2009 Minerals Yearbook

LIME [ADVANCE RELEASE]

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LIME

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In 2009, the U.S. economy suffered the effects of the longest recession since the 1930s, which began in December 2007 and ended by the summer of 2009 (National Bureau of Economic Research, 2008). Initially, the recovery was slow, as the economy grew at an annual rate of only 2.2% in the third quarter, but the growth rate picked up noticeably in the fourth quarter, expanding at a 5.7% rate (Rampell, 2010).

As a result of the severe economic downturn, compared with that of the previous year, lime sold and used in the United States decreased by 21% to a total of 15.8 million metric tons (Mt) (17.4 million short tons). The value of U.S. lime production, however, decreased by only 9.8% or $180 million to $1.66 billion (table 1). The disproportionate decrease in production compared with the decrease in value was the result of average price increases of nearly 14% compared with those of 2008. With a few exceptions, consumption of lime in most markets recorded large decreases compared with that of 2008.

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 U.S. Environmental Protection Agency (EPA) published regulations to require reporting of greenhouse gas emissions from all sectors of the economy effective December 29, 2009 (U.S. Environmental Protection Agency, 2009a). The final rule applied to fossil fuel suppliers and industrial gas suppliers, direct greenhouse gas emitters, and manufacturers of heavy-duty and off-road vehicles and engines. As a direct greenhouse gas emitter, this rule would apply to the lime industry. The rule did not require control of greenhouse gases; it required only that sources above certain threshold levels monitor and report emissions. The rule covered carbon dioxide emissions (CO_2) from the calcination of limestone from all kilns combined, which was a significant change from the proposed rule published October 27, 2009 (Environmental Protection Agency, 2009b), which would have required lime producers to calculate CO_2 emissions from each kiln (a much more difficult and expensive process). The final rule also covered emissions of CO_2, methane, and nitrous oxides from the combustion of fuels from each lime kiln and each stationary combustion unit (National Lime Association, 2009).

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 2009, of the more than 90 operations that were canvassed, responses were received for 78 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 2009, quicklime was produced at 73 lime plants that operated all or part of the year, and included 31 plants with collocated hydrating plants. Hydrated lime also was produced at 14 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 was 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. Missouri was the only State with production that exceeded 2 Mt; States with production between 1 and 2 Mt were, in descending order, Alabama, Kentucky, Ohio, Nevada, and Texas.

Total lime sold or used by domestic producers in 2009 was 15.8 Mt, a decrease of 4.1 Mt or 21% compared with that of 2008. Production included the commercial sale or captive consumption 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, the majority of U.S. lime production sold and used is in the form of high-calcium quicklime. In 2009, the production of high-calcium quicklime decreased by 21% to 11.8 Mt (13.0 million short tons), and accounted for 75% of total production. The production of high-calcium hydrate decreased by 18%. Production of dolomitic quicklime decreased by 21%, while production of dolomitic hydrate decreased by 27%. Commercial sales decreased to 14.5 Mt (16.0 million short tons), and captive consumption decreased to 1.26 Mt (1.39 million short tons).

As a result of the recession and severe economic downturn, a significant number of lime plants were idle part or all of 2009. Plants idle all year included Carmeuse Lime & Stone's Grand River, OH, South Chicago, IL, and Winchester, VA, plants; Chemical Lime Co.'s Douglas, AZ, Grantsville, UT, and Tenmile, ID, plants; and Jomico LLC's Bonne Terre, MO, plant. Plants that operated intermittently or were shut down early in the year included Carmeuse's Manitowoc, WI, and River Rouge, MI, plants, and Chemical Lime's Alabaster, AL, plant and Belen, NM, hydrator. In addition, individual kilns were idled at some large multikiln plants to reduce unneeded capacity.

At yearend, the top 10 companies were, in descending order of U.S. lime production, Carmeuse, Chemical Lime, Graymont Ltd., Mississippi Lime Co., United States Lime & Minerals, Inc., Martin Marietta Magnesia Specialties LLC, Western Lime Corp., Southern Lime Co., American Crystal Sugar Co., and ArcelorMittal USA Inc. These companies reported production from 45 lime plants and 12 separate hydrating plants and accounted for 90% of the combined commercial lime sales and 86% of total lime production.

Consumption

In early 2009, the U.S. economy was mired in the longest recession since the Great Depression of the 1930s, and lime sales reflected the Nation's economic conditions by recording large decreases in most markets. Signs of a recovery were finally felt in the fourth quarter of 2009 when the steel market began to recover. The boost lime sales received in the fourth quarter resulted in apparent consumption of 16.1 Mt. The approximate breakdown of consumption by general end-use sectors was as follows: 34% for environmental uses, 31% for metallurgical uses, 25% 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 decreased by 2.34 Mt and accounted for 57% of the overall decrease in lime consumption. Other market sectors recorded significant but much smaller decreases—construction [649,000 metric tons (t)], environmental (560,000 t), and chemical and industrial (505,000 t).

Commercial sales accounted for 90% of total lime consumption and 92% of domestic production. Captive lime accounted for the remainder of consumption 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 consumption 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 consumption 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 24% of lime sold by domestic lime companies and the lime produced and used by ArcelorMittal USA from its captive lime plant. As a result of the recession, operating rates of U.S. steel mills decreased dramatically beginning in late 2008. In December 2008, raw steel capacity utilization had dropped to its lowest point at only 41%. It averaged less than 44% through the first 6 months of 2009, and it slowly increased during the second half of the year but still only averaged 62% in the fourth quarter (Fenton, 2009, 2010). In 2009, lime consumption from domestic sources for steelmaking and related uses was 3.8 Mt, a decrease of 35% compared with that of 2008. This large decrease parallels the decrease in U.S. raw steel production of 37% to 58.2 Mt in 2009 from 91.9 Mt in 2008 (M.D. Fenton, U.S. Geological Survey, written commun., April 16, 2010).

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. Lime consumption in nonferrous metallurgy decreased by 21% in 2009. Although specific data are not collected on lime consumption for copper recovery or for gold recovery, both markets likely decreased as a result of a 12% decrease in copper flotation concentrate production and an 8% decrease in gold production compared with those of 2008 (D.L. Edelstein, U.S. Geological Survey, written commun., April 19, 2010; George, 2010b). The decrease in copper flotation concentrate production followed significant revisions to mine plans by several copper producers, including the closure of a mine opened during 2008. Domestic consumption

of refined copper trended lower owing to weaker housing and automotive demand, and several brass mills closed during the year (Edelstein, 2010). The decrease in U.S. gold output was primarily the result of reduced production from several gold mines in Nevada and the closure of one mine in Montana and one in Nevada. These decreases were partially offset by increases in production from one new gold mine in Washington and increases from several mines in Nevada (George, 2010a).

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 increased slightly compared with that of 2008.

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 2009, lime consumption for all sludge treatment decreased by about 28% compared with that of 2008.

In flue gas desulfurization (FGD) systems serving coal-fired powerplants, incinerators (most are waste-to-energy powerplants), and industrial plants, lime is injected into the flue gas to remove 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 (NO_x). Utility powerplants were by far the largest consumers of lime for FGD and accounted for 93% of the total FGD market in 2009. Incinerators, industrial boilers, and other FGD uses accounted for the remaining 7%. In 2009, consumption decreased in all FGD markets—utility powerplants decreased by 14%, incinerators decreased by 8%, and the combined industrial boiler and other FGD markets decreased by 62% compared with those of 2008. Despite these overall decreases, the specific use of hydrated lime for FGD at utility powerplants actually increased by 16%, reflecting the growing use of hydrated lime to treat SO_3 emissions from SCR systems.

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 2009, consumption for pulp and paper production decreased by 6% compared with that of 2008.

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 decreased by nearly 15% compared with that of 2008.

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 2009, sales of lime for use in asphalt increased by 12% compared with those for 2008, but the 281,000 t sold was still 20% 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. There is competition between lime, cement, fly ash, cement kiln dust, 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 2009, the soil stabilization market was adversely affected by the severe economic downturn and by reduced highway spending levels in major markets. The American Recovery and Reinvestment Act of 2009 was signed into law in February 2009. It allocated nearly $50 billion for transportation, but only $26.6 billion of that was for the repair or construction of highways or bridges. By the end of 2009, the Federal Highway Administration had authorized 10,000 projects (of which about 6,100 were underway) in all States and territories for a total of $22.4 billion. This represented 84% of total funds available to States (U.S. Department of Transportation, 2010). In the case of Texas, the majority of funds were directed toward bridge construction and other projects that did not require soil stabilization. Total U.S. lime sales for soil stabilization decreased by nearly 40% (or 557,000 t) compared with those for 2008, and the decrease in sales from Texas lime plants accounted for 53% of the nationwide decrease.

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 stuccos and plasters, enhancing the strength, durability, 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 lime may be used in some types of nonresidential construction, most is used in residential construction, and the annual value of residential construction decreased by 27% compared with that of 2008 (U.S. Census Bureau, 2010). Nearly all lime sold for traditional building uses is in the form of hydrate; in 2009, sales of hydrated lime for traditional building uses decreased by 30% compared with those of 2008. Most of the lime (87% in 2009) 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 decreased compared with that of 2008. 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.

Prices continued to increase, with quicklime prices increasing about $11 per metric ton and hydrate prices increasing about $19 per ton, although the latter may also reflect a shift in product mix. Large price increases that went into effect beginning in 2009 were announced by some of the leading lime companies in late 2008. It appears that, despite the decrease in sales, lime producers were able to push through higher prices. Fuel surcharges (not included in the 2008 prices reported in table 5) were applied by many of the lime companies in early 2008 but were no longer in effect in 2009, when fuel prices decreased dramatically. In recent years, lime companies have reported that they were unable to keep up with rising production costs, and the large 2009 price increases were lime company efforts to reestablish operating margins.

The following average values are compared with those of 2008. The average for all types of lime sold increased to $103.80 per ton ($94.20 per short ton) or a 13% increase. The average value for high-calcium quicklime sold increased by nearly 12% to $98.20 per ton ($89.10 per short ton), and the average value for dolomitic quicklime sold increased by nearly 14% to $111.90 per ton ($101.50 per short ton). The average value of high-calcium hydrate increased by nearly 20%, and the average value of dolomitic hydrate increased by more than 9%.

Foreign Trade

The United States exported and imported quicklime, hydrated lime (slaked lime), hydraulic lime, and calcined dolomite (dolomitic lime). Combined exports of lime were 108,000 t (119,000 short tons) valued at $18.5 million. About 89% of exports went to Canada, with the remaining going to Mexico (9%), and other countries (2%) (table 6).

Combined imports of lime were 422,000 t (465,000 short tons) valued at $53.2 million, with 85% from Canada, 14% from Mexico, and 1% from other countries (table 7). Canada was the primary source of quicklime (high-calcium and dolomitic) imports and accounted for 89% of the total, but imports of hydrated lime were more evenly split, with Canada and Mexico accounting for 56% and 42%, respectively.

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

Lime is not a commodity that is traded internationally. 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. New estimates were made for India's lime production covering the period 2005–09, based on steel production and other market assumptions (table 8).

Outlook

Through the early part of 2010, the U.S. economy appeared to be showing signs of recovery. There were, however, existing factors that could derail the U.S. economic recovery by adversely affecting financial markets. These included debt problems in some European Union countries, the U.S. Federal deficit, and the large oil spill in the Gulf of Mexico that could negatively affect various industries in the region. A recovering U.S. economy would likely bolster lime sales in most markets, although construction may lag any recovery.

In 2009, lime's largest market, steelmaking and related uses, recorded a decrease in consumption of 35% compared with that in 2008. This market segment normally accounts for about 30% of lime consumption, but in 2009, that percentage dropped to 24%. U.S. raw steel production for the year to date through May was around 32.6 Mt (67% higher than the same period in 2009), which projected through yearend would equate to an annual production of 78 Mt (American Iron and Steel Institute, 2010). This compares with domestic raw steel production of 58.0 Mt for 2009, 91.9 Mt for 2008, 98.1 Mt for 2007, and 98.2 Mt for 2006. If 2010 trend continues, then this would likely result in an increase in lime consumption for steelmaking to 5.2 Mt from 3.8 Mt in 2009.

FGD is the second leading end-use market for lime. With the economy beginning to recover, electric power generation rates are expected to increase compared with those of 2009. Coal accounts for nearly 50% of net electrical generation on an annual basis, and it is these coal-fired powerplants that use the majority of lime consumed for FGD. In 2010, this market is expected to recover some of the lost sales experienced in 2009.

Longer term growth is still expected in the FGD and related markets as a result of EPA's clean air interstate rule (CAIR) or its replacement. The CAIR was designed originally to permanently cap emissions of SO_2 and NO_x in 28 Eastern States and the District of Columbia and would reduce these emissions through a cap-and-trade system. The original CAIR was vacated in July 2008 by the Circuit Court for the District of Columbia Court of Appeals, finding that it had "more than several fatal flaws." In December 2008, the CAIR was revived when, upon rehearing, the court agreed with the EPA that the effect of vacating the CAIR was detrimental to the environment. The court partly reversed its original decision by remanding the CAIR to the agency for revision and reinstated the CAIR until a new rule is ready to replace it. The EPA informed the court that development and finalization of a replacement rule could take about 2 years (Demase and others, 2009).

FGD systems that use limestone already dominate the utility powerplant market, and lime price increases in recent years have effectively taken lime out of consideration for use in large new wet FGD systems at powerplants. However, opportunities continue to exist for dry lime FGD systems on smaller utility and industrial boiler units and for the use of hydrated lime to treat SO_3 wastes from SCR systems that control NO_x emissions.

In conclusion, driven primarily by the recovering steel market, domestic lime output in 2010 may increase by 10% to 15% to between 17.4 and 18.2 Mt. It will likely, however, take years for lime demand to recover to the levels achieved prior to the recession, considering that it took more than a decade for lime consumption to climb back to previous levels after the major 1981–82 recession.

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TABLE 1

SALIENT LIME STATISTICS[1, 2]

		2005	2006	2007	2008	2009
United States[3]						
Number of plants[4]		94	91	89	90 r	83
Sold or used by producers:						
Quicklime:						
High-calcium	thousand metric tons	14,100	15,000	14,700	14,900	11,800
Dolomitic	do.	2,990	2,950	2,700	2,310	1,830
Total	do.	17,100	18,000	17,400	17,200	13,700
Hydrated lime:						
High-calcium	do.	2,220	2,370	2,240	2,070	1,690
Dolomitic	do.	474	409	352	358	261
Total	do.	2,700	2,780	2,590	2,420	1,950
Dead-burned dolomite[5]	do.	200	200	200	200	200
Grand total:						
Quantity	do.	20,000	21,000	20,200	19,900	15,800
Value[6]	thousand dollars	1,500,000	1,700,000	1,760,000	1,840,000	1,660,000
Average value	dollars per metric ton	75.00	81.20	87.10	92.40	105.00
Lime sold by producers:						
Quicklime	thousand metric tons	15,900	16,600	16,100	16,000	12,600
Hydrated lime	do.	2,700	2,780	2,590	2,420	1,950
Total	do.	18,600	19,400	18,700	18,400	14,500
Value	thousand dollars	1,370,000	1,560,000	1,600,000	1,690,000	1,510,000
Lime used by producers	thousand metric tons	1,490	1,620	1,530	1,470	1,260
Value	thousand dollars	129,000	144,000	155,000	149,000	150,000
Exports:[7]						
Quantity	do.	133	116	144	174	108
Value	do.	17,500	19,200	24,800	27,100	18,500
Imports for consumption:[7]						
Quantity	thousand metric tons	310	298	375	307	422
Value	thousand dollars	33,100	36,300	49,600	39,400	53,200
Consumption, apparent[8]	thousand metric tons	20,200	21,200	20,400	20,000	16,100
World, production	do.	270,000 r	284,000 r	296,000 r	307,000 r	299,000 e

[e]Estimated. [r]Revised. do. Ditto.

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

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

[3]Excludes regenerated lime; includes Puerto Rico.

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

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

[6]Selling value, free on board plant.

[7]Source: U.S. Census Bureau.

[8]Defined 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)
2008:					
Alabama	6 r	108	2,210	2,320	$239,000
Arizona, Colorado, Montana, Nevada, New Mexico, Utah, Wyoming	16	241	2,610	2,850	254,000
California, Idaho, Oregon, Washington	9	54	259	314	37,100
Illinois, Indiana, Missouri	6 r	453	3,380 r	3,830 r	337,000 r
Iowa, Nebraska, South Dakota	3	41	302	343	31,600
Kentucky, Tennessee, West Virginia	6 r	136	2,670 r	2,810 r	229,000 r
Ohio	6	117	1,550	1,670	166,000
Pennsylvania	4	186	942	1,130	126,000
Texas	5	680	819	1,500	128,000
Wisconsin	4	162	690	852	71,500
Other[6]	25 r	246	2,000	2,240	217,000
Total	90 r	2,420	17,400	19,900	1,840,000
2009:					
Alabama	6	114	1,840	1,960	225,000
Arizona, Colorado, Montana, Nevada, New Mexico, Utah, Wyoming	13	195	2,310	2,500	256,000
California, Idaho, Oregon, Washington	9	47	119	166	28,200
Illinois, Indiana, Missouri	4	371	2,650	3,020	306,000
Iowa, Nebraska, South Dakota	3	41	257	298	29,500
Kentucky, Tennessee, West Virginia	6	102	2,110	2,220	197,000
Ohio	5	85	1,040	1,130	129,000
Pennsylvania	4	167	818	985	126,000
Texas	5	453	590	1,040	105,000
Wisconsin	4	145	606	751	70,100
Other[6]	24	232	1,470	1,710	184,000
Total	83	1,950	13,800	15,800	1,660,000

[r]Revised.

[1]Excludes regenerated lime.

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

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

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

[5]Includes dead-burned dolomite.

[6]Includes 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 tons[3] and thousand dollars)

Use	2008		2009	
	Quantity[4]	Value[5]	Quantity[4]	Value[5]
Chemical and industrial:				
Fertilizer, aglime and fertilizer	43	3,940	52	6,770
Glass	206	19,000	106	10,900
Paper and pulp	865	79,900	814	83,900
Precipitated calcium carbonate	1,110	102,000	944	109,000
Sugar refining	675	62,400	733	74,600
Other chemical and industrial[6]	1,500	139,000	1,240	143,000
Total	4,400	406,000	3,890	428,000
Metallurgical:				
Steel and iron:				
Basic oxygen furnaces	2,590	239,000	1,600	176,000
Electric arc furnaces	2,840	263,000	1,920	207,000
Other steel and iron	431	39,800	302	28,800
Total	5,860	542,000	3,810	411,000
Nonferrous metallurgy[7]	1,370	127,000	1,080	107,000
Total metallurgical	7,230	668,000	4,900	519,000
Construction:				
Asphalt	250	23,100	281	34,500
Building uses	362	33,500	254	32,200
Soil stabilization	1,410	130,000	848	82,700
Other construction	53	4,930	39	4,300
Total	2,070	191,000	1,420	154,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	3,630	335,000	3,110	274,000
Incinerators	235	21,700	216	25,100
Industrial boilers and other FGD	77	7,090	29	3,650
Total	3,940	364,000	3,360	303,000
Sludge treatment:				
Sewage	118	10,900	86	9,450
Other, industrial and hazardous	113	10,500	81	8,500
Total	231	21,300	167	18,000
Water treatment:				
Acid-mine drainage	90	8,290	82	10,500
Drinking water	945	87,300	963	99,600
Wastewater	597	55,200	630	74,400
Total	1,630	151,000	1,680	184,000
Other environmental	143	13,300	184	20,100
Total environmental	5,950	550,000	5,390	525,000
Refractories (dead-burned dolomite)	200 [8]	19,700 [9]	200 [8]	30,000 [8]
Grand total	19,900	1,840,000	15,800	1,980,000

[1]Excludes regenerated lime. Includes Puerto Rico.

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

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

[4]Quantity 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.

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

[6]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.

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

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

[9]Value 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 tons[3] and thousand dollars)

Use	2008 Quantity[4]	2008 Value[5]	2009 Quantity[4]	2009 Value[5]
Chemical and industrial	571	61,200	482	66,700
Construction:				
Asphalt	215	23,100	251	31,700
Building uses	354	38,000	248	31,600
Soil stabilization	564	60,400	310	30,400
Other construction	11	1,180	12	1,420
Total	1,140	123,000	821	95,100
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	97	10,400	113	14,800
Incinerators	31	3,330	31	4,070
Industrial boilers and other FGD	36	3,840	19	2,610
Total	164	17,600	163	21,500
Sludge treatment:				
Sewage	30	3,260	16	2,270
Other sludge treatment	44	4,690	28	3,830
Total	74	7,940	44	6,100
Water treatment:				
Acid-mine drainage	69	7,350	46	6,320
Drinking water	161	17,200	138	18,000
Wastewater	160	17,200	193	24,200
Total	390	41,800	377	48,500
Other environmental	42	4,490	38	4,790
Metallurgy	40	4,340	30	4,010
Grand total	2,420	260,000	1,950	247,000

[1]Excludes regenerated lime. Includes Puerto Rico.

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

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

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

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

TABLE 5

LIME PRICES[1]

Type	2008 Dollars per metric ton	2008 Dollars per short ton[2]	2009 Dollars per metric ton	2009 Dollars per short ton[2]
Sold and used:				
Quicklime	89.90	81.60	102.00	92.50
Hydrate	107.20	97.30	126.40	114.70
Average all types[3]	92.40	83.90	105.00	95.20
Sold:				
High-calcium quicklime	87.80	79.70	98.20	89.10
Dolomitic quicklime	98.50	89.30	111.90	101.50
Average quicklime	89.20	80.90	100.00	90.70
High-calcium hydrate	103.90	94.30	124.60	113.00
Dolomitic hydrate	126.40	114.70	138.20	125.30
Average hydrate	107.20	97.30	126.40	114.70
Average all types[3]	91.70	83.20	103.80	94.20

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

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

[3]Includes dead-burned dolomite.

TABLE 6

U.S. EXPORTS OF LIME, BY TYPE[1]

(Metric tons and dollars)

Type	2008 Quantity[2]	2008 Value[3]	2009 Quantity[2]	2009 Value[3]
Calcined dolomite:				
Canada	65,000	$10,100,000 r	43,100	$7,200,000
Japan	567	566,000	--	--
Other	303 r	101,000 r	370	119,000
Total	65,800	10,700,000	43,400	7,320,000
Hydraulic lime:				
Austria	--	--	667	120,000
Bahamas, The	307	60,000	209	56,900
Canada	4,400	917,000	4,880	916,000
Saudi Arabia	265	47,800	1	6,730
Other	298 r	304,000 r	337	145000
Total	5,270	1,330,000	6,090	1,240,000
Quicklime:				
Canada	81,800	10,500,000	34,200	5,610,000
Costa Rica	80	24,800	477	150,000
Mexico	5,490	536,000	9,710	1,030,000
Other	515 r	923,000 r	151	319,000
Total	87,900	12,000,000	44,500	7,100,000
Slaked lime, hydrate:				
Angola	857	428,000	18	4,980
Canada	13,700	2,340,000	13,600	2,620,000
Nigeria	662	179,000	449	122,000
Other	133 r	74,200 r	42	72,600
Total	15,400	3,020,000	14,100	2,820,000
Grand total	174,000	27,100,000	108,000	18,500,000

[r]Revised. -- Zero.

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

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

[3]Declared free alongside ship valuation.

Source: U.S. Census Bureau.

TABLE 7

U.S. IMPORTS FOR CONSUMPTION OF LIME, BY TYPE[1]

(Metric tons and dollars)

Type	2008 Quantity[2]	2008 Value[3]	2009 Quantity[2]	2009 Value[3]
Calcined dolomite:				
Canada	17,600	$2,130,000	7,740	$1,200,000
Mexico	--	--	33,000	2,520,000
Other	86	70,100	8	13,800
Total	17,700	2,200,000	40,700	3,730,000
Hydraulic lime:				
Canada	--	--	53	10,900
France	194	132,000	181	113,000
Mexico	286	32,700	61	7,520
Netherlands	40	31,300	72	25,500
Other	69 r	63,400 r	56	27,800
Total	589 r	260,000	423	185,000
Quicklime:				
Canada	238,000	29,700,000	322,000	40,100,000
Mexico	5,950	429,000	5,070	553,000
Other	1,730	386,000	1,180	682,000
Total	245,000	30,500,000	329,000	41,300,000
Slaked lime, hydrate:				
Canada	19,000	2,340,000	29,200	3,680,000
Mexico	23,400	3,100,000	22,100	3,210,000
Other	717 r	980,000 r	1,100	1,070,000
Total	43,200	6,420,000	52,300	7,960,000
Grand total	307,000	39,400,000	422,000	53,200,000

[r]Revised. -- Zero.

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

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

[3]Declared 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]	2005	2006	2007	2008	2009[e]
Australia[e]	1,500	1,600	1,600	2,200 [r]	2,000
Austria	460 [r]	465 [r]	491 [r]	612 [r]	500
Belgium[e, 4]	2,300	2,400	2,400 [r]	2,300 [r]	2,000
Bosnia and Herzegovina	186	218	237	216	210
Brazil	6,500	7,057	7,393 [r]	7,400 [r, e]	7,450
Bulgaria[4]	1,352	1,409	1,443 [r]	1,500 [e]	1,500
Canada	2,289	2,185	2,134	2,069	1,601 [5]
Chile[e]	600	660	720 [r]	690 [r]	700
China[e]	150,000	160,000	170,000	180,000	185,000
Croatia[e, 4]	250 [r]	260 [r, 5]	572 [r, 5]	600 [r]	600
Czech Republic	1,211	1,218	1,277 [r]	1,200 [r, e]	1,200
Egypt[e]	800	800	1,000 [r, 5]	1,000 [r, 5]	1,000
Finland[e]	430	430	517 [r, 5]	482 [r, 5]	500
France[e, 4]	3,300	4,000	4,000	4,000	3,500
Germany	6,823	7,119	7,218	7,313 [r]	6,000
Hungary[e]	500	500	500	500	500
India[e]	11,000 [r]	12,000 [r]	12,000 [r]	13,000 [r]	13,000
Iran[e]	2,500	2,600	2,600	2,700	2,700
Israel	166	158	282	481	480
Italy[e, 6]	6,300	5,900	6,000	6,000	6,000
Jamaica	270	304	277	313	300
Japan, quicklime only	8,879	9,014	9,359	9,528 [r]	8,400
Kazakhstan	702	769	828	885	804 [5]
Korea, Republic of[e]	3,600 [5]	3,700 [r]	3,900 [r]	4,000 [r]	3,600
Malaysia[e]	700	800	1,300	900	800
Mexico[e, 4]	6,500	6,500	6,200 [r]	6,000 [r]	5,500
Peru	215	216	215 [e]	215 [e]	216 [p, 5]
Poland	1,749	1,936	2,143	1,952 [r]	1,950
Romania[e]	1,791 [5]	1,942 [5]	2,000 [r]	2,000 [r]	2,000
Russia[e]	8,200	8,200	8,200	8,200	7,000
Saudi Arabia[e]	360	360	400	400	400
Serbia	400 [7]	377	320	320	320
Slovakia	946	1,104	1,123	1,082 [r]	1,080
Slovenia[e]	1,500	1,500	1,500	1,500	NA
South Africa, burnt lime sales	1,417	1,585	1,599	1,593	1,375 [5]
Spain[e, 4]	1,818 [5]	2,000	2,000	2,000	2,000
Sweden[e]	740 [r]	750 [r]	780 [r]	750 [r]	600
Taiwan[e]	444 [5]	450	470	450	450
Thailand[e]	800	800	800	800	750
Tunisia	424	401	395	369 [r]	370
Turkey[e, 4]	3,600 [r]	3,800 [r]	4,000 [r]	4,000 [r]	3,800
United Kingdom[e]	2,000	2,000	2,000	1,500	1,500
United States, including Puerto Rico	20,000	21,000	20,200	19,900	15,800 [5]
Venezuela[e]	400	400	400	400	400
Vietnam	1,737	1,592 [r]	1,438 [r]	1,679 [r]	1,700
Zambia[e]	180	180	190	150	150
Other[e]	1,760 [r]	1,710 [r]	1,690 [r]	1,750 [r]	1,710
Total	270,000 [r]	284,000 [r]	296,000 [r]	307,000 [r]	299,000

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

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

[2]Table includes data available through March 29, 2010.

[3]In 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.

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

TABLE 8—Continued

QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE: WORLD PRODUCTION, BY COUNTRY[1, 2]

[5]Reported figure.

[6]Includes hydraulic lime.

[7]Montenegro and Serbia formally declared independence in June 2006 from each other and dissolved their union.