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LIME

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LIME

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In 2005, U.S. production of lime increased slightly, but the rounded grand total was essentially unchanged at 20.0 million metric tons (Mt) (22.0 million short tons) compared with 2004 (table 1). The value of production increased by $130 million to $1.50 billion as a result of overall price increases of nearly 9% in 2005. Decreased consumption of quicklime by the steel industry was balanced by increased consumption of hydrated lime in construction markets.

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 was not sent to independent hydrators that purchase quicklime for hydration in order to avoid double counting. 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 2005, of the 95 operations to which an annual survey form was sent, responses were received from 81 plants, representing 95% of the total sold or used by producers. Production data for the 14 nonrespondents were estimated based on prior-year production figures and other information.

Lime is a basic chemical that was produced as quicklime or hydrate at in 35 States and Puerto Rico (table 2). At the end of 2005, quicklime was being produced at 85 lime plants operating kilns, which included 38 plants with collocated hydrating plants. Hydrated lime also was produced at 12 standalone hydrating facilities, including 2 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, Kentucky, and Alabama; States with production between 1 and 2 Mt were, in descending order, Ohio, Texas, Nevada, and Pennsylvania.

Total lime sold or used by domestic producers in 2005 was 20 Mt, about the same as in 2004. Production included the commercial sale or captive consumption of quicklime, hydrated lime, and dead-burned refractory dolomite. The production of high-calcium and dolomitic quicklime was essentially unchanged, but production of high-calcium hydrate increased by 3.8% and dolomitic hydrate increased by 12.6%. Commercial sales increased by about 114,000 metric tons (t) (126,000 short tons) to about 18.6 Mt (20.5 million short tons), and captive consumption decreased by 27,000 t (30,000 short tons) to 1.49 Mt (1.64 million short tons).

In late 2005, National Lime & Stone Co. announced that it was closing its Carey lime plant in Ohio. The lime operation was a small part of the company's business and had operated at a loss 4 of the past 6 years. A steep rise in energy costs plus increasingly stringent environmental regulations also contributed to the decision to close the plant (Pit & Quarry, 2005§[1]).

Carmeuse Lime announced plans to upgrade production and distribution of lime products at several of its lime operations. The plans included the restart of a 136,000-metric-ton-per-year (t/yr) (150,000-short-ton-per-year) kiln at its Black River, KY, plant. Additionally, Carmeuse will construct a new hydrator plant and distribution terminal in South Carolina and upgrade existing hydrator plants in Alabama, Illinois, Louisiana, Pennsylvania, and Ontario, Canada (Carmeuse Lime, 2005a). Carmeuse also announced the closure of its Hanover, PA, lime plant. The plant had a capacity of about 180,000 t/yr from three calcimatic kilns that burned waste oil for fuel. The decision to close the plant was based on the age of the equipment, high operating costs, and the fact that recently completed capacity improvements at other Carmeuse plants more than made up

[1]References that include a section mark (§) are found in the Internet References Cited section.

for the lost production. The site will remain operational as a distribution terminal working in conjunction with the company's Annville, PA, plant and other plants in the company network (Carmeuse Lime, 2005b; Industrial Minerals, 2005).

Oglebay Norton Co. (parent company of Global Stone Corp.) began what turned out to be a very busy year by emerging from Chapter 11 bankruptcy protection on January 31, pursuant to a plan of reorganization approved by the U.S. Bankruptcy Court for the District of Delaware on November 17, 2004. Effective May 1, 2005, Oglebay Norton unified all its limestone and lime operations under the name O-N Minerals. The new name applies to all the company's Michigan Limestone Operations and Global Stone locations. In October, Oglebay Norton announced that its wholly owned subsidiary O-N Minerals had entered into an agreement with Western Lime Corp. (West Bend, WI), whereby Western Lime will lease land at O-N Minerals' Port Inland limestone operation on Michigan's Upper Peninsula and construct a lime plant. O-N Minerals will supply stone to the lime plant, which will operate a single lime kiln with a capacity of about 180,000 t/yr. The lime plant is expected to be operational in 2007 and will be Western Lime's third lime plant. Lastly, Oglebay Norton sold its O-N Minerals (St. Clair) Co. lime and limestone operation in Marble City, OK, to United States Lime & Minerals, Inc. The operation was formerly known as Global Stone St. Clair, Inc. (Oglebay Norton Co., 2005§).

In addition to the acquisition of the St. Clair operation mentioned above, U.S. Lime & Minerals, Inc. also entered into the initial contract for the construction of a third kiln at its Arkansas Lime Co. plant in Batesville, AR. The contract will include enhancements to crushing and stone handling facilities, and construction of additional product silos and load outs. The new kiln will increase plant capacity by about 50%. The project was expected to be completed by summer 2006 (United States Lime & Minerals, Inc., 2005§).

Graymont (PA) Inc. started up its new 1,090-metric-ton-per-day (t/d) preheater rotary kiln (designated kiln #6) at its Pleasant Gap, PA, plant in October. A new hydrating plant, additional lime storage, and new loading facilities were also part of the project. Graymont, which has three lime plants in Centre County, PA, is in the process of consolidating all its Pennsylvania lime production at the Pleasant Gap plant. The company ceased production at its Con Lime plant in 2001 and expected to end lime production at its Bellefonte plant by summer 2006. To replace capacity lost by closing these plants, in addition to kiln #6, Graymont has future plans to construct a 950-t/d rotary kiln at Pleasant Gap that will be designated kiln #7 (Graymont Ltd., 2005§).

Mississippi Lime Co. commissioned its second RCE vertical shaft kiln in August. The RCE lime kiln is manufactured by RCE Industrieofenbau Engineering GmbH of Austria (a subsidiary of Swiss kiln company Maerz Ofenbau AG). The kiln is a high efficiency single shaft kiln designed to produce lime with low levels of impurities, such as sulfur. This is the second of three identical gas-fired shaft kilns being constructed by Mississippi Lime; the first kiln went into operation in 2002 (Maerz Ofenbau AG, 2005§).

Hurricanes Katrina and Rita had minimal impact on U.S. lime operations. The only lime plant that was in the immediate New Orleans, LA, area (owned by USG Corp.) closed in 2004. There were some disruptions in normal sales activities at lime plants or hydrating plants in the region, but the facilities were not directly affected.

At yearend, the top 10 companies, in descending order of production, were Carmeuse Lime, Chemical Lime Co., Graymont Ltd., Mississippi Lime, O-N Minerals, United States Lime & Minerals, Martin Marietta Magnesia Specialties LLC, Western Lime Corp., Southern Lime Co., and Cutler-Magner Corp. These companies operated 44 lime plants and 8 separate hydrating plants and accounted for nearly 90% of the combined commercial sales of quicklime and hydrated lime and 84% of total lime production.

Environment

The U.S. Environmental Protection Agency (EPA) announced in December that it was proposing 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. The proposed revisions addressed two categories of particulate matter—fine particles ($PM_{2.5}$), which are particles 2.5 micrometers (μm) in diameter and smaller; and inhalable coarse particles ($PM_{10-2.5}$), which are particles between 2.5 and 10 μm. Under the proposed rule, the current annual standard for $PM_{2.5}$ of 15 micrograms per cubic meter (μg/m^3) would be retained, and the daily limit would be reduced to 35 μg/m^3 from 65 μg/m^3. For $PM_{10-2.5}$, the EPA is proposing to reduce the current 24-hour standard to 70 μg/m^3 from 150 μg/m^3. The standard would apply to airborne mixes of coarse particles that come from such sources as high-density traffic on paved roads and industry. The proposed standard would not apply to mixes of coarse particles that do not pose much risk to public health, such as windblown dust and soils and agricultural and mining sources (U.S. Environmental Protection Agency, 2006§).

Lime plants tend to be inherently dusty operations; more stringent regulation of particulate matter emissions would increase costs by increasing monitoring and possibly require installation of additional control technologies. This would be the case especially if the plant is located in a nonattainment area, which is an area that fails to meet emission standards. When a nonattainment designation takes effect in an area, the State and local governments have 3 years to develop implementation plans to meet the EPA standards by reducing air pollutant emissions that contribute to fine particle concentrations.

Consumption

The breakdown of consumption by general end-use sectors was as follows: 36% for metallurgical uses, 28% for environmental uses, 21% for chemical and industrial uses, 14% for construction uses, and 1% for refractory dolomite (table 4). Consumption increased in the construction and the chemical and industrial sectors by about 10% and 2%, respectively. Consumption decreased by about 2% in both the environmental and metallurgical sectors.

Commercial sales accounted for about 93% of total lime consumption. Captive lime accounted for about 7% 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 4 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 30% of all lime consumed in the United States. In 2005, estimated raw steel production in the United States decreased by nearly 6% compared with that of 2004. This decrease was reflected in the consumption of lime for steel and iron uses, which decreased by more than 3% to 5.98 Mt (6.59 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 4 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 by 4% in 2005. The increase was primarily in the ore concentration sector as domestic production of copper concentrates and gold each increased by about 2% in 2005 (Edelstein, 2006§; George, 2006§).

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.

Other environmental uses include the softening and clarification of municipal potable water and neutralization of acid-mine drainage and industrial discharges. 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 7% compared with that of 2004.

In flue gas desulfurization (FGD) systems serving coal-fired powerplants, incinerators, 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 powerplants are now designed to produce byproduct gypsum from the SO_2 emissions suitable for use in manufacturing gypsum wallboard. 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). In 2005, consumption in the utility powerplant FGD market decreased by 40,000 t, while consumption in the incinerator and industrial boiler sectors were essentially unchanged.

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.

According to the American Forest & Paper Association's annual survey of paper, paperboard, and pulp capacity, U.S. paper and paperboard production capacity declined in 2005, extending a trend that began in 2001 (Paper Age, 2006§). Lime consumption for pulp and paper production decreased by nearly 4% in 2005.

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 decreased by about 5% compared with 2004.

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 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 2005, sales of lime for use in asphalt increased by nearly 8% compared with the revised figure for 2004.

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 increased by 8% compared with the revised figure for 2004. The total of 1.73 Mt set a new record high for the market, surpassing the previous high (achieved in 2003) by 90,000 t.

In the traditional building sector, quicklime is used to make calcium silicate building products, such as autoclaved aerated concrete and sand-lime brick. Autoclaved aerated concrete has the advantage of producing building materials that can be cut, drilled, and nailed like wood but otherwise possess qualities similar to regular concrete products.

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-based mortars, which was standard before the development of portland-cement-based mortars. Modern portland-cement-based 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.

According to the U.S. Census Bureau, the annual value of construction put in place increased by 9% in 2005 compared with that of 2004. The values of residential and nonresidential construction increased by 11% and 6%, respectively (U.S. Census Bureau, 2006§). The strong construction markets resulted in an 8% increase in the amount of hydrated lime sold for the traditional building markets. 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 was essentially unchanged in 2004. 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 8. 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.

Coal is the primary fuel used to manufacture lime in the United States, and even in the most fuel efficient kilns, fuel is currently the largest cost component of production. Beginning in summer 2003, spot prices for high-British-thermal-unit coals from central and northern Appalachia doubled in price, and prices for coals from the Illinois Basin and the Uintah Basin (Utah) increased by 50% to 75% (U.S. Department of Energy, Energy Information Administration, 2006§). Lime companies have been forced to raise lime prices accordingly.

Pushed primarily by significant price increases for quicklime, the average for all types of lime sold increased to $74.00 per metric ton ($67.10 per short ton), an 8% increase compared with the average for 2004. The average value for high-calcium quicklime increased by more than 9% to $70.10 per metric ton ($63.60 per short ton) and the average for dolomitic quicklime increased by more than 7% to $74.80 per metric ton ($67.90 per short ton). Owing to corrections made to data that involved several companies, revisions were made to most 2004 lime prices listed in table 8.

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 133,000 t (147,000 short tons) valued at $17.5 million, with about 91% exported to Canada, about 8% exported to Mexico, and the remaining 1% going to other countries (table 6). Combined imports of lime were 310,000 t valued at $33 million, with nearly 79% from Canada, nearly 21% 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 nearly 82%. With Mexico's proximity to the large soil stabilization markets in Texas, it was not surprising that Mexico was the dominant supplier of hydrated lime, providing 69% of 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.

Current Research and Technology

The Ohio Air Quality Development Authority announced that it was partially funding a $2.1 million project at Ohio State University to scale up from laboratory to bench scale a process to capture CO_2 from flue gas using a specially constructed calcium sorbent. The lime-based sorbent will be manufactured by Specialty Minerals, Inc. (subsidiary of Mineral Technologies Inc.), although several other environmental and energy partners are involved. The process is promising because it captures CO_2 from flue gas without first cooling the gas, it captures SO_2, the lime can be regenerated, the reaction creates heat that can be converted into electricity, and the costs of the process are potentially lower than alternative methods (Ohio Air Quality Development Authority, 2005§). Obviously, any lime-based CO_2 capture process will only be practical if the lime sorbent absorbs substantially more CO_2 dioxide than is released in producing the sorbent. The process will require, therefore, that the sorbent be regenerated in a fashion that does not involve the typical release of CO_2 from calcination.

Outlook

High energy prices and rising interest rates may slow the growth of the domestic economy. A slowing economy coupled with continued consolidation of the steel industry and closures of less efficient steel mills may cause a decrease in domestic raw steel production and the quantity of lime consumed by the steel industry. The steel industry has reorganized in recent years and become much more efficient and competitive, but it is still vulnerable to developments in world steel markets. Trade in steel, raw materials, and steel-containing products continues to be susceptible to distortion by foreign government subsidies, trade barriers, and currency manipulation.

The ore concentration market is expected to remain strong, bolstered by increasing production of copper concentrates from operations in Arizona and New Mexico. Domestic production of copper concentrates is forecast to increase by about 25% during 2006-07 compared with 2005 levels (D.L. Edelstein, U.S. Geological Survey, written commun., May 4, 2006). This increase is expected to boost lime sales in the Southwest.

The currently in-place acid rain program (Clean Air Act Amendments) and the clean air interstate rule (finalized in 2005), which covers 28 Eastern States and the District of Columbia and calls for further reductions in SO_2 and NO_x emissions, are expected to lead to the installation of FGD scrubbers on as much as 49 gigawatts of powerplant capacity by 2010. In addition, current regulations covering emissions from small municipal incinerators and waste-to-energy incinerators and the standards the EPA is required to develop for control of hazardous air pollutants from various industrial categories also provide significant growth opportunities for lime in the FGD market. Major areas of complexity and uncertainty, however, involve the trading of SO2 emissions allowances (their availability and cost), the resultant timing of FGD equipment installations, and competition with limestone-based scrubbing systems. Increased hydrate sales are expected for the control of sulfur trioxide emissions from SCR-NOx control systems at powerplants.

On August 10, the President signed the Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU) (Public Law 109-59). This Act reauthorized Federal surface transportation programs through the end of fiscal year 2009. Total funding in the bill was $286.4 billion for the 6-year authorization period, but in actuality the act provided $244.1 billion for the 5 years remaining before fiscal year 2009 since the previous funding bill expired in 2003. Of this amount, 79% is provided for highway programs. One aspect of the law that will have important impacts on States that pay large amounts into the Highway Trust Fund is the Equity Bonus Program, which ensures that each State's return on its share of contributions to the Highway Trust Fund (in the form of gas and other highway taxes) is at least 90.5% in 2005 and increasing toward a minimum 92% relative rate of return by 2008, while at the same time holding 27 States harmless (meaning they will not receive less actual money than they have in the past). This increase is particularly important to such States as Arizona, California, Colorado, Michigan, and Texas that contribute more money to the Highway Trust Fund than they receive in return in Federal transportation funding. This increased funding helps lime's road stabilization and hot-mix asphalt markets, especially in large-market States like California and Texas. Overall, SAFETEA-LU will essentially be a continuation of previous funding levels for transportation projects, such as highway construction, and will at least provide stability for planning and commissioning of highway transportation projects through 2009. Lime's road stabilization and hot-mix asphalt markets will not receive the big boost that higher funding levels might have provided, but current funding levels will support a continuation of current lime stabilization and hot-mix asphalt sales.

The recent growth in hydrated lime sales for traditional building uses has been driven by low interest rates, which fueled the boom in residential and nonresidential construction. After setting a record for new home construction starts in 2005, new home construction starts are expected to decrease in 2006 and 2007 (National Association of Home Builders, 2006§). The nonresidential sector, however, is expected to remain strong (American Institute of Architects, 2006§). Population increases in the South and Southwest will fuel demand for Type S lime for exterior stucco and mortar mixes for concrete blocks, but rising interest rates could have a dampening effect on construction and thus on lime sold for building uses nationwide.

The domestic lime industry is operating at a high utilization rate, and if there is a significant increase in demand, then there may be supply shortages. The industry is adding new capacity in Arkansas, Kentucky, Michigan, Missouri, Pennsylvania, and Texas, so adequate supplies will be available in the near future. The continued closure of smaller, older lime plants for economic reasons, including the cost of complying with new environmental regulations, is likely.

Overall, lime demand is expected to remain strong in 2006, but much depends on how the economy performs, especially with respect to the steel market. Driven by increased copper production, the ore concentration market is expected to expand during the next couple of years. Asphalt and soil stabilization will likely be the strongest markets as was the case in 2005. Prices are expected to continue moving upward, but probably not as steeply as in 2005.

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TABLE 1
SALIENT LIME STATISTICS[1, 2]

		2001	2002	2003	2004	2005
United States[3]						
Number of plants[4]		103	99	96	91 r	94
Sold or used by producers:						
Quicklime:						
High-calcium	thousand metric tons	13,600	13,400	13,900	14,200	14,100
Dolomitic	do.	2,580	2,420	2,460	3,020 r	2,990
Total	do.	16,200	15,800	16,400	17,200	17,100
Hydrated lime:						
High-calcium	thousand metric tons	2,030	1,500	2,140	2,140 r	2,220
Dolomitic	do.	447	431	464	421 r	474
Total	do.	2,470	1,930	2,610	2,570 r	2,700
Dead-burned dolomite[5]	do.	200	200	200	200	200
Grand total:						
Quantity	do.	18,900	17,900	19,200	20,000	20,000
Value[6]	thousand dollars	1,160,000	1,120,000	1,240,000	1,370,000	1,500,000
Average value	dollars per metric ton	61.30	62.60	64.80	68.90 r	75.00
Lime sold	thousand metric tons	17,000	16,500	17,700	18,400 r	18,600
Lime used	do.	1,840	1,340	1,470	1,520 r	1,490
Exports:[7]						
Quantity	do.	96	106	98	100	133
Value	thousand dollars	11,900	13,100	13,700	14,300 r	17,500
Imports for consumption:[7]						
Quantity	thousand metric tons	115	157	202	232	310
Value	thousand dollars	15,100	19,700	22,500	25,900	33,000
Consumption, apparent[8]	thousand metric tons	18,900	17,900	19,300	20,100 r	20,200
World, production	do.	121,000	120,000 r	125,000 r	127,000 r	127,000 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, excluding cost of containers.
[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)
2004:					
Alabama	5	165	2,120	2,280	$164,000
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming	18	299	2,340	2,640	168,000
California, Oregon, Washington	8	87	291	378	33,200
Illinois, Indiana, Missouri	6	465	3,310 r	3,770 r	263,000 r
Iowa, Nebraska, South Dakota	3	W	W	370 r	24,500 r
Kentucky, Tennessee, West Virginia	5	127	2,710	2,830	176,000
Ohio	7	105	1,770	1,880	133,000 r
Pennsylvania	6	171	1,050	1,220	100,000
Texas	5	630	996	1,630	115,000
Wisconsin	4	181	670	850	53,900
Other[6]	24	336 r	2,150 r	2,140	141,000 r
Total	91 r	2,570 r	17,400	20,000	1,370,000

See footnotes at end of table.

TABLE 2—Continued

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

[r]Revised. 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 RANGE OF PRODUCTION[1, 2]

	2004			2005		
Range of production	Plants	Quantity (thousand metric tons)[3]	Percentage of total	Plants	Quantity (thousand metric tons)[3]	Percentage of total
Less than 25,000 metric tons	18 r	253 r	1 r	19	242	1
25,000 to 100,000 tons	13 r	437 r	2 r	13	415	2
100,000 to 200,000 tons	19 r	1,930 r	10 r	19	1,850	9
200,000 to 300,000 tons	14 r	2,780 r	14 r	17	3,330	17
300,000 to 400,000 tons	11	3,400 r	17 r	9	2,610	13
400,000 to 600,000 tons	6 r	2,660 r	13 r	6	2,430	10
More than 600,000 tons	10	8,500	43	11	9,180	48
Total	91 r	20,000	100	94	20,000	100

[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.

TABLE 4

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

(Thousand metric tons[3] and thousand dollars)

Use	2004 Quantity[4]	2004 Value[5]	2005 Quantity[4]	2005 Value[5]
Chemical and industrial:				
Fertilizer, aglime and fertilizer	33	3,090	29	3,300
Glass	120	8,250	148	11,200
Paper and pulp	802	51,600	772	55,500
Precipitated calcium carbonate	1,180	82,800	1,130	92,800
Sugar refining	707	41,300 r	834	63,900
Other chemical and industrial[6]	1,360 r	107,000 r	1,380	108,000
Total	4,200 r	294,000 r	4,290	335,000
Metallurgical:				
Steel and iron:				
Basic oxygen furnaces	3,070	214,000	2,680	208,000
Electric arc furnaces	2,690	185,000	2,980	230,000
Other steel and iron	425	27,500	323	23,000
Total	6,190	427,000	5,980	461,000
Nonferrous metallurgy[7]	1,240	75,700	1,290	87,500
Total	7,430	503,000	7,270	548,000
Construction:				
Asphalt	421 r	33,800 r	453	38,000
Building uses	456 r	48,300 r	493	54,000
Soil stabilization	1,600 r	110,000	1,730	120,000
Other construction	12	1,070	55	3,930
Total	2,490 r	193,000 r	2,730	216,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	3,510 r	213,000 r	3,470	217,000
Incinerators	135	9,990	133	12,000
Industrial boilers and other FGD	49	4,070	50	4,620
Total	3,690 r	227,000 r	3,650	234,000
Sludge treatment:				
Sewage	200	14,200	176	14,400
Other, industrial, hazardous, etc.	116	8,650	117	9,380
Total	316	22,900	293	23,700
Water treatment:				
Acid-mine drainage	101 r	7,500 r	118	11,000
Drinking water	865 r	59,400 r	906	67,400
Wastewater	503	37,300	463	38,200
Total	1,470	104,000 r	1,490	117,000
Other	138 r	10,200 r	98	8,110
Total	5,620 r	364,000 r	5,530	382,000
Refractories (dead-burned dolomite)	200 [8]	20,700 [9]	200 [8]	21,600 [9]
Grand total	20,000	1,370,000 r	20,000	1,500,000

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 magnesia, paper and pulp, precipitated calcium carbonate, basic oxygen furnaces, and refractories.

[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 (such as copper and gold) 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 5

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

(Thousand metric tons[3] and thousand dollars)

Use	2004		2005	
	Quantity[4]	Value[5]	Quantity[4]	Value[5]
Chemical and industrial	515 r	51,400 r	539	55,400
Construction:				
Asphalt	354 r	29,400 r	408	34,900
Building uses	442 r	47,300 r	481	53,000
Soil stabilization	508 r	38,900 r	466	32,800
Other construction	8	786	5	514
Total	1,310 r	116,000 r	1,360	121,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	149 r	10,700 r	220	13,300
Incinerators	21	1,910	21	2,170
Industrial boilers and other FGD	22	2,310	27	2,840
Total	192 r	14,900 r	268	18,300
Sludge treatment:				
Sewage	39	3,230	40	3,700
Other sludge treatment	43	4,080	54	5,090
Total	82	7,310	94	8,800
Water treatment:				
Acid-mine drainage	61 r	4,990 r	85	8,460
Drinking water	148 r	13,100 r	127	12,200
Wastewater	175	14,900	151	14,400
Total	384 r	33,000 r	363	35,100
Other environmental	38 r	3,220 r	23	2,240
Metallurgy	43	3,760	47	4,500
Grand total	2,570 r	230,000 r	2,700	246,000

[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 6

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

Type	2004 Quantity (metric tons)[2]	2004 Value[3]	2005 Quantity (metric tons)[2]	2005 Value[3]
Calcined dolomite:				
Canada	23,400	$5,610,000	27,000	$6,490,000
Germany	--	--	16	3,840
Mexico	111	32,700	19	5,280
Other[4]	111	54,900	361	151,000
Total	23,600	5,690,000	27,400	6,650,000
Hydraulic lime:				
Bahamas, The	146	32,500	76	13,100
Canada	6,710	966,000	3,340	623,000
Mexico	14	12,000	--	--
Other[5]	216	97,000	235	191,000
Total	7,080	1,110,000	3,650	827,000
Quicklime:				
Bahamas, The	320	66,600	372	87,500
Canada	55,300	5,040,000	83,000	7,200,000
Costa Rica	377	164,000	80	22,800
Mexico	4,310	594,000	8,710	1,010,000
Other[6]	1 r	54,900	134	26,600
Total	60,300	5,920,000 r	92,300	8,350,000
Slaked lime, hydrate:				
Canada	6,030	944,000	7,400	1,140,000
Mexico	1,010	259,000	1,330	333,000
Philippines	181	24,100	431	62,000
Other[7]	1,330	311,000	611	181,000
Total	8,550	1,540,000	9,760	1,720,000
Grand total	99,600	14,300,000 r	133,000	17,500,000

[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.

[4]Includes Finland (2004), Japan, Uruguay, and Venezuela (2005).

[5]Includes Argentina (2005), Australia (2005), Bahrain (2005), Bermuda (2005), Honduras, Israel (2005), Japan, the Republic of Korea (2005), Lithuania (2005), the Philippines (2004), and the United Kingdom (2005).

[6]Includes Argentina (2005), Australia, Chile (2004), the Dominican Republic (2005), and Singapore (2004).

[7]Includes Ecuador (2005), Honduras (2004), Hong Kong (2005), Malaysia (2005), the Netherlands (2004), South Africa, Trinidad and Tobago (2004), and the United Kingdom.

Source: U.S. Census Bureau.

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

Type	2004 Quantity (metric tons)[2]	2004 Value[3]	2005 Quantity (metric tons)[2]	2005 Value[3]
Calcined dolomite:				
Canada	21,600	$2,120,000	43,700	$4,330,000
Mexico	538	66,700	194	41,000
Other[4]	158	69,100	164	83,300
Total	22,300	2,250,000	44,000	4,460,000
Hydraulic lime:				
Canada	4	2,100	30	2,680
Mexico	4,440	489,000	1,130	133,000
Other[5]	746	378,000	356	328,000
Total	5,190	869,000	1,520	463,000
Quicklime:				
Canada	127,000	16,400,000	190,000	21,300,000
Mexico	47,000	2,760,000	40,500	2,310,000
Other[6]	262	126,000	989	393,000
Total	174,000	19,200,000	232,000	24,000,000
Slaked lime, hydrate:				
Canada	9,200	976,000	9,740	1,070,000
Mexico	20,400	2,240,000	22,500	2,500,000
Other[7]	354	287,000	538	516,000
Total	30,000	3,500,000	32,700	4,080,000
Grand total	232,000	25,900,000	310,000	33,000,000

[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.
[4]Includes China and Spain.
[5]Includes Belgium (2004), the Dominican Republic (2004), France, Germany (2004), Israel (2005), Italy, and Switzerland (2004).
[6]Includes Australia (2004), Belgium (2004), Brazil (2004), China, Colombia (2005), Denmark (2005), Germany (2005), Japan, Saudi Arabia (2004), Sweden (2004), and the United Kingdom (2005).
[7]Includes Belgium, Brazil (2004), France, Germany, Hong Kong (2005), Italy, Japan, the Netherlands (2005), Switzerland (2005), and the United Kingdom.

Source: U.S. Census Bureau.

TABLE 8

LIME PRICES[1]

Type	2004 Dollars per metric ton	2004 Dollars per short ton[2]	2005 Dollars per metric ton	2005 Dollars per short ton[2]
Sold and used:				
Quicklime	65.40 r	59.40 r	72.10	65.50
Hydrate	89.70 r	81.40 r	91.10	82.70
Dead-burned dolomite	93.80	85.10	96.20	87.20
Average all types	68.90 r	62.50 r	75.00	68.00
Sold:				
High-calcium quicklime	64.10 r	58.20 r	70.10	63.60
Dolomite quicklime	69.60 r	63.10 r	74.80	67.90
Average quicklime	65.10 r	59.00 r	70.90	64.30
High-calcium hydrate	85.60 r	77.60 r	86.60	78.60
Dolomite hydrate	110.60 r	100.40 r	112.30	101.80
Average hydrate	89.70 r	81.40 r	91.10	82.70
Dead-burned dolomite	97.50	88.50	107.10	97.20
Average all types	68.70 r	62.30 r	74.00	67.10

[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 9

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

(Thousand metric tons)

Country[3]	2001	2002	2003	2004	2005[e]
Australia[e]	1,500	1,500	1,500	1,500	1,500
Austria[e]	2,000	2,000	2,000	2,000	2,000
Belgium[e, 4]	2,000	2,000	2,000	2,000	2,000
Brazil[e]	6,300 [5]	6,500	6,500	6,500	6,500
Bulgaria	2,025	1,136	2,902	2,900 [e]	2,500
Canada	2,213	2,248	2,216	2,200 [e]	2,250 [5]
Chile[e]	1,000	1,000	1,000	1,000	1,000
China[e]	22,000	22,500	23,000	23,500	24,000
Colombia	1,300	1,300	1,300 [e]	1,300 [e]	1,300
Czech Republic[e]	1,300	1,120	1,263 [5]	1,300	1,300
Egypt[e]	800	800	800	800	800
France[e, 4]	3,000	3,000	3,000	3,000	3,000
Germany	6,630	6,620	6,637	6,680 [r]	6,700
India[e]	910	900	900	900	920
Iran[e]	2,000	2,200	2,300 [r]	2,500 [r]	2,500
Italy[e, 6]	3,500	3,000	3,000	3,000	3,000
Japan, quicklime only	7,586	7,420	7,953	8,507 [r]	8,600
Mexico[e, 4]	4,800	5,100	5,700	5,700	5,700
Poland	2,049	1,960	1,955	1,950 [e]	2,000
Romania	1,790	1,829	2,025	2,000 [e]	2,000
Russia[e]	8,000	8,000	8,000	8,200 [r]	8,200
Slovakia	816	912	847	850 [e]	850
Slovenia	1,434	1,636	1,500	1,500 [e]	1,500
South Africa, burnt lime sales	1,615	1,585 [r]	1,518 [r]	1,738 [r]	1,400
Spain[e, 4]	1,700	1,800	1,800	1,800	1,800
Taiwan[e]	800	750	800	800	800
Turkey[e, 4]	3,200	3,300	3,300	3,400	3,400
United Kingdom[e]	2,500	2,000	2,000	2,000	2,000
United States, including Puerto Rico, sold or used by producers	18,900	17,900	19,200	20,000	20,000 [5]
Vietnam	1,351	1,426	1,450 [e]	1,500 [e]	1,650
Other[e]	6,140 [r]	6,340 [r]	6,220 [r]	6,220 [r]	6,230
Total	121,000	120,000 [r]	125,000 [r]	127,000 [r]	127,000

[e]Estimated. [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 March 31, 2006.

[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]Sales only; data may be incomplete.

[5]Reported figure.

[6]Includes hydraulic lime.