



2010 Minerals Yearbook

LIME

LIME

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In 2010, the U.S. economy began a slow recovery from the longest recession since the 1930s. Increased consumption in steelmaking, chemical and industrial uses, and in flue gas desulfurization (FGD) led a surprisingly strong recovery in domestic lime production. In 2010, lime production increased by 2.5 million metric tons (Mt) (about 2.8 million short tons) and thus regained a large portion of the 4.1 Mt (4.5 million short tons) decrease reported for 2009. Lime sold and used in the United States totaled 18.3 Mt with a value of \$1.92 billion (table 1).

The term lime as used throughout this chapter refers primarily to six chemicals produced by the calcination of high-purity calcitic or dolomitic limestone followed by hydration where necessary. There are two high-calcium forms—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). 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, carbide plants, and water-treatment plants. Regenerated lime, however, is beyond the scope of this report.

Legislation and Government Programs

The lime industry is a significant producer of greenhouse gases, primarily in the form of carbon dioxide generated from the calcination of limestone and from fuels burned to achieve calcination. In May, the U.S. Environmental Protection Agency (EPA) issued a final rule that addresses greenhouse gas (GHG) emissions from stationary sources under the Clean Air Act (CAA) permitting programs. This final rule sets thresholds for GHG emissions that define when permits under the New Source Review Prevention of Significant Deterioration (PSD) and CAA Title V Operating Permit programs are required for new and existing industrial facilities. This final rule “tailors” the requirements of these CAA permitting programs to facilities responsible for nearly 70% of national GHG emissions from stationary sources. Beginning in January 2011, facilities already subject to PSD permitting that wish to construct a new facility or modify an existing facility with expected GHG emissions above 75,000 short tons per year (on a carbon dioxide equivalent basis) would be subject to GHG permitting requirements under PSD, and they would need to determine the best available control technology (BACT) for their GHG emissions. This rule would apply to the Nation’s largest GHG emitters, such as cement plants, powerplants, and refineries, as well as lime plants (U.S. Environmental Protection Agency, 2010b).

In November, the EPA published GHG BACT guidance, where BACT was defined as an emissions limitation based on the maximum degree of reduction for GHGs that would be emitted from any proposed major stationary source or major modification of an existing source. In the BACT review, permitting agencies must identify available control technologies, eliminate those that are technically impractical, rank remaining controls based on environmental effectiveness, and evaluate cost effectiveness of controls and energy and environmental impacts (U.S. Environmental Protection Agency, 2010a).

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, such as high-calcium or dolomitic. Because value data were not collected by end use, value data listed in table 3 were determined by calculating the average value per metric ton of lime sold or used for each respondent and then multiplying that figure by the quantity of lime that the respondent reported sold or used for each end use. Table 3 lists the total quantity sold or used for an end use and the total value of the quicklime and hydrate sold or used for that end use calculated as described above. A similar methodology using average hydrate values was used to calculate the value of hydrate sold and used listed in table 4.

In 2010, of the 85 operations that were canvassed, responses were received for 75 plants, representing 96% of the total sold or used by producers. Production data for the nonrespondents were estimated based on prior-year production figures and other information or were included with data reported for other operations.

Lime is a basic chemical that was produced as quicklime in 29 States and Puerto Rico. During 2010, quicklime was produced at 76 lime plants, and included 32 plants with collocated hydrating plants. Hydrated lime also was produced at 15 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 tables 1 and 2 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 a small number of slurry plants where lime was converted to liquid form by the addition of water prior to sale; this 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 percent solids required for each job. States with production exceeding 2 Mt were, in descending order, Missouri and Alabama; States with production between 1 and 2 Mt were, in descending order, Kentucky, Ohio, Texas, Pennsylvania, and Nevada.

Total lime sold or used by domestic producers in 2010 was 18.3 Mt, an increase of 2.5 Mt or about 16% compared with that of 2009. 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 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 2010, the production of high-calcium quicklime increased by nearly 17% to 13.8 Mt (15.2 million short tons), and accounted for 75% of total production. The production of high-calcium hydrate increased by 13%. Production of dolomitic quicklime increased by 15%, but production of dolomitic hydrate continued to be adversely affected by the depressed housing and construction markets and decreased by 8%. Commercial sales increased to 16.9 Mt (18.6 million short tons), and captive consumption increased to 1.37 Mt (1.51 million short tons).

In 2010, there were only minor company changes in the U.S. lime industry. Chemical Lime Co. (Fort Worth, TX) changed its name to Lhoist North America to more closely align its North American operations with its parent, the Lhoist Group (Brussels, Belgium). Missouri Lime LLC (Bonne Terre, MO) was sold in the fall and was in the process of changing its name to Valley Minerals LLC.

Although the lime industry reported significant production increases at many plants, a number of the plants idled in 2009 remained shut down during 2010. These included three Lhoist North America plants (Douglas, AZ; Tenmile, ID; and Grantsville, UT) and two Carmeuse Lime & Stone plants (South Chicago, IL; and Winchester, VA).

At yearend, the top 10 companies were, in descending order of U.S. lime production, Carmeuse, Lhoist, Graymont Ltd., Mississippi Lime Co., United States Lime & Minerals, Inc., Western Lime Corp., Martin Marietta Magnesia Specialties LLC, Southern Lime Co., ArcelorMittal USA Inc., and American Crystal Sugar Co. These companies reported production from 45 lime plants and 12 separate hydrating plants and accounted for nearly 91% of the combined commercial lime sales and 88% of total lime production.

Consumption

In 2010, the U.S. economy was recovering from the longest recession since the Great Depression of the 1930s, and lime consumption reflected the Nation’s economic recovery—strong in some sectors while lagging in others. The approximate breakdown of lime consumption by general end-use sectors was as follows: 35% for metallurgical uses, 32% for environmental uses, 23% for chemical and industrial uses, 9% 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. Consumption for metallurgical uses, which had accounted for 57% of the overall decrease in lime consumption in 2009, recorded the most significant gains in 2010, increasing by 1.55 Mt and accounting for 62% of the overall increase in lime consumption. Other market sectors recorded significant but much smaller increases—environmental [501,000 metric tons (t)], chemical and industrial (287,000 t), and construction (127,000 t).

Commercial sales accounted for 92% of domestic production. Captive lime accounted for the remainder of domestic production and was used mainly in the production of steel in basic oxygen furnaces (BOF), sugar refining, magnesia production, and refractories. Almost all data on captive lime production are withheld to avoid disclosing company proprietary information. As a result, table 3 lists the total quantity and value of lime by end use. End uses with captive production are listed in footnote 4 of the table.

In steel refining, quicklime is used as a flux to remove impurities, such as phosphorus, silica, and sulfur. The steel industry accounted for 29% of lime sold by domestic lime companies and the lime produced and used by ArcelorMittal USA from its captive lime plant. In 2009, U.S. steel production decreased by 36% (33.2 Mt) compared with that of 2008, and raw steel capacity utilization at U.S. steel mills averaged only 51% for the year. In 2010, demand picked up significantly and steel production increased by 38% (22.4 Mt) to 80.6 Mt and raw steel capacity utilization averaged 70% (Fenton, 2011; World Steel Association, undated). In 2010, lime consumption from domestic sources for steelmaking and related uses was 5.3 Mt, an increase of 39% compared with that of 2009.

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, to recover nickel by precipitation, and to control the pH of the sodium cyanide solution used to leach gold and silver from the ore. 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 these various uses (aluminum and bauxite processing, concentration of 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 2010, lime consumption in nonferrous metallurgy increased by about 5% to 1.13 Mt, but this was only a modest recovery from the 21% decrease recorded in 2009. Although specific data are not collected on lime consumption for copper recovery or for gold recovery, the increase in nonferrous lime consumption was likely the result of the

increase in gold production of about 7% compared with that of 2009 (George, 2011). Copper flotation concentrate production, in comparison, decreased by about 4% in 2010. Mine production of copper was at its lowest level since 1985 owing to lower ore grades and production cutbacks announced following the sharp fall in copper prices at yearend 2008 (Edelstein, 2011).

Environmental remediation uses of lime in mining include treatment of the tailings that result from the recovery of precious metals, such as gold and silver. These tailings may contain elevated levels of cyanides, and lime is used to recover cyanides in such treatment processes as alkaline chlorination, Caro's acid (H_2SO_5), Cyanisorb™, and sulfur dioxide/air.

Lime is used, generally in conjunction with soda ash, for softening municipal and plant process water. This precipitation process removes bivalent 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 by about 5% compared with that of 2009.

In sewage treatment, the traditional role of lime is to control pH in the sludge digester, which removes dissolved and suspended solids that contain phosphates and nitrogen compounds. Lime also aids in clarification 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 2010, lime consumption for all sludge treatment increased by nearly 17% compared with that of 2009.

In 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 acidic gases, particularly sulfur dioxide (SO_2) and hydrochloric acid (HCl). It also may be used to stabilize the resulting sludge before disposal. Many FGD systems at utility powerplants are now designed to produce byproduct gypsum from the SO_2 emissions. 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 (SO_3) emissions from selective catalytic reduction (SCR) systems installed at powerplants to control emissions of nitrogen oxides (NOx). Utility powerplants were by far the largest consumers of lime for FGD and accounted for 92% of the total FGD lime market in 2010. Incinerators, industrial boilers, and other FGD uses accounted for the remaining 8%. The FGD market benefitted from increased coal consumption for electricity generation as a result of the unusually long, hot summer experienced in the East and South. In 2010, lime consumption in all FGD markets increased by 421,000 t, but most of the increase was in the utility powerplants sector. The trend toward greater use of hydrated lime to treat SO_3 emissions from SCR systems at utility powerplants continued with consumption increasing by 39% compared with that of 2009.

Lime is used by the pulp and paper industry in the basic Kraft pulping process where wood chips and an aqueous solution (called liquor) of sodium hydroxide and sodium sulfide are heated in a digester. The cooked wood chips (pulp) are discharged under pressure along with the spent liquor. The pulp is screened, washed, and sent directly either to the paper machine or to the 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 2010, consumption for pulp and paper production increased by about 4% compared with that of 2009.

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. CO_2 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 by nearly 7% compared with that of 2009.

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 CO_2 to precipitate calcium carbonate.

In road paving, hydrated lime is used in hot mix asphalt to act as an antistripping agent. Stripping is generally defined as a loss of adhesion between the aggregate surface and the asphalt cement binder in the presence of moisture. Lime also is used in cold in-place recycling for the rehabilitation of distressed asphalt pavements. Existing asphalt 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 surface. In 2010, sales of lime for use in asphalt increased for the second year in a row and were up by nearly 6% compared with those for 2009, but the 297,000 t sold was still 16% below the quantity sold in 2007.

In construction, hydrated lime and quicklime 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

included 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 soil stabilization, lime competes with 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. In 2010, the soil stabilization market continued to be adversely affected by the slow recovery from the recession and by reduced highway spending at the State level, although some additional Federal funding would have been available from the American Recovery and Reinvestment Act of 2009, which was signed into law in February 2009. Primarily as a result of increased demand for a small number of specific projects, lime sold for soil stabilization increased to 983,000 t or by 16% compared with that of 2009. This was, however, still 30% less than the quantity sold for stabilization in 2008 (1.41 Mt) and 36% less than that of 2007 (1.54 Mt).

Hydrated lime is used in the traditional building sector in mortars, plaster, and stucco. Standard 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 was standard before the development of portland cement mortars. Modern portland cement 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. Although the annual value of residential construction decreased only slightly, the annual value of nonresidential construction decreased by 14% compared with that of 2009 (U.S. Census Bureau, 2011). Nearly all lime sold for traditional building uses is in the form of hydrate; in 2010, sales of hydrated lime for traditional building uses decreased by 11% compared with those of 2009. Most of the lime sold for building uses was produced at a handful of plants located 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 (EAF), and in continuous steel casting. Although the data reported in this chapter were rounded to one significant figure to avoid disclosing company proprietary data, the production of dead-burned dolomite increased by 20% compared with that of 2009. Magnesita Refractories Co. (formerly LWB Refractories Co.) at its York, PA, plant and Carmeuse at its Millersville, OH, plant were the only significant producers. 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 average values per ton for the various types of lime are listed in table 5. All value data for lime are reported by type of lime produced—high-calcium quicklime, high-calcium hydrate, dolomitic quicklime, and dolomitic hydrate. To avoid revealing company proprietary data, value data for dead-burned dolomite are included with the averages for all types.

Lime prices stabilized in 2010 after moderate annual increases in recent years and the large increase recorded in 2009. The following average values are compared with those of 2009. The average value for all types of lime sold increased slightly to \$104.30 per metric ton (\$94.60 per short ton). The average value for high-calcium quicklime sold increased by \$2.40 per ton to \$100.60 per ton (\$91.30 per short ton). Reflecting increased supplies in the Midwest from plants that were idle all or part of 2009, the average value for dolomitic quicklime sold decreased by nearly 7% to \$104.30 per ton (\$94.60 per short ton). The average value of high-calcium hydrate decreased slightly, while the average value of dolomitic hydrate increased slightly.

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 215,000 t (237,000 short tons) valued at \$36.2 million. About 88% of exports went to Canada, with the bulk of the remaining exports going to Russia (6%) and Mexico (4%) (table 6).

Combined imports of lime were 445,000 t (491,000 short tons) valued at \$61.5 million, with 90% from Canada, 9% from Mexico, and 1% from other countries (table 7). Canada was the primary import source of high-calcium quicklime and accounted for 98% of the total. Imports of dolomitic quicklime came almost exclusively from Canada (68%) and Mexico (31%), as was the case for hydrated lime Canada (58%) and Mexico (40%).

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

There is only limited international trade in lime. 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 as a result 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 in the European Union, or to supply lime products of quality not locally available.

With the exception of some industrialized nations, accurate lime production data for individual countries are difficult to obtain. Besides production by large commercial lime companies, lime is produced by small-scale manufacturers operating simple

kilns to supply individual villages and by industries producing lime for captive consumption. These variations and the frequent confusion with limestone data make accurate reporting extremely difficult and certainly incomplete. In some cases, lime sales data have been used to estimate country production figures. Beginning in 2006, major revisions were made to the estimates for China based on new information. Beginning in 2009, major revisions were made to estimates for India, based on steel production and other market assumptions (table 8).

Outlook

Although insulated from some of the effects of economic downturns by having diverse markets, the U.S. lime industry experienced lost sales in most markets owing to the severity of the 2008–09 recession. Steelmaking remains the leading market for lime, and the slowly recovering economy has seen a rebound in domestic steel production, but it still is significantly below prerecession levels. U.S. steel production is expected to exhibit a modest increase in 2011, with greater growth expected in 2012. Lime sales for steelmaking are expected to follow suit.

FGD is the second leading end-use market for lime. With the economy recovering, albeit slowly, electric power generation rates are expected to increase, and lime consumption for FGD also is expected to increase. Long-term growth is still expected in the FGD and related markets as a result of EPA's replacing the clean air interstate rule (CAIR). CAIR was vacated in July 2008 by the Circuit Court for the District of Columbia Court of Appeals but was revived when the court agreed with the EPA that the effect of vacating the CAIR was detrimental to the environment. The EPA was instructed, however, to revise or replace the CAIR in order to fix major flaws. In July 2010, the EPA proposed a rule known as the clean air transport rule (CATR) that would require 31 States and the District of Columbia to significantly improve air quality by reducing powerplant emissions that contribute to ozone and fine particle pollution in other States. Specific to the FGD market, 28 States would be required to reduce annual SO₂ and NO_x emissions. The final rule was expected in midyear 2011 and would go into effect 1 year after passage of the final rule, although a delay to allow utilities more time to comply was being proposed by industry.

The CATR may have mixed results with respect to lime consumption for FGD. Utilities may install additional FGD controls but also may choose to switch fuels from coal to cleaner burning natural gas and to retire older plants and replace them with natural-gas-fired plants. Fuel switching makes economic sense, especially if natural gas prices stay within a range of \$4 to \$7 per million British thermal units (Btu). By comparison, coal prices in 2010 suggested an estimated coal cost for powerplants of \$4.75 per million Btu. There is already evidence of a shift from the use of coal to natural gas in the utility market. In 2010, coal accounted for an estimated 47% of electricity generated compared with 51% in 2005. In 2010, natural gas' share was an estimated 23% compared with 17% in 2005 (Zhou, 2010).

The nonferrous metallurgy market for lime is expected to benefit from increased U.S. mine production of copper in 2011, following restoration of production at curtailed operations.

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TABLE 1
SALIENT LIME STATISTICS^{1,2}

	2006	2007	2008	2009	2010
United States ³					
Number of plants ⁴	91	89	90	81 ^r	85
Sold or used by producers:					
Quicklime:					
High-calcium thousand metric tons	15,000	14,700	14,900	11,800	13,800
Dolomitic do.	2,950	2,700	2,310	1,830	2,110
Total do.	18,000	17,400	17,200	13,600 ^r	15,900
Hydrated lime:					
High-calcium do.	2,370	2,240	2,070	1,690	1,910
Dolomitic do.	409	352	358	261	239
Total do.	2,780	2,590	2,420	1,950	2,150
Dead-burned dolomite ⁵ do.	200	200	200	200	200
Grand total:					
Quantity do.	21,000	20,200	19,900	15,800	18,300
Value ⁶ thousand dollars	1,700,000	1,760,000	1,840,000	1,660,000	1,920,000
Average value dollars per metric ton	81.20	87.10	92.40	105.02	105.35
Lime sold by producers:					
Quicklime thousand metric tons	16,600	16,100	16,000	12,600	14,700
Hydrated lime do.	2,780	2,590	2,420	1,950	2,140
Total do.	19,400	18,700	18,400	14,500	16,900
Value thousand dollars	1,560,000	1,600,000	1,690,000	1,510,000	1,760,000
Lime used by producers thousand metric tons	1,620	1,530	1,470	1,260	1,370
Value thousand dollars	144,000	155,000	149,000	147,000 ^r	161,000
Exports: ⁷					
Quantity do.	116	144	174	108	215
Value do.	19,200	24,800	27,100	18,500	36,200
Imports for consumption: ⁷					
Quantity thousand metric tons	298	375	307	422	445
Value thousand dollars	36,300	49,600	39,400	53,200	61,500
Consumption, apparent ⁸ thousand metric tons	21,200	20,400	20,000	16,100	18,500
World, production do.	285,000 ^r	296,000	307,000	297,000 ^r	311,000 ^e

^eEstimated. ^rRevised. do. Ditto.

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

²To convert metric tons to short tons, multiply metric tons by 1.102.

³Excludes regenerated lime; includes Puerto Rico.

⁴Includes most producer-owned hydrating plants not located at lime plants.

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

⁶Selling value, free on board plant.

⁷Source: U.S. Census Bureau.

⁸Defined as sold or used plus imports minus exports.

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

State	Plants ³	Hydrated (thousand metric tons) ⁴	Quicklime ⁵ (thousand metric tons) ⁴	Total (thousand metric tons) ⁴	Value (thousands)
2009:					
Alabama	6	114	1,840	1,960	\$226,000 ^r
Arizona, Colorado, Montana, Nevada, Utah, Wyoming	13	193 ^r	2,210 ^r	2,410 ^r	246,000 ^r
California, Idaho, Oregon, Washington	9	48 ^r	213 ^r	260 ^r	38,000 ^r
Indiana, Missouri	4	371	2,530 ^r	2,900 ^r	295,000 ^r
Iowa, Nebraska, South Dakota	3	(6)	298	298	29,500
Kentucky, Tennessee, West Virginia	6	103 ^r	2,240 ^r	2,340 ^r	208,000 ^r
Ohio	5	85	1,040	1,130	129,000
Pennsylvania	4	167	818	985	126,000
Texas	5	454 ^r	590	1,040	105,000
Wisconsin	4	145	606	751	70,000 ^r
Other ⁷	22 ^r	233 ^r	1,470	1,710	184,000
Total	81 ^r	1,910	13,900	15,800	1,660,000
2010:					
Alabama	6	153	2,000	2,150	239,000
Arizona, Colorado, Montana, Nevada, New Mexico, Utah, Wyoming	14	189	2,330	2,510	274,000
California, Idaho, Oregon, Washington	9	52	212	264	39,700
Indiana, Missouri	5	401	3,140	3,540	361,000
Iowa, Nebraska, South Dakota	3	(6)	354	354	35,700
Kentucky, Tennessee, West Virginia	6	112	2,490	2,600	235,000
Ohio	5	79	1,530	1,610	164,000
Pennsylvania	4	179	926	1,110	145,000
Texas	5	553	730	1,280	136,000
Wisconsin	4	150	716	866	81,200
Other ⁷	24	236	1,740	1,980	215,000
Total	85	2,100	16,200	18,300	1,920,000

^rRevised.

¹Excludes regenerated lime.

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

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

⁴To convert metric tons to short tons, multiply metric tons by 1.102.

⁵Includes dead-burned dolomite.

⁶Withheld to avoid disclosing company proprietary data; included in "Quicklime."

⁷Includes Arkansas, Florida, Georgia, Louisiana, Massachusetts, Michigan, Minnesota, North Dakota, Oklahoma, Puerto Rico, and Virginia.

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

(Thousand metric tons³ and thousand dollars)

Use	2009		2010	
	Quantity ⁴	Value ⁵	Quantity ⁴	Value ⁵
Chemical and industrial:				
Fertilizer, aglime and fertilizer	52	5,460	52	5,480
Glass	106	11,100	181	19,100
Paper and pulp	814	85,500	843	88,800
Precipitated calcium carbonate	944	99,100	1,010	106,000
Sugar refining	731 ^r	76,800	671	70,700
Other chemical and industrial ⁶	1,240	130,000	1,420	149,000
Total	3,890	408,000	4,170	440,000
Metallurgical:				
Steel and iron:				
Basic oxygen furnaces	1,690 ^r	178,000	2,430	256,000
Electric arc furnaces	2,000 ^r	210,000	2,670	281,000
Other steel and iron	121 ^r	12,700	212	22,300
Total	3,810	400,000	5,310	559,000
Nonferrous metallurgy ⁷	1,080	114,000	1,130	119,000
Total metallurgical	4,900	514,000	6,440	679,000
Construction:				
Asphalt	281	29,500	297	31,300
Building uses	254	26,700	230	24,200
Soil stabilization	848	89,100	983	104,000
Other construction	39	4,100	39	4,110
Total	1,420	149,000	1,550	163,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	3,110	327,000	3,520	371,000
Incinerators	216	22,700	227	23,900
Industrial boilers and other FGD	64 ^r	6,720	70	7,380
Total	3,390^r	356,000	3,820	402,000
Sludge treatment:				
Sewage	86	9,030	110	11,600
Other, industrial and hazardous	81	8,510	85	8,960
Total	167	17,500	195	20,500
Water treatment:				
Acid-mine drainage	82	8,610	90	9,480
Drinking water	963	101,000	911	96,000
Wastewater	630	66,200	649	68,400
Total	1,680	176,000	1,650	174,000
Other environmental	149 ^r	15,600	226	23,800
Total environmental	5,390	367,000	5,890	620,000
Refractories (dead-burned dolomite)	200 ⁸	18,700 ⁹	200 ⁸	22,500 ⁹
Grand total	15,800	1,660,000	18,300	1,920,000

^rRevised.

¹Excludes regenerated lime. Includes Puerto Rico.

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

³To convert metric tons to short tons, multiply metric tons by 1.102.

⁴Quantity includes 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.

⁵The U.S. Geological Survey does not collect value data by end use; the values shown are derived from average lime values.

⁶May 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.

⁷Includes aluminum and bauxite, magnesium, ore concentration (copper and gold), and other nonferrous uses.

⁸Data are rounded to no more than one significant digit to avoid disclosing company proprietary data.

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

⁹Value was derived from an average lime value per metric ton rather than a specific average value per metric ton of dead-burned dolomite.

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

(Thousand metric tons³ and thousand dollars)

Use	2009		2010	
	Quantity ⁴	Value ⁵	Quantity ⁴	Value ⁵
Chemical and industrial	482	60,900 ^r	539	67,200
Construction:				
Asphalt	251	31,700	262	32,700
Building uses	248	31,300 ^r	220	27,400
Soil stabilization	310	39,200 ^r	378	47,100
Other construction	12	1,520 ^r	10	1,250
Total	821	104,000 ^r	870	108,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	113	14,300	157	19,600
Incinerators	31	3,920 ^r	31	3,860
Industrial boilers and other FGD	19	2,400 ^r	23	2,870
Total	163	20,600 ^r	211	26,300
Sludge treatment:				
Sewage	16	2,020 ^r	16	1,990
Other sludge treatment	28	3,540 ^r	30	3,740
Total	44	5,560 ^r	46	5,730
Water treatment:				
Acid-mine drainage	46	5,810 ^r	45	5,610
Drinking water	138	17,400 ^r	140	17,500
Wastewater	193	24,400 ^r	186	23,200
Total	377	47,600 ^r	371	46,200
Other environmental	38	4,800 ^r	72	8,970
Metallurgy	30	3,790 ^r	43	5,360
Grand total	1,950	247,000 ^r	2,150	268,000

^rRevised.

¹Excludes regenerated lime. Includes Puerto Rico.

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

³To convert metric tons to short tons, multiply metric tons by 1.102.

⁴Quantity includes hydrated lime sold and used, where “used” denotes lime produced for internal company use in building, chemical and industrial, and metallurgical sectors.

⁵The U.S. Geological Survey does not collect value data by end use; the values shown are derived from an average value per metric ton of hydrated lime.

TABLE 5
LIME PRICES¹

Type	2009		2010	
	Dollars per metric ton	Dollars per short ton ²	Dollars per metric ton	Dollars per short ton ²
Sold and used:				
Quicklime	102.00	92.50	102.70	93.20
Hydrate	126.40	114.70	125.00	113.40
Average all types ³	105.00	95.30 ^r	105.40	95.60
Sold:				
High-calcium quicklime	98.20	89.10	100.60	91.20
Dolomitic quicklime	111.90	101.50	104.30	94.60
Average quicklime	100.00	90.70	101.00	91.70
High-calcium hydrate	124.60	113.00	122.70	111.30
Dolomitic hydrate	138.20	125.30	139.30	126.60
Average hydrate	126.40	114.70	124.60	113.00
Average all types ³	103.80	94.20	104.30	94.60

^rRevised.

¹Average value per ton, on a free-on-board-plant basis, 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	2009		2010	
	Quantity ²	Value ³	Quantity ²	Value ³
Calcined dolomite:				
Canada	43,100	7,200,000	57,300	10,000,000
Germany	--	--	1,080	295,000
Colombia	3	2,850	317	108,000
Mexico	267	66,800	34	7,570
Other	100 ^r	49,000 ^r	296	136,000
Total	43,400	7,320,000	59,100	10,600,000
Hydraulic lime:				
Austria	667	120,000	--	--
Bahamas, The	209	56,900	123	30,100
Canada	4,880	916,000	3,640	757,000
Other	338 ^r	151,000 ^r	165	411,000
Total	6,090	1,240,000	3,930	1,200,000
Quicklime:				
Canada	34,200	5,610,000	109,000	14,900,000
Costa Rica	477	150,000	662	212,000
Mexico	9,710	1,030,000	8,490	982,000
Russia	--	--	13,400	3,000,000
Other	151	319,000	675	805,000
Total	44,500	7,100,000	132,000	19,900,000
Slaked lime, hydrate:				
Angola	18	4,980	884	505,000
Canada	13,600	2,620,000	18,300	3,550,000
Nigeria	449	122,000	304	127,000
Other	42	72,600	373	356,000
Total	14,100	2,820,000	19,900	4,540,000
Grand total	108,000	18,500,000	215,000	36,200,000

^rRevised. -- Zero.

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

²To convert metric tons to short tons, multiply metric tons by 1.102.

³Declared free alongside ship valuation.

Source: U.S. Census Bureau.

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

(Metric tons and dollars)

Type	2009		2010	
	Quantity ²	Value ³	Quantity ²	Value ³
Calcined dolomite:				
Canada	7,740	1,200,000	29,600	4,580,000
Mexico	33,000	2,520,000	13,200	4,470,000
Other	8	13,800	409	292,000
Total	40,700	3,730,000	43,200	9,340,000
Hydraulic lime:				
Canada	53	10,900	31	3,770
France	181	113,000	240	127,000
Mexico	61	7,520	--	--
Netherlands	72	25,500	--	--
Other	56	27,800	43	23,900
Total	423	185,000	314	155,000
Quicklime:				
Canada	322,000	40,100,000	340,000	42,400,000
Colombia	3	371,000	2,010	255,000
Mexico	5,070	553,000	4,680	569,000
Other	1,180	310,000 ^r	873	482,000
Total	329,000	41,300,000	348,000	43,700,000
Slaked lime, hydrate:				
Canada	29,200	3,680,000	31,500	4,250,000
Mexico	22,100	3,210,000	21,700	3,410,000
Other	1,100	1,070,000	909	728,000
Total	52,300	7,960,000	54,000	8,390,000
Grand total	422,000	53,200,000	445,000	61,500,000

^rRevised. -- Zero.

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

²To convert metric tons to short tons, multiply metric tons by 1.102.

³Declared cost, insurance, and freight valuation.

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	2006	2007	2008	2009	2010 ^c
Australia ^e	1,600	1,600	2,200	2,000	2,000
Austria	465	491	612	507 ^r	500
Belgium ^{e,4}	2,400	2,400	2,300	2,000	2,000
Bosnia and Herzegovina	218	237	216	281 ^r	280
Brazil ^e	7,057 ⁵	7,393 ⁵	7,400	7,450	7,700
Bulgaria ⁴	1,409	1,443	1,422 ^r	950 ^r	1,000
Canada	2,185	2,134	2,069	1,601	1,910
Chile ^e	820 ^r	840 ^r	820 ^r	790 ^r	800
China ^e	160,000	170,000	180,000	185,000	190,000
Croatia ^{e,4}	260 ⁵	572 ⁵	541 ^r	415 ^r	415
Czech Republic	1,218	1,277	1,150 ^r	1,000 ^r	1,100
Egypt ^e	800	1,000 ⁵	1,000 ⁵	800 ^r	800
Finland ^e	430	517 ⁵	482 ⁵	500	475
France ^{e,4}	4,000	4,000	4,000	3,500	3,500
Germany	7,119	7,218	7,313	5,830 ^r	6,850

See footnotes at end of table.

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

(Thousand metric tons)

Country ³	2006	2007	2008	2009	2010 ^e
Hungary ^e	500	500	500	500	500
India ^e	12,000	12,000	13,000	13,000	14,000
Iran ^e	2,600	2,600	2,700	2,700	2,700
Israel	158	282	481	429 ^r	430
Italy ^{e,6}	5,900	6,000	6,000	6,000	6,000
Jamaica	304	277	313	300	300
Japan, quicklime only	9,014	9,359	9,528	6,746 ^r	7,200
Kazakhstan	988 ^r	1,023 ^r	906 ^r	798 ^r	881 ⁵
Korea, Republic of ^e	3,700	3,900	4,000	3,800 ^r	3,900
Malaysia ^e	800	1,300	900	800	900
Mexico ^{e,4}	6,500	6,200	6,000	5,500	5,800
Peru ^e	216 ⁵	215	215	216 ⁵	216
Poland	1,936	2,143	1,952	1,716 ^r	1,800
Romania ^e	1,942 ⁵	2,000	2,000	1,600 ^r	2,000
Russia ^e	8,200	8,200	8,200	7,000	8,000
Saudi Arabia ^e	360	400	400	400	400
Serbia	377	320	292 ^r	251 ^r	280
Slovakia	1,104	1,123	1,082	867 ^r	900
Slovenia ^e	1,500	1,500	1,500	1,500 ^r	1,500
South Africa, burnt lime sales	1,585	1,599	1,593	1,375	1,286 ⁵
Spain ^{e,4}	2,000	2,000	2,000	2,000	2,200
Sweden ^e	750	780	750	600	700
Taiwan ^e	450	470	450	450	450
Thailand ^e	800	800	800	750	750
Tunisia	401	395	369	366 ^r	370 ⁵
Turkey ^{e,4}	3,800	4,000	4,000	3,800	4,300
United Kingdom ^e	2,000	2,000	1,500	1,500	1,500
United States, including Puerto Rico	21,000	20,200	19,900	15,800	18,300 ⁵
Venezuela ^e	400	400	400	400	400
Vietnam	1,592	1,438	1,619 ^r	1,538 ^r	1,600
Zambia ^e	160 ^r	165 ^r	135 ^r	130 ^r	140
Other ^e	1,610 ^r	1,590 ^r	1,660 ^r	1,600 ^r	1,610
Total	285,000 ^r	296,000	307,000	297,000 ^r	311,000

^eEstimated. ^rRevised.

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

²Table includes data available through April 29, 2011.

³In addition to the countries listed, Argentina, Chad, Iraq, Nigeria, Pakistan, 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.

data are not reported; available general information is inadequate to formulate reliable estimates of output levels.

⁴Production estimate based on sales only; data may be incomplete.

⁵Reported figure.

⁶Includes hydraulic lime.