



2017 Minerals Yearbook

LIME [ADVANCE RELEASE]

LIME

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In 2017, lime production in the United States (including Puerto Rico) was 17.6 million metric tons (Mt) and had a value of \$2.30 billion (table 1). These were increases of 327,000 metric tons (t) and \$132 million from those of 2016. Lime consumption decreased in three major market sectors (chemical, industrial and construction, and water treatment), although increases were recorded for sales in environmental, metallurgy, and refractory sectors (table 3). On average, prices for lime sold or used were higher in 2017 than in 2016 (table 5).

Lime plants and facilities need to be close to markets that have access to suitable transportation networks to allow for cost-effective production and distribution. The U.S. lime industry is dominated by a few large-scale producers with nationwide supply and distribution networks. Because there is a scarcity of high-quality limestone deposits for which required zoning and mining permits can be obtained, production capacity increases are usually met by replacing older kilns at existing plants and thus using existing air quality permits for new, more efficient, and higher capacity kilns that have reduced emissions.

Lime, as quicklime, is a basic chemical produced in 28 States and Puerto Rico. As in 2016, the U.S. lime industry consisted of 31 companies in 2017 (Corathers, 2017). Of these, 16 companies produced lime products for sale, 10 produced lime that was used entirely for internal company purposes, and 5 did both. Owing to its chemical reactivity and short shelf life, lime is not stockpiled in large amounts, and data on stocks are not collected. Thus, on an annual basis, lime “sold or used” is considered to be equivalent to both production and consumption. In 2017, Alabama and Missouri were the only two States that had production in excess of 2 Mt. Three States had production of between 1 and 2 Mt.

The term “lime” as used throughout this report refers primarily to six chemicals produced by the calcination of high-purity limestone (calcium carbonate, CaCO_3) or dolomite [$\text{CaMg}(\text{CO}_3)_2$], 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, $\text{Ca}(\text{OH})_2$]. There are four calcium-magnesium (dolomitic) forms: dolomitic quicklime ($\text{CaO}\cdot\text{MgO}$), dolomitic hydrate type N [$\text{Ca}(\text{OH})_2\cdot\text{MgO}$], dolomitic hydrate type S [$\text{Ca}(\text{OH})_2\cdot\text{Mg}(\text{OH})_2$], and refractory dead-burned dolomite ($\text{CaO}\cdot\text{MgO}$). 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 similar carbonate materials, such as aragonite, chalk, coral, marble, and seashells, if they are of high chemical purity. Lime also is regenerated and produced

as a byproduct by carbide plants, paper mills, sugar mills, and water-treatment plants. Regenerated lime, however, is not covered in this report.

In the United States, most lime (about 84%) is produced as quicklime (table 1). Hydrated lime (also called slaked lime) is a dry calcium hydroxide powder made from reacting quicklime with a controlled amount of water in a hydrator. Slaked lime also includes dispersions (suspensions) of calcium hydroxide particles in water, either in the form of milk of lime or lime putty. Milks of lime contain up to 40% by weight of solids, and lime putties contain 55% to 70%. Slaked lime is widely used in aqueous systems as a low-cost alkali to neutralize or balance acidity (Oates, 1998, p. 1, 229).

Production

Domestic production data for lime were derived by the U.S. Geological Survey (USGS) from a voluntary canvass of U.S. operations. The canvass was sent to primary producers of quicklime and hydrate, but 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 94 operations that were canvassed in 2017, data were either received or estimated for 85 operations, and 9 operations were idle during the entire year. Data received represented 96% of the total lime sold or used by producers listed in tables 1 through 5. Production data for the nonrespondents were estimated on the basis of prior-year production data and other information.

In 2017, quicklime was produced at 75 lime plants, including 30 plants with colocated hydrating plants. Hydrated lime also was produced at 18 stand-alone hydrating facilities, including 5 plants where the kilns had been shut down but 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 sourced from other States. There were also stationary lime slurry plants in some States where hydrated lime was converted (slaked) to form lime slurry (milk of lime) by the addition of water prior to sale. Mobile hot lime slurry production systems also were used to slake quicklime or to make hydrated lime slurry to the percentage of solids (milks of lime or lime putties) required for specific jobs.

Data on lime sold or used in the United States are reported by U.S. Census Bureau region (table 2). In 2017, production, or the total amount of lime sold or used by domestic producers, including Puerto Rico, was 17.6 Mt, a slight increase compared with that of 2016 (table 1). The total included the commercial

sale or captive consumption by producers (described by the term “used”) of quicklime, hydrated lime, and dead-burned refractory dolomite. Data on the production of hydrated lime were incomplete because some producers do not report data on downstream hydrating plants.

Most U.S. lime production sold or used is in the form of high-calcium quicklime. In 2017, production of high-calcium quicklime increased slightly to 12.2 Mt and dolomitic quicklime increased by 8% to 2.6 Mt from that of 2016 (table 1). The production of high-calcium hydrate increased slightly from that of 2016, and dolomitic hydrate production decreased slightly from that of 2016. Commercial sales of quicklime and hydrate increased slightly to 16.4 Mt, and lime produced for captive consumption decreased by 5% to 1.20 Mt, from those of 2016.

At yearend, the top 10 lime companies were, in descending order of U.S. lime production, Lhoist North America; Carmeuse Lime and Stone; Graymont Ltd.; Mississippi Lime Co.; United States Lime & Minerals, Inc.; Martin Marietta Magnesia Specialties LLC; Pete Lien & Sons, Inc.; Unimin Corp. (doing business as Southern Lime Co.); Cheney Lime & Cement Co.; and Greer Lime Co. These companies reported production from 45 lime plants and 10 stand-alone hydrating plants and accounted for nearly 96% of the combined commercial lime sales and 81% of total lime production.

On June 1, Graymont idled its lime kiln operations at the Green Bay facility, WI, owing to low prices in the North American lime industry. Plans were to convert the Green Bay facility into a bulk hydrate and terminal operation (Graymont Ltd., 2017).

Graymont continued to develop its Rexton project, a new limestone processing plant in the Upper Peninsula of Michigan. Graymont added loading infrastructure at a nearby dock to accommodate limestone shipping on the Great Lakes (Graymont Ltd., 2018, p. 23).

Consumption

In 2017, reported U.S. lime consumption increased in most major market sectors (table 3). The percentage distribution of lime consumption by general end-use sector was little changed from that of 2016 and was 34% for metallurgical uses, 30% for environmental uses, 21% for chemical and industrial uses, 11% for construction uses, and 1% for refractories. These end-use data were based on lime sold or used by domestic producers and do not include lime imports.

Commercial sales (lime sold by producers) accounted for 93% of total U.S. lime consumption (table 1). Captive lime (lime that is used by companies for internal purposes) accounted for the remainder of consumption and was used in the production of steel in basic oxygen furnaces (BOFs), magnesia production, precipitated calcium carbonate production, sugar refining, and refractories (dead-burned dolomite). As a result, table 3 lists only the total quantity (commercial plus captive) by end use. Additional end uses with captive consumption are listed in footnote 5 of table 3.

In steel production, quicklime is used as a flux and slagging agent in BOFs and electric arc furnaces (EAFs) to remove impurities, such as phosphorus, silica, and sulfur, from the hot metal. The steel industry accounted for 28% of lime sold or

used by domestic lime producers. According to the World Steel Association (2018), U.S. steel production in 2017 increased by 5.3% from that of 2016; lime sold for total steel and iron uses in 2017 was 8% more than that of 2016 (table 3).

In nonferrous metallurgy, lime is used in the beneficiation of copper and zinc ores to neutralize the acidic effects of pyrite and other sulfides and to maintain the proper pH in the flotation circuits. It is also used as a so-called depressant to prevent pyrite from entering the copper or zinc concentrate. Lime is used to process alumina and magnesia, extract uranium from gold slimes, and recover nickel by precipitation.

Gold and silver are recovered using heap leaching and by conventional milling and subsequent leaching of the slurry. Heap leaching involves crushing the ore, mixing it with lime or portland cement for pH control and sometimes 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 or thiourea solution at a level between 10 and 11 to maximize the recovery of precious metals and to prevent the creation of hydrogen cyanide gas.

Lime consumption data for nonferrous metallurgical uses [alumina 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 2017, lime consumption in nonferrous metallurgy decreased slightly to 1.10 Mt (table 3) from the peak of 1.33 Mt in 2015.

Lime is used in numerous processes to treat discharges to the environment 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 precious metals mine tailings 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 cations) that contribute to the hardness of water. This process also reduces carbonate alkalinity and total dissolved solids. Lime consumption for drinking water treatment decreased slightly in 2017 compared with that of 2016 (table 3).

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 aids in clarifying wastewater and in destroying harmful bacteria and is used to stabilize the resulting sewage sludge for beneficial use or disposal. 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, depending on the biosolids classification. The National Lime Association (undated) has a concise description of lime’s use in biosolids stabilization. In 2017, lime consumption for all sludge treatment decreased by 5% compared with that of 2016 (table 3).

In flue gas treatment (FGT) systems serving coal-fired powerplants, incinerators (most are waste-to-energy powerplants), and other industrial plants, lime is injected into the flue gas to remove gaseous pollutants, particularly sulfur dioxide (SO₂) and hydrochloric acid (HCl). Many FGT systems at utility powerplants are now designed to produce byproduct synthetic gypsum (CaSO₄·2H₂O) from the captured SO₂. This gypsum is suitable for use in manufacturing wallboard, as an additive in portland cement, and as a soil amendment in agriculture. Hydrated lime may be used in another FGT-related market—to control sulfur trioxide (SO₃) emissions from selective catalytic reduction systems installed at powerplants to control emissions of nitrogen oxides (NO_x). Utility powerplants were by far the leading consumers of lime for FGT and accounted for 89% of the total FGT lime market in 2017 (table 3). Incinerators, industrial boilers, and other FGT uses accounted for the remainder. In 2017, lime consumption increased in the utility powerplant market by 9%, but decreased by 12% in the incinerators market, and decreased slightly in the industrial boilers and other FGT markets (table 3). The use of hydrated lime in FGT in 2017 increased by 5% to 485,000 t (table 4). This increase was attributed to increased consumption by the utility powerplant and incinerator FGT sectors.

Slaked lime is used by the pulp and paper industry in the basic kraft pulping process for converting wood chips into wood pulp. Slaked lime is sometimes used to produce calcium hypochlorite bleach for bleaching the paper pulp. The paper industry also uses lime as a coagulant aid in the clarification of plant process water. In 2017, consumption for pulp and paper production decreased by 3% from that in 2016 (table 3).

Lime is used in the manufacture of a wide range of chemicals. Lime is used to make precipitated calcium carbonate (PCC) for use as a specialty filler in premium-quality coated and uncoated papers, paints, and plastics. The most common method of making PCC in the United States is the carbonation process. Carbon dioxide (CO₂) is bubbled through calcium hydroxide (as 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 decreased by 4% compared with that of 2016 (table 3).

The chemical industry also uses lime in the manufacture of alkalis. Other chemical uses include the production of calcium carbide, which is formed when quicklime is combined with coke; calcium carbide, in turn, is used to make acetylene and calcium cyanamide. Lime is also used to make calcium hypochlorite bleaches, citric acid, petrochemicals, and many other chemicals.

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

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 the pH, providing excess lime as an alkalinity buffer, flocculating bentonite drilling muds, removing soluble carbonate (CO₃²⁻) ions, controlling corrosion, and activating fatty-acid oil-base mud additives (M-I LLC, 2018).

In the construction sector, hydrated lime is used in hot mix asphaltic concrete 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 water. Lime also is used in cold, in-place recycling for the rehabilitation of distressed asphaltic concrete pavements. Existing asphaltic 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 asphaltic concrete surface. In 2017, sales of lime for use in asphaltic concrete increased by 10% compared with those in 2016 (table 3).

Hydrated lime and quicklime also are used to stabilize fine-grained soils, such as hydraulic clay fills or otherwise poor-quality clay and silty materials obtained from cuts or borrow pits, in place of materials that are employed as subbases. 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 major 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). The choice of material for soil stabilization depends on availability, price, contract specifications, soil chemistry, and State and Federal funding in the case of highway construction projects. The amount of lime consumed for soil stabilization in 2017 decreased by 4% compared with that of 2016 (table 3). According to the U.S. Census Bureau (2018, table 2), public spending on highway and street construction was \$87.7 billion in 2017, down by about 4% from the \$91.1 billion spent in 2016.

Hydrated lime is used in the building sector for some mortars, plasters, and stuccos. 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 some 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 commonplace 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.

Almost all lime sold or used in 2017 for building use was in the form of hydrate [263,000 t (table 4) out of 289,000 t of total lime (table 3)]. In 2017, the total amount of lime consumed in building uses, such as in aerated concrete, mortar, plaster, and whitewash, increased by 6% compared with that of 2016 (table 3). Most of the lime sold or used for construction purposes was produced at a few plants primarily in Missouri, Nevada, South Dakota, 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 BOFs. Refractory brick also is used in the lining of many treatment and casting ladles, in cement clinker kilns, in argon-oxygen decarburization and vacuum-oxygen decarburization converters, in EAFs, and in continuous steel casting. The data on dead-burned dolomite reported in table 3 were rounded to one significant digit to avoid disclosing company proprietary data; unrounded data show that the consumption of dead-burned dolomite in 2017 was slightly more than that in 2016. Magnesita Refractories Co. at its York, PA, plant and Carmeuse at its Millersville, OH, plant were the only significant domestic 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 such as 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 disclosing company proprietary data, value data for dead-burned dolomite have not been reported separately but are included within the weighted average of all types of lime. The total weighted average price of all quicklime and hydrate sold or used in 2017 increased by 4% per metric ton. Annual average prices for high-calcium quicklime and high-calcium hydrate sold increased slightly in 2017 compared with those for 2016, by \$0.60 and \$1.00 per metric ton, respectively. Annual average prices for dolomitic quicklime and dolomitic hydrate sold increased by \$1.00 and \$3.90 per metric ton, respectively. During the past 10 years, the total annual weighted average price for all types increased by \$43.80 per metric ton.

Foreign Trade

The United States exported and imported calcined dolomite (dolomitic lime), hydrated lime (slaked lime), hydraulic lime, and quicklime. Total exports and imports of lime were very small—each about 2%—compared with the total amount produced domestically in 2017. Total exports of lime in 2017 were 391,000 t valued at \$74.2 million (table 6). About 94% of exports went to Canada; most of the remaining exports went to Belgium (2%) and Mexico (2%). Total imports of lime were 367,000 t valued at \$60.1 million, with about 91% from Canada, 7% from Mexico, and 1% from other countries (table 7). Canada provided nearly all the high-calcium quicklime and dolomitic (calcined dolomite) lime, and 59% of slaked lime imports.

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

In 2017, global lime production was 410 Mt, not significantly changed from 2016 but an average of 16% higher than global production in 2013–15 (table 8). The leading lime-producing countries in 2017 were China (about 70%), the United States (4%), India (4%), Russia (3%), and Brazil (2%). Lime is mostly traded on a regional basis because it is a low-value, bulk, and reactive product that cannot be shipped long distances and compete with lime produced locally. Most countries have limestone or dolomite deposits, and they are able to manufacture at least basic forms of 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 and are commonly incomplete. 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. Also, there is common misreporting of crushed limestone production data as lime data. In some cases, lime sales data have been used as a proxy for country production figures.

Zambia.—Carmeuse signed an agreement with Handyman's Lime and Astro Quarries to manage a new 200,000-metric-ton-per-year lime plant and quarry in Ndola. The plant and quarry would employ around 100 people (Carmeuse Group, 2017).

Outlook

Economic forecasters predict sustained growth in the domestic economy in terms of growth in the U.S. real gross domestic product (GDP). The U.S. real GDP is forecast to grow at a rate of about 2% annually in 2017–19 (World Bank, The, 2018, p. 4). Lime sales in markets such as chemical and industrial, construction, and steel are expected to increase with improvements in the overall economy.

The outlook for FGT (lime's second leading market) is more difficult to predict. With the recent boom in natural gas exploration, large increases in natural gas reserves, and low natural gas prices, U.S. electric utilities have increasingly shifted their fuel use from coal to natural gas either by conversion of the coal-fired plants or by shutting down coal-fired plants. Natural gas has the advantage of producing lower levels of emissions than coal and, as a result, does not usually require SO₂ scrubbing, which could lead to decreased FGT lime consumption. The U.S. Energy Information Administration (2019, p. 25) forecast the breakout of total domestic utility-scale electricity generation in 2018 to be 34% from natural gas and 28% from coal. In 2017, natural gas supplied 31% and coal supplied 31% of total U.S. electricity generation. In 2019, natural gas and coal are forecast to generate 37% and 25% of electricity, respectively.

References Cited

- Carmeuse Group, 2017, A new state of the art lime plant and quarry in Zambia: Luxembourg City, Luxembourg, Carmeuse Group press release, April 14, 2 p. (Accessed October 18, 2019, at <http://www.carmeuse.com/sites/default/files/20170414pressreleasemo-ndola.pdf>.)
- Corathers, L.A., 2017, Directory of lime plants and hydrating plants in the United States in 2016: U.S. Geological Survey Mineral Industry Surveys, August, 14 p. (Accessed October 29, 2019, at <https://minerals.usgs.gov/minerals/pubs/commodity/lime/dir-2016-lime.pdf>.)
- Graymont Ltd., 2017, Graymont announces the idling of its lime production kilns in Green Bay, Wisconsin: Richmond, British Columbia, Canada, Graymont Ltd. news release, April 4. (Accessed October 17, 2019, at <https://www.graymont.com/en/news/graymont-announces-idling-its-lime-production-kilns-green-bay-wisconsin>.)
- Graymont Ltd., 2018, 2017 sustainability report: Richmond, British Columbia, Canada, Graymont Ltd., March 20, 36 p. (Accessed October 17, 2019, at https://www.graymont.com/sites/default/files/brochures/pdf/p27_gra_sustainability_report2017_ang_07-03-2019.pdf.)
- M-I LLC, 2018, Lime: Houston, TX, M-I SWACO product sheet, 2 p. (Accessed October 17, 2019, at <https://www.slb.com/-/media/Files/miswaco/ps-drilling-fluids/lime.pdf?la=en&hash=2FD5F24971492980C016D52C63F7FFCC7B40F0A7>.)
- National Lime Association, [undated], Biosolids and sludge: Arlington, VA, National Lime Association. (Accessed on October 21, 2019, at <http://lime.org/lime-basics/uses-of-lime/enviromental/biosolids-and-sludge/>.)
- Oates, J.A.H., 1998, Lime and limestone—Chemistry and technology, production and uses: Weinheim, Germany, Wiley-VCH Verlag GmbH, 455 p.
- U.S. Census Bureau, 2018, Monthly construction spending, December 2017: U.S. Census Bureau news release CB18-18, February 1. (Accessed October 21, 2019, at <https://www.census.gov/construction/c30/pdf/pr201712.pdf>.)
- U.S. Energy Information Administration, 2019, Short-term energy outlook: U.S. Energy Information Administration, October 8, 53 p. (Accessed October 17, 2019, at https://www.eia.gov/outlooks/steo/arc_hives/oct19.pdf.)
- World Bank, The, 2018, Global economic prospects: Washington, DC, The World Bank, June, 159 p. (Accessed October 21, 2019, at <https://openknowledge.worldbank.org/handle/10986/29801>.)
- World Steel Association, 2018, World crude steel output increases by 5.3% in 2017: Brussels, Belgium, World Steel Association press release, January 24. (Accessed October 18, 2019, at <https://www.worldsteel.org/media-centre/press-releases/2018/World-crude-steel-output-increases-by-5.3--in-2017.html>.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

- 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

	2013	2014	2015	2016	2017
United States: ²					
Number of plants ³	85	86	86	85	85
Lime sold or used by producers:					
Quantity:					
Quicklime:					
High-calcium thousand metric tons	13,800	14,100	13,100	12,100 ^r	12,200
Dolomitic do.	2,850	2,740	2,550	2,430 ^r	2,630
Total do.	16,600	16,800	15,600	14,500 ^r	14,800
Hydrated lime:					
High-calcium do.	2,050	2,190	2,150	2,350 ^r	2,360
Dolomitic do.	260	279	279	280 ^r	276
Total do.	2,310	2,470	2,430	2,630 ^r	2,640
Dead-burned dolomite ⁴ do.	200	200	200	200	200
Total do.	19,100	19,500	18,300	17,300 ^r	17,600
Value ⁵ thousand dollars	2,320,000	2,390,000	2,290,000	2,170,000 ^r	2,300,000
Average value dollars per metric ton	121.20	122.40	125.30	125.10	130.33
Lime sold by producers (commercial sales):					
Quantity:					
Quicklime ⁶ thousand metric tons	15,500	15,700	14,500	13,400 ^r	13,800
Hydrated lime do.	2,310	2,470	2,430	2,630 ^r	2,640
Total do.	17,800	18,100	17,000	16,100 ^r	16,400
Value ⁵ thousand dollars	2,140,000	2,210,000	2,110,000	2,010,000 ^r	2,140,000
Lime used by producers:					
Quantity thousand metric tons	1,380	1,400	1,280	1,260	1,200
Value ⁵ thousand dollars	187,000	180,000	176,000	158,000 ^r	156,000
Exports: ⁷					
Quantity thousand metric tons	271	320	346	329	391
Value ⁸ thousand dollars	48,300	57,600	62,600	64,500	74,200
Imports for consumption: ⁷					
Quantity thousand metric tons	394	414	391	376	367
Value ⁹ thousand dollars	64,100 ^r	67,700 ^r	66,900 ^r	61,500 ^r	62,300
Consumption, apparent ¹⁰ thousand metric tons	19,300	19,600	18,300	17,400 ^r	17,600
World production do.	340,000	350,000	370,000 ^r	410,000 ^r	410,000

^rRevised. do. Ditto.

¹Table includes data available through January 9, 2020. Data 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.

⁴Data are rounded to no more than one significant digit to avoid disclosing company proprietary data.

⁵Selling value, free-on-board plant.

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 REGION¹

Year and region or division	Quantity				Value	
	Hydrated (thousand metric tons)	Quicklime ² (thousand metric tons)	Total (thousand metric tons)	Percent of total	Total (thousand dollars)	Percent of total
2016:						
Northeast ³	185 ^r	822 ^r	1,010	6	130,000 ^r	9 ^r
Midwest ⁴	928 ^r	5,660 ^r	6,590 ^r	39	843,000 ^r	38 ^r
South:						
South Atlantic ⁵	218 ^r	651 ^r	869 ^r	5	107,000	5
East South Central ⁶	233	3,860 ^r	4,090 ^r	24 ^r	477,000 ^r	21 ^r
West South Central ⁷	770	1,220	1,980	11	226,000	10
West ⁸	295	2,480	2,770	16	384,000	17
Total	2,630	14,700 ^r	17,300 ^r	100	2,170,000 ^r	100
2017:						
Northeast ³	141	763	905	5	186,000	8
Midwest ⁴	891	5,920	6,810	40	876,000	39
South:						
South Atlantic ⁵	220	717	937	5	115,000	5
East South Central ⁶	285	3,930	4,220	23	496,000	21
West South Central ⁷	800	1,110	1,910	11	222,000	10
West ⁸	302	2,560	2,860	16	404,000	17
Total	2,640	15,000	17,600	100	2,300,000	100

^rRevised.

¹Table includes data available through January 9, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes dead-burned dolomite.

³Massachusetts and Pennsylvania.

⁴Indiana, Iowa, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

⁵Florida, Georgia, Puerto Rico, Virginia, and West Virginia.

⁶Alabama, Kentucky, and Tennessee.

⁷Arkansas, Louisiana, Oklahoma, and Texas.

⁸Arizona, 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	2016	2017
Chemical and industrial:		
Fertilizer, including aglime	75 ^r	79
Glass	W	W
Paper and pulp ⁴	950 ^r	919
Precipitated calcium carbonate ⁴	690	659
Sugar refining ⁴	647 ^r	646
Other chemical and industrial ⁵	1,570 ^r	1,350
Total	3,930	3,660
Metallurgical:		
Steel and iron:		
Basic oxygen furnaces ⁴	1,860 ^r	1,880
Electric arc furnaces	2,470 ^r	2,760
Other steel and iron	184	218
Total	4,520 ^r	4,870
Nonferrous metallurgy ⁶	1,110 ^r	1,100
Total metallurgical	5,630	5,960
Construction:		
Asphalt	238 ^r	261
Building uses	272 ^r	289
Soil stabilization	1,410 ^r	1,350
Other construction	46 ^r	32
Total	1,970 ^r	1,930
Environmental:		
Flue gas treatment:		
Utility powerplants	3,160 ^r	3,440
Incinerators	203 ^r	178
Industrial boilers and other flue gas treatment	255	254
Total	3,620 ^r	3,870
Sludge treatment:		
Sewage	129 ^r	123
Other, industrial and hazardous	W	W
Total	129 ^r	123
Water treatment:		
Acid-mine drainage	W	W
Drinking water	808 ^r	787
Wastewater	390 ^r	364
Total	1,200	1,150
Other environmental	151 ^r	221
Total environmental	5,100 ^r	5,360
Refractories (dead-burned dolomite) ^{4,7}	200	200
Miscellaneous and unspecified	505 ^r	538
Grand total	17,300 ^r	17,600

^rRevised. W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified."

¹Table includes data available through January 9, 2020. Data are rounded to no more than three significant digits; may not add to totals shown. Excludes lime kiln dust and regenerated lime.

²Includes Puerto Rico.

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.

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 alumina and bauxite, magnesium, metals concentration (copper and gold), and other nonferrous metallurgy 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^{1,2,3,4}

(Thousand metric tons)

Use	2016	2017
Chemical and industrial	554	519
Construction:		
Asphalt	215	237
Building uses	268	263
Soil stabilization	W	W
Other construction	570 ^r	574
Total	1,050	1,070
Environmental:		
Flue gas treatment:		
Utility powerplants	332	359
Incinerators	24	27
Industrial boilers and other flue gas treatment	104 ^r	99
Total	460	485
Sludge treatment:		
Sewage	36 ^r	33
Other sludge treatment	82	99
Total	117 ^r	132
Water treatment:		
Acid-mine drainage	35	35
Drinking water	125 ^r	120
Wastewater	151	120
Total	311 ^r	275
Other environmental	56	82
Metallurgy	79 ^r	74
Grand total	2,630 ^r	2,640

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

¹Table includes data available through January 9, 2020. Data are rounded to no more than three significant digits; may not add to totals shown. Excludes regenerated lime.

²Includes Puerto Rico.

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 the building, chemical and industrial, and metallurgical sectors.

TABLE 5
LIME PRICES IN THE UNITED STATES, BY TYPE^{1,2,3}

Type	2016		2017	
	Dollars per metric ton	Dollars per short ton	Dollars per metric ton	Dollars per short ton
Sold or used:				
Quicklime ⁴	121.00	109.70	121.80	110.50
Hydrated lime	145.50	132.00	146.70	133.10
Weighted average all types	125.10	113.50	130.33	118.20
Sold:				
Quicklime:				
High-calcium	117.70	106.70	118.30	107.30
Dolomitic	130.60	118.40	131.60	119.40
Average quicklime ⁴	119.80	108.70	120.60	109.40
Hydrated lime:				
High-calcium	141.80	128.70	142.80	129.50
Dolomitic	176.30	160.00	180.20	163.50
Average hydrated lime	145.50	132.00	146.70	133.10
Weighted average all types	124.30	112.70	129.70	117.70

¹Table includes data available through January 9, 2020.

²Average value per ton, free-on-board plant, including cost of containers.

³Unit values for metric tons and short tons were rounded independently.

⁴Includes dead-burned dolomite.

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

(Metric tons and dollars)

Type and country or locality	2016		2017	
	Quantity	Value ²	Quantity	Value ²
Calcined dolomite:				
Argentina	380	\$131,000	472	\$160,000
Belgium	5,320	1,170,000	6,440	1,380,000
Bolivia	--	--	2	6,260
Brazil	--	--	301	71,000
Canada	40,000	9,590,000	62,900	15,200,000
Dominican Republic	110	129,000	--	--
Kazakhstan	--	--	1	2,980
Mexico	91	24,900	430	116,000
South Africa	--	--	118	121,000
Turkmenistan	--	--	6	7,730
United Arab Emirates	90	75,500	445	392,000
Total	46,000	11,100,000	71,200	17,400,000
Hydraulic lime:				
Afghanistan	--	--	4	5,420
Canada	6,570	1,540,000	4,040	797,000
Finland	--	--	3	3,900
France	2	2,770	5	7,130
Germany	7	12,000	42	54,300
Honduras	--	--	3	3,570
Italy	--	--	12	15,900
Liberia	--	--	15	6,010
Mexico	2	3,100	5	5,960
United Kingdom	4	5,590	15	19,800
Other [5 countries and (or) localities]	154 ^r	83,900 ^r	4	5,360
Total	6,740	1,640,000	4,150	924,000
Quicklime:				
Canada	237,000	37,800,000	280,000	44,000,000
China	9	6,600	27	20,100
Costa Rica	496	197,000	491	197,000
Ireland	248	323,000	318	428,000
Malaysia	2	4,000	21	23,000
Mexico	6,690	1,090,000	5,630	1,040,000
Netherlands	114	141,000	239	266,000
Panama	--	--	93	24,700
Saudi Arabia	--	--	62	65,600
Singapore	2,000	780,000	4,420	2,180,000
Other [11 countries and (or) localities]	308 ^r	242,000 ^r	51	59,700
Total	246,000	40,600,000	291,000	48,300,000
Slaked lime, hydrate:				
Bermuda	51	10,300	51	10,400
Canada	15,300	3,940,000	19,000	5,270,000
Chile	12,800	6,150,000	3,890	1,220,000
China	13	8,760	58	15,400
Colombia	--	--	308	34,500
Costa Rica	284	114,000	192	83,700
Germany	--	--	577	287,000
Mexico	110	58,100	108	61,500
Oman	965	234,000	314	69,200
Suriname	147	219,000	194	219,000
Other [10 countries and (or) localities]	581 ^r	398,000 ^r	178	306,000
Total	30,300	11,100,000	24,900	7,580,000
Grand total	329,000	64,500,000	391,000	74,200,000

^rRevised. -- Zero.

¹Table includes data available through January 9, 2020. Data 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 or locality	2016		2017	
	Quantity	Value ^{r,2}	Quantity	Value ²
Calcined dolomite:				
Canada	41,700	\$7,160,000	43,300	\$7,120,000
Germany	2	11,900	75	14,700
Italy	25	10,000	2	4,770
Sweden	1	5,950	--	--
Total	41,700	7,190,000	43,300	7,140,000
Hydraulic lime:				
Belgium	--	--	(3)	7,110
Canada	--	--	508	146,000
Dominican Republic	346	117,000	122	47,500
France	256	151,000	290	201,000
Germany	16	6,910	67	39,700
Italy	6	17,200	29	28,200
Mexico	--	--	21	2,280
Total	623	292,000	1,040	471,000
Quicklime:				
Austria	--	--	28	34,800
Canada	282,000	42,000,000	261,000	38,500,000
China	347	154,000	142	136,000
Dominican Republic	--	--	1	13,700
France	15	12,900	17	11,900
Italy	119	111,000	16	48,100
Japan	18	19,600	9	15,300
Mexico	4,370	755,000	8,950	1,620,000
Thailand	16	46,000	15	46,200
United Kingdom	4	29,600	306	257,000
Other [4 countries and (or) localities]	194 ^r	187,000	(3)	2,360
Total	287,000	43,300,000	271,000	40,700,000
Slaked lime, hydrate:				
Belgium	200	80,500	196	107,000
Canada	30,400	6,380,000	30,800	7,270,000
Dominican Republic	499	121,000	2,690	693,000
Germany	39	192,000	92	687,000
Italy	33	103,000	76	230,000
Mexico	15,300	3,430,000	17,000	4,080,000
Netherlands	259	161,000	230	154,000
Switzerland	--	--	77	53,900
Trinidad and Tobago	--	--	494	173,000
United Kingdom	15	28,600	111	335,000
Other [11 countries and (or) localities]	165	176,000	240	198,000
Total	46,900 ^r	10,700,000	52,000	14,000,000
Grand total	376,000	61,500,000	367,000	62,300,000

^rRevised. -- Zero.

¹Table includes data available through January 9, 2020. Data 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 OR LOCALITY¹

(Thousand metric tons, gross weight unless otherwise specified)

Country or locality ²	2013	2014	2015	2016	2017
Angola ^c	880	880	900	860	840
Australia, sales ^c	2,100	2,000	2,000	2,000	2,000
Austria ^e	780	830	820	810	830
Belarus	748	769	626	474	452
Belgium ³	1,404 ^r	1,481 ^r	1,468 ^r	1,500 ^e	1,500 ^e
Bosnia and Herzegovina	387	428	423	458	452
Brazil ^c	8,400	8,300	8,300	8,100	8,300
Bulgaria, industrial	1,377 ^r	1,482 ^r	1,473 ^r	1,518 ^r	1,400
Canada, shipments	1,865 ^r	1,995 ^r	1,852 ^r	1,807 ^r	1,827
Chile ^c	950	900	910	920	930
China ^c	220,000	230,000	250,000 ^r	290,000 ^r	290,000
Croatia	185	205	186	165	150 ^e
Czechia	982	1,011 ^r	1,006 ^r	1,066 ^r	1,100 ^e
Egypt ^c	800	750	720	700	770
Finland ^c	450	460	470	470	470
France	3,371 ^r	2,864 ^r	2,504 ^r	2,500 ^e	2,600 ^e
Germany	6,883 ^r	6,747 ^r	6,847 ^r	6,973 ^r	7,000 ^e
Hungary ^c	250	270	310	300 ^r	340
India ^c	16,000	16,000	16,000	16,000	16,000
Iran ^c	2,800	2,800	2,800	2,900	3,100
Ireland ^c	300 ^r	270	260	280	300
Israel	300	250	554	573 ^r	590 ^e
Italy ^{c,3}	3,600	3,600	3,500	3,600	3,600
Jamaica	106	104	105	110 ^e	110 ^e
Japan, quicklime only	7,619 ^r	7,911 ^r	7,336 ^r	7,341 ^r	7,300 ^e
Kazakhstan	869	923	871	928 ^r	1,044
Korea, Republic of ^c	5,000	5,100	5,100	5,100	5,200
Malaysia, sales ^c	1,100	1,400	1,500	1,600	1,600
Peru ^c	230	240	240	250	250
Poland	1,709 ^r	1,817 ^r	1,942 ^r	1,869 ^r	1,842
Romania	1,698 ^r	1,723 ^r	1,907 ^r	1,951 ^r	2,126
Russia, industrial and construction	10,902 ^r	11,583 ^r	11,221 ^r	11,000	11,000 ^e
Serbia	328 ^r	235	316	322 ^r	350 ^e
Slovakia	813	827	778	801	774
Slovenia	861 ^r	919 ^r	1,103 ^r	1,046 ^r	1,100 ^e
South Africa, burnt lime sales	1,187 ^r	1,255 ^r	1,115 ^r	1,117 ^r	1,100 ^e
Spain, sales ^c	1,800	1,800	1,800	1,800	1,800
Sweden ^c	810	700	700	710	710
Taiwan	282	261	211	214 ^r	247
Thailand, sales ^c	800	800	780	780 ^r	820
Tunisia	293	253	308 ^r	206 ^r	210 ^e
Turkey, sales ^c	4,400	4,300	4,400 ^r	4,500 ^r	4,700
Ukraine	3,892 ^r	3,134 ^r	2,717 ^r	2,542 ^r	2,500 ^e
United Arab Emirates ^c	450	430	460	470	480
United Kingdom ^c	1,500	1,600	1,600	1,500	1,500
United States, including Puerto Rico	19,000 ^r	20,000 ^r	18,000 ^r	17,000 ^r	18,000
Venezuela ^c	400	360	350	290	290
Vietnam ^c	850	850	840	840	840
Zambia ^c	280	280 ^r	280 ^r	300 ^r	310
Other ^{c,4}	1,700 ^r	1,700 ^r	1,700 ^r	2,000 ^r	2,000
Total	340,000	350,000	370,000 ^r	410,000 ^r	410,000

See footnotes at end of table.

TABLE 8—Continued
QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE: WORLD PRODUCTION,
BY COUNTRY OR LOCALITY¹

^cEstimated. ^fRevised.

¹Table includes data available through August 29, 2018. All data are reported unless otherwise noted. Totals, U.S. data, and estimated data are rounded to no more than two significant digits; may not add to totals shown.

²In addition to the countries and (or) localities listed, Argentina, Chad, Iraq, North Korea, Lebanon, Mexico, Nigeria, Pakistan, Saudi Arabia, Syria, and several other nations may have produced lime, but available information was inadequate to make reliable estimates of output.

³Includes hydraulic lime.

⁴Includes Afghanistan, Albania, Algeria (hydraulic only), Armenia, Azerbaijan (construction only), Cameroon, Cuba, Cyprus (hydrated only), Denmark (sales), Eritrea, Estonia, Ethiopia, Guatemala (hydrated only), Kenya, Kyrgyzstan, Libya, Macedonia, Malawi, Moldova, Mongolia, Montenegro, New Zealand, Nicaragua, Norway, Panama, Paraguay, Philippines, Qatar, Senegal, Switzerland, Tanzania, Turkmenistan, and Uganda.