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LIME

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LIME

By M. Michael Miller

Domestic survey data and tables were prepared by Lisa D. Miller, statistical assistant, and the world production table was prepared by Glenn J. Wallace, international data coordinator.

In 2006, U.S. production of lime set a new domestic record in quantity and value. Production increased by 5% to 21.0 million metric tons (Mt) (about 23.1 million short tons) compared with that of 2005 (table 1). The value of production increased by $200 million to $1.70 billion as a result of increased production and overall price increases of about 8%. Nearly 70% of the increase came from Alabama and Midwestern States, stretching from Pennsylvania west to Illinois.

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.

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 4 were determined by calculating the average value per metric ton of quicklime sold or used for each respondent and then multiplying it by the quantity of quicklime that the respondent reported sold or used for each end use. The table 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. The same methodology was used to calculate the value of hydrate sold and used listed in table 5.

In 2006, of the 91 operations to which an annual survey form was sent, responses were received from 83 plants representing 98% of the total sold or used by producers. Production data for the eight nonrespondents were estimated based on prior-year production figures and other information.

Lime is a basic chemical that was produced as quicklime or hydrate in 35 States and Puerto Rico (table 2). At the end of 2006, quicklime was being produced at 84 lime plants operating kilns, which included 34 plants with collocated hydrating plants. Hydrated lime also was produced at 13 standalone hydrating facilities, which included 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 (owing to their physical proximity to one another) 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. States with production exceeding 2 Mt were, in descending order, Missouri, Alabama, and Kentucky; States with production between 1 and 2 Mt were, in descending order, Ohio, Texas, Nevada, Pennsylvania, and Indiana.

Total lime sold or used by domestic producers in 2006 was 21.0 Mt, a 5% increase compared with the total in 2005. Production included the commercial sale or captive consumption of quicklime, hydrated lime, and dead-burned refractory dolomite. The production of high-calcium quicklime increased by 6.3% and production of high-calcium hydrate increased by 6.8%. Production of dolomitic quicklime decreased slightly (less than 2%), but dolomitic hydrate production decreased by 13.7%. Commercial sales increased by about 807,000 metric tons (t) (890,000 short tons) to about 19.4 Mt (21.4 million short tons), and captive consumption increased by 129,000 t (142,000 short tons) to 1.62 Mt (1.79 million short tons).

Ash Grove Cement Co. closed its Rivergate lime plant in Portland, OR, ending quicklime production at the end of May. The company, however, agreed to lease the plant's storage, hydrating, and bagging operations to Graymont Ltd. The lime kilns at the plant will remain shut down, and the facility is now operating under Graymont Western U.S. Inc. as a hydrating plant only (Limelites, 2006b).

Carmeuse Lime announced that it acquired Rockwell Lime Co. of Manitowoc, WI, effective July 25. Rockwell Lime, which was founded in 1906, produces dolomitic quicklime, a number of specialized dolomitic hydrate products, and aggregate. The plant will do business as Rockwell Lime, a subsidiary of Carmeuse Lime (Pallotta, 2006).

Chemical Lime Co. announced plans to spend $30 million at its New Braunfels, TX, plant for a new lime kiln and to upgrade some of the plant's existing equipment with new air emissions controls. The new kiln will be built with best available control technology, thus allowing increased lime production with minimized air emissions. The new kiln and environmental control improvements are expected to be completed in early 2008 (Global Cement & Lime Magazine, 2006).

In response to a growing market demand for calcium hydroxide emission control reagents in the Ohio River region, Chemical Lime announced plans to construct a hydrating plant in the Louisville, KY, area. The quicklime feedstock will be supplied from Chemical Lime's network of eastern U.S. lime plants. This facility will be designed to produce Sorbacal® SP, Chemical Lime's proprietary emission control reagent for acid gas control applications, as well as standard hydrated lime products for the traditional construction, industrial, and water treatment markets (Schantz, 2006).

Chemical Lime was involved in some other noteworthy events, which included an acquisition, a divestiture, and a plant restart. The company acquired Franklin Industrial Minerals (the operating division of Franklin Industries, Inc., Nashville, TN). Franklin is a major U.S. producer of chemical-grade crushed and ground limestone from nine mining and processing facilities in five States (O'Driscoll, 2007). Chemical Lime's parent, the Lhoist Group of Belgium, sold its refractories subsidiary, LWB Refractories GmbH & Co., to Rhone Capital LLC. LWB Refractories operates refractory dead-burned dolomite plants in France, Germany, and York, PA (Industrial Minerals, 2007). After being idle since 1999, Chemical Lime restarted quicklime production at its Tenmile plant in southeastern Idaho. The plant, which was originally constructed in 1991-92, operates a vertical shaft kiln of the Maerz parallel flow regenerative type.

Cutler Magner Co., Duluth, MN, announced plans for a $36 million expansion project at its CLM Corp. lime plant in Superior, WI. The heart of the project is the addition of a fifth kiln designed and installed by Metso Minerals (a division of Metso Corp., headquartered in Helsinki, Finland). Construction of the new kiln was to begin in the fall of 2006 and be completed by December 2007. Kiln construction was estimated to account for about 50% of the project cost (Nelson, 2006).

Gallatin Materials LLC (majority owned by coal company Alpha Natural Resources, Inc.) is constructing a lime plant at Verona, KY, to serve steel, utility, and other markets in the region. Gallatin Materials will install two preheater rotary kilns, each capable of producing an estimated 250,000 metric tons per year of lime. Limestone kiln feed will be supplied from the nearby Sterling Materials Mine; Sterling Materials is owned and operated by Sterling Ventures LLC. The first kiln is expected to begin operating in late 2007, while the second kiln is scheduled to come online in 2009 (Alpha Natural Resources Inc., 2007).

Graymont (PA) Inc. began work on the final pieces of its $120 million program to improve and upgrade its lime operations in Pennsylvania. As part of the program, Graymont shut down its two other Pennsylvania plants (Con Lime in 2001 and Bellefonte in 2006) and consolidated all lime production at its Pleasant Gap plant. Construction was started on a new hydrating plant, which was expected to begin operation in the first quarter of 2007. Work was also begun on a 950-metric-ton-per-day straight rotary kiln (designated as kiln #7) scheduled for startup by September 2007. Kiln #7 will produce quicklime primarily for the steel market. In an apparent first for the U.S. lime industry, Graymont will be installing a heat recovery system on the new kiln to produce steam that will produce sufficient electricity to supply one-half of the plant's power requirements (Thomas, 2006).

Mississippi Lime Co. commissioned its third RCE vertical shaft kiln in July 2006. The RCE lime kiln is manufactured by RCE Industrieofenbau Engineering GmbH of Austria, which is a subsidiary of Swiss kiln company Maerz Ofenbau AG. This is the third of three identical gas-fired shaft kilns installed by Mississippi Lime; the previous two RCE kilns went into service in 2002 and 2005 (Maerz News, 2006). The capacity added by the new kiln and the other RCE kilns allowed Mississippi Lime to close its Springfield, MO, plant, which the company had acquired from Ash Grove Cement in 2001. Mississippi Lime also announced plans to install an additional hydrator at its lime plant in Ste. Genevieve, MO, and to construct a hydrating plant at the Weirton Ice and Coal Co.'s Ohio River terminal in Weirton, WV. The Weirton plant will supply regional environmental markets such as acid mine drainage, water treatment, and flue gas desulfurization. Both plants were expected to be operational by the second quarter 2007 (Harris, 2006).

Despite minor construction delays, United States Lime & Minerals, Inc. completed construction of a third kiln at its Arkansas Lime Co. plant in Batesville, AR. The new kiln started production in the fourth quarter; completion of other ancillary structures was expected by yearend (United States Lime & Minerals, Inc., 2006).

At yearend, the top 10 companies were, in descending order of U.S. lime production, Carmeuse Lime, Chemical Lime, Graymont, Mississippi Lime, United States Lime & Minerals, Martin Marietta Magnesia Specialties LLC, O-N Minerals, Western Lime Corp., Southern Lime Co., and Mittal Steel U.S.A. (formerly Ispat Inland Inc.). These companies operated 44 lime plants and 9 separate hydrating plants and accounted for nearly 89% of the combined commercial sales of quicklime and hydrated lime and about 85% of total lime production.

Environment

In September, the U.S. Environmental Protection Agency (EPA) announced final revisions to its national air quality standards for fine particulate matter and some coarse particles. When breathed, these particles can accumulate in the respiratory system and are associated with numerous health effects. For fine particles [≤2.5 micrometers (µm) in diameter], the 24-hour standard was strengthened to 35 micrograms per cubic meter ($\mu g/m^3$) from 65 $\mu g/m^3$, and the annual standard was retained at 15 $\mu g/m^3$. For inhalable coarse particles (>2.5 and <10 µm), the existing 24-hour standard of 150 $\mu g/m^3$ was retained. Under the final rule, only two additional lime plants (located in particulate matter nonattainment areas) will be affected and may require additional air monitoring and possibly installation of additional control technologies (Limelites, 2006a).

Consumption

The breakdown of consumption by general end-use sectors was as follows: 36% for metallurgical uses, 29% for environmental uses, 21% for chemical and industrial uses, 13% for construction uses, and 1% for refractory dolomite (table 3). Consumption increased in all general sectors except construction, which decreased by about 4% compared with that of 2005. The chemical and industrial and environmental sectors increased by about 8% and 7%, respectively, compared with revised 2005 totals. The metallurgical sector increased by about 4%.

Commercial sales accounted for about 92% of total lime consumption. Captive lime accounted for about 8% of consumption and was used mainly in the production of steel in basic oxygen furnaces, sugar refining, magnesia production, and refractories. Almost all data on captive lime consumption, excluding the sugar industry, 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.

There were revisions made in the 2005 data for some specific end-use categories owing to better information on previously estimated sales. In addition, there were some end-use categories (such as paper and pulp, wastewater, and other environmental) where significant increases were reported in 2006 that were, at least in part, the result of changes in how a company reported end-use data to the USGS.

In steel refining, quicklime is used as a flux to remove impurities, such as phosphorus, silica, and sulfur. The steel industry accounted for 30% of all lime consumed in the United States. In 2006, raw steel production in the United States increased by nearly 4% compared with that of 2005. This increase was reflected in the consumption of lime for steel and iron uses, which increased by more than 4% to 6.25 Mt (6.89 million short tons).

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. Such leaching processes are called dump leaching when large pieces of ore are involved, heap leaching when small pieces of ore are involved, and carbon-in-pulp cyanidation when the ore is leached in agitation tanks. Dump and heap leaching involve crushing the ore, mixing it with lime for pH control and agglomeration, and stacking the ore in heaps 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 consumed for these various uses is included in table 3 under the category “Nonferrous metallurgy.” Lime usage in nonferrous metallurgy (aluminum and bauxite processing, concentration of copper and gold ores, and unspecified nonferrous uses) increased only slightly in 2006. However, the ore concentration sector increased by more than 5% driven by a 15% increase in copper ore concentrate. Copper concentrate output rose following a return to full production at Asarco LLC’s mines in Arizona (after a strike in 2005), increased output from the Kennecott Utah Copper Corp.’s Bingham Canyon Mine in Utah, and startup of concentrate production at Phelps Dodge Corp.’s Morenci Mine in Arizona (Edelstein, 2007).

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.

There were some significant revisions in various water treatment categories (table 3) for 2005 owing to the receipt of better information on the end uses of lime sold to other lime companies. These revision affected environmental applications, which include its use in the softening and clarification of municipal potable water, neutralization of acid-mine drainage and industrial discharges, and in sewage (wastewater) treatment. 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. More recently, the leading use in sewage treatment has been 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. Lime consumption for all sludge treatment decreased by about 10% compared with that of 2005.

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 suitable for use in manufacturing gypsum wallboard, cement production, and 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). The utility powerplant category dominates the FGD market, and regularly accounts for more than 90% of the total FGD market. In 2006, consumption increased in all FGD markets, with the largest increase reported in the incinerator market, which increased by 93,000 t or 70% compared with that of 2005. There are 89 waste-to-energy powerplants in the United States and nearly all (>99% by rated daily capacity) are subject to acid-gas controls as required by the Clean Air Act Amendments of 1990. There are a number of different acid-gas control systems and several use dry lime or lime slurry as the sorbent to neutralize acid gases such as hydrochloric acid (Kiser and Zannes, 2004).

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 to the paper machine or for bleaching. 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. Lime consumption for pulp and paper production increased by 15% in 2006. About one-third of the increase was the result of increased lime production at the Bowater Inc. paper mill in Tennessee, but much of the remaining increase may have been the result of reporting discrepancies between the 2005 and 2006 data, rather than actual increased sales.

Lime is used to make precipitated calcium carbonate (PCC), a specialty filler used in premium-quality coated and uncoated papers, paint, and plastics. The most common PCC production process used in the United States is the carbonation process. Carbon dioxide (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 use for PCC production increased by nearly 10% compared with that of 2005.

Lime is used, generally in conjunction with soda ash, for softening 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.

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. The CO_2 is obtained as a byproduct of lime production.

In road paving, hydrated lime is used in hot mix asphalt to act (HMA) 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 by 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 2006, sales of lime for use in asphalt decreased by about 5% compared with those for 2005.

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 decreased by about 5% compared with those for 2005. Although this decrease may have been simply a 1-year phenomenon, with the cost of lime increasing an average of 6% to 9% per year in the past 3 years, customers may be seeking lower-cost alternatives to lime such as kiln dust or fly ash.

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.

Owing to the downturn in the U.S. housing market, the annual value of residential construction put in place decreased by nearly 2% in 2006 compared with that of 2005 (U.S. Census Bureau, 2007). This was mirrored by the 2% decrease in sales of hydrated lime for traditional building uses. The bulk (nearly 80%) of lime sold for building uses is produced at five plants located in Nevada, Ohio, Utah, 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 basic oxygen furnaces. Refractory brick also is used in the lining of many treatment and casting ladles, in argon oxygen decarburization and vacuum oxygen decarburization converters, in electric arc furnaces, and in continuous steel casting. Although the actual numbers are rounded to one significant figure to avoid disclosing company proprietary data, the production of dead-burned dolomite sold and used increased by 3.6% compared with that of 2005. This was the fourth year in a row that dead-burned dolomite production increased, and the 2006 production represents nearly a 35% increase compared with the quantity produced in 2002. LWB Refractories Co., York, PA, and Carmeuse Lime, Millersville, OH, were the only significant producers. Hydrated lime is 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 7. The values are reported in dollars per metric ton and dollars per short ton. All value data for lime are reported by type of lime produced—high-calcium quicklime, high-calcium hydrate, dolomitic quicklime, dolomitic hydrate, and dead-burned dolomite. Emphasis is placed on the average value per metric ton of lime sold.

There was significant upward movement in lime prices, and the average for all types of lime sold increased to $80.50 per metric ton ($73.00 per short ton), nearly a 9% increase compared with the average for 2005. The average value for high-calcium quicklime increased by nearly 9% to $76.20 per metric ton ($69.10 per short ton) and the average for dolomitic quicklime increased by more than 10% to $82.60 per metric ton ($75.00 per short ton). The average values of high-calcium hydrate and dolomitic hydrate increased by 9% and

7%, respectively. The average value of dead-burned dolomite increased by 26%.

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 116,000 t (128,000 short tons) valued at $19.2 million, with about 95% exported to Canada, about 2% exported to Mexico, and the remaining 3% going to other countries (table 6). Combined imports of lime were 298,000 t (328,000 short tons) valued at $36.3 million, with 83% from Canada, 16% from Mexico, and less than 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. Mexico was the leading exporter of hydrated lime to the United States and accounted for 59% of U.S. imports.

There is some confusion on what is being reported as imports and exports of hydraulic lime. Natural hydraulic lime is produced from siliceous or argillaceous limestones that contain varying amounts of silica, alumina, and iron. There is no production of natural hydraulic lime in the United States. Synthetic hydraulic lime is produced by mixing hydrated lime with pozzolanic or hydraulic materials such as portland cement. Exports could be synthetic hydraulic lime or, because the chemistry is quite similar, portland cement (or some other hydraulic cement product).

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

World Review

With the exception of some industrialized nations, accurate lime production data for individual countries are difficult to obtain. The variations in quality and types of lime, production technologies, and industries manufacturing lime and the frequent confusion with limestone data make accurate reporting extremely difficult and certainly incomplete (table 8). In addition to routine revisions made to individual country data, major revisions were made to the estimates for China based on new information.

Outlook

Most lime markets are considered to be mature with little potential for large growth. The exception continues to be the FGD market, which is expected to display significant growth as a result of the clean air interstate rule (CAIR). The CAIR will permanently cap emissions of SO_2 and NO_x in 28 Eastern States and the District of Columbia and will reduce these emissions through a cap and trade system. The Phase I cap for NO_x emissions is scheduled for 2009, and the Phase I cap for SO_2 emissions is scheduled for 2010. 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 new FGD systems at powerplants. However, opportunities exist for dry lime FGD systems on small utility and industrial boiler units and for the use of hydrated lime to treat SO_3 wastes from selective catalytic reduction systems that control NO_x emissions.

The rate of increase in steel production and steel shipments slowed during the last quarter of 2006 as demand for steel products slowed (especially for automobile production). This slowdown continued into the spring of 2007, and year-to-date production for the week ending May 5, 2007, was 7% less than that in the same period in 2006 (American Iron and Steel Institute, 2007). Lime consumption for iron and steel uses will probably follow this trend and exhibit a decrease in 2007 compared with 2006 levels.

Upward pressures on lime prices will continue primarily in the form of high fuel prices. Although lime plants use large amounts of fuel (mostly coal) to fire the lime kilns, compared with utility powerplants they are small consumers and as a result lack the purchasing power of a utility. In addition, expectations for strong rail freight demand and ongoing tight rail capacity are expected to result in rail rate increases continuing in 2007. This will result in higher delivered coal costs to the lime companies, and, conversely, will increase the delivered price to the customer of lime shipped by rail.

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TABLE 1

SALIENT LIME STATISTICS[1, 2]

		2002	2003	2004	2005	2006
United States[3]						
Number of plants[4]		99	96	91	94	91
Sold or used by producers:						
Quicklime:						
High-calcium	thousand metric tons	13,400	13,900	14,200	14,100	15,000
Dolomitic	do.	2,420	2,460	3,020	2,990	2,950
Total	do.	15,800	16,400	17,200	17,100	18,000
Hydrated lime:						
High-calcium	do.	1,500	2,140	2,140	2,220	2,370
Dolomitic	do.	431	464	421	474	409
Total	do.	1,930	2,610	2,570	2,700	2,780
Dead-burned dolomite[5]	do.	200	200	200	200	200
Grand total:						
Quantity	do.	17,900	19,200	20,000	20,000	21,000
Value[6]	thousand dollars	1,120,000	1,240,000	1,370,000	1,500,000	1,700,000
Average value	dollars per metric ton	62.60	64.80	68.90	75.00	81.20
Lime sold	thousand metric tons	16,500	17,700	18,400	18,600	19,400
Lime used	do.	1,340	1,470	1,520	1,490	1,620
Exports:[7]						
Quantity	do.	106	98	100	133	116
Value	thousand dollars	13,100	13,700	14,300	17,500	19,200
Imports for consumption:[7]						
Quantity	thousand metric tons	157	202	232	310	298
Value	thousand dollars	19,700	22,500	25,900	33,100 r	36,300
Consumption, apparent[8]	thousand metric tons	17,900	19,300	20,100	20,200	21,200
World, production	do.	221,000 r	236,000 r	249,000 r	259,000 r	271,000 e

[e]Estimated. [r]Revised.

[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 producer-owned hydrating plants not located at lime plants.

[5]Data are rounded to no more than one significant digit to protect 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)
2005:					
Alabama	5	145	2,100	2,240	$180,000
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming	19	386	2,670	3,060	221,000
California, Oregon, Washington	8	69	299	368	44,100
Illinois, Indiana, Missouri	7	510	3,250	3,760	280,000
Iowa, Nebraska, South Dakota	3	W	W	366	26,400
Kentucky, Tennessee, West Virginia	5	124	2,670	2,790	188,000
Ohio	7	130	1,660	1,790	130,000
Pennsylvania	7	161	936	1,100	104,000
Texas	5	628	982	1,610	112,000
Wisconsin	4	195	694	888	61,300
Other[6]	24	348	2,090	2,440	156,000
Total	94	2,700	17,400	20,000	1,500,000
2006:					
Alabama	5	164	2,290	2,450	224,000
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming	20	357	2,910	3,260	237,000
California, Oregon, Washington	6	70	253	323	39,000
Illinois, Indiana, Missouri	7	549	3,450	4,000	322,000
Iowa, Nebraska, South Dakota	3	W	W	352	26,900
Kentucky, Tennessee, West Virginia	5	133	2,730	2,860	209,000
Ohio	7	140	1,710	1,850	150,000
Pennsylvania	6	177	984	1,160	115,000
Texas	5	654	995	1,650	130,000
Wisconsin	4	196	726	922	70,700
Other[6]	23	340	2,170	2,510	181,000
Total	91	2,780	18,200	21,000	1,700,000

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

[1]Excludes regenerated lime.

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

[3]Includes 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, Virginia, and data indicated by the symbol W.

TABLE 3

LIME SOLD AND USED BY PRODUCERS IN THE UNITED STATES, BY USE[1, 2]

(Thousand metric tons[3] and thousand dollars)

Use	2005		2006	
	Quantity[4]	Value[5]	Quantity[4]	Value[5]
Chemical and industrial:				
Fertilizer, aglime and fertilizer	29	3,300	32	3,260
Glass	148	11,200	196	16,100
Paper and pulp	743 r	52,500 r	855	69,800
Precipitated calcium carbonate	1,130	92,800	1,230	111,000
Sugar refining	834	63,900	783	58,300
Other chemical and industrial[6]	1,300 r	104,000 r	1,410	121,000
Total	4,180 r	328,000 r	4,510	380,000
Metallurgical:				
Steel and iron:				
Basic oxygen furnaces	2,680	208,000	2,750	233,000
Electric arc furnaces	2,980	230,000	3,100	266,000
Other steel and iron	323	23,000	393	30,100
Total	5,980	461,000	6,250	529,000
Nonferrous metallurgy[7]	1,290	87,500	1,320	90,600
Total	7,270	548,000	7,570	620,000
Construction:				
Asphalt	453	38,000	432	38,200
Building uses	493	54,000	481	54,600
Soil stabilization	1,730	120,000	1,650	126,000
Other construction	55	3,930	67	5,590
Total	2,730	216,000	2,630	224,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	3,470	217,000	3,530	238,000
Incinerators	133	12,000	226	21,100
Industrial boilers and other FGD	50	4,620	72	6,940
Total	3,650	234,000	3,830	266,000
Sludge treatment:				
Sewage	176	14,400	141	12,100
Other, industrial, hazardous, etc.	117	9,380	123	9,800
Total	293	23,700	263	21,900
Water treatment:				
Acid-mine drainage	138 r	12,300 r	113	10,500
Drinking water	975 r	72,000 r	992	80,200
Wastewater	484 r	39,500 r	644	57,200
Total	1,600 r	124,000 r	1,750	148,000
Other environmental	98	8,110	200	17,800
Total	5,640 r	389,000 r	6,040	454,000
Refractories (dead-burned dolomite)	200 [8]	21,600 [9]	200 [8]	26,800 [9]
Grand total	20,000	1,500,000	21,000	1,700,000

[r]Revised.

[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.

TABLE 3—Continued

LIME SOLD AND USED BY PRODUCERS IN THE UNITED STATES, BY USE[1, 2]

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

[8]Data are rounded to one significant digit to protect company proprietary data.

[9]Values are estimated based on average value per metric ton of dead-burned dolomite for each year.

TABLE 4

HYDRATED LIME SOLD OR USED IN THE UNITED STATES, BY END USE[1, 2]

(Thousand metric tons[3] and thousand dollars)

Use	2005 Quantity[4]	2005 Value[5]	2006 Quantity[4]	2006 Value[5]
Chemical and industrial	540 r	55,400	542	61,200
Construction:				
Asphalt	408	34,900	381	34,400
Building uses	481	53,000	470	53,600
Soil stabilization	466	32,800	466	37,600
Other construction	5	514	16	1,770
Total	1,360	121,000	1,330	127,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	220	13,300	165	11,000
Incinerators	21	2,170	40	3,860
Industrial boilers and other FGD	27	2,840	34	3,820
Total	268	18,300	239	18,700
Sludge treatment:				
Sewage	40	3,700	30	3,170
Other sludge treatment	54	5,090	51	4,910
Total	94	8,800	80	8,080
Water treatment:				
Acid-mine drainage	85	8,460	58	5,770
Drinking water	127	12,200	167	16,400
Wastewater	151	14,400	238	23,800
Total	363	35,100	463	46,000
Other environmental	24 r	2,240	66	6,270
Metallurgy	47	4,500	57	5,590
Grand total	2,700	246,000	2,780	273,000

[r]Revised.

[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 average lime values.

TABLE 5
LIME PRICES[1]

Type	2005 Dollars per metric ton	2005 Dollars per short ton[2]	2006 Dollars per metric ton	2006 Dollars per short ton[2]
Sold and used:				
Quicklime	72.10	65.50	78.10	70.80
Hydrate	91.10	82.70	98.30	89.20
Dead-burned dolomite	96.20	87.20	115.10	104.40
Average all types	75.00	68.00	81.20	73.70
Sold:				
High-calcium quicklime	70.10	63.60	76.20	69.10
Dolomitic quicklime	74.80	67.90	82.60	75.00
Average quicklime	70.90	64.30	77.20	70.00
High-calcium hydrate	86.60	78.60	94.50	85.70
Dolomitic hydrate	112.20 r	101.80	120.50	109.30
Average hydrate	91.10	82.70	98.30	89.20
Dead-burned dolomite	107.10	97.20	135.20	122.60
Average all types	74.00	67.10	80.50	73.00

[r]Revised.
[1]Average value per ton, on a free on board plant basis, including cost of containers.
[2]Conversions were made from unrounded metric ton values and may not be conversions of the rounded values.

TABLE 6
U.S. EXPORTS OF LIME, BY TYPE[1]

Type	2005 Quantity (metric tons)[2]	2005 Value[3]	2006 Quantity (metric tons)[2]	2006 Value[3]
Calcined dolomite:				
Canada	27,000	$6,490,000	38,400	$7,050,000
Germany	16	3,840	264	56,200
Taiwan	--	--	560	115,000
Other	380 r	156,000 r	592	253,000
Total	27,400	6,650,000	39,800	7,480,000
Hydraulic lime:				
Bahamas, The	76	13,100	327	53,900
Canada	3,340	623,000	3,260	532,000
Taiwan	--	--	154	27,800
Other	235	191,000	402	118,000
Total	3,650	827,000	4,140	732,000
Quicklime:				
Bahamas, The	372	87,500	627	171,000
Canada	83,000	7,200,000	58,400	7,520,000
Costa Rica	80	22,800	138	41,100
Mexico	8,710	1,010,000	1,380	163,000
Other	134	26,600	63	124,000
Total	92,300	8,350,000	60,600	8,020,000
Slaked lime, hydrate:				
Canada	7,400	1,140,000	10,400	2,820,000
Mexico	1,330	333,000	283	43,400
Philippines	431	62,000	431	62,000
Other	611	181,000	213	86,500
Total	9,760	1,720,000	11,300	3,010,000
Grand total	133,000	17,500,000	116,000	19,200,000

See footnotes at end of table.

TABLE 6—Continued

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

[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]

Type	2005 Quantity (metric tons)[2]	2005 Value[3]	2006 Quantity (metric tons)[2]	2006 Value[3]
Calcined dolomite:				
Canada	43,700	$4,330,000	46,000	$4,740,000
Mexico	194	41,000	90	16,700
Other	164	83,300	238	124,000
Total	44,000	4,460,000	46,300	4,880,000
Hydraulic lime:				
Canada	30	2,680	--	8,750
Mexico	1,130	133,000	1,980	222,000
Other	356	328,000	232	231,000
Total	1,520	463,000	2,210	462,000
Quicklime:				
Canada	190,000	21,300,000	189,000	24,400,000
Mexico	40,500	2,310,000	27,000	1,570,000
Other	989	393,000	623	592,000
Total	232,000	24,000,000	217,000	26,600,000
Slaked lime, hydrate:				
Canada	9,740	1,070,000	12,100	1,380,000
Mexico	22,500	2,500,000	19,700	2,210,000
Other	538	545,000 r	1,540	760,000
Total	32,700	4,110,000 r	33,400	4,340,000
Grand total	310,000	33,100,000 r	298,000	36,300,000

[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]	2002	2003	2004	2005	2006[e]
Australia[e]	1,500	1,500	1,500	1,500	1,600
Austria[e]	2,000	2,000	2,000	2,000	2,000
Belgium[e, 4]	2,000	2,000	2,400 r	2,300 r	2,400
Brazil[e]	6,500	6,600 r	6,900 r	6,900 r	6,900 p
Bulgaria	1,136	2,902	2,900 e	2,500 e	2,500
Canada	2,248	2,221 r	2,410 r	2,410 r, e	2,410 p
Chile	212 r	274 r	361 r	409 r	453
China[e]	120,000 r	130,000 r	140,000 r	150,000 r	160,000
Colombia[e]	1,300	1,300	1,300	1,300	1,300
Czech Republic	1,246 r	1,250 r	1,264 r	1,211 r	1,250
Egypt[e]	800	800	800	800	800
France[e, 4]	3,500 r	3,500 r	3,600 r	3,400 r	3,500
Germany	6,872 r	6,876 r	6,947 r	6,823 r	7,000
Hungary[e]	500	500	500	500	500
India[e]	900	900	900	920	910
Iran[e]	2,200	2,300	2,500	2,500	2,500
Israel	752	702	113 r	166 r	170
Italy[5]	4,373 r	4,504 r	4,630 r	4,700 r, e	4,800
Japan, quicklime only	7,420	7,953	8,507	8,879 r	8,900
Korea, Republic of	3,024	3,579	3,574	3,600	3,600
Mexico[e, 4]	5,100	5,700	5,700	5,700	5,700
Poland	1,960	1,955	1,950 e	2,000 e	2,000
Romania	1,829	2,025	2,000 e	2,000 e	2,000
Russia[e]	8,000	8,000	8,200	8,200	8,200
Slovakia	912	847	850 e	850 e	850
Slovenia	1,636	1,500	1,500 e	1,500 e	1,500
South Africa, burnt lime sales	1,585	1,518	1,738	1,417 r	1,600
Spain[e, 4]	1,800	1,800	1,818 r, 6	1,700 r	1,800
Sweden[e]	580	590	590	600	600
Taiwan	504 r	520 r	494 r	444 r	450
Turkey[e, 4]	3,300	3,300	3,400	3,600	3,600
United Kingdom[e]	2,000	2,000	2,000	2,000	2,000
United States, including Puerto Rico	17,900	19,200	20,000	20,000	21,000 6
Vietnam	1,420 r	1,384 r	1,464 r	1,718 r	1,750
Other[e]	4,480 r	4,430 r	4,460 r	4,500 r	4,520
Total	221,000 r	236,000 r	249,000 r	259,000 r	271,000

[e]Estimated. [p]Preliminary. [r]Revised.

[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 April 23, 2007.

[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.

[5]Includes hydraulic lime.

[6]Reported figure.