



2012 Minerals Yearbook

MAGNESIUM

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 Glenn J. Wallace, international data coordinator.

Primary magnesium was produced by one company in the United States, and much of the U.S. demand was met by imports. Israel was the principal source of imported magnesium metal and alloys, and Canada accounted for 48% of the scrap imports, which have become an important source of supply. Aluminum alloying, diecasting, iron and steel desulfurization, and metal reduction were the principal applications for magnesium in the United States in 2012. Consumption of primary magnesium in the United States in 2012 decreased by 11% [8,700 metric tons (t)] compared with that in 2011. Increased consumption of secondary magnesium offset the decline in primary magnesium consumption as production of secondary magnesium increased by 10,000 t (15%) compared with that in 2011. Estimated world production of primary magnesium was 802,000 t in 2012. China continued to dominate world production, accounting for 87% of the total (excluding the United States). Because of the continued imposition of antidumping duties, the quantity of pure magnesium imported from China to the United States was minimal. Israel was the leading supplier of imported pure metal (82%). China (33%) and Israel (28%) were the leading suppliers of magnesium alloys.

Legislation and Government Programs

The U.S. International Trade Commission (ITC) performed an expedited second sunset review of antidumping duties on imports of granular magnesium from China. In September, the ITC determined that revoking the country-wide antidumping duty of 305.56% ad valorem would likely lead to continuation or recurrence of dumping of granular magnesium from China and ruled to continue the original antidumping duty. The ITC had issued the original antidumping duty order in 2001 and issued a continuation following the first 5-year review in 2007 (U.S. International Trade Commission, 2012a, b).

The U.S. Department of Commerce, International Trade Administration (ITA), completed a preliminary review of antidumping duties on imports of granular magnesium from China for November 1, 2010, through October 31, 2011, for China Minmetals Non-Ferrous Metals Co. Ltd. (CMN). CMN reported that it had not shipped any of this material to the United States, but the deadline to report this to the ITA had passed. As a result, the ITA determined that CMN was not entitled to the separate rate that it had received in earlier reviews (24.67% ad valorem) and would be assessed duties at the China-wide rate of 305.56% ad valorem (U.S. Department of Commerce, International Trade Administration, 2012c).

The ITA revised its final decision regarding imports of pure magnesium from the Chinese firm Tianjin Magnesium International Co. Ltd. into the United States from May 1, 2006, through April 30, 2007, because the review was “tainted by fraud” based on the information originally submitted. In

December 2010, the ITA had originally calculated a dumping margin of 0.63% ad valorem, but amended the duty to 111.73% ad valorem (U.S. Department of Commerce, International Trade Administration, 2012b).

In May, the U.S. Court of International Trade (CIT) denied an appeal from U.S. Magnesium LLC (Salt Lake City, UT) that contested a 2011 decision by the ITC to revoke antidumping duties on pure magnesium from Russia. In a 5-year sunset review of imports of magnesium from China and Russia, the ITC had determined that the duties on magnesium from China should be maintained, but the duties on magnesium from Russia should be discontinued. U.S. Magnesium challenged the ITC’s decision not to cumulate imports from China and Russia. U.S. Magnesium said that they were used interchangeably, even though imports from Russia were mostly pure magnesium and imports from China were magnesium alloy. The CIT determined that, although there was some overlap in uses for the two, the interchangeability was limited (U.S. Court of International Trade, 2012).

In December, the CIT reinstated an antidumping duty of 15.77% ad valorem assessed on magnesium metal imported into the United States from Russia by VSMPO-Avisma Corp. during the period of April 1, 2006, through March 31, 2007. In the original ruling on the case, the 15.77% rate had been imposed, but Avisma appealed and the rate was subsequently lowered to 8.51% ad valorem by the CIT. However, that ruling was appealed to the U.S. Court of Appeals for the Federal Circuit, which ordered the CIT to reinstate the 15.77% rate (U.S. Department of Commerce, International Trade Administration, 2012a).

In 2011, the European Union, Mexico, and the United States filed a complaint with the World Trade Organization (WTO) concerning Chinese export taxes on several mineral products, including magnesium. The WTO ruled that the export taxes violated international trade agreements, and China appealed the ruling. 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. In December, the Government of China announced that it would remove the 10% export tax on magnesium ingot and alloys beginning January 1, 2013 (American Metal Market, 2012; World Trade Organization, 2012; Yee, 2013b).

In November, the U.S. Department of Justice and Pennsylvania’s Department of Environmental Protection (DEP) filed suit in U.S. District Court to collect more than \$1.13 million in cleanup costs from 17 entities that sent material to be recycled at Remacor Inc.’s defunct magnesium recycling plant in West Pittsburg, PA. The plant had operated from 1975 to 2005 when a fire destroyed some of its equipment. The suit

alleged that Remacor continued accepting magnesium from companies even though it could not process the material and that the company mislabeled and mishandled the material. Beginning in 2006, the DEP and the U.S. Environmental Protection Agency cleaned up the site, including removal of more than 2,700 t of waste, at a cost of \$10.4 million (Frizell, 2012; Poole, 2012).

Production

U.S. Magnesium 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 plant in Rowley, UT. By July, U.S. Magnesium had completed ramping up a 21,500-metric-ton-per-year (t/yr) expansion, increasing the plant's capacity to 63,500 t/yr. A substantial portion of U.S. Magnesium's output from the expansion was to be supplied to Allegheny Technologies Inc.'s (Pittsburgh, PA) nearby titanium sponge plant. Magnesium chloride generated at the titanium sponge plant (from recovering titanium from titanium tetrachloride) was to be sent back to U.S. Magnesium's plant to be processed into magnesium metal and chlorine (Waite, 2012b).

In January, Fundamental Research Corp. (Vancouver, British Columbia, Canada) announced that it had completed a preliminary economic assessment for Molycor Gold Corp.'s (Vancouver) Tami-Mosi magnesium project near Ely, NV. Based on mining 294,000 t/yr of dolomite, with an average grade of 12.6% magnesium and a processing plant with a capacity to produce 30,000 t/yr of magnesium ingot, the capital cost would be about \$425 million and the operating cost would be \$1.28 per pound of magnesium. Molycor planned to begin commercial production in 2016. At a 12% cutoff grade, the company estimated an inferred resource of 412 million metric tons (Mt) with an average grade of 12.3% magnesium and containing more than 50 Mt of magnesium (Fundamental Research Corp., 2012). In April, Molycor's name was changed to Nevada Clean Magnesium Inc. (Molycor Gold Corp., 2012).

Consumption

Data for magnesium metal are collected from two voluntary surveys of U.S. operations by the U.S. Geological Survey. Of the 59 companies canvassed for magnesium consumption data, 46% responded, representing 54% of the magnesium-base scrap consumption listed in table 2 and the primary magnesium consumption listed in table 3. Data for the 32 nonrespondents were estimated on the basis of prior-year consumption levels and other factors.

Primary magnesium consumption in 2012 was about 11% less than that in 2011 (table 3), although this was attributed to increased use of secondary magnesium; secondary production increased by 15% compared with that in 2011. Use as a reducing agent for titanium and other metals accounted for 34% of primary magnesium consumption, followed by use in aluminum alloys with 33%. Consumption of primary magnesium for diecasting, 14% of the total, decreased by 55% from that in 2011. Consumption of scrap for castings in 2012 increased dramatically, to 10,600 t from 324 t (table 2) in 2011, offsetting most of the decreased primary magnesium use in castings.

The aluminum and magnesium diecasting firm, Spartan Light Metal Products Inc. (St. Louis, MO) announced that it planned to invest \$12.5 million to add two new production lines at its Mexico, MO, facility by 2017. One production line would manufacture head covers and oil sumps for Volkswagen AG, and the other would make battery cases for General Motors Corp.'s (GM) electric vehicles. Spartan also expected to increase production of parts for Toyota Corp.'s vehicles (Long, 2012).

Research and Development

Considerable research and development work was taking place to adapt magnesium and its alloys for new applications. United Kingdom-based Magnesium Elektron (a subsidiary of Luxfer Group) developed a new family of alloys—Synermag®—that showed potential as a bioabsorbable material. The magnesium alloys were being evaluated for medical uses as orthopedic implants and vascular stents (Magnesium Elektron, 2012).

GM, along with its partners Meridian Lightweight Technologies Inc. and The Ohio State University, received \$2.7 million from the U.S. Department of Energy to develop an integrated supervacuum diecasting to produce thin-walled vehicle doors using a new magnesium alloy. The goal was to achieve a 50% manufacturing energy savings compared to the multipiece, multistep, stamping and joining process currently used to manufacture car doors. By substituting magnesium for steel inner panels, car doors could weigh 60% less, resulting in fuel economy improvements and carbon emission savings (U.S. Department of Energy, 2012a).

GM developed a new thermal-forming process and corrosion-resistance treatment for magnesium alloys, which would enable them to be used as an alternative to aluminum and steel for vehicle body panels. In GM's patented process, the alloy is heated to 450 °C, allowing the material to be molded into precise, rigid shapes. Using this process, GM developed a production-ready magnesium panel that would reduce weight by 1 kilogram compared to a steel panel (Bomey, 2012; Katakis, 2012).

The U.S. Department of Energy's Ames Laboratory was working to improve a process developed in the 1990s using magnesium to separate rare-earth metals from neodymium-iron-boron magnet scrap. Because rare-earth metal prices were low, the goal of the original process was to produce a magnesium and neodymium alloy because the neodymium added important strength to magnesium, rather than to separate high-purity rare earths. With the rapid increase in prices for rare-earth materials, the goal became the separation of rare earths in order to recycle them for use in new magnets. During the process, uncoated magnets that contain dysprosium, neodymium, and praseodymium are heated in a radio frequency furnace with chunks of magnesium. As the magnesium melts, the three rare earths diffuse into the molten magnesium. The molten magnesium-rare-earths mixture is cast into ingots, then the magnesium is boiled off, leaving just the rare earths (U.S. Department of Energy, 2012b).

Stocks

Producers' yearend 2012 stocks of primary magnesium were slightly lower than those at yearend 2011; producer stock data were withheld to avoid disclosing company proprietary data. Consumer stocks of primary and alloy magnesium were 4,580 t at yearend 2012, 6% less than the yearend 2011 level of 4,860 t.

Prices

At the beginning of 2012, the Platts Metals Week U.S. spot Western magnesium price range was \$2.05 to \$2.20 per pound. The price range increased to its high for the year at \$2.15 to \$2.30 per pound in early February where it remained until mid-July when the price range declined slightly to \$2.15 to \$2.25 per pound, where it remained until yearend. The average Platts Metals Week U.S. spot Western magnesium price in 2012 was \$2.20 per pound, about 8% less than the 2011 average of \$2.40 per pound.

Press reports indicated that aluminum producers had contracted for most of their magnesium requirements for 2013 at \$1.90 to \$2.00 per pound in November. Other press reports indicated that prices for primary magnesium were from \$1.95 to \$2.05 per pound for contracts signed in October. Contract prices for secondary 90/10 alloy for 2013 delivery were reported to be \$1.70 to \$1.80 per pound (McBeth, 2012b; Waite, 2012a).

During the first half of the year, magnesium prices in China ranged from \$2,975 to \$3,120 per metric ton. In July, the price increased to \$3,300 per metric ton and then declined gradually to \$3,220 per metric ton in November. The increase in July was mainly attributed to a shortage of coke gas in Shanxi and Shaanxi Provinces, the leading magnesium-producing areas in China (Leung and Yee, 2012).

Foreign Trade

Total U.S. magnesium exports for 2012 were 49% more than those in 2011 (table 5). Canada (32%), Mexico (26%), and Singapore (20%) were the principal destinations. Magnesium imports for consumption in 2012 were 5% more than those in 2011 (table 6). Israel (33%) was the principal source of magnesium imports, mostly metal, and Canada (23%) was the second ranked source of magnesium imports, mostly waste and scrap. Total net imports of magnesium were 10% less than those in 2011; net imports of metal and semifabricated products increased by 5% and 53%, respectively, and net imports of alloys and scrap decreased by 29% and 7%, respectively.

World Review

Australia.—Latrobe Magnesium Ltd. (Sydney, New South Wales) announced that it would reduce the size of its proposed primary magnesium plant in the Latrobe Valley, Victoria, to 5,000 t/yr from the initially planned 10,000 t/yr. This reduction was expected to lower the capital cost to about \$40 million from \$100 million. Latrobe Magnesium planned to extract magnesium metal from fly ash produced by coal-fired powerplants. Construction of the plant was scheduled to begin in July 2013, with production to begin a year later (Latrobe Magnesium Ltd., 2012).

China.—According to the China Non-Ferrous Metals Industry Association, magnesium production for the year was 698,000 t, a 6% increase compared with that of 2011. The increased production was attributed to new smelters that were commissioned during the year. Several magnesium smelters were closed in the third quarter because of coke gas shortages, heavy rain, and hot temperatures (Leung and Yee, 2012). Magnesium production in China was 322,000 t in the first half of 2012, 8.5% lower than that in the first half of 2011, and through August, production was 430,000 t, about 15% less than that in the same period of 2011. However, production increased significantly during the fourth quarter resulting in a net increase for the year. Magnesium production has shifted to Shaanxi Province from Shanxi Province in recent years owing to lower energy costs as the result of using residual gas from coking operations as a fuel source. During the first half of the year, 46% of the output was from Shaanxi Province, 31% from Shanxi Province, and 12% from Ningxia Province (Chao, 2012a; Platts Metals Week, 2012a). CM Group estimated that the cost of magnesium production in Shaanxi Province averaged \$1,973 per metric ton compared with \$2,614 per metric ton in other regions (McBeth, 2012a).

Taiyuan Yiwei Magnesium Co. Ltd. produced 30,000 t of magnesium in 2012, far below its capacity of 134,000 t/yr. Shortages of coking gas, low magnesium prices, and weak demand for magnesium exports were cited for the reduced production level. Taiyuan Yiwei planned to increase production to 40,000 t in 2013 (Shair, 2013).

In October, Jinxin Magnesium Co. Ltd. (a subsidiary of Baotou Tianhong Magnesium Co. Ltd.) restarted production from its 20,000-t/yr smelter in Inner Mongolia Province. The smelter was shut down in 2008 owing to low prices. Baotou Tianhong Magnesium announced that its 20,000-t/yr Baotou smelter would be shut down gradually as production at the Jinxin smelter was ramped up, citing obsolete equipment at Baotou as the reason for its closure (Chao, 2012c).

China's Shaanxi Fugu Tianyu Mineral Industrial Group Co. Ltd. commissioned its 30,000-t/yr magnesium production line in Shaanxi Province, during the fourth quarter of 2012 and planned to complete the rampup in the first quarter of 2013. The expansion increased Tianyu's capacity to 45,000 t/yr from 15,000 t/yr (Platts Metals Week, 2012c; Yee, 2013c).

In August, Gansu Tianyuan Magnesium Co. Ltd. started construction of a magnesium alloy smelter in Gansu Province. Capacity and expected completion of the smelter were not available (Chao, 2012b).

In December, Hebi Mingyuan Magnesium Ltd. started construction of a 55,000-t/yr magnesium plant. The plant, in Hebi, Henan Province, was expected to be completed in the second half of 2014 (Shair, 2012).

Qinghai Salt Lake Magnesium Co. Ltd. was constructing a 100,000-t/yr smelter to produce magnesium from lake brines in Golmud, Qinghai Province. Expansion to 150,000 t/yr was planned. During the fourth quarter of the year, Magontec Ltd. (Sydney) started construction of a 56,000-t/yr foundry in Golmud to be supplied with molten magnesium from the adjacent smelter. Schedules for both projects were not available (Magontec Ltd., 2012a).

Korea, Republic of.—In October, POSCO Co. Ltd. (Pohang) began magnesium ingot shipments from its newly constructed 10,000-t/yr Okgye plant in Gangneung, Gangwon Province, using dolomite from nearby mines as feedstock. POSCO planned to expand the primary magnesium plant's capacity to 100,000 t/yr by 2018. Output from the Okgye plant would supply POSCO's 3,000-t/yr magnesium sheet plant in Suncheon, Jeollanam Province, and South Korean magnesium diecasting companies. POSCO also was constructing a new 10,000-t/yr line to produce 2,000-millimeter-wide plate at the Suncheon plant, which was expected to be in commercial production by August 2013. This plate, the widest in the world, was expected to be used by South Korean automobile manufacturers. POSCO also completed the development of a magnesium automobile front seat frame and was marketing the frame to South Korean auto manufacturers. The company planned to develop a magnesium rear seat frame by March 2013 (Japan Metal Bulletin, 2012; Platts Metals Week, 2012b; POSCO Co. Ltd., 2012).

Malaysia.—CVM Minerals Ltd. (Hong Kong) continued to ramp up production at its plant in Perak, which began production late in 2011. Maintenance issues slowed the rampup of the smelter, and production was not expected to reach full capacity until mid-2013 (Yee, 2012a, b; 2013a).

Romania.—Magontec completed construction of secondary magnesium plant in Santana to serve its customers in eastern Europe. Production started in the second quarter of the year (Magontec Ltd., 2012b).

Outlook

U.S. magnesium consumption was 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. Magnesium consumption in 2012 was approaching its prerecession 2008 level, and a recovering economy could result in magnesium consumption returning to or exceeding this level. However, a significant portion of U.S. demand for magnesium will depend on its use in aluminum alloys, and primary aluminum production through May 2013 was 5% less than that in the same period of 2012. During 2013, two primary aluminum smelters shut down a total of 220,000 t/yr of capacity, which was likely to result in decreased domestic magnesium use in aluminum alloying. Use of magnesium in the Kroll process of titanium production was expected to increase as the use of titanium in aerospace applications increased, such as in The Boeing Co.'s 787 Dreamliner passenger jet. Magnesium use in the production of beryllium also was expected to increase with rampup of a new beryllium smelter in Ohio that was completed in 2011. However, consumption of magnesium for desulfurization of iron and steel was expected to decline because domestic steel production was 6% less during the first half of 2013 than that of 2012 (World Steel Association, 2013).

The use of magnesium in diecasting was expected to increase with increased automobile production and increased intensity of use. Domestic automobile production during the first half of 2012 increased by 5.4% compared with production in the first half of 2011 (Ward's Automotive Group, 2013). Magnesium content in automobiles was expected to increase as

manufacturers replace steel automotive body parts with lighter materials to increase fuel efficiency. Some manufactures were switching to die-cast magnesium and aluminum-magnesium alloys for additional automotive parts.

Most of the growth in magnesium use 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. However, because of the limited number of producers outside of China, domestic automotive manufacturers may be less likely to choose magnesium than other lightweight materials, such as plastic, because Chinese producers have 80% of global primary magnesium capacity, and antidumping duties assessed on magnesium imported from China deters imports from China. The limited supply from producers outside China was one of the reasons that the U.S. automotive industry had been reluctant to use magnesium for many years. As a result of the downturn in the U.S. economy and the limited number of suppliers of magnesium, at least six large diecasting facilities have closed since 2008.

Analysts projected that global primary magnesium consumption would increase by 6.6% per year from 2012 through 2016 and by 7.1% per year from 2017 through 2026. China's consumption, which was forecast to increase by 12% per year in 2012–16, was expected to account for the majority of the increase. Production was expected to keep up with demand as about 190,000 t/yr of additional primary magnesium capacity was under construction in China, and additional capacity may come onstream in Australia, Canada, the Middle East, and the Republic of Korea (McBeth, 2012a).

Exports of magnesium from China were expected to increase during 2013 compared with exports in 2012 following removal of the export tax in 2012, and as producers expanded capacity and restarted capacity that was idled owing to shortages of coke gas in 2012. Export growth, however, was expected to be limited by continued weak demand from overseas markets.

References Cited

- 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.
- Bomey, Nathan, 2012, GM researchers have way to use magnesium in place of steel, aluminum: Detroit [MI] Free Press, October 24. (Accessed October 24, 2012, at <http://www.freep.com/article/20121024/BUSINESS01/310240025/GM-researchers-have-way-to-use-magnesium-in-place-of-steel-aluminum>.)
- Chao, Mikeala, 2012a, China Jan-Jun magnesium production down 8.5%: Metal-Pages, July 25. (Accessed July 30, 2012, via <http://www.metal-pages.com/>.)
- Chao, Mikeala, 2012b, Gansu Tianyuan breaks ground for magnesium alloy industrial park: Metal-Pages, August 17. (Accessed September 14, 2012, via <http://www.metal-pages.com/>.)
- Chao, Mikeala, 2012c, Inner Mongolia Jinxin to start magnesium production on October 20: Metal-Pages, October 8. (Accessed October 12, 2012, via <http://www.metal-pages.com/>.)
- Frizell, Samuel, 2012, EPA sues 17 firms to recover cleanup cost: American Metal Market, v. 119, no. 46–5, November 16, p. 6.
- Fundamental Research Corp., 2012, Molycor Gold Corporation (TSXV: MOR, Frankfurt: M1V, OTCPK: MLYFF)—Positive PEA on Tami Mosi magnesium project: Fundamental Research Corp., January 19, 14 p. (Accessed February 7, 2012, at [http://www.researchfrc.com/research/pdf/MOR/MOR Update - January 2012.pdf](http://www.researchfrc.com/research/pdf/MOR/MOR%20Update%20-%20January%202012.pdf).)
- Japan Metal Bulletin, 2012, POSCO to start commercial production of world widest Mg plate for vehicles: Japan Metal Bulletin, January 19. (Accessed February 6, 2012, at <http://www.japanmetalbulletin.com/?p=19501>.)

- Katakis, Manoli, 2012, GM pioneers magnesium sheet metal forming process: GM Authority.com, October 23. (Accessed August 26, 2013, at <http://gmauthority.com/blog/2012/10/gm-pioneers-magnesium-sheet-metal-forming-process/>.)
- Latrobe Magnesium Ltd., 2012, LMG reduces capital costs for Latrobe Valley magnesium plant to \$35–40m: Sydney, New South Wales, Australia, Latrobe Magnesium Ltd. press release, July 23, 2 p. (Accessed August 1, 2012, at <http://www.latrobemagnesium.com/docs/announcements 2012/lmg reduces cap costs 23-jul-12.pdf>.)
- Leung, Joshua, and Yee, Alvin, 2012, More Chinese magnesium shutdowns have small effect on price: *Platts Metals Week*, v. 83, no. 32, August 6, p. 1, 13–14.
- Long, Kimberly, 2012, Spartan Light Metal Products: Mexico [MO] Ledger, March 28. (Accessed May 7, 2012, at <http://www.mexicoledger.com/topstories/x1440914730/Spartan-Light-Metal-Products>.)
- Magnesium Elektron, 2012, Magnesium Elektron announces development of bioabsorbable alloys: Manchester, United Kingdom, Magnesium Elektron press release, March 27. (Accessed June 21, 2012, at <http://www.magnesium-elektron.com/news-article.asp?ID=54>.)
- Magontec Ltd., 2012a, Magontec's Golmud plant—New sources for magnesium alloy production: Sydney, New South Wales, Australia, Magontec Ltd. press release, June. (Accessed November 8, 2012, at <http://magontec.com/magontec/index.php?navID=55>.)
- Magontec Ltd., 2012b, New plant for magnesium recycling in Romania: Sydney, New South Wales, Australia, Magontec Ltd. press release, April. (Accessed November 8, 2012, at <http://magontec.com/magontec/index.php?navID=55>.)
- McBeth, Karen, 2012a, Chinese consumption drives global magnesium demand—Analysts: *Platts Metals Week*, v. 83, no. 22, May 28, p. 3.
- McBeth, Karen, 2012b, US spot magnesium slow; 2013 contracts at \$2: *Platts Metals Daily*, v. 1, no. 28, December 7, p. 6–7.
- 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-name-to-nevada-clean-magnesium-inc/>.)
- Platts Metals Week, 2012a, Chinese magnesium output varies: *Platts Metals Week*, v. 83, no. 42, October 15, p. 12–13.
- Platts Metals Week, 2012b, Posco's Mg plant on track for June: *Platts Metals Week*, v. 83, no. 18, April 30, p. 10.
- Platts Metals Week, 2012c, Tianyu to open new magnesium lines: *Platts Metals Week*, v. 83, no. 17, April 23, p. 10.
- Poole, Eric, 2012, DOJ, DEP seeking \$1.13M in Remacor cleanup: *Ellwood City [PA] Ledger*, November 14. (Accessed November 14, 2012, at http://www.ellwoodcityledger.com/news/local_news/doj-dep-seeking-m-in-remacor-cleanup/article_3d3d39a5-cc93-5485-aa1b-c2b29cebb1ab.html.)
- POSCO Co. Ltd., 2012, Conference inviting magnesium refining clients: Seoul, Republic of Korea, POSCO press release, October 26. (Accessed October 31, 2012, at <http://www.posco.co.kr/homepage/docs/eng2/jsp/prcenter/news/s91c10100151.jsp>.)
- Shair, Wendy, 2012, Hebi Mingyuan starts building magnesium plant: *Platts Metals Daily*, v. 1, no. 35, December 18, p. 7.
- Shair, Wendy, 2013, Yiwei plans 2013 magnesium output at 40,000 mt: *Platts Metals Daily*, v. 2, no. 8, January 11, p. 7–8.
- U.S. Court of International Trade, 2012, Slip Op. 12-64: U.S. Court of International Trade, May 16, 13 p. (Accessed August 7, 2012, at http://www.cit.uscourts.gov/SlipOpinions/Slip_op12/12-64.pdf.)
- U.S. Department of Commerce, International Trade Administration, 2012a, Magnesium metal from the Russian Federation—Notice of reinstated final results of administrative review pursuant to court decision: *Federal Register*, v. 77, no. 239, December 12, p. 73979–73980.
- U.S. Department of Commerce, International Trade Administration, 2012b, Pure magnesium from the People's Republic of China—Notice of court decision not in harmony with final results and notice of amended final results: *Federal Register*, v. 77, no. 94, May 15, p. 28570–28571.
- U.S. Department of Commerce, International Trade Administration, 2012c, Pure magnesium in granular form from the People's Republic of China—Preliminary results of antidumping duty administrative review: *Federal Register*, v. 77, no. 149, August 2, p. 46030–46033.
- U.S. Department of Energy, 2012a, Energy Department announces new investments in innovative manufacturing technologies: U.S. Department of Energy news release, June 12. (Accessed June 12, 2012, at <http://energy.gov/articles/energy-department-announces-new-investments-innovative-manufacturing-technologies-0>.)
- U.S. Department of Energy, 2012b, U.S. Department of Energy's Ames Laboratory improving process to recycle rare-earth materials: Ames, IA, U.S. Department of Energy news release, October 24. (Accessed October 25, 2012, at <http://www.ameslab.gov/news/news-releases/reclaiming-rare-earths>.)
- U.S. International Trade Commission, 2012a, Pure magnesium from China—Institution of a five-year review: *Federal Register*, v. 77, no. 21, February 1, p. 5049–5052.
- U.S. International Trade Commission, 2012b, USITC makes determination in five-year (sunset) review concerning pure magnesium (granular) from China: U.S. International Trade Commission news release, September 12. (Accessed September 28, 2012, at http://www.usitc.gov/press_room/news_release/2012/er0912kk1.htm.)
- Waite, Suzy, 2012a, Magnesium mating season in full swing: *American Metal Market*, v. 119, no. 45–2, November 6, p. 6.
- Waite, Suzy, 2012b, U.S. Mag run rate increases as Utah expansion finished: *American Metal Market*, v. 119, no. 28–3, July 11, p. 11.
- Ward's Automotive Group, 2013, North America production summary, June 2013: Detroit, MI, Ward's Automotive Group news release, July 15. (Accessed August 6, 2013, at <http://wardsauto.com/datasheet/north-america-production-summary-june-2013>.)
- World Steel Association, 2013, Crude steel production: Brussels, Belgium, World Steel Association, July 22. (Accessed August 6, 2013, at <http://www.worldsteel.org/statistics/crude-steel-production.html>.)
- 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, 2012a, CV Minerals sees 2012 magnesium ingot output at 5,000 mt: *Platts Metals Week*, v. 83, no. 15, April 9, p. 15–16.
- Yee, Alvin, 2012b, CVM takes Malaysia magnesium plant offline, delays ramp-up: *Platts Metals Week*, v. 83, no. 2, January 9, p. 9.
- Yee, Alvin, 2013a, Malaysia's CVM eyes March restart after plant upgrades: *Platts Metals Daily*, v. 2, no. 14, January 21, p. 7.
- Yee, Alvin, 2013b, Spot FOB China magnesium trades thin, inquiries slow: *Platts Metals Daily*, v. 2, no. 12, January 17, p. 6.
- Yee, Alvin, 2013c, Tianyu eyes tripling of magnesium ingot output in 2013: *Platts Metals Daily*, v. 2, no. 17, January 24, p. 6.

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. Ch. in *Mineral Commodity Summaries*, annual.
- Magnesium. *Mineral Industry Surveys*, quarterly.
- Magnesium, Its Alloys and Compounds. Open-File Report 01–341, 2001.
- 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. Circular 1196–E, 2004.

Other

- American Metal Market*, daily.
- 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.
- Metal Bulletin*.
- Platts Metals Week*.

TABLE 1
SALIENT MAGNESIUM STATISTICS¹

(Metric tons unless otherwise specified)

	2008	2009	2010	2011	2012
United States:					
Production:					
Primary magnesium	W	W	W	W	W
Secondary magnesium	88,400	68,600	72,000 ^r	67,200 ^r	77,200
Exports	14,400	19,600	14,800	12,300	16,900
Imports for consumption	83,300	47,300	52,700	48,400	47,000
Consumption, primary	72,000 ^r	53,200 ^r	56,600 ^r	80,600 ^r	71,900
Yearend stocks, producer	W	W	W	W	W
Yearend price ² dollars per pound	3.05–3.25	2.20–2.40	2.35–2.50	2.05–2.20	2.15–2.25
World, primary production ^e	670,000	590,000 ^r	747,000 ^r	757,000 ^r	802,000

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

¹Data are rounded to no more than three significant digits.

²Source: Platts Metals Week.

TABLE 2
MAGNESIUM RECOVERED FROM SCRAP PROCESSED IN THE
UNITED STATES, BY KIND OF SCRAP AND FORM OF RECOVERY¹

(Metric tons)

	2011	2012
KIND OF SCRAP		
New scrap:		
Magnesium-base	10,200 ^r	18,000
Aluminum-base	32,900 ^r	34,000
Total	43,100 ^r	52,000
Old scrap:		
Magnesium-base	1,210	1,210
Aluminum-base	22,800	24,000
Total	24,100	25,200
Grand total	67,200 ^r	77,200
FORM OF RECOVERY		
Magnesium alloy ingot ²	W	W
Magnesium alloy castings	324 ^r	10,600
Aluminum alloys	63,800 ^r	65,000
Other ³	3,000 ^r	1,510
Total	67,200 ^r	77,200

^rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other."

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

²Includes secondary magnesium content of both secondary and primary alloy ingot.

³Includes chemical and other dissipative uses, cathodic protection, and data indicated by symbol W.

TABLE 3
U.S. CONSUMPTION OF PRIMARY MAGNESIUM, BY USE¹

(Metric tons)

Use	2011	2012
For structural products:		
Castings:		
Die	22,500	10,100
Permanent mold	193 ^r	186
Sand	498	475
Wrought products ²	3,720 ^r	1,920
Total	26,900	12,700
For distributive or sacrificial purposes:		
Aluminum alloys	25,400 ^r	23,500
Cathodic protection (anodes)	876	921
Iron and steel desulfurization	6,430	8,120
Nodular iron	457	472
Reducing agent for titanium, zirconium, hafnium, uranium, beryllium	18,800 ^r	24,100
Other ³	1,720	2,090
Total	53,700 ^r	59,200
Grand total	80,600 ^r	71,900

^rRevised.

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

²Includes sheet and plate and forgings.

³Includes chemicals and scavenger, deoxidizer, and powder.

TABLE 4
YEAREND MAGNESIUM PRICES

		2011	2012
U.S. spot dealer import	dollars per pound	2.05–2.15	1.90–2.00
U.S. spot Western	do.	2.05–2.20	2.15–2.25
China	dollars per metric ton	3,000–3,050	3,150–3,190
European free market	do.	3,125–3,200	3,100–3,300
do. Ditto.			

Source: Platts Metals Week.

TABLE 5
U.S. EXPORTS OF MAGNESIUM, BY COUNTRY¹

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)
2011:								
Brazil	--	--	--	--	148	\$553	8	\$300
Canada	233	\$747	1,590	\$4,800	1,540	6,140	260	4,530
Mexico	1,160	2,780	70	239	1,310	5,220	154	1,740
Singapore	--	--	3,440	8,620	20	67	44	879
United Kingdom	35	35	11	22	100	380	470	15,000
Other	255	400	411	926	382	2,180	684	13,200
Total	1,680	3,960	5,520	14,600	3,500	14,500	1,620	35,600
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

-- Zero.

¹Data 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 COUNTRY¹

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)
2011:								
Canada	11,400	\$21,200	9	\$50	975	\$4,220	74	\$3,100
China	1	5	65	449	2,960	8,440	400	3,150
Israel	--	--	12,100	58,400	2,560	13,700	--	--
Kazakhstan	--	--	409	1,740	--	--	--	--
Mexico	1,680	3,160	--	--	3	16	444	3,690
Russia	--	--	470	1,720	--	--	(2)	10
United Kingdom	1,640	4,440	--	--	888	13,200	15	1,040
Other	7,240	20,000	1,250	6,560	3,790	14,900	41	1,840
Total	22,000	48,700	14,300	68,900	11,200	54,600	974	12,800
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

-- Zero.

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

²Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7
WORLD ANNUAL PRIMARY MAGNESIUM
PRODUCTION CAPACITY, DECEMBER 31, 2012¹

(Metric tons)

Country	Capacity
Brazil	22,000
China	1,150,000
India	900
Israel	34,000
Kazakhstan	30,000
Korea, Republic of	10,000
Malaysia	15,000
Russia	80,000
Serbia	5,000
Ukraine	15,000
United States	63,500
Total	1,430,000

¹Includes 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	2008	2009	2010	2011	2012
Brazil	15,000	16,000	16,000	16,000	16,000
Canada	2,000 ³	--	--	--	--
China	559,000	501,000	654,000	661,000	698,000
Israel	32,051 ⁴	19,405 ⁴	23,309 ⁴	26,284 ^{r,4}	27,000
Kazakhstan	21,000	21,000	21,000	21,000	21,000
Korea, Republic of	--	--	--	--	2,500
Malaysia	--	--	--	200 ^{r,4}	5,000
Russia ³	37,000	29,000 ^r	29,000 ^r	29,000 ^r	29,000
Serbia	1,500	1,500	1,500	1,500	1,500
Ukraine	2,000	2,000	2,000	2,000	2,000
United States	W	W	W	W	W
Total	670,000	590,000 ^r	747,000 ^r	757,000 ^r	802,000

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

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

²Table includes data available through July 12, 2013.

³Includes secondary.

⁴Reported figure.