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2016 Minerals Yearbook

LIME [ADVANCE RELEASE]

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Lime

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Domestic survey data and tables were prepared by Molly L. Reid, statistical assistant.

In 2016, lime production in the United States (including Puerto Rico) was 17.7 million metric tons (Mt) and had a value of $2.21 billion (table 1). Based on unrounded data, these were decreases of about 564,000 metric tons (t) and $74.9 million from those of 2015. Lime consumption decreased in most major market sectors (chemical and industrial, environmental, metallurgical, and refractories), although a modest increase was recorded for sales in the construction sector (table 3). On average, prices for lime sold or used were essentially the same in 2015 and 2016 (table 5), which was the first time since 1998 that prices did not increase.

Lime plants and facilities need to be located 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 2015, the U.S. lime industry consisted of 31 companies in 2016 (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 2016, Alabama and Missouri were the only two States that had production in excess of 2 Mt. There were three States with 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 [$CaMg(CO_3)_2$], 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, $Ca(OH)_2$]. There are four calcium-magnesium (dolomitic) forms: dolomitic quicklime ($CaO \cdot MgO$), dolomitic hydrate type N [$Ca(OH)_2 \cdot MgO$], dolomitic hydrate type S [$Ca(OH)_2 \cdot Mg(OH)_2$], and refractory dead-burned dolomite ($CaO \cdot MgO$). 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 (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 2016, data were received for 85 operations, including 9 that were idle during the entire year. Data received represented 98% 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 2016, 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 2016, production, or the total amount of lime sold or used by domestic producers,

including Puerto Rico, was 17.7 Mt, a 3% decrease compared with that of 2015 (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 2016, production of high-calcium quicklime decreased by 6% to 12.2 Mt, and dolomitic quicklime increased by 3% to 2.6 Mt from that of 2015 (table 1). The production of high-calcium hydrate increased by 10% from that of 2015, and dolomitic hydrate production was about the same as 2015. Commercial sales of quicklime and hydrate decreased by 3% to 16.4 Mt, and lime produced for captive consumption decreased slightly to 1.26 Mt, from those of 2015.

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.; Martin Marietta Magnesia Specialties LLC; United States Lime & Minerals, Inc.; Unimin Corp. (doing business as Southern Lime Co.); Cheney Lime & Cement Co.; Pete Lien & Sons, Inc.; 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 80% of total lime production.

On January 29, Carmeuse Lime and Stone started one of the two new gas-fired vertical shaft kilns at its Clear Brook plant near Winchester, VA. The second kiln was started later in 2016. The new kilns would replace the plant's existing rotary lime kiln. Each of the new kilns would have a capacity to produce 400 metric tons per day, the combination of which would double the plant's previous operating capacity (Carmeuse Lime and Stone, 2016; Industrial Info Resources, 2016).

In 2016, Graymont Ltd. started its new lime kiln, a vertical shaft parallel flow regenerative kiln, at its Pleasant Gap, PA, plant. The new kiln increased the plant's capacity by 25% (Graymont Ltd., 2012; 2017b, p. 15). Graymont continued to work on developing its Rexton project in the Upper Peninsula of Michigan, including expansion of the limestone quarry operations and the eventual construction of lime production facilities (Graymont Ltd., 2015; 2017b, p. 23).

Consumption

In 2016, reported U.S. lime consumption decreased in most major market sectors (table 3). The percentage distribution of lime consumption by general end-use sector was little changed from that of 2015, and was 33.5% for metallurgical uses, 29.1% for environmental uses, 22.2% for chemical and industrial uses, 11.2% for construction uses, and 1.1% for refractories. These end-use data were based on lime sold or used by domestic producers and do not include lime imports. Lime consumption tonnage for all environmental uses was generally significantly lower in 2016 than in 2015, led by a combined 457,000-t, or 26%, decrease in use in sludge and water treatment.

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 27% of lime sold or used by domestic lime producers. According to the World Steel Association (2017), U.S. steel production in 2016 was slightly less than that of 2015; lime sold for total steel and iron uses in 2016 was 3% less than that of 2015 (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 2016, lime consumption in nonferrous metallurgy decreased by 16% to 1.12 Mt from the peak of 1.33 Mt in 2015 (table 3).

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 by 11% in 2016 compared with that of 2015 (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 2016, lime consumption for all sludge treatment increased compared with that of 2015.

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 (SO_2) and hydrochloric acid (HCl). Many FGT systems at utility powerplants are now designed to produce byproduct synthetic gypsum ($CaSO_4 \cdot 2H_2O$) from the captured SO_2. 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 (SO_3) 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 87% of the total FGT lime market in 2016 (table 3). Incinerators, industrial boilers, and other FGT uses accounted for the remainder. In 2016, lime consumption decreased in the utility powerplant and incinerators FGT markets by 3% and 14%, respectively, but increased by 20% in the industrial boilers and other FGT markets (table 3). The use of hydrated lime in FGT in 2016 increased by about 25% to 460,000 t (table 4). This increase was attributed to the utility powerplant and industrial boilers 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 also 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 2016, consumption for pulp and paper production increased slightly from that in 2015 (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 (CO_2) 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 14% compared with that of 2015 (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 CO_2 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 (CO_3^{2-}) 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 2016, sales of lime for use in asphaltic concrete increased by 22% compared with those in 2015 (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. According to the U.S. Census Bureau (2017, table 2), public spending on highway and street construction was $91.2 billion in 2016, up from the $89.4 (revised) billion spent in 2015. The amount of lime consumed for soil stabilization in 2016 increased by 8% compared with that of 2015 (table 3).

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 2016 for building use was in the form of hydrate [268,000 t (table 4) out of 271,000 t of total lime (table 3)]. In 2016, the total amount of lime consumed in building uses, such as in aerated concrete, mortar, plaster, and whitewash, decreased by 16% compared with that of 2015 (table 3). Most of the lime sold or used for construction 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 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 2016 was slightly more than that of 2015. 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 2016 was essentially unchanged per metric ton. Prices for high-calcium lime sold decreased slightly in 2016 compared with those for 2015; the decreases ranged from $0.90 to $1.60 per metric ton, except for dolomitic quicklime and dolomitic hydrate, which increased by $0.70 and $6.30 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 2016. Total exports of lime in 2016 were 329,000 t valued at $64.5 million (table 6). About 91% of exports went to Canada, with most of the remaining exports going to Chile (4%), Mexico (2%), and Belgium (2%). Total imports of lime were 376,000 t valued at $59.7 million, with about 94% from Canada, nearly 5% from Mexico, and 1% from other countries (table 7). Canada provided nearly all of the high-calcium quicklime and dolomitic (calcined dolomite) lime, and 65% 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 2016, global lime production was estimated to be at least 350 Mt, not significantly changed from overall levels in 2013–15 (table 8). The leading lime-producing countries in 2016 were China (about 66%), the United States (5%), India (5%), 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. In some cases, lime sales data have been used as a proxy for country production figures.

Canada.—In December, Graymont received an environmental assessment certificate for its proposed lime plant and limestone quarry near Giscome, British Columbia. The lime plant would initially have one vertical kiln with a production capacity of 200,000 metric tons per year (t/yr) and a targeted startup in 2018, pending operational permit approval. Should future market conditions warrant, two additional 200,000-t/yr kilns could be built (Graymont Ltd., 2015, 2016, 2017a).

Thailand.—In September, Carmeuse Group and GP Group acquired a 45% stake in the Golden Lime Public Company Ltd., the leading Thai producer of lime. Thailand is one of the largest consumers of lime and lime-derived products in southeast Asia, mainly owing to a large and diversified industrial and agricultural base (Carmeuse Group, 2016).

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 2016–18 (World Bank, The, 2017, p. 1). 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 SO_2 scrubbing, which could lead to decreased FGT lime consumption. The U.S. Energy Information Administration (2018, p. 21) forecast the breakout of total domestic utility-scale electricity generation in 2017 would be 32% from natural gas and 30% from coal. In 2016, natural gas supplied 34% and coal supplied 30% of total U.S. electricity generation. In 2018, natural gas and coal were forecast to generate 34% and 28% of electricity, respectively.

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TABLE 1
SALIENT LIME STATISTICS[1]

		2012	2013	2014	2015	2016
United States:[2]						
Number of plants[3]		87	85	86	86	85
Lime sold or used by producers:						
Quantity:						
Quicklime:						
High-calcium	thousand metric tons	13,600	13,800	14,100	13,100	12,200
Dolomitic	do.	2,790	2,850	2,740	2,550	2,620
Total	do.	16,300	16,600	16,800	15,600	14,900
Hydrated lime:						
High-calcium	do.	2,000	2,050	2,190	2,150	2,360
Dolomitic	do.	253	260	279	279	281
Total	do.	2,260	2,310	2,470	2,430	2,640
Dead-burned dolomite[4]	do.	200	200	200	200	200
Grand total	do.	18,800	19,200	19,500	18,300	17,700
Value[5]	thousand dollars	2,230,000	2,320,000	2,390,000	2,290,000	2,210,000
Weighted average value	dollars per metric ton	118.50	121.20 r	122.40	125.30	125.10
Lime sold by producers (commercial sales):						
Quantity:						
Quicklime[6]	thousand metric tons	15,200	15,500	15,700	14,500	13,800
Hydrated lime	do.	2,250	2,310	2,470	2,430	2,620
Total	do.	17,500	17,800	18,100	17,000	16,400
Value[5]	thousand dollars	2,050,000	2,140,000	2,210,000	2,110,000	2,040,000
Lime used by producers (captive consumption):						
Quantity	thousand metric tons	1,340	1,380	1,400	1,280	1,260
Value[5]	thousand dollars	177,000	187,000	180,000	176,000	172,000
Exports:[7]						
Quantity	thousand metric tons	211 r	271 r	320	346	329
Value[8]	thousand dollars	36,700	48,300 r	57,600	62,600 r	64,500
Imports for consumption:[7]						
Quantity	thousand metric tons	468	394	414	391	376
Value[9]	thousand dollars	66,000 r	61,800 r	65,300 r	64,600 r	59,700
Consumption, apparent[10]	thousand metric tons	19,100	19,300	19,600	18,300	17,700
World, production	do.	330,000 r	340,000 r	350,000	340,000 r	350,000

rRevised. do. Ditto.
[1]Table includes data available through May 21, 2019. Data are rounded to no more than three significant digits, except world production data, which are rounded to two significant digits, and average values; may not add to totals shown. Excludes regenerated lime.
[2]Includes Puerto Rico.
[3]Includes most producer-owned hydrating plants not located at lime plants.
[4]Data are rounded to no more than one significant digit to avoid disclosing company proprietary data.
[5]Selling value, free-on-board plant.
[6]Includes dead-burned dolomite.
[7]Source: U.S. Census Bureau.
[8]Free alongside ship valuation.
[9]Cost, insurance, and freight valuation.
[10]Defined 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 REGION[1]

Region or division and year	Quantity				Value	
	Hydrated (thousand metric tons)	Quicklime[2] (thousand metric tons)	Total (thousand metric tons)	Percent of total	Total (thousand dollars)	Percent of total
2015:						
Northeast[3]	175	892	1,070	6	148,000	6 r
Midwest[4]	874	6,080	6,960	38	871,000	38 r
South:						
South Atlantic[5]	209	561	770	4	105,000	5
East South Central[6]	215	4,340	4,560	25	526,000	23
West South Central[7]	692	1,210	1,900	10	219,000	10 r
West[8]	267	2,740	3,000	16	418,000	18
Total	2,430	15,800	18,300	100	2,290,000	100
2016:						
Northeast[3]	184	828	1,010	6	131,000	6
Midwest[4]	929	5,960	6,890	39	880,000	40
South:						
South Atlantic[5]	219	653	871	5	107,000	5
East South Central[6]	233	3,930	4,160	23	485,000	22
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	15,100	17,700	100	2,210,000	100

[r]Revised.
[1]Table includes data available through May 21, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes dead-burned dolomite.
[3]Production in Massachusetts and Pennsylvania.
[4]Production in Indiana, Iowa, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.
[5]Production in Florida, Georgia, Puerto Rico, Virginia, and West Virginia.
[6]Production in Alabama, Kentucky, and Tennessee.
[7]Production in Arkansas, Louisiana, Oklahoma, and Texas.
[8]Production in 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	2015	2016
Chemical and industrial:		
Fertilizer, including aglime	77	74
Glass	178	W
Paper and pulp[4]	943	951
Precipitated calcium carbonate[4]	798	690
Sugar refining[4]	640	649
Other chemical and industrial[5]	1,580	1,560
Total	4,220	3,930
Metallurgical:		
Steel and iron:		
Basic oxygen furnaces[4]	2,140	2,100
Electric arc furnaces	2,570	2,530
Other steel and iron	251	184
Total	4,960	4,810
Nonferrous metallurgy[6]	1,330	1,120
Total metallurgical	6,280	5,930
Construction:		
Asphalt	196	239
Building uses	323 r	271
Soil stabilization	1,330	1,440
Other construction	62	44
Total	1,910 r	1,990
Environmental:		
Flue gas treatment:		
Utility powerplants	3,310	3,200
Incinerators	235	202
Industrial boilers and other flue gas treatment	213	255
Total	3,760	3,660
Sludge treatment:		
Sewage	104	130
Other, industrial and hazardous	262	W
Total	365	130
Water treatment:		
Acid-mine drainage	88	W
Drinking water	907	809
Wastewater	426	389
Total	1,420	1,200
Other environmental	155	152
Total environmental	5,700	5,140
Refractories (dead-burned dolomite)[4, 7]	200 r	200
Miscellaneous and unspecified	XX	507
Grand total	18,300	17,700

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified." XX Not applicable.
[1]Includes Puerto Rico.
[2]Table includes data available through May 21, 2019. Data are rounded to no more than three significant digits; may not add to totals shown. Does not include lime kiln dust and regenerated lime.
[3]The U.S. Geological Survey does not collect value data by end use; in previous years value data were estimated.
[4]Includes lime sold and used, where "used" denotes lime produced for internal company use.
[5]May 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.
[6]Includes alumina and bauxite, magnesium, metals concentration (copper and gold), and other nonferrous uses.
[7]Data 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	2015	2016
Chemical and industrial	564	554
Construction:		
Asphalt	172	215
Building uses	266	268
Soil stabilization	W	W
Other construction	487 [r]	568
Total	925	1,050
Environmental:		
Flue gas treatment:		
Utility powerplants	260	332
Incinerators	30	24
Industrial boilers and other flue gas treatment	80	105
Total	369	460
Sludge treatment:		
Sewage	29	37
Other sludge treatment	84	82
Total	113	118
Water treatment:		
Acid-mine drainage	38	35
Drinking water	159	126
Wastewater	146	151
Total	342	312
Other environmental	54	56
Metallurgical	65	78
Grand total	2,430	2,640

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other construction."
[1]Includes Puerto Rico.
[2]Table includes data available through May 21, 2019. Data are rounded to no more than three significant digits; may not add to totals shown. Excludes regenerated
[3]The U.S. Geological Survey does not collect value data by end use; in previous years value data were estimated.
[4]Includes 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]

Type	2015		2016	
	Dollars per metric ton	Dollars per short ton	Dollars per metric ton	Dollars per short ton
Sold or used:				
Quicklime	121.50	110.30	121.00	109.70
Hydrated lime	146.40	132.80	145.50	132.00
Weighted average, all types[3]	125.30	113.70	125.10	113.50
Sold:				
Quicklime:				
High-calcium	118.60	107.60	117.70	106.70
Dolomitic	129.90	117.80	130.60	118.40
Average quicklime	120.40	109.20	119.80	108.70
Hydrated lime:				
High-calcium	143.40	130.10	141.80	128.70
Dolomitic	170.00	154.20	176.30	160.00
Average hydrated lime	146.40	132.90	145.50	132.00
Weighted average, all types[3]	124.40	112.90	124.30	112.70

[1]Average value per ton, free-on-board plant, including cost of containers. Table includes data available through May 21, 2019.
[2]Unit values for metric tons and short tons were rounded independently.
[3]Includes dead-burned dolomite.

TABLE 6
U.S. EXPORTS OF LIME, BY TYPE AND COUNTRY OR LOCALITY[1]

(Metric tons and dollars)

Type and country or locality	2015		2016	
	Quantity	Value[2]	Quantity	Value[2]
Calcined dolomite:				
Argentina	280	96,700	380	131,000
Belgium	6,730	1,800,000	5,320	1,170,000
Brazil	24	15,000	--	--
Canada	52,500	12,200,000	40,000	9,590,000
Dominican Republic	--	--	110	129,000
Mexico	384	149,000	91	24,900
United Arab Emirates	21	18,100	90	75,500
Venezuela	33	25,000	--	--
Total	60,000	14,300,000	46,000	11,100,000
Hydraulic lime:				
Austria	6	7,160	--	--
Bahamas, The	15	3,510	28	7,720
Canada	9,380	2,240,000	6,570	1,540,000
China	13	21,100	--	--
France	6	8,430	2	2,770
Germany	2	2,830	7	12,000
Japan	5	6,000	53	69,300
Mexico	47	41,200	2	3,100
Trinidad and Tobago	--	--	73	6,900
United Kingdom	--	--	4	5,590
Other	9 r	14,300 r	--	--
Total	9,480	2,350,000	6,740	1,640,000
Quicklime:				
Bahamas, The	21	6,270	185	38,500
Canada	247,000	39,100,000 r	237,000	37,800,000
Chile	1,160	347,000	66	20,100
Costa Rica	215	86,100	496	197,000
Denmark	--	--	20	24,200
Ireland	14	19,200	248	323,000
Israel	--	--	16	12,200
Mexico	7,480	1,070,000	6,690	1,090,000
Netherlands	44	47,200	114	141,000
Singapore	18	15,100	2,000	780,000
Other	2,660 r	586,000 r	32	157,000
Total	259,000 r	41,200,000	246,000	40,600,000
Slaked lime, hydrate:				
Bermuda	51	9,930	51	10,300
Canada	16,500 r	3,870,000 r	15,300	3,940,000
Chile	116	80,500	12,800	6,150,000
Costa Rica	293	129,000	284	114,000
Korea, Republic of	32	230,000	55	225,000
Mexico	19	8,300	110	58,100
Nigeria	137	43,400	92	16,100
Oman	363	80,000	965	234,000
Panama	73	19,000	360	88,000
Suriname	--	--	147	219,000
Other	452 r	202,000 r	87	77,600
Total	18,000	4,680,000 r	30,300	11,100,000
Grand total	346,000	62,600,000 r	329,000	64,500,000

rRevised. -- Zero.
[1]Table includes data available through May 21, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Free alongside ship valuation.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF LIME, BY TYPE AND COUNTRY OR LOCALITY[1]

(Metric tons and dollars)

Type and country or locality	2015		2016	
	Quantity	Value[2]	Quantity	Value[2]
Calcined dolomite:				
Canada	48,200	7,600,000	41,700	6,970,000
Germany	40	18,300	2	7,690
Italy	52	19,500	25	7,010
Sweden	--	--	1	5,300
Total	48,300	7,630,000	41,700	6,990,000
Hydraulic lime:				
Canada	60	7,300	--	--
Dominican Republic	148	39,000	346	90,300
France	350	163,000	256	109,000
Germany	32	6,860	16	3,710
Italy	19	2,630	6	15,900
Japan	20	77,800	--	--
United Kingdom	16	8,140	--	--
Total	645	305,000	623	219,000
Quicklime:				
Canada	292,000	45,500,000	282,000	41,100,000
Chile	89	10,700	(3)	8,470
China	55	39,200	347	128,000
France	34	16,100	15	7,920
Germany	116	96,100	194	167,000
Italy	(3)	66,400	119	107,000
Japan	71	68,700	18	17,300
Mexico	804	124,000	4,370	750,000
Thailand	18	49,100	16	43,800
United Kingdom	2	17,900	4	25,900
Other	3 r	18,400 r	--	--
Total	293,000	46,000,000	287,000	42,300,000
Slaked lime, hydrate:				
Belgium	207	71,000	200	55,500
Canada	30,800	6,240,000 r	30,400	6,230,000
Chile	--	--	61	40,600
Dominican Republic	--	--	499	105,000
France	106	157,000	49	67,000
Germany	43	203,000	39	185,000
Italy	124	306,000	33	98,800
Japan	15	18,600	30	41,900
Mexico	17,200	3,360,000	15,300	3,200,000
Netherlands	269	133,000	259	133,000
Other	324 r	132,000 r	50	50,400
Total	49,100	10,600,000	47,000	10,200,000
Grand total	391,000	64,600,000	376,000	59,700,000

rRevised. -- Zero.

[1]Table includes data available through May 21, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Cost, insurance, and freight valuation.

[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 8

QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE: WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Thousand metric tons)

Country or locality[2]	2012	2013	2014	2015	2016
Angola[e]	NA	880	880	900	860
Australia, sales[e]	2,200	2,100	2,000 [r]	2,000 [r]	2,000
Austria	781	780	830	820	810 [e]
Belarus	747	748	769	626	474
Belgium[3]	1,400 [r]	1,400 [r]	1,480 [r]	1,470 [r]	1,500 [e]
Bosnia and Herzegovina	398	387	428	423	458
Brazil[e]	8,300	8,400	8,300	8,300	8,100
Bulgaria, industrial	1,430 [r]	1,380 [r]	1,480 [r]	1,470 [r]	1,400 [e]
Canada, shipments	1,970 [r]	1,860 [r]	2,000 [r]	1,850 [r]	1,900 [e]
Chile[e]	970	950	900	910	920
China[e]	200,000	220,000	230,000	220,000 [r]	230,000
Croatia	207	185	205	186	165
Czechia	973 [r]	982 [r]	1,010 [r]	1,010 [r]	1,070
Egypt[e]	800	800	750	720	700
Finland[e]	450	450	460	470	470
France	3,900 [e]	3,370 [r]	2,860 [r]	2,500 [r]	2,500 [e]
Germany	6,580 [r]	6,880 [r]	6,750 [r]	6,850 [r]	6,800 [e]
Hungary	230	250 [r]	270 [r]	310 [e]	290 [e]
India[e]	15,000	16,000	16,000	16,000	16,000
Iran[e]	2,800	2,800	2,800	2,800	2,900
Ireland[e]	300	290	270	260	280
Israel	770	300	250	554	570 [e]
Italy[e, 3]	5,800	3,600 [r]	3,600	3,500 [r]	3,600
Jamaica	84	106	104	105	110 [e]
Japan, quicklime only	7,580 [r]	7,620 [r]	7,910 [r]	7,340 [r]	7,300 [e]
Kazakhstan	908	869	923	871	439
Korea, Republic of[e]	5,200	5,000	5,100 [r]	5,100	5,100
Malaysia, sales[e]	1,100	1,100	1,400 [r]	1,500	1,600
Peru[e]	220	230 [r]	240	240	250
Poland	1,800 [r]	1,710 [r]	1,820 [r]	1,940 [r]	1,870
Romania	1,710 [r]	1,700	1,720	1,910 [r]	1,950
Russia, industrial and construction	10,900	10,900 [r]	11,600 [r]	11,200 [r]	11,000 [e]
Serbia[3]	239	279	235	316 [r]	330 [e]
Slovakia	903	813	827	778	801
Slovenia[e]	100	100	100	100	100
South Africa, burnt lime sales	1,210 [r]	1,190 [r]	1,260 [r]	1,120 [r]	1,120
Spain, sales[e]	1,800	1,800	1,800	1,800	1,800
Sweden[e]	960 [r]	810 [r]	700	700 [r]	710
Taiwan	287	282 [r]	261 [r]	211 [r]	216
Thailand, sales[e]	800	800	800	780	790
Tunisia	340	293	253	250 [r, e]	250 [e]
Turkey, sales[e]	4,500	4,400	4,300	4,200	4,300
Ukraine	4,420 [r]	3,890 [r]	3,130 [r]	2,720 [r]	2,800 [e]
United Arab Emirates[e]	400	450	430	460	470
United Kingdom[e]	1,500	1,500	1,600	1,600	1,500
United States, including Puerto Rico	18,800	19,200	19,500	18,300	17,700
Venezuela[e]	400	400	360	350	290
Vietnam[e]	850	850	850	840	840
Zambia[e]	250	280	300	310 [r]	320
Other[e, 4]	2,100 [r]	2,200 [r]	2,300 [r]	2,300 [r]	2,300
Total	330,000 [r]	340,000 [r]	350,000	340,000 [r]	350,000

[e]Estimated. [r]Revised. NA Not available.

[1]Table includes data available through October 25, 2017. All data are reported unless otherwise noted. Totals and estimated data are rounded to two significant digits, and U.S. production is rounded to no more than three significant digits; may not add to totals shown.

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

[3]Includes hydraulic lime.

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