal Market, v. 121, no. 23–3, June 12, p. 5.

Cowden, Michael, 2014, U.S. Magnesium to increase capacity: American Metal Market, v. 122, no. 7–3, February 12, p. 4.

Fahys, Judy, 2011, Court—Utah company belongs on Superfund list: Salt Lake [UT] Tribune, January 14. (Accessed January 18, 2011, at http://www.sltrib.com/sltrib/home/51052941-76/magnesium-epa-company-site.html.csp.)

Latrobe Magnesium Ltd., 2013, Latrobe Magnesium secures brownfield site in Latrobe Valley for future magnesium plant: Sydney, New South Wales, Australia, Latrobe Magnesium Ltd. press release, October 23, 2 p. (Accessed July 8, 2014, at http://www.latrobemagnesium.com/docs/announcements 2013/secures site.pdf.)

Leung, Joshua, 2013a, Century Sunshine eyes 56% rise in 2014 Mg output: Platts Metals Daily, v. 2, no. 150, August 5, p. 5.

Leung, Joshua, 2013b, Century Sunshine eyes fivefold Mg capacity increase: Platts Metals Daily, v. 2, no. 131, July 9, p. 6–7.

Magontec Ltd., 2013, Presentation of the Qinghai Salt Lake Magnesium project at the 70th IMA conference in Xi'an: Sydney, New South Wales, Australia, Magontec Ltd. press release, June. (Accessed July 9, 2014, at http://magontec.com/magontec/index.php?navID=55.)

Molycor Gold Corp., 2012, Molycor announces change of company name to Nevada Clean Magnesium Inc.: Vancouver, British Columbia, Canada, Molycor Gold Corp. press release, April 16. (Accessed August 6, 2013, at http://www.nevadacmi.com/molycor-announces-change-of-company-nameto-nevada-clean-magnesium-inc/.)

McBeth, Karen, 2012, US spot magnesium slow; 2013 contracts at $2: Platts Metals Daily, v. 1, no. 28, December 7, p. 6–7.

McBeth, Karen, 2013a, European magnesium prices fall by $50-75/mt: Platts Metals Daily, v. 2, no. 96, May 17, p. 8.
McBeth, Karen, 2013b, US begins 2012-2013 Chinese magnesium duty review: Platts Metals Daily, v. 2, no. 127, July 2, p. 7–8.
McBeth, Karen, 2013c, US magnesium sees wide ranges with little spot activity: Platts Metals Daily, v. 2, no. 33, February 15, p. 5–6.
McBeth, Karen, 2013d, US Mg prices may find floor after rapid decline elsewhere: Platts Metals Daily, v. 2, no. 134, July 12, p. 7–8.
McBeth, Karen, 2014, Magnesium demand to rise 7.7% on year—CM Group: Platts Metals Daily, v. 3, no. 106, June 2, p. 4–5.
Nevada Clean Magnesium Inc., 2013, Nevada Clean Magnesium expands board of directors with appointment of construction project management and logistics expert, Stephen Thorlakson: Vancouver, British Columbia, Canada, Nevada Clean Magnesium Inc. press release, December 23. (Accessed July 9, 2014, at http://www.nevadacmi.com/nevada-clean-magnesium-expands-board-of-directors-with-appointment-of-construction-project-management-and-logistics-expert-stephen-thorlakson/.)
Shair, Wendy, 2012, Hebi Mingyuan starts building magnesium plant: Platts Metals Daily, v. 1, no. 35, December 18, p. 7.
Shair, Wendy, 2013a, Chaohu Yunhai to produce 20,000 mt magnesium alloy: Platts Metals Daily, v. 2, no. 93, May 14, p. 7.
Shair, Wendy, 2013b, Malaysian Mg producer CVM Minerals narrows H1 losses: Platts Metals Daily, v. 2, no. 168, August 29, p. 6–7.
Shair, Wendy, 2013c, Wulong completes 60,000 mt magnesium alloy project: Platts Metals Daily, v. 2, no. 44, March 5, p. 7.
Shair, Wendy, 2013d, Yiwei plans 2013 magnesium output at 40,000 mt: Platts Metals Daily, v. 2, no. 8, January 11, p. 7–8.
Shair, Wendy, 2014a, China's 2013 primary magnesium usage up 13%: Platts Metals Daily, v. 3, no. 40, February 26, p. 7.
Shair, Wendy, 2014b, China's Baiyu to start up new Mg alloy line at end-Jan: Platts Metals Daily, v. 3, no. 12, January 17, p. 7.
Shair, Wendy, 2014c, China's Wulong starts up new magnesium alloy line: Platts Metals Daily, v. 3, no. 5, January 8, p. 4.
U.S. Department of Commerce, International Trade Administration, 2013, Pure magnesium from the People's Republic of China—Preliminary results of 2011–2012 antidumping duty administrative review: Federal Register, v. 78, no. 111, June 10, p. 34646–34648. (Accessed August 20, 2013, at http://www.gpo.gov/fdsys/pkg/FR-2013-06-10/pdf/2013-13702.pdf.)
U.S. Environmental Protection Agency, 2014a, Inventory of U.S. greenhouse gas emissions and sinks—1990–2012: U.S. Environmental Protection Agency 430–R–12–003, 529 p. (Accessed September 8, 2014, at http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html#fullreport.)
U.S. Environmental Protection Agency, 2014b, Superfund site progress profile—US Magnesium, Superfund Information Systems. (Accessed September 8, 2014, at http://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0802704#CleanupProgress.)
Waite, Suzy, 2012, Magnesium mating season in full swing: American Metal Market, v. 119, no. 45–2, November 6, p. 6.
Ward's Automotive Group, 2014, North America production summary, June 2014: Detroit, MI, Ward's Automotive Group news release, July 17. (Accessed July 25, 2014, at http://wardsauto.com/datasheet/north-america-production-summary-june-2014.)
White, Frances, 2013, Fuel-efficient cars & planes cheaper with magnesium drawn from ocean: Richland, WA, U.S. Department of Energy, Pacific Northwest National Laboratory news release, September 19. (Accessed November 19, 2013, at http://www.pnnl.gov/news/release.aspx?id=1009.)
World Steel Association, 2013, Crude steel production: Brussels, Belgium, World Steel Association, July 22. (Accessed August 6, 2013, at http://www.worldsteel.org/dms/internetDocumentList/steel-stats/2013/Crude-steel-pdf/document/Crude steel December 2013.pdf.)
World Steel Association, 2014, Crude steel production: Brussels, Belgium, World Steel Association, July 22. (Accessed July 24, 2014, at http://www.worldsteel.org/dms/internetDocumentList/steel-stats/2014/Crude-steel-production-0614/document/Crude steel production 0614.pdf.)
World Trade Organization, 2012, Dispute settlement—Dispute DS394 China—Measures related to the exportation of various raw materials: World Trade Organization, January 30. (Accessed February 17, 2012, at http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds394_e.htm#bkmk394abr.)
Yee, Alvin, 2013a, China spot magnesium steady; overseas demand weak: Platts Metals Daily, v. 2, no. 248, December 19, p. 4–5.
Yee, Alvin, 2013b, Malaysia's CVM eyes March restart after plant upgrades: Platts Metals Daily, v. 2, no. 14, January 21, p. 7.
Yee, Alvin, 2013c, Spot FOB China magnesium trades thin, inquiries slow: Platts Metals Daily, v. 2, no. 12, January 17, p. 6.
Yee, Alvin, 2014a, China May unwrought magnesium exports down 4%: Platts Metals Daily, v. 3, no. 122, June 24, p. 5–6.
Yee, Alvin, 2014b, China Mg output plunges 31% in Dec, up 4% on year: Platts Metals Daily, v. 3, no. 34, February 18, p. 6.
Yee, Alvin, 2014c, China's 2014 Mg output seen rising 10%–CMA: Platts Metals Daily, v. 3, no. 42, February 28, p. 8.
Yee, Alvin, 2014d, China's Dec unwrought Mg exports rise 33% on year: Platts Metals Daily, v. 3, no. 15, January 22, p. 8.
Yee, Alvin, and Watanabe, Mayumi, 2013, China magnesium export offers slip below $2,800/mt FOB: Platts Metals Daily, v. 2, no. 85, May 2, p. 6–7.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Evaporites and Brines. Ch. in United States Mineral Resources, Professional Paper 820, 1973.
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. Ch. in Mineral Commodity Summaries, annual.
Magnesium, Its Alloys and Compounds. Open-File Report 01–341, 2001.
Magnesium. Mineral Industry Surveys, quarterly.
Magnesium (Mg). Ch. in Metal Prices in the United States Through 2010, Scientific Investigations Report 2012–5188, 2013.
Magnesium Recycling in the United States in 1998. Ch. in Flow Studies for Recycling Metal Commodities in the United States, Circular 1196–A–M, 2004.

Other

Economics of Magnesium Metal, The (10th ed.). Roskill Information Services Ltd., 2008.
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.

TABLE 1
SALIENT MAGNESIUM STATISTICS[1]

(Metric tons unless otherwise specified)

		2009	2010	2011	2012	2013
United States:						
Production:						
Primary magnesium		W	W	W	W	W
Secondary magnesium		68,600	72,000	67,200	77,100 r	79,100
Exports		19,600	14,800	12,300	18,300 r	16,100
Imports for consumption		47,300	52,700	48,400	50,800 r	45,900
Consumption, primary		53,200	56,600	80,600	71,900	68,500
Yearend stocks, producer		W	W	W	W	W
Yearend price[2]	dollars per pound	2.20–2.40	2.35–2.50	2.05–2.20	2.15–2.25	2.10–2.15
World, primary production[e]		588,000 r	745,000 r	755,000 r	787,000 r	877,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Data are rounded to no more than three significant digits.
[2]Source: Platts Metals Week.

TABLE 2
MAGNESIUM RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES, BY KIND OF SCRAP AND FORM OF RECOVERY[1]

(Metric tons)

	2012	2013
KIND OF SCRAP		
New scrap:		
Magnesium-base	18,000	19,100
Aluminum-base	34,000	34,900
Total	52,000	54,000
Old scrap:		
Magnesium-base	1,210	606
Aluminum-base	24,000	24,500
Total	25,200	25,100
Grand total	77,100 r	79,100
FORM OF RECOVERY		
Magnesium alloy ingot[2]	W	W
Magnesium alloy castings	10,100 r	11,900
Aluminum alloys	65,000	66,000
Other[3]	1,510	734
Total	76,600 r	78,600

[r]Revised. W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes secondary magnesium content of both primary and secondary alloy ingot.
[3]Includes chemical and other dissipative uses, cathodic protection, and data indicated by symbol W.

TABLE 3

U.S. CONSUMPTION OF PRIMARY MAGNESIUM, BY USE[1]

(Metric tons)

Use	2012	2013
For structural products:		
Castings:		
Die	10,100	9,850
Permanent mold	186	296
Sand	475	683
Wrought products[2]	1,920	2,240
Total	12,700	13,100
For distributive or sacrificial purposes:		
Aluminum alloys	23,500	24,400
Cathodic protection (anodes)	921	1,090
Iron and steel desulfurization	8,120	8,170
Nodular iron	472	626
Reducing agent for titanium, zirconium, hafnium, uranium, beryllium	24,100	19,300
Other[3]	2,100 r	1,860
Total	59,200	55,500
Grand total	71,900	68,500

[r]Revised.

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

[2]Includes sheet and plate and forgings.

[3]Includes chemicals and scavenger, deoxidizer, and powder.

TABLE 4

YEAREND MAGNESIUM PRICES

		2012	2013
U.S. spot dealer import	dollars per pound	1.90–2.00	1.90–1.95
U.S. spot Western	do.	2.15–2.25	2.10–2.15
China	dollars per metric ton	3,150–3,190	2,600–2,630
European free market	do.	3,100–3,300	2,700–2,800

do. Ditto.

Source: Platts Metals Week.

TABLE 5

U.S. EXPORTS OF MAGNESIUM, BY COUNTRY[1]

Country	Waste and scrap		Metal		Alloys		Powder, sheets, tubing, ribbons, wire, other forms	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
2012:								
Brazil	--	--	550	$2,120	805	$9,590	7	$275
Canada	510	$1,540	2,530	8,830	2,450	9,490	286	5,360
Mexico	1,270	3,140	83	179	3,270	13,300	113	1,660
Singapore	4	10	3,660	9,840	--	--	18	434
United Kingdom	103	122	18	36	81	287	484	14,700
Other	215	475	188	406	700	3,640	964	17,700
Total	2,100	5,290	7,020	21,400	7,310	36,300	1,870	40,100
2013:								
Brazil	--	--	1,480	5,400	1,010	7,370	3	164
Canada	317	1,010	1,310	4,850	1,540	6,010	122	5,760
Mexico	67	195	26	57	5,290	21,800	156	4,620
Singapore	--	--	2,790	6,910	--	--	9	1,400
United Kingdom	--	--	60	120	91	325	502	15,500
Other	87	218	125	296	317	1,740	805	27,600
Total	471	1,420	5,790	17,600	8,240	37,200	1,600	55,100

-- Zero.

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

Source: U.S. Census Bureau.

TABLE 6

U.S. IMPORTS FOR CONSUMPTION OF MAGNESIUM, BY COUNTRY[1]

Country	Waste and scrap		Metal		Alloys, magnesium content		Powder, sheets, tubing, ribbons, wire, other forms, magnesium content	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
2012:								
Canada	9,990	$19,700	755	$1,160	1,070	$5,040	6	$1,080
China	1	3	56	426	4,180	11,700	246	2,210
Israel	(2)	2	13,300	58,400	3,550	17,700	--	--
Kazakhstan	--	--	585	2,150	--	--	--	--
Mexico	1,960	5,020	--	--	59	191	561	4,260
Russia	--	--	833	2,800	58	320	2	61
United Kingdom	2,400	7,060	4	18	892	14,400	30	1,440
Other	6,570	16,000	729	4,130	2,920	12,200	37	1,670
Total	20,900	47,800	16,200	69,100	12,700	61,500	882	10,700
2013:								
Canada	7,030	16,600	1,360	1,720	1,140	4,190	9	685
China	166	302	2	16	3,360	9,190	227	2,250
Israel	--	--	10,500	45,300	4,350	21,200	--	--
Kazakhstan	--	--	1,080	3,870	--	--	--	--
Mexico	2,880	6,980	--	--	162	505	568	4,170
Russia	--	--	1,200	3,810	234	793	--	--
United Kingdom	1,390	3,720	8	56	893	15,500	14	914
Other	6,040	15,700	994	5,290	2,250	8,900	18	1,180
Total	17,500	43,300	15,200	60,100	12,400	60,200	836	9,200

-- Zero.

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

[2]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7

WORLD ANNUAL PRIMARY MAGNESIUM

PRODUCTION CAPACITY, DECEMBER 31, 2013[1]

(Metric tons)

Country	Capacity
Brazil	22,000
China	1,540,000
India	900
Israel	34,000
Kazakhstan	30,000
Korea, Republic of	10,000
Malaysia	15,000
Russia	80,000
Serbia	6,000
Ukraine	22,000
United States	63,500
Total	1,820,000

[1]Includes capacity at operating plants as well as at plants on standby basis.

TABLE 8

MAGNESIUM: ESTIMATED PRIMARY WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country[3]	2009	2010	2011	2012	2013
Brazil	16,000	16,000	16,000	16,000	16,000
China	501,000	654,000	661,000	698,000	770,000
Israel	19,405 [4]	23,309 [4]	26,284 [4]	27,292 [r, 4]	28,000
Kazakhstan	21,000	21,000	21,000	21,000	23,000
Korea, Republic of	--	--	--	2,500	7,500
Malaysia	--	--	200 [4]	200 [r]	500
Russia[5]	29,000	29,000	29,000	20,000 [r]	32,000
Serbia	NA [r]	NA [r]	NA [r]	NA [r]	NA
Ukraine	2,000	2,000	2,000	2,000	--
United States	W	W	W	W	W
Total	588,000 [r]	745,000 [r]	755,000 [r]	787,000 [r]	877,000

[r]Revised. NA Not Available. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

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

[2]Includes data available through June 15, 2014.

[3]In addition to the countries listed, Serbia produced magnesium, but available information is inadequate to make reliable estimates.

[4]Reported figure.

[5]Includes secondary.