



2013 Minerals Yearbook

LIME [ADVANCE RELEASE]

LIME

By M. Michael Miller

Domestic survey data and tables were prepared by Martha L. Jackson, statistical assistant, and the world production table was prepared by Glenn J. Wallace, international data coordinator.

In 2013, lime production in the United States was 19.2 million metric tons (Mt) and had a value of \$2.32 billion (table 1). Based on unrounded data, this was a slight increase of about 350,000 metric tons (t) from that of 2012. Lime consumption increased in most major market sectors (chemical and industrial, environmental, metallurgical, and refractories), although consumption by the construction sector was essentially unchanged. On average, lime prices increased slightly by \$2.60 per metric ton.

The U.S. lime industry is characterized by high barriers to entry, which include an industry dominated by a few large-scale producers with nationwide supply and distribution networks, a scarcity of high-quality limestone deposits on which the required zoning and mining permits can be obtained, the need for lime plants and facilities to be located close to markets with access to suitable transportation networks to allow for cost-effective production and distribution, environmental regulations making it difficult to permit new lime kilns, and the high capital cost of the plants and facilities. Production capacity increases are usually met by retiring older kilns and using the existing air quality permits for new, lower emitting kilns with larger capacities.

In 2013, the U.S. lime industry (including that in Puerto Rico) was composed of 30 companies, which included 15 companies that only produced lime products for sale, 10 companies that produced lime that was used entirely for internal company purposes, and 5 companies that did both. Owing to its reactivity and short shelf life, lime is not stockpiled in large amounts and data on stocks are not collected. On an annual basis, lime “sold and used” is considered to be equivalent to production and consumption. Lime is a basic chemical produced (as quicklime) in 29 States and Puerto Rico.

The term lime as used throughout this report refers primarily to six chemicals produced by the calcination of high-purity limestone or dolomite, followed by hydration where necessary. There are two high-calcium forms of lime—high-calcium quicklime (calcium oxide, CaO) and high-calcium hydrated lime [calcium hydroxide, Ca(OH)₂]. There are four dolomitic forms—dolomitic quicklime (CaO·MgO), dolomitic hydrate type N [Ca(OH)₂·MgO], dolomitic hydrate type S [Ca(OH)₂·Mg(OH)₂], and refractory dead-burned dolomite (CaO·MgO). The terms “type N” and “type S” refer to “Normal hydrated lime” and “Special hydrated lime” that are differentiated primarily by the compounds’ plasticity (ability to retain water) and oxide content. There are also air-entrained versions of these hydrates designated as “type NA” and “type SA.”

At present, all commercially produced lime in the United States is manufactured from limestone or dolomite, but lime also can be produced from a variety of calcareous materials, such as

aragonite, chalk, coral, marble, and shell. It also is regenerated (produced as a byproduct) by paper mills and carbide plants. Regenerated lime, however, is beyond the scope of this report.

Production

Domestic production data for lime were derived by the U.S. Geological Survey (USGS) from a voluntary survey of U.S. operations. The survey was sent to primary producers of quicklime and hydrate, but in order to avoid double counting, it was not sent to independent hydrators that purchase quicklime for hydration. Quantity data were collected for 28 specific and general end uses, and value data were collected by type of lime. Of the 90 operations that were canvassed in 2013, data were received for 82 operations, including 6 that were idle during the entire year. Data received represented 97% of the total lime sold or used by producers listed in tables 1–5. Production data for the nonrespondents were estimated based on prior-year production data and other information.

In 2013, quicklime was produced at 76 lime plants, including 31 plants with colocated hydrating plants. Hydrated lime also was produced at 13 standalone hydrating facilities, including 3 plants where the kilns had been shut down and hydrate was manufactured from quicklime produced offsite. These numbers do not necessarily agree with the number of plants reported in table 1 because, for data collection purposes, some company operations have been combined at the respondent’s request. In a few States with no quicklime production, hydrating plants used quicklime shipped from other States. There were also stationary slurry plants in some States where lime was converted to liquid form by the addition of water prior to sale; this product is sometimes called milk-of-lime. In addition to stationary slurry plants, there were mobile hot lime slurry production systems designed to slake quicklime or slurry hydrated lime to the percentage of solids required for each job.

Formerly, data on lime sold or used in the United States by State (with some regional groupings of States) were shown in table 2. However, owing to industry consolidation and the need to protect company proprietary data, data on lime sold or used in the United States are now reported by U.S. Census Bureau region. In 2013, States having production exceeding 2 Mt were, in descending order, Missouri, Alabama, and Kentucky; States with production of between 1 and 2 Mt were, in descending order, Ohio, Texas, Nevada, and Pennsylvania.

Total lime sold or used by domestic producers in 2013 was 19.2 Mt (table 1), a small increase compared with that of 2012. Production included the commercial sale or captive consumption (described by the term “used”) of quicklime, hydrated lime, and dead-burned refractory dolomite. Data were incomplete on the production of hydrated lime because some producers do not report data on downstream hydrating plants.

Traditionally, most U.S. lime production sold and used is in the form of high-calcium quicklime. In 2013, production of high-calcium and dolomitic quicklimes increased slightly to 13.8 Mt and 2.87 Mt, respectively. The production of high-calcium hydrate and dolomitic hydrate each increased slightly compared with the revised totals for 2012. Commercial sales of quicklime and hydrate increased slightly to 17.8 Mt, while lime produced for captive consumption increased by 3% to 1.39 Mt.

At yearend, the top 10 lime companies were, in descending order of U.S. lime production, Carmeuse Lime and Stone, Lhoist North America, Graymont Ltd., Mississippi Lime Co., Martin Marietta Magnesia Specialties LLC, United States Lime & Minerals, Inc., Unimin Corp. (doing business as Southern Lime Co.), Cheney Lime & Cement Co., Greer Lime Co., and ArcelorMittal USA Inc. These companies reported production from 42 lime plants and 12 separate hydrating plants and accounted for nearly 93% of the combined commercial lime sales and nearly 89% of total lime production.

Graymont Ltd. continued planning of a vertical shaft parallel flow regenerative lime kiln at its Pleasant Gap, PA, plant. The company received the required air quality permit in late 2012 and expected to begin kiln construction by yearend 2013. Completion of the project was expected to take 3 years (Milazzo, 2014).

Carmeuse Lime and Stone and Keystone Properties, LLC announced plans to construct a lime plant at the Keystone Jacksonville Terminal on the St. Johns River in Jacksonville, FL. The lime plant will be a joint venture between Carmeuse and Keystone, and it will operate as Jacksonville Lime, LLC. The plans called for the installation of two vertical shaft kilns with the capacity to produce about 136,000 metric tons of quicklime per year. The project was conditional upon the receipt of all applicable approvals and permits, and was contingent on support from available State and local incentive programs for capital investment and job creation (Carmeuse Lime and Stone, 2013).

Consumption

In 2013, U.S. lime consumption increased in all major market sectors with the exception of construction. The percentage breakdown of lime consumption by general end-use sectors was unchanged from that of 2012 at 38% for metallurgical uses, 31% for environmental uses, 22% for chemical and industrial uses, 8% for construction uses, and 1% for refractory dolomite (table 3). These end-use data were based on lime sold and used by domestic producers and do not include lime imports.

Commercial sales accounted for 92% of total U.S. lime consumption and 93% of domestic production. Captive lime accounted for the remainder of consumption and was used in the production of steel in basic oxygen furnaces (BOF), magnesia production, precipitated calcium carbonate production, sugar refining, and refractories (dead-burned dolomite). Almost all end-use data on captive lime consumption are withheld to avoid disclosing company proprietary information. As a result, table 3 only lists the total quantity (commercial plus captive) by end use. End uses with captive consumption are listed in footnote 5 of table 3.

In steel refining, quicklime is used as a flux and slagging agent to remove impurities, such as phosphorus, silica, and sulfur. The steel industry accounted for 30% of lime sold and used by domestic lime producers. According to the World Steel Association (undated), U.S. steel production in 2013 decreased slightly from that of 2012; lime consumption for steelmaking in 2013, however, was essentially unchanged from that of 2012.

In nonferrous metallurgy, lime is used in the beneficiation of copper ores to neutralize the acidic effects of pyrite and other iron sulfides and to maintain the proper pH in the flotation process. Lime is used to process alumina and magnesia, to extract uranium from gold slimes, and to recover nickel by precipitation.

Gold and silver are recovered using heap leaching and by conventional milling and subsequent leaching of the slurry. The sodium cyanide solution dissolves gold from the ore and forms a stable gold-cyanide complex, and the gold can then be separated through the use of highly activated carbon. Heap leaching involves crushing the ore, mixing it with lime for pH control and agglomeration, and stacking the ore in heaps on specially prepared pads for treatment with cyanide solution. Lime is used to maintain the pH of the cyanide solution at a level between 10 and 11 to maximize the recovery of precious metals and to prevent the creation of hydrogen cyanide.

Lime consumption data for nonferrous metallurgical uses [aluminum and bauxite processing, flotation processing of sulfide ores (principally copper and gold ores), and unspecified nonferrous uses] are combined to avoid disclosing company proprietary data and are reported in table 3 under metallurgical, nonferrous metallurgy. In 2013, lime consumption in nonferrous metallurgy increased by 8% to 1.46 Mt, which exceeds the most recent peak of 1.37 Mt reached in 2007 and 2008. Although specific data are not collected on lime consumption for copper recovery or for gold recovery, they make up a large part of the nonferrous metallurgy market. Recovery of copper from flotation concentrates increased by more than 8% compared with that of 2012 (Brininstool, 2013, 2014). Domestic gold production, however, decreased slightly compared with that of 2012 (George, 2014).

Lime is used in numerous processes to treat mining-related discharges in active or abandoned mines. These processes include the treatment of acid-mine drainage from operating and abandoned mines, specialized treatment processes such as catalyzed cementation of arsenic and other heavy metals, and treatment of mine tailings that result from the recovery of precious metals to recover cyanides.

Lime is used, generally in conjunction with soda ash (Na_2CO_3), for softening municipal and plant process water. This precipitation process removes soluble calcium and magnesium cations (and to a lesser extent, ferrous iron, manganese, strontium, and zinc) that contribute to the hardness of water. This process also reduces carbonate alkalinity and total dissolved solids. Lime consumption for drinking water treatment decreased in 2013 by about 6% compared with that of 2012.

In sewage treatment, the traditional role of lime is to control pH in the sludge digester, where it removes dissolved and suspended solids that contain phosphates and nitrogen compounds. Lime also aids in clarifying and in destroying

harmful bacteria. The leading use in sewage treatment is to stabilize the resulting sewage sludge. Sewage sludge stabilization, also called biosolids stabilization, reduces odors, pathogens, and putrescibility of the solids. Lime stabilization involves mixing quicklime with the sludge to raise the temperature and pH of the sludge to minimum levels for a specified period of time. In 2013, lime consumption for all sludge treatment decreased by 10% compared with that of 2012. Most of the decrease was in the treatment of industrial and hazardous wastes.

In flue gas desulfurization (FGD) systems serving coal-fired powerplants, incinerators (most are waste-to-energy powerplants), and industrial plants, lime is injected into the flue gas to remove gaseous pollutants, particularly sulfur dioxide (SO₂) and hydrochloric acid (HCl). Many FGD systems at utility powerplants are now designed to produce byproduct gypsum from the captured SO₂. This byproduct material is suitable for use in manufacturing gypsum wallboard, as an additive in portland cement, and as a soil amendment in agriculture. Hydrated lime may be used in another FGD-related market—to control sulfur trioxide (SO₃) emissions from selective catalytic reduction (SCR) systems installed at powerplants to control emissions of nitrogen oxides (NO_x). Utility powerplants were by far the largest consumers of lime for FGD and accounted for 93% of the total FGD lime market in 2013 (table 3). Incinerators, industrial boilers, and other FGD uses accounted for the remaining 7%. In 2013, lime consumption in all FGD markets increased by about 4% compared with that of 2012. Most of the increase was in the utility powerplants sector, which increased by 192,000 t. The industrial boiler and other FGD uses sector increased by 10,000 t, while the incinerators sector decreased by 53,000 t. The use of hydrated lime in FGD treatment in 2013 increased to 305,000 t (table 4), a 15% increase compared with the total for 2012. Much of this increase was attributed to the expanding treatment of SO₃ emissions from SCR systems at utility powerplants.

Lime is used by the pulp and paper industry in the basic Kraft pulping process where wood chips and an aqueous solution of sodium hydroxide and sodium sulfide (called liquor) are heated in a pressurized digester. The cooked wood chips (pulp) along with spent liquor are discharged (blown) under reduced pressure to a washing or evaporating system, respectively. The pulp is then screened, washed, and sent directly either to a paper machine or a bleaching plant. Lime is sometimes used to produce calcium hypochlorite bleach for bleaching the paper pulp. The spent liquor is processed through a recovery furnace, where dissolved organics are burned to recover waste heat, sodium sulfide, and sodium carbonate. The recovered sodium sulfide and sodium carbonate are diluted with water and then treated with slaked lime to recausticize the sodium carbonate into sodium hydroxide (caustic soda) for reuse. The byproduct calcium carbonate is recalcined in a lime kiln to recover lime for reuse. The paper industry also uses lime as a coagulant aid in the clarification of plant process water. In 2013, consumption for pulp and paper production increased by about 3% compared with that of 2012 (table 3).

Lime is used to make precipitated calcium carbonate (PCC), a specialty filler used in premium-quality coated and uncoated

papers, paint, and plastics. The most common PCC production process used in the United States is the carbonation process. Carbon dioxide is bubbled through milk-of-lime to form a precipitate of calcium carbonate and water. The reaction conditions determine the size and shape of the resulting PCC crystals. Lime used for PCC production increased slightly compared with that of 2012 (table 3).

The chemical industry uses lime in the manufacture of alkalis. Quicklime is combined with coke to produce calcium carbide, which is used to make acetylene and calcium cyanide. Lime is used to make calcium hypochlorite, citric acid, petrochemicals, and other chemicals.

In sugar refining, milk-of-lime is used to raise the pH of the product stream, precipitating colloidal impurities. The lime itself is then removed by reaction with CO₂ to precipitate calcium carbonate.

An experimental agricultural use for hydrated lime that has been undergoing field trials is as an additive to crop residues, such as corn stover, to produce cattle feed that can replace a substantial portion of the grain normally fed to cattle. The crop residue is ground, treated with hydrated lime slurry, and then stored in an oxygen-free container—typically a plastic “ag bag” or a bunker—for at least a week. The hydrated lime makes the crop residue digestible by the cattle. This treated crop residue can replace about 20% of grain fed to the cattle, and, with the addition of wet distiller grains (byproducts of corn ethanol production) to provide protein, the treated crop residue may be able to replace more than 60% of grain feed (Archer Daniels Midland Co., 2013). The extent of lime use in this sector in 2013 was unknown.

Hydrated lime is used in oil and gas drilling as a source of alkalinity and calcium in both oil- and water-base drilling fluids. Drilling fluid applications include increasing pH, providing excess lime as an alkalinity buffer, flocculating bentonite drilling muds, removing soluble carbonate (CO₃⁻²) ions, controlling corrosion, and activating fatty-acid oil-base mud additives (M-I LLC, 2011).

In the construction sector, hydrated lime is used in hot mix asphalt concrete to act as an antistripping agent. Stripping is generally defined as a loss of adhesion between the aggregate surface and the asphalt binder in the presence of moisture. Lime also is used in cold, in-place recycling for the rehabilitation of distressed asphalt concrete pavements. Existing asphalt concrete pavement is pulverized using a milling machine, and a hot lime slurry is added along with asphalt emulsion. The cold recycled mix is placed and compacted by conventional paving equipment, which produces a smooth base course for the new asphalt concrete surface. In 2013, sales of lime for use in asphalt concrete decreased by about 11% compared with those for 2012 (table 3).

Hydrated lime and quicklime also are used to stabilize fine-grained soils in place of materials that are employed as subbases, such as hydraulic clay fills or otherwise poor-quality clay and silty materials obtained from cuts or borrow pits. Lime also is used in base stabilization, which includes upgrading the strength and consistency properties of aggregates that may be judged unusable or marginal without stabilization. Common applications for lime stabilization include the construction of

airfields, building foundations, earthen dams, parking areas, and roads.

Lime sales for soil stabilization tend to be cyclical, especially in large market areas such as Texas. In the soil stabilization market, lime competes with portland cement, cement kiln dust, fly ash, and other additives (liquid enzymes, for example). Choices made by consumers can depend on availability, price, contract specifications, soil chemistry, and State and Federal funding in the case of highway construction projects. Public spending on highway construction and repair was \$81.1 billion in 2013, slightly more than the \$80.4 billion spent in 2012 (United Press International, Inc., 2014). Lime consumed for soil stabilization in 2013 was essentially unchanged compared with that of 2012 (table 3).

Hydrated lime is used in the traditional building sector in mortars, plaster, and stucco. Standard masonry cement mortars that include lime exhibit superior workability balanced with appropriate compressive strength, as well as low water permeability and superior bond strength. Lime is a major constituent in exterior and interior plasters and stuccos, enhancing the durability, strength, and workability of these finishes. A small amount of hydrated lime also is used in the renovation of old structures built with lime mortars, which were standard before the development of portland cement mortars. Modern portland cement-base mortars are incompatible with old lime mortars. Hydrated lime also is used to make synthetic hydraulic lime, which is produced by blending powdered hydrated lime with pulverized pozzolanic or hydraulic materials.

The U.S. Census Bureau collects data on construction spending for residential construction and 16 categories of nonresidential construction. In 2013, the U.S. values of all private and residential construction increased by 9% and 18%, respectively, when compared with those of 2012 (U.S. Census Bureau, undated). Almost all lime sold in 2013 for building use (table 4) was in the form of hydrate [238,000 t of hydrate (table 4) out of 239,000 t of total lime (table 3)]. In 2013, sales of total lime consumed in traditional building materials, such as in aerated concrete, mortar, plaster, and white wash, increased by 6% compared with those of 2012 (table 3). Most of the lime sold for building uses was produced at a few plants in Nevada, Ohio, Texas, and Wisconsin.

Dead-burned dolomite, also called refractory lime, is used as a component in tar-bonded refractory brick or monolithics manufactured for use in BOF. Refractory brick also is used in the lining of many treatment and casting ladles, in argon-oxygen decarburization and vacuum-oxygen decarburization converters, in electric arc furnaces, and in continuous steel casting. The data reported in this chapter were rounded to one significant figure to avoid disclosing company proprietary data; unrounded data showed that the production of dead-burned dolomite in 2013 increased slightly compared with that of 2012 (table 3). Magnesita Refractories Co. at its York, PA, plant and Carmeuse at its Millersville, OH, plant were the only significant producers of dead-burned dolomite. Although dead-burned dolomite is the primary form of lime used in refractories, hydrated lime may be used to produce silica refractory brick used to line industrial furnaces.

Prices

The USGS calculates unit values of lime products from the quantity and value data reported for lime sold or used by the lime producers on a free-on-board plant basis, including the cost of containers. These provide average values that eliminate variables, for example, potentially significant differences between list prices and individual supply contracts. There are no published lime prices in trade publications, so historically the data listed in table 5 have been used as representative of U.S. lime prices. To avoid revealing company proprietary data, value data for dead-burned dolomite have not been reported separately, but are included with the weighted average of all types. Prices for most types of lime recorded small increases compared with those for 2012, ranging from \$2.30 to \$3.70 per metric ton. The price for dolomitic hydrate was the exception with an increase of \$7.90 per metric ton. The total weighted average price of all lime types increased by 2.2%. With the exception of the dolomitic hydrate price, the annual increases in 2013 were smaller than those during the past decade in which the total average price increased by \$5.80 per metric ton, or by 6.4% per year.

Foreign Trade

The United States exported and imported calcined dolomite (dolomitic lime), hydrated lime (slaked lime), hydraulic lime, and quicklime. Combined exports of lime were 270,000 t valued at \$48.2 million. About 85% of exports went to Canada, with most of the remaining exports going to Russia (4%), Mexico (3%), Germany (3%), and Oman (2%) (table 6).

Combined imports of lime were 394,000 t valued at \$64.1 million, with 94% from Canada, 5% from Mexico, and 1% from other countries (table 7). Canada provided 99% each of dolomitic (calcined dolomite) and high-calcium quicklime imports. Imports of hydrated lime came mostly from Canada (68%) and Mexico (28%).

No tariffs are placed on imports of hydraulic lime, quicklime, and slaked lime from countries with normal trade relations (NTR) with the United States. A 3% ad valorem tariff is placed on imports of calcined dolomite from NTR countries.

World Review

Globally, lime is mostly traded on a regional basis. Traditionally, lime has been a low-value bulk product that could not be shipped long distances and compete with lime produced locally. Most countries have limestone or dolomite deposits and are able to manufacture lime for their own consumption. There may be some trade between countries on a regional basis where distances are not too great, such as within the European Union, or to supply lime products of a quality not locally available.

With the exception of some industrialized nations, accurate lime production data for individual countries are difficult to obtain. In addition to production by large commercial lime companies, lime is produced by small-scale manufacturers operating simple kilns to supply local consumers and by industries producing lime for internal consumption. These variations and the frequent reporting of crushed limestone production data as lime make accurate collection of international

lime data difficult and incomplete. In some cases, lime sales data have been used as a surrogate for country production figures (table 8).

Outlook

Economic forecasts predict sustained growth in the domestic economy [as measured by growth in the U.S. real gross domestic product (GDP)]. The U.S. real GDP is expected to grow at a rate of 2.6% in 2014, 3.1% in 2015, and 2.6% from 2016 to 2020 (Consensus Economics, 2014). Lime sales in markets such as chemical and industrial, construction, and steel should increase with improvements in the overall economy.

The outlook for FGD (lime's second leading market) is more difficult to analyze. With the recent boom in natural gas exploration, large increases in natural gas reserves, and lower natural gas prices, some U.S. electric utilities have increasingly shifted their fuel use from coal to natural gas. Natural gas also has the advantage of having lower air emissions than coal and, as a result, does not require SO₂ scrubbing; this could lead to decreased FGD lime consumption.

Wet limestone scrubbing (WLS) has been the preferred SO₂ removal technology for coal-fired powerplants in recent decades, but two potential issues have arisen. With the possible domestic regulation of greenhouse gases in the future, the use of WLS becomes problematic because the process generates CO₂ as a byproduct. WLS also requires some form of purge stream to prevent accumulation of chlorides, high concentrations of dissolved sulfate, and common trace impurities, such as mercury and oxides of arsenic, boron, and selenium. Treatment methods have been and continue to be developed to remove these contaminants, but regulations are tightening with regard to disposal of powerplant wastewater streams. Two emerging technologies, novel integrated desulfurization and circulating fluidized bed scrubbing (also called circulating dry scrubbing), combine features of existing technologies and offer excellent SO₂ removal with efficient reagent use. Hydrated lime is the primary reactant in both systems (Buecker, 2011). As a result, the FGD market is expected to increase during the next 3 to 5 years despite the fuel switching away from coal.

References Cited

- Archer Daniels Midland Co., 2013, ADM Second Crop™—How it works: Decatur, IL, Archer Daniels Midland Co. (Accessed April 23, 2013, at <http://www.adm.com/en-US/products/grain-farmer-services/SecondCrop/HowItWorks/Pages/default.aspx>.)
- Buecker, Brad, 2011, Circulating dry scrubbers—A new wave in FGD?: Power Engineering, November 1. (Accessed April 30, 2013, at <http://www.power-eng.com/articles/print/volume-115/issue-11/features/circulating-dry-scrubbers-a-new-wave-in-fgd.html>.)
- Brininstool, Mark, 2013, Copper in December 2013: U.S. Geological Survey Mineral Industry Surveys, May, 12 p. (Accessed May 23, 2013, at <http://minerals.usgs.gov/minerals/pubs/commodity/copper/mis-201312-coppe.pdf>.)
- Brininstool, Mark, 2014, Copper: U.S. Geological Survey Mineral Commodity Summaries [2014], p. 48–49.
- Carause Lime and Stone, 2013, Press release—Carause Lime and Stone: Pittsburgh, PA, Carause Lime and Stone press release, April 11, 2 p.
- Consensus Economics Inc., 2014, Trends in productivity and wages: Consensus Economics Inc., May 9. (Accessed May 9, 2014, at http://www.consensuseconomics.com/special_data.htm.)
- George, M.W., 2014, Gold in November and December 2013: U.S. Geological Survey Mineral Industry Surveys, March, 5 p. (Accessed March 28, 2014, at http://minerals.usgs.gov/minerals/pubs/commodity/gold/mis-201311_12-gold.pdf.)
- Milazzo, Britney, 2014, Graymont set to add kiln at Pleasant Gap plant: Centre Daily Times, March 26. (Accessed April 22, 2014, at <http://www.centredaily.com/2014/03/26/4105456/graymont-adding-kiln-at-pleasant.html>.)
- M-I LLC, 2011, Lime: Houston, TX, M-I SWACO product sheet, 2 p. (Accessed April 30, 2013, at www.slb.com/~media/Files/miswaco/product_sheets/lime.pdf.)
- United Press International, Inc., 2014, Construction spending in 2013 topped 2012 by 4.8 percent: United Press International, Inc., Business news, February 3. (Accessed May 8, 2014, at http://www.upi.com/Business_News/2014/02/03/Construction-spending-in-2013-topped-2012-by-48-percent/UPI-44571391452552/.)
- U.S. Census Bureau, [undated], Construction spending—Historical value put in place: U.S. Census Bureau. (Accessed May 9, 2014, via http://www.census.gov/construction/c30/historical_data.html.)
- World Steel Association, [undated], Annual crude steel production archive: Brussels, Belgium. (Accessed May 1, 2014, at <http://www.worldsteel.org/statistics/statistics-archive.html>.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

- Directory of Lime Plants in the United States in 2013. Mineral Industry Surveys, 2014.
- Historical Statistics for Mineral and Material Commodities in the United States, Data Series 140.
- Lime. Ch. in Mineral Commodity Summaries, annual.
- Lime in the United States—1950 to 2001. Mineral Industry Surveys, 2002.
- Lime in the United States—1960 to 2009. Mineral Industry Surveys, 2011.
- Lime Kiln Dust as a Potential Raw Material in Portland Cement Manufacturing. Open-File Report 2004–1336, 2004.
- Limestone and Dolomite. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

Other

- Chemistry and Technology of Lime and Limestone. John Wiley & Sons, Inc., 1980.
- Lime. Ch. in Industrial Minerals and Rocks (7th ed.). Society for Mining, Metallurgy, and Exploration, Inc., 2006.
- Lime. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
- Lime and Limestone—Chemistry and Technology, Production and Uses. Wiley-VCH Verlag GmbH, 1998.
- Lime/Limestone Ch. in Chemical Economics Handbook. IHS Chemical.

TABLE 1
SALIENT LIME STATISTICS¹

	2009	2010	2011	2012	2013
United States ²					
Number of plants ³	81	85	87	87	85
Lime sold or used by producers:					
Quantity thousand metric tons	15,800	18,300	19,100	18,800	19,200
Value ⁴ thousand dollars	1,660,000	1,950,000	2,130,000	2,230,000	2,320,000
Average value dollars per metric ton	105.00	107.00	111.50	118.50	121.10
Quicklime:					
High-calcium thousand metric tons	11,800	13,300	13,900	13,600	13,800
Dolomitic do.	1,830	2,570	2,690	2,790 ^r	2,870
Total do.	13,600	15,900	16,600	16,300	16,600
Hydrated lime:					
High-calcium do.	1,690	1,910	2,010	2,000 ^r	2,050
Dolomitic do.	261	239	230	253 ^r	260
Total do.	1,950	2,150	2,240	2,260	2,310
Dead-burned dolomite ⁵ do.	200	200	200	200	200
Lime sold by producers:					
Quicklime ⁶ thousand metric tons	12,600	14,700	15,400	15,200	15,500
Hydrated lime do.	1,950	2,140	2,240	2,250	2,310
Total do.	14,500	16,900	17,700	17,500	17,800
Value ⁴ thousand dollars	1,510,000	1,790,000	1,950,000	2,050,000	2,140,000
Lime used by producers thousand metric tons	1,260	1,380	1,430	1,340	1,390
Value ⁴ thousand dollars	150,000	169,000	183,000	177,000	184,000
Total exports: ⁷					
Quantity thousand metric tons	108	215	231	212	270
Value ⁸ thousand dollars	18,500	36,200	40,100	36,700	48,200
Total imports for consumption: ⁷					
Quantity thousand metric tons	422	445	512	468	394
Value ⁹ thousand dollars	53,200	61,500	69,900	68,300	64,100
Consumption, apparent ¹⁰ thousand metric tons	16,100	18,500	19,400	19,100	19,300
World, production do.	291,000 ^r	309,000 ^r	323,000 ^r	343,000 ^r	353,000 ^e

^eEstimated. ^rRevised. do. Ditto.

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

²Includes Puerto Rico.

³Includes most producer-owned hydrating plants not located at lime plants.

⁴Selling value, free-on-board plant.

⁵Data are rounded to no more than one significant digit to avoid disclosing company proprietary data.

⁶Includes dead-burned dolomite.

⁷Source: U.S. Census Bureau.

⁸Free alongside ship valuation.

⁹Cost, insurance, and freight valuation.

¹⁰Defined as sold or used plus imports minus exports.

TABLE 2
LIME SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY U.S. CENSUS BUREAU REGIONS

Region or division	Hydrated (thousand metric tons)	Quicklime ¹ (thousand metric tons)	Total (thousand metric tons)	Percent of total	Value (thousands)	Percent of total
2012:						
Northeast ²	162	1,010	1,170	6	165,000	7
Midwest ³	761	6,570	7,330	39	859,000	39
South:						
South Atlantic ⁴	210	607	817	4	110,000	5
East South Central ⁵	222	4,430	4,660	25	517,000	23
West South Central ⁶	665	1,150	1,810	10	201,000	9
West ⁷	236	2,790	3,030	16	378,000	17
Total	2,260	16,600	18,800	100	2,230,000	100
2013:						
Northeast ²	154	1,030	1,180	6	165,000	7
Midwest ³	809	6,700	7,500	39	895,000	39
South:						
South Atlantic ⁴	230	609	839	4	114,000	5
East South Central ⁵	216	4,440	4,650	24	524,000	23
West South Central ⁶	671	1,120	1,790	9	200,000	9
West ⁷	231	2,970	3,200	17	424,000	18
Total	2,310	16,900	19,200	100	2,320,000	100

¹Includes dead-burned dolomite.

²Region includes Massachusetts and Pennsylvania.

³Region includes Indiana, Iowa, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

⁴Division includes Florida, Georgia, Puerto Rico, Virginia, and West Virginia.

⁵Division includes Alabama, Kentucky, and Tennessee.

⁶Division includes Arkansas, Louisiana, Oklahoma, and Texas.

⁷Region includes Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming.

TABLE 3
LIME SOLD OR USED BY PRODUCERS IN THE
UNITED STATES, BY USE^{1,2,3}

(Thousand metric tons)

Use	2012 Quantity ⁴	2013 Quantity ⁴
Chemical and industrial:		
Fertilizer, including aglime	84	82
Glass	168	178
Paper and pulp	890	916
Precipitated calcium carbonate	880	900
Sugar refining	651	680
Other chemical and industrial ⁵	1,480	1,480
Total	4,150	4,240
Metallurgical:		
Steel and iron:		
Basic oxygen furnaces	2,450	2,560
Electric arc furnaces	3,050	2,930
Other steel and iron	227	296
Total	5,730	5,780
Nonferrous metallurgy ⁶	1,350	1,460
Total metallurgical	7,080	7,240
Construction:		
Asphalt	237	212
Building uses	226	239
Soil stabilization	1,010	1,010
Other construction	56	56
Total	1,530	1,520
Environmental:		
Flue gas desulfurization (FGD):		
Utility powerplants	3,490	3,680
Incinerators	222	169
Industrial boilers and other FGD	103	113
Total	3,810	3,960
Sludge treatment:		
Sewage	104	100
Other, industrial and hazardous	144	124
Total	249	224
Water treatment:		
Acid-mine drainage	84	87
Drinking water	920	868
Wastewater	555	566
Total	1,560	1,520
Other environmental	217	240
Total environmental	5,830	5,950
Refractories (dead-burned dolomite)	200 ⁷	200 ⁷
Grand total	18,800	19,200

¹Includes Puerto Rico.

²Data are rounded to no more than three significant digits; may not add to totals shown. Excludes regenerated lime.

³The U.S. Geological Survey does not collect value data by end use; in previous years value data were estimated.

⁴Includes lime sold and used, where "used" denotes lime produced for internal company use for basic oxygen furnaces, magnesia, paper and pulp, precipitated calcium carbonate, refractories, and sugar refining.

⁵May include alkalis, calcium carbide and cyanamide, calcium hypochlorite, citric acid, food (animal or human), oil and grease, oil well drilling, petrochemicals, tanning, and other uses. Magnesia is included here to avoid disclosing proprietary data.

⁶Includes aluminum and bauxite, magnesium, metals concentration (copper and gold), and other nonferrous uses.

⁷Data are rounded to no more than one significant digit to avoid disclosing company proprietary data.

TABLE 4
HYDRATED LIME SOLD OR USED IN THE
UNITED STATES, BY END USE^{1,2,3}

(Thousand metric tons)

Use	2012	2013
	Quantity ⁴	Quantity ⁴
Chemical and industrial	591	600
Construction:		
Asphalt	217	191
Building uses	225	238
Soil stabilization	415	412
Other construction	8	7
Total	866	848
Environmental:		
Flue gas desulfurization (FGD):		
Utility powerplants	188	227
Incinerators	32	30
Industrial boilers and other FGD	45	49
Total	265	305
Sludge treatment:		
Sewage	20	25
Other sludge treatment	50	54
Total	71	80
Water treatment:		
Acid-mine drainage	32	27
Drinking water	152	156
Wastewater	194	202
Total	379	386
Other environmental	44	52
Metallurgy	41	39
Grand total	2,260	2,310

¹Includes Puerto Rico.

²Data are rounded to no more than three significant digits; may not add to totals shown. Excludes regenerated lime.

³The U.S. Geological Survey does not collect value data by end use; in previous years value data were estimated.

⁴Includes hydrated lime sold and used, where "used" denotes lime produced for internal company use in building, chemical and industrial, and metallurgical sectors.

TABLE 5
LIME PRICES IN THE UNITED STATES, BY TYPE¹

Type	2012 ²		2013 ²	
	Dollars per metric ton	Dollars per short ton	Dollars per metric ton	Dollars per short ton
Sold and used:				
Quicklime	115.40	104.70	117.80	106.80
Hydrate	136.90	124.20	140.60	127.50
Weighted average all types ³	118.50	107.50	121.10	109.80
Sold:				
High-calcium quicklime	112.20	101.80	114.70	104.00
Dolomitic quicklime	124.00 ^r	112.50 ^r	126.30	114.50
Average quicklime	114.20	103.60	116.60	105.80
High-calcium hydrate	134.80 ^r	122.30 ^r	137.60	124.80
Dolomitic hydrate	156.30 ^r	141.80 ^r	164.20	148.90
Average hydrate	137.30	124.50	140.60	127.50
Weighted average all types ³	117.50	106.60	120.10	109.00

^rRevised.

¹Average value per ton, free-on-board plant, including cost of containers.

²Unit values in metric and short tons were rounded independently.

³Includes dead-burned dolomite.

TABLE 6
U.S. EXPORTS OF LIME, BY TYPE¹

(Metric tons and dollars)

Type and country	2012		2013	
	Quantity	Value ²	Quantity	Value ²
Calcined dolomite:				
Argentina	60	13,300	243	68,600
Brazil	3,750	869,000	4,510	1,360,000
Canada	52,200	9,520,000	51,500	9,610,000
Colombia	131	53,100	18	14,200
Ecuador	4	8,240	187	52,200
France	500	143,000	--	--
Germany	280	79,800	6,900	2,220,000
Japan	97	140,000	56	69,400
Mexico	259	86,100	374	116,000
Taiwan	80	27,400	38	41,500
Other	112 ^r	68,200 ^r	231	227,000
Total	57,500	11,000,000	64,100	13,800,000
Hydraulic lime:				
Afghanistan	--	--	62	13,600
Bahamas, The	100	21,800	108	37,200
Canada	6,410	1,450,000	5,780	1,340,000
Other	233	167,000	85	42,900
Total	6,750	1,640,000	5,970	1,420,000
Quicklime:				
Bahamas, The	164	38,900	18	3,820
Brazil	19	26,400	9	45,800
Canada	114,000	16,900,000	151,000	23,000,000
Costa Rica	533	218,000	497	201,000
Ecuador	15	24,600	15	30,200
Indonesia	182	69,200	52	18,900
Mexico	6,490	810,000	8,620	1,140,000
Netherlands	67	98,000	--	--
Russia	568	687,000	10,300	1,900,000
United Arab Emirates	117	175,000	3	5,030
Other	52 ^r	66,200 ^r	38	38,700
Total	122,000	19,100,000	170,000	26,400,000
Slaked lime, hydrate:				
Angola	473	173,000	108	33,400
Canada	18,500	3,330,000	21,500	4,280,000
Costa Rica	252	95,200	232	96,200
Korea, Republic of	36	243,000	34	234,000
Nigeria	362	111,000	469	140,000
Oman	4,640	689,000	6,050	1,300,000
Trinidad and Tobago	191	56,600	--	--
Venezuela	--	--	1,420	474,000
Other	500 ^r	267,000 ^r	169	71,400
Total	24,900	4,970,000	30,000	6,630,000
Grand total	212,000	36,700,000	270,000	48,200,000

^rRevised. -- Zero.

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

²Free alongside ship valuation.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF LIME, BY TYPE¹

(Metric tons and dollars)

Type and country	2012		2013	
	Quantity	Value ²	Quantity	Value ²
Calcined dolomite:				
Canada	51,600	8,350,000	21,400	4,750,000
Italy	818	169,000	133	106,000
Mexico	203	34,400	--	--
Other	14	62,100	25	17,800
Total	52,600	8,620,000	21,500	4,880,000
Hydraulic lime:				
Canada	91	10,500	5	6,190
China	--	--	957	666,000
Dominican Republic	--	--	97	33,600
France	224	166,000	206	150,000
Germany	99	36,600	17	6,520
Italy	--	--	19	11,300
Netherlands	(3)	2,630	--	--
Total	414	215,000	1,300	874,000
Quicklime:				
Canada	359,000	48,500,000	314,000	46,100,000
Dominican Republic	484	196,000	185	84,500
Malaysia	22	10,600	--	--
Mexico	2,870	498,000	3,090	594,000
Switzerland	20	5,130	100	47,500
United Kingdom	3	24,800	2	13,000
Other	387 ^r	340,000 ^r	340	337,000
Total	363,000	49,500,000	318,000	47,200,000
Slaked lime, hydrate:				
Belgium	385	241,000	551	296,000
Canada	35,500	6,100,000	36,400	7,430,000
France	52	88,400	43	72,500
Germany	51	137,000	38	126,000
Japan	74	76,300	56	71,500
Mexico	14,700	2,700,000	15,000	2,620,000
Netherlands	481	249,000	384	195,000
United Kingdom	73	92,100	101	141,000
Other	563 ^r	469,000 ^r	773	528,000
Total	51,500	9,920,000	52,800	11,200,000
Grand total	468,000	68,300,000	394,000	64,100,000

^rRevised. -- Zero.

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

²Cost, insurance, and freight valuation.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 8
QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Thousand metric tons)

Country ³	2009	2010	2011	2012 ^e	2013 ^e
Australia, sales ^e	2,500	2,200	2,200	2,200	2,100
Austria	725	734 ^r	801 ^r	800 ^r	800
Belgium ^e	2,400	2,400	2,400	2,400	2,400
Bosnia and Herzegovina	281	339	489	398 ^{r,4}	400
Brazil	6,600	7,761	8,235	8,300	8,350
Bulgaria	950	1,309	1,495	1,425 ^{r,4}	1,400
Canada	1,601	1,913	1,959	1,955 ⁴	1,802 ^{p,4}
Chile ^e	790	890 ^r	860 ^r	970 ^r	950
China ^e	185,000	190,000	200,000	220,000	230,000
Croatia	350	330	271	425	400
Czech Republic ^e	1,000	1,000	1,000	1,000	1,000
Egypt ^e	800	800	800	800	800
Finland ^e	500	475	475	475	475
France ^e	3,500	3,800	3,900	3,900	3,900
Germany	5,945	6,856	7,113	6,672 ⁴	6,700
Hungary ^e	210 ⁴	260 ⁴	250	230 ^r	200
India ^e	13,000	14,000	15,000	15,000	16,000
Iran ^e	2,600	2,700	2,800	2,800	2,800
Ireland ^e	220	220	300	300	300
Israel	429	658	715	770 ^r	770
Italy ^{e,5}	5,400	6,000	6,200	6,200	6,200
Jamaica ^e	300	300	300	300	300
Japan, quicklime only	6,746	8,547	8,005	7,581 ^{r,4}	7,600
Kazakhstan	798	881	958	1,000 ^r	1,000
Korea, Republic of ^e	NA ^r	NA ^r	NA ^r	NA ^r	NA
Malaysia, sales ^e	1,000	1,000	1,000	1,100	1,100
Peru ^e	216	216	216	220	225
Poland	1,704	1,799	2,036	1,779 ^{r,4}	1,665 ⁴
Romania ^e	1,600	2,000	2,000	2,000	2,000
Russia ^e	7,000	9,500 ⁴	10,100 ⁴	10,800 ^r	10,800
Serbia	251	239	274	239 ^{r,4}	240
Slovakia	867	986	971	1,000	90
Slovenia ^e	1,500	1,500	1,200	1,200	1,400
South Africa, burnt lime sales	1,368	1,292	1,539	1,209 ^{r,4}	1,300
Spain, sales ^e	1,800	1,900	1,900	1,800	1,900
Sweden ^e	600	700	700	700	700
Taiwan ^e	450	460	460	460	470
Thailand, sales ^e	770	800	800	800	800
Tunisia	366	348	283	340 ^r	350
Turkey, sales ^e	3,800	4,300	4,300	4,500	4,500
Ukraine	4,101	4,220	4,253	4,196 ⁴	4,200
United Arab Emirates ^e	147	174	340	400	450
United Kingdom ^e	1,500	1,500	1,500	1,500	1,500
United States, including Puerto Rico	15,800	18,300	19,100	18,800 ⁴	19,200 ⁴
Venezuela ^e	400	400	400	400	400
Vietnam	1,584	1,454	1,500 ^r	1,500	1,500
Other ^e	1,690 ^r	1,730 ^r	1,540 ^r	1,880 ^r	1,920
Total, grand	291,000 ^r	309,000 ^r	323,000 ^r	343,000 ^r	353,000

^eEstimated. ^pPreliminary. ^rRevised. NA Not available.

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

²Includes data available through August 6, 2014.

³In addition to the countries listed, Argentina, Chad, Iraq, Lebanon, Mexico, Nigeria, North Korea, Pakistan, Saudi Arabia, Syria, and several other nations produce lime, but output data are not reported; available general information is inadequate to formulate reliable estimates of output levels.

⁴Reported figure.

⁵Includes hydraulic lime.