LIME

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In 2002, U.S. production of lime was 17.9 million metric tons (Mt) (19.7 million short tons), a decrease of 1.0 Mt (1.1 million short tons) compared with 2001 (table 1). This was the largest single-year decrease in production tonnage since 1982. Production was reported down in 24 out of the 32 States reporting production. The value of lime sold or used was $1.12 billion.

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

Lime is a basic chemical that was produced as quicklime at 92 plants in 32 States and Puerto Rico (table 2). At the end of 2002, hydrated lime was being produced at 10 separate hydrating facilities (including 1 plant where the kilns had been shut down but hydrate was manufactured from quicklime produced offsite). In four States with no quicklime production, hydrating plants used quicklime shipped in from other States. There were also a small number of slurry plants where lime was converted to liquid form by the addition of water prior to sale; this is some times called milk-of-lime. Principal producing States, in descending order of production, were Missouri, Alabama, Kentucky, Ohio, Texas, and Pennsylvania.

Domestic production data for lime are derived by the U.S. Geological Survey (USGS) from a voluntary survey of U.S. operations. The survey is sent to primary producers of quicklime and hydrate, but not to independent hydrators that purchase quicklime for hydration so as to avoid double counting. Quantity data are collected for 28 specific and general end uses, and value data are collected by type of lime, such as high-calcium or dolomitic. Because value data are not collected by end use, value data shown in table 4 are 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 is used to calculate the value of hydrate sold and used in table 5.

In 2002, of the 106 lime operations to which an annual survey form was sent, 7 were closed or idle all year, and of the remaining 99, 84 responded to the survey, representing 96% of the total sold or used by producers. Production data for the 15 nonrespondents were estimated based on prior-year production figures and other information. There were 79 plants in the United States that produced high-calcium quicklime and 24 plants that produced dolomitic quicklime. Excluding independent hydrators (which are not surveyed), high-calcium hydrate was produced at 38 facilities, and dolomitic hydrate, at 7 facilities. Most hydrators are actually collocated with lime plants.

Total lime sold or used by domestic producers in 2002 decreased by more than 5% to 17.9 Mt compared with 2001. Production included the commercial sale or captive consumption of quicklime, hydrated lime, and dead-burned refractory dolomite. Production of quicklime decreased by 395,000 metric tons (t) (435,000 short tons), and production of hydrate decreased by 543,000 t (599,000 short tons), although the percentage decrease was more significant in the hydrate sector where it represented a 22% decline compared with that of 2001. High-calcium quicklime production decreased by less than 2%, while dolomitic quicklime production decreased by about 6%. High-calcium hydrate and dolomitic hydrate decreased by 26% and 4%, respectively. Commercial sales dropped by 495,000 t (546,000 short tons) to about 16.5 Mt (18.2 million short tons), and captive consumption also dropped by 495,000 t (546,000 short tons) to 1.34 Mt (1.48 million short tons). Commercial sales decreased in all the large general market sectors—chemical and industrial by 6%, construction by 8%, metallurgical by 4%, and environmental by 3%. The 27% decrease in captive consumption compared with 2001 was the result of closures of captive lime plants in the chemical and industrial and metallurgical sectors and the transfer of operations of a steel company lime plant to a commercial lime company.

Carmeuse North America (Carmeuse NA) idled its lime plant in San Antonio, TX, in early 2002 and, in an effort to increase the visibility of its brand name, renamed all its lime subsidiaries as Carmeuse Lime. International Steel Group (ISG), which purchased the assets of LTV Steel Corp. (including its lime plant in Ohio), restarted steel production at the Cleveland Works steel mill and restarted lime production at the Grand River, OH, lime plant. Carmeuse Lime was selected to manage and operate the lime plant and in early 2003 signed a long-term lease agreement with ISG. As part of the agreement, the plant will operate under the name Carmeuse Lime Grand River Operation. The plant was initially operated just to provide lime to the Cleveland Works steel mill, but by the end of the year, it also was offering lime to commercial customers (Anthony Pallotta, Carmeuse Lime, written commun., January 2003). This was standard procedure when the plant was owned and operated by LTV Steel. In 2002, production from the Grand River lime plant was reported as sales, which accounts for much of the significant decrease in captive lime consumption.

In early March, SCANA Corp. of Charleston, SC, sold its interest in Palmetto Lime LLC to Chemical Lime Co. SCANA and Chemical Lime had been partners in the 254,000-metric-ton-per-year (t/yr) plant located in Charleston. The plant was originally a joint venture of SCANA and APG Lime Corp., which was acquired by Chemical Lime in 1999 (National Lime Association, 2002a). The plant has been shut down since 2000. Vessel Mineral Products Co., a small lime producer in Bonne Terre, MO, ceased lime production in March 2002. The company was forced to shut down lime production owing to the financial difficulties experienced by its steel industry customers (Royce Vessell, Vessell Mineral Products Co., written commun., March 2003).

On August 1, Osborne Materials Group purchased Ohio lime producer Huron Lime Co. Huron Lime operates three straight-rotary kilns at its plant on the shore of Lake Erie between Cleveland and Toledo, OH. The company's major markets are steel and water treatment. Osborne Materials owns a limestone quarry on Drummond Island, MI, which supplies stone to several lime producers (although not currently to Huron). Osborne also owns several ready-mix concrete plants (National Lime Association, 2002b).

Western Sugar Co. closed its sugar mill and associated lime plant at Bayard, NE. This is the 10th sugar mill that has closed since 1993, with the majority located in California. There has been a fundamental change in the ownership of many of the sugar mills. Originally, the majority of sugar mills were owned by sugar companies, but in recent years, these companies have found operating the mills to be uneconomic because of depressed sugar prices. Their only options were to close the mills or try to sell them to competitors or the beet growers that depend on the mills as a market for their crops. As a result, Imperial Sugar Co. sold three of its Holly Sugar Corp. mills to American Crystal Sugar Co. and sold its Michigan Sugar Co. subsidiary and its four mills in Michigan to a cooperative of sugar beet growers (American Crystal Sugar Co., 2002§[1]; Sugar Publications, 2002§). Imperial Sugar also sold one of its Holly Sugar Corp. mills in Worland, WY, to a group of sugar beet growers and local investors. The mill operates under the name Wyoming Sugar Co. LLC (Gransbery, 2002§). Tate & Lyle Plc sold Western Sugar Co. and its six mills in Colorado, Montana, Nebraska, and Wyoming to the Rocky Mountain Sugar Growers Cooperative (Zellar, 2002§).

At yearend, the top 10 companies, in descending order of production, were Carmeuse Lime, Chemical Lime, Graymont Ltd., Mississippi Lime Co., Global Stone Corp., Martin Marietta Magnesia Specialties Inc., U.S. Lime & Minerals Co., Austin White Lime Co., Vulcan Materials Co., and Southern Lime Co. These companies operated 44 lime plants and 7 separate hydrating plants and accounted for 87% of the combined commercial sales of quicklime and hydrated lime and nearly 81% of total lime production.

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

Environment

Emissions generated from the calcination of limestone and dolomite and from the combustion of coal and other fuels make the lime industry subject to reporting under the Emergency Planning and Community Right-To-Know Act. The reporting threshold for certain pollutants has been lowered (mercury and dioxins in 1999 and lead in 2001); as a result, most lime plants must submit toxic release inventory reports.

Air emissions are regulated under the Clean Air Act. In December, the U.S. Environmental Protection Agency (EPA) issued a proposed rule regulating hazardous air pollutants (HAPs) from commercial lime plants, captive lime plants at steel mills, captive lime plants at nonferrous metal production facilities, and producers of dead-burned dolomite. The EPA has identified the lime industry as a source of HAP emissions that include hydrochloric acid and the metals antimony, arsenic, beryllium, cadmium, chromium, lead, manganese, mercury, nickel, and selenium. The proposed rule would establish particulate matter (PM) emission limits for lime kilns, lime coolers, and mineral-processing operations with stacks. PM is not a HAP but is considered a permissible surrogate for HAP metals. The PM emission limit for all kilns and lime coolers at an existing lime plant would be 0.12 pound per short ton of stone feed. The PM emission limit for kilns and lime coolers at a new lime plant would be 0.10 pound per short ton of stone feed. The compliance date for existing lime plants will be 3 years after the effective date of the publication of the final rule in the Federal Register (U.S. Environmental Protection Agency, 2002).

Consumption

The breakdown of consumption by major end uses (table 4) was as follows: 35% for metallurgical uses, 28% for environmental uses, 24% for chemical and industrial uses, 12% for construction uses, and 1% for refractory dolomite. Captive lime accounted for about 8% of consumption and was used mainly in the production of steel in basic oxygen furnaces, sugar refining, and magnesia production. Almost all data on captive lime consumption, excluding the sugar industry, are withheld to protect 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 about 30% of all lime consumed in the United States. Raw steel production in the United States increased by more than 2% in 2002, but lime consumption for steel reported a slight decrease to 5.36 Mt (5.91 million short tons) compared with 2001. Part, although not all, of this divergence in steel production and lime consumption can be explained by the fact that more steel was produced in 2002 in electric arc furnaces than in basic oxygen furnaces. Electric arc furnaces consume less lime per ton of steel than do basic oxygen furnaces.

Dolomitic quicklime is often substituted for a fraction of the high-calcium quicklime to extend refractory life. Dolomitic quicklime also is used as a flux in the manufacture of glass. Steel is the largest market for dolomitic lime, and although total dolomitic quicklime production decreased by 6% in 2002, by the fall of 2002, demand for dolomitic quicklime in the Midwest was up, and supplies were tight. The decrease in dolomitic quicklime production was the result of decreased demand for the production of magnesia and magnesium metal. Discounting these two markets, consumption of dolomitic quicklime by the steel industry appears to have increased.

In response to a spate of steel company bankruptcies and complaints by steel companies of unfair trade practices, the U.S. International Trade Commission (ITC), as authorized by the Trade Act of 1974, initiated a section 201 investigation in 2001. As a result of recommendations made by the ITC, on March 5, 2002, the President imposed tariffs for 3 years ranging from 8% to 30% on various types of imported steel, excluding imports from free-trade partners. The tariffs went into effect on March 20, and were applied to imports of slab steel, finished flat products, hot-rolled and cold-finished bar, tin mill products, and six other categories. The tariffs were scheduled to decrease in each of the subsequent years (Thelen Reid & Priest LLP, 2002§). The tariffs, which were under constant attack by domestic consumers and foreign producers seeking exclusions to the tariffs for specific steel products, may have slowed the increase in import levels. The purpose of the tariffs, however, was circumvented to some extent by a shift in the sources of the imports. Imports from such countries as those of the European Union and Japan decreased significantly, but imports from exempted countries, such as free-trade partners Canada and Mexico and developing countries, more than made up for the decrease. Overall imports of raw steel actually increased by 8% in 2002 when compared with those of 2001. The imposition of the tariffs, however, did result in higher steel prices, at least in the short term (American Iron and Steel Institute, 2003§).

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 agitated 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 "Other nonferrous metallurgy."

Lime usage in nonferrous metallurgy (aluminum and bauxite processing, concentration of copper and gold ores, and magnesium production) decreased by nearly 17% in 2002. U.S. mine production of copper decreased by 16% compared with 2001 as a result of production cutbacks by Phelps Dodge Corp., which closed its Miami, AZ, leach operations and halved production at the Bagdad, AZ, and Sierrita, AZ, mines (Edelstein, 2003). U.S. mine production of gold decreased by 15% mainly as a result of Barrick Gold Corp.'s shutdown of operations at its McLaughlin, CA, and Ruby Hill, NV, mines and Glamis Gold Ltd.'s closure of the Picacho, CA, mine (Amey and Hilliard, 2002, 2003). In addition, magnesium producer Northwest Alloys closed its Addy, WA, plant in 2001.

The tailings that result from the recovery of precious metals may contain elevated levels of cyanides. Lime is used to recover cyanides in such treatment processes as Cyanisorb, alkaline chlorination, and sulfur dioxide/air.

In the environmental sector, lime is used in the softening and clarification of municipal potable water and to neutralize acid-mine 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 clarification and in destroying harmful bacteria. More recently, the largest 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 increased by more than 3% compared with that of 2001.

In flue gas desulfurization (FGD) systems serving coal-fired powerplants, incinerators, and industrial plants, lime is used to react with sulfur oxides in the flue gas and may be used to stabilize the resulting sludge before disposal. In 2002, the overall FGD market decreased slightly compared with 2001. There was a 6% decrease in the consumption of lime by coal-fired powerplants and a nearly 300% increase in lime consumed in "Industrial boilers and other FGD," but the overall FGD market displayed only a slight decrease. The large increase in the industrial boilers and other FGD market was the result of a change in reporting by one of the large FGD reagent suppliers, and it is not known if there was in fact a dramatic increase in this market or if it was simply a reporting error in either 2001 or 2002.

In 1998 and 1999, total FGD sales were actually higher than reported because lime sold for industrial boilers (approximately 20,000 to 30,000 t/yr) was included in the category "Other environmental" in table 4 to avoid disclosing company proprietary data. Beginning with this year's report, sales for industrial boilers are combined with sales for "other FGD," which will allow an accurate total FGD number to be reported.

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 in the pulp and paper market increased by about 5% in 2002.

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 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 3% compared with that of 2001.

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 alkalies. 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 carbon dioxide to precipitate calcium carbonate. The carbon dioxide is obtained as a byproduct of lime production. Collecting lime production data from the sugar industry has always been difficult, and USGS figures include estimates that may have been too high in recent years. Data on lime consumed for sugar refining have been revised downward for 1999 through 2001.

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 2002, sales of lime for use in asphalt decreased by 12% compared with those of 2001.

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 roads, airfields, building foundations, earthen dams, and parking areas. Lime sales for soil stabilization decreased by 10%, retreating from the alltime high reported in 2001. The Texas market continued to be the largest consumer of stabilization lime, and coupled with sales within the nearby States of Arkansas, Louisiana, Mississippi, and Oklahoma, the Texas lime producers accounted for nearly 50% of the total U.S. market. This, however, was a decrease of about 26% compared with 2001.

Texas is the largest market for lime used in hot-mix asphalt and soil stabilization. Texas, like most other States, is experiencing increasing budget deficits, and the decrease in lime sales for asphalt and soil stabilization was the direct result of reduced funding by the State for highway construction projects. It is likely that similar circumstances existed in other States.

In the traditional building sector, quicklime is used to make calcium silicate building products, such as sand-lime brick and autoclaved aerated concrete, which has the advantage of producing building materials that can be cut, drilled, and nailed like wood but with the advantages of a concrete product.

Hydrated lime is used in the traditional building sector where it is still used in plaster, stucco, and mortars to improve durability. The use of hydrated lime in traditional building uses decreased by about 5% in 2002. Although spending on residential buildings and public construction increased, it is likely that the nearly 18% decrease in nonresidential construction depressed the traditional building-use markets (U.S. Census Bureau, 2003§). A small amount of hydrated lime (estimated to be less than 2% of total building uses) also is used on 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.

Dead-burned dolomite, also called refractory lime, is used as a component in tar-bonded refractory brick used in basic oxygen furnaces. 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, rounded to three significant figures, 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.

In 2002, despite attempts made by some of the commercial lime companies to raise prices, the average for all types of lime sold increased only slightly to $62.30 per metric ton ($56.50 per short ton). In the commercial sector, the average value per ton of high-calcium quicklime, dolomitic quicklime, high-calcium hydrate, and dead-burned dolomite all increased, but the dolomitic hydrate value decreased. The most significant increase was in the average high-calcium hydrate value, which increased by more than 12% in 2002. This was mainly the result of the large decrease in sales of hydrated lime for soil stabilization. Hydrated lime for soil stabilization, specifically in the large Texas market, does not demand the usual price premium of $10 to $20 per metric ton, which is the normal difference between quicklime and hydrate prices in other markets. In other words, lesser amounts of lower valued material were included in the average calculations.

Although there continued to be occasional price increase announcements by some of the larger lime companies, not surprisingly they found it difficult to push through price increases when demand was dropping, competition remained strong, and the industry suffered from excess capacity. In addition, long-term contracts restrict the ability of lime companies to raise prices until such existing contracts expire.

Foreign Trade

The United States exported and imported quicklime, hydrated lime (slaked lime), hydraulic lime, and calcined dolomite (dolomitic lime). Combined exports of lime (table 6) were 106,000 t (117,000 short tons) valued at $13.1 million, with 84% exported to Canada, 7% exported to Guyana, 7% exported to Mexico, and the remaining 2% going to various other countries. Combined imports of lime (table 7) were 157,000 t (173,000 short tons) valued at $19.7 million, with 82% from Canada, 16% from Mexico, and the remaining 2% from various countries.

Data on exports of hydraulic lime are questionable. There is only one known producer of hydraulic lime in the United States, and with exports totaling 13,100 t in 2001 and 8,710 t in 2002, it is likely that what was classified as hydraulic lime was in fact portland cement (or some other hydraulic cement product). Chemically, hydraulic lime and portland cement are quite similar.

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 industrialized nations with good data collection, accurate lime data for many countries are difficult to acquire. The variations in quality, types of lime, production technologies, and industries manufacturing lime and the frequent confusion with limestone data make accurate reporting of world lime data extremely difficult and certainly incomplete (table 9). The following is a brief discussion of acquisitions and new construction in specific countries.

Australia.—David Mitchell Ltd., Australia's largest independent producer of lime and limestone, was acquired by the diversified industrial minerals company Unimin Australia Ltd. David Mitchell operates 12 plants in eastern Australia—in New South Wales, Queensland, Tasmania, and Victoria—and produces about 220,000 t/yr of lime and 830,000 t/yr of limestone. David Mitchell is an unlisted public company that was founded in 1878 (Industrial Minerals, 2003).

Chile.—The Chilean lime market is served by two private producers—Soprocal Calerías e Industrias S.A. and Industria Nacional del Cemento S.A.—and two plants operated by the copper mining company Corporación Nacional del Cobre de Chile. Domestic lime plants are unable to meet the supply requirements of the large Chilean mining industry, and the shortfall is currently being met by expensive imports from Argentina. South American Gold and Copper Co. Ltd. (SAGC) has two lime projects in the works that may go a long way toward meeting current and future demand by the copper mining industry. SAGC's Cal Norte project is in the final kiln-selection stage, and the company is planning to build a coal-fired preheater rotary in the 150- to 180-metric-ton-per-day (t/d) range. The plant will be supplied by the nearby underground Hornito limestone mine. The plant and mine are located at a low elevation (1,000 meters), which should allow snow-free, year-round operations. The plant is expected to supply lime to the Los Pelambres and El Soldado copper mines and be operational by the end of 2004. SAGC's Catedral project will be significantly larger and calls for construction of a 600-t/d gas-fired kiln served by an underground mine. Catedral's main potential markets are the Andina, El Teniente, and Los Bronces copper mines (Industrial Minerals, 2002).

Finland.—In November, Saxo Mineral OY (a wholly-owned subsidiary of Sweden's SMA Svenska Mineral AB) commissioned its new lime plant at Röyttä near Tornio in northern Finland. The kiln is a newly developed F12-6 type Maerz PFR-Finelime Shaft Kiln with a capacity of 400 to 550 t/d depending on stone size. SMA Svenska, a market leader in Sweden, also operates lime and limestone plants in Estonia, Finland, and Norway (Gräsberg, 2003).

Malaysia.—RCI Lime Sdn. Bhd. (RCI Lime), a business unit of Rock Chemical Industries Group, embarked on an expansion plan to install a new 250-t/d Cimprogetti TWIN D lime kiln and an 8-metric-ton-per-hour hydrator at its plant in Ipoh. The new kiln, which will be petroleum coke fired, was scheduled to startup in the third quarter of 2002. Prior to installation of the new equipment, RCI Lime's production capacity for quicklime and hydrated lime was 69,300 t/yr and 26,200 t/yr, respectively (Cimprogetti S.p.A., 2002§; Kuala Lumpur Stock Exchange, 2002§). CAO Industries Sdn. Bhd. is installing a FORINDUS 100-t/d vertical-shaft kiln at an unspecified location in Malaysia. The kiln will be sawdust fueled and was expected to be commissioned in June 2003 (Chan, 2003).

Mexico.—Lhoist Group of Belgium, through its joint-venture partner Grupo Calider S.A. de C.V., acquired Calteco S.A. de C.V. Calteco's main facility is at Tecolotlan, 110 kilometers southwest of Guadalajara, where it has a lime plant and hydrator. It also operates a hydrating plant near Guadalajara. The company is a supplier of quicklime to industrial applications, such as steel, and of hydrated lime to construction markets (Lhoist Group, 2002a§).

Poland.—Lhoist Group acquired from Heidelberg Cement Group the Gorazdze-Wapno Sp. z o. o. high-calcium lime operation and the PPHU Wapno-Sabinow Sp. z o. o. dolomitic lime operation. Gorazdze-Wapno, which sources its limestone from the adjacent deposits of Gorazdze Cement S.A. under a long-term supply-and-quarry-management contract, produced about 200,000 t of lime in 2001. Wapno-Sabinow produced about 40,000 t of dolomitic lime for the steel industry in Poland (Lhoist Group, 2002b§).

Spain.—Caleras de San Cucao in Asturias constructed a gas-fired Cimprogetti TWIN-D SS-70 kiln designed to produce alternatively calcitic lime and dolomitic lime. Caleras de San Cucao was founded in 1941, originally to provide lime for calcium carbide production and for the steel market. This unit will be one of the most modern lime plants in Spain. Production was scheduled to start in the summer of 2002 (El Comercio Digital S.L., 2001§).

Zambia.—The only lime producer in Zambia is Ndola Lime Co. Ltd. (NLC) (a subsidiary of majority-state-owned Zambia Consolidated Copper Mines Ltd.). NLC operates an annular shaft vertical kiln commissioned in 1986, a rotary kiln commissioned in 1973, and a hydrating plant commissioned in 1961. The combined capacity of the two kilns is about 1,000 t/d or about 330,000 t/yr, but in recent years the plant has been producing less than 140,000 t/yr. Konkola Copper Mines Plc and Mopani Copper Miner Plc are the largest customers and account for about 80% of sales (C. Lumpu, Copperbelt Lime Co. Ltd., written commun., December 2002). The Zambia Privatisation Agency invited offers by competitive tender for the purchase of 100% shareholding of NLC in June 2002. Bids were received from Chillerton Cement (Z) Ltd., Copperbelt Lime Co. Ltd., and Twiga Chemical Industries Ltd. The bids were rejected following close scrutiny, as weighed against the privatization objectives (Times Reporter, 2003§).

Outlook

Although lime has many uses, a few uses tend to make up the bulk of consumption. The following discusses some of the major markets and their specific conditions.

The section 201 tariffs on steel imports were imposed by the President with the understanding that their 3-year duration would give domestic steel companies time to reorganize and become more competitive. With many steel companies in bankruptcy, the industry reorganization began to take shape in 2002 but only after the assumption of pension liabilities of bankrupt steel companies by the Pension Benefit Guaranty Corporation. The reorganization took the form of acquisitions of bankrupt steel companies by solvent steel companies. Higher steel prices allowed increased production from steel mills and the restart of mills idled during company bankruptcies. This trend is expected to continue, and lime consumption should increase, at least in the short term, as more integrated steel mills that operate basic oxygen furnaces resume production. Basic oxygen furnaces consume roughly twice the lime per ton of steel than do electric arc furnaces operated at minimills.

Phase II of the Clean Air Act Amendments (CAAA), which went into effect on January 1, 2000, remains the driving force behind potential growth in the FGD market. Little or no growth is expected during the next 2 to 3 years in the utility FGD market, but the costs of lime-based scrubbers have decreased significantly over the years and display more favorable economics and efficiencies especially for the smaller units regulated under Phase II.

Under the CAAA, the EPA is required to develop standards for industrial categories of major sources of HAPs that require the application of maximum achievable control technology (MACT). HAP reductions from flue gas streams have been mandated for the secondary aluminum industry, with lime-based control designated as the MACT. Regulations have been passed or are pending for other industrial sectors, and lime-based control technologies are cost-effective means for controlling various HAPs. Regulations covering emissions from small municipal incinerators and waste-to-energy incinerators also favor the use of lime scrubbers.

Federal funding for transportation projects, such as highway construction, makes up the bulk of funding for such projects. The current transportation legislation (Transportation Equity Act for the 21st Century) covered a 6-year period from September 1998 to September 2003. On April 11, 2003, Congress passed a fiscal year 2004 budget resolution providing an outline of how Federal revenues will be spent in the coming fiscal year. While not binding, the resolution is important because it helps set the overall spending number Congress plans to abide by. For the 6-year period from 2004 to 2009, the conference report allocates a total of $273 billion for transportation programs (including $231 billion for highways)—a nearly 30% increase in contract authority. If new transportation legislation is enacted at these higher funding levels, then such an increase will provide a boost to lime stabilization and hot-mix asphalt sales. Also, there is growing acceptance in the United States of the use of ultrathick pavement designs that are designed to last 50 years or more. These perpetual or extended-life pavements combine an impermeable, rut-resistant, and wear-resistant top structural layer with a rut-resistant and durable intermediate layer and a fatigue-resistant and durable base layer. Only periodic surface restoration is necessary (approximately every 20 years), offering advantages in speed of construction and construction costs (Transportation Research Board, 2001§). Lime is used in the base and subbase to provide long-term stabilization and in the asphalt mix to increase moisture resistance, slow oxidation, and reduce rutting. The budget difficulties experienced by State governments will continue have a delaying effect on road and highway construction until the deficits are eliminated or the States identify additional revenue sources.

In summary, with the continuing economic uncertainties, the near-term outlook for lime is for a flat to modest increase in demand. In the longer term, increased demand is expected in the environmental and road construction sectors, and an improvement in the overall economy would bolster the steel and chemical and industrial sectors.

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TABLE 1
SALIENT LIME STATISTICS[1]

(Thousand metric tons unless otherwise specified)[2]

		1998	1999	2000	2001	2002
United States[3]						
Number of plants[4]		107	107 r	106 r	103 r	99
Sold or used by producers:						
High-calcium quicklime		14,800	14,100	14,300	13,600 r	13,400
Dolomitic quicklime		2,740	3,000	3,000	2,580	2,420
Total		17,500	17,100	17,300	16,200	15,800
High-calcium hydrated lime		1,950	2,010	1,550	2,030	1,500
Dolomitic hydrated lime		383	298	421	447	431
Total		2,330	2,310	1,970	2,470	1,930
Dead-burned dolomite[5]		300	300	200	200	200
Grand total		20,100	19,700	19,500 r	18,900	17,900
Value[6]	thousands	$1,210,000	$1,190,000	$1,180,000 r	$1,160,000	$1,120,000
Average value per metric ton		$60.30	$60.40	$60.60	$61.30	$62.60
Lime sold		17,800	17,400 r	17,500	17,000	16,500
Lime used		2,320	2,310 r	2,020 r	1,840 r	1,340
Exports:[7]						
Quantity		56	59	73	96	106
Value	thousands	$9,110	$8,270	$9,960	$11,900	$13,100
Imports for consumption:[7]						
Quantity		231	140	113	115	157
Value	thousands	$22,700	$15,700	$13,500	$15,100	$19,700
Consumption, apparent[8]		20,300	19,700 r	19,600	18,900 r	17,900
World, production		117,000	116,000	118,000	117,000 r	116,000 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)
2001:					
Alabama	5	128	1,910	2,030	$127,000
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming	20	307	2,360	2,670	162,000
California, Oregon, Washington	8 r	64	317 r	381 r	28,300 r
Illinois, Indiana, Missouri	9	310	3,390	3,700	216,000
Iowa, Nebraska, South Dakota	4	W	W	252	16,100
Kentucky, Tennessee, West Virginia	5	106	2,230	2,330	134,000
Ohio	8	119	1,780	1,900	114,000
Pennsylvania	7	205	1,070	1,280	86,500
Texas	6 r	736	852 r	1,590 r	106,000 r
Wisconsin	4	157	460	617	36,900
Other[6]	27 r	341	2,030	2,120	131,000
Total	103 r	2,470	16,400 r	18,900	1,160,000
2002:					
Alabama	5	100	1,940	2,040	$127,000
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming	20	303	1,990	2,300	147,000
California, Oregon, Washington	8	55	233	288	29,100
Illinois, Indiana, Missouri	9	312	3,410	3,720	221,000
Iowa, Nebraska, South Dakota	3	W	W	252	17,800
Kentucky, Tennessee, West Virginia	5	100	2,170	2,270	131,000
Ohio	8	122	1,510	1,630	98,100
Pennsylvania	6	192	1,030	1,230	87,600
Texas	5	289	1,240	1,530	98,400
Wisconsin	4	159	444	603	35,600
Other[6]	26	302	1,980	1,990	126,000
Total	99	1,930	15,900	17,900	1,120,000

[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, Georgia, Louisiana, Massachusetts, Michigan, Minnesota, North Dakota, Oklahoma, Puerto Rico, South Carolina, 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]

	2001			2002		
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 tons	22 r	300 r	2 r	27	353	2
25,000 to 100,000 tons	28 r	1,630 r	8	21	1,160	6
100,000 to 200,000 tons	21	3,000 r	14	21	3,190	18
200,000 to 300,000 tons	13 r	3,160	19 r	10	2,460	14
300,000 to 400,000 tons	6 r	2,070 r	9 r	8	2,540	14
400,000 to 500,000 tons	7	3,360 r	20 r	6	2,870	16
More than 600,000 tons	6 r	5,360 r	28 r	6	5,320	30
Total	103 r	18,900	100	99	17,900	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 and thousand dollars)[3]

Use	2001 Quantity[4]	2001 Value[5]	2002 Quantity[4]	2002 Value[5]
Chemical and industrial:				
Fertilizer, aglime and fertilizer	24	$1,760	28	$2,160
Glass	66	3,820	101	6,140
Paper and pulp	827	49,800	868	50,700
Precipitated calcium carbonate	1,150	72,700	1,180	76,200
Sugar refining	724 r	40,200 r	582	35,700
Other chemical and industrial[6]	1,730	115,000	1,470	103,000
Total	4,520 r	283,000 r	4,230	274,000
Metallurgical:				
Steel and iron:				
Basic oxygen furnaces	3,260	194,000	3,600	218,000
Electric arc furnaces	1,960	117,000	1,510	92,900
Other steel and iron	250	14,000	255	14,700
Total	5,460	325,000	5,360	326,000
Nonferrous metallurgy[7]	1,170	61,200	973	54,900
Total	6,630	386,000	6,330	381,000
Construction:				
Asphalt	390	30,800	342	28,000
Building uses	467	45,300	447	44,700
Soil stabilization	1,530	96,600	1,380	83,700
Other construction	18	1,280	42	2,880
Total	2,400	174,000	2,210	159,000
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	2,920	158,000	2,740	149,000
Incinerators	198	12,900	137	9,360
Industrial boilers and other FGD	65 r	4,730 r	259	15,600
Total	3,190 r	176,000 r	3,140	174,000
Sludge treatment:				
Sewage	216	13,600	148	9,230
Other, industrial, hazardous, etc.	110	6,890 r	189	11,400
Total	326	20,500 r	336	20,700
Water treatment:				
Acid mine drainage	78	5,110	76	5,120
Drinking water	961	59,000	813	50,800
Waste water	410	26,800	377	26,000
Total	1,450	91,000	1,270	81,900
Other	138 r	8,680	191	13,700
Total	5,100	296,000	4,930	290,000
Refractories, dead-burned dolomite	200 [8]	19,000 [9]	200 [8]	15,000 [9]
Grand total	18,900	1,160,000	17,900	1,120,000

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, mason's lime, 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, citric acid, food (animal or human), gelatin, oil, grease, oil well drilling, tanning, and other uses. Magnesia is included here to avoid disclosing company proprietary data.
[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 5
HYDRATED LIME SOLD OR USED IN THE UNITED STATES, BY END USE[1, 2]

(Thousand metric tons and thousand dollars)[3]

Use	2001 Quantity[4]	2001 Value[5]	2002 Quantity[4]	2002 Value[5]
Chemical and industrial	476	$39,300	443	$40,900
Construction:				
Asphalt	351	28,700	318	26,600
Building uses	454	44,500	432	43,800
Soil stabilization	589	41,700	157	11,200
Other construction	12	897	6	526
Total	1,410	116,000	913	82,200
Environmental:				
Flue gas desulfurization (FGD):				
Utility powerplants	39	2,930	36	3,030
Incinerators	29	2,170	36	2,870
Industrial boilers and other FGD	43	3,340	51	4,710
Total	111	8,440	123	10,600
Sludge treatment:				
Sewage	41	2,790	26	1,950
Other sludge treatment	14	1,070	19	1,690
Total	55	3,860	45	3,640
Water treatment:				
Acid mine drainage	63	4,240	52	3,770
Drinking water	154	12,500	135	11,700
Waste water	142	10,400	136	11,200
Total	359	27,200	323	26,600
Other environmental	44	3,230	64	5,090
Metallurgy	23	1,790	23	1,740
Grand total	2,470	200,000	1,930	171,000

[1]Excludes regenerated lime. Includes Puerto Rico.
[2]Data are rounded to no more than three significant digits; may not add to totals shown.
[3]To convert metric tons to short tons, multiply metric tons by 1.102
[4]Quantity includes hydrated lime sold and used, where "used" denotes lime produced for internal company use in building, chemical and industrial, and metallurgical sectors.
[5]The U.S. Geological Survey does not collect value data by end use; the values shown are mainly derived from average lime values.

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

Type	2001 Quantity (metric tons)[2]	2001 Value[3]	2002 Quantity (metric tons)[2]	2002 Value[3]
Calcined dolomite:				
Canada	7,610	$1,850,000	19,800	$4,830,000
Mexico	242	71,300	558	112,000
New Zealand	268	146,000	71	37,500
Other[4]	85 r	31,500 r	70	21,700
Total	8,210	2,100,000	20,500	5,010,000
Hydraulic lime:				
Canada	12,900	1,350,000	8,510	957,000
Mexico	44	8,380	64	19,400
New Zealand	62	21,200	--	--
Other[5]	138 r	94,200 r	142	43,200
Total	13,100	1,470,000	8,710	1,020,000
Quicklime:				
Canada	55,500	5,580,000	55,100	4,420,000
Costa Rica	443	92,300	59	9,800
Guyana	--	--	7,330	727,000
Mexico	10,200	1,260,000	6,950	769,000
Other[6]	78	45,200	336	90,400
Total	66,200	6,990,000	69,800	6,020,000
Slaked lime, hydrate:				
Bahamas, The	2,190	382,000	42	7,470
Canada	5,500	841,000	5,410	837,000
Philippines	91	11,000	418	55,600
Other[7]	554	132,000	739	181,000
Total	8,330	1,370,000	6,610	1,080,000
Grand total	95,800	11,900,000	106,000	13,100,000

[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 Belize, Chile, Germany, and South Africa.
[5]Includes Argentina, The Bahamas, France, Guatemala, Israel, Italy, and Japan.
[6]Includes The Bahamas, Colombia, the Dominican Republic, France, Germany, the Republic of Korea, Trinidad and Tobago, Saudi Arabia, Slovenia, the United Arab Emirates, and Venezuela.
[7]Includes Angola, Mexico, and Trinidad and Tobago.

Source: U.S. Census Bureau.

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

Type	2001 Quantity (metric tons)[2]	2001 Value[3]	2002 Quantity (metric tons)[2]	2002 Value[3]
Calcined dolomite:				
Canada	11,100	$3,020,000	9,790	$774,000
Mexico	20	3,310	1,550	268,000
Other[4]	650	210,000	401	107,000
Total	11,800	3,230,000	11,700	1,150,000
Hydraulic lime:				
Canada	59	27,600	162	38,900
Mexico	275	42,400	2,000	229,000
Other[5]	184	88,600	528	293,000
Total	518	159,000	2,690	562,000
Quicklime:				
Canada	87,600	9,540,000	113,000	14,700,000
Mexico	750	84,100	13,500	860,000
Other[6]	172	208,000	126	217,000
Total	88,500	9,840,000	127,000	15,800,000
Slaked lime, hydrate:				
Canada	5,840	623,000	6,370	617,000
Mexico	8,660	1,060,000	8,780	1,100,000
Other[7]	113	193,000	672	498,000
Total	14,600	1,870,000	15,800	2,210,000
Grand total	115,000	15,100,000	157,000	19,700,000

[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 Argentina, China, Germany, Italy, the Republic of Korea, and Spain.
[5]Includes Belgium, France, Italy, Switzerland, and the United Kingdom.
[6]Includes Belgium, China, Italy, Japan, the Netherlands, Switzerland, Thailand, and the United Kingdom.
[7]Includes Belgium, China, France, Germany, Italy, Japan, Switzerland, and the United Kingdom.

Source: U.S. Census Bureau.

TABLE 8
LIME PRICES[1]

Type	2001 Dollars per metric tons	2001 Dollars per short ton[2]	2002 Dollars per metric tons	2002 Dollars per short ton[2]
Sold and used:				
Quicklime	58.00 r	52.60 r	59.20	53.70
Hydrate	80.70	73.20	88.50	80.30
Dead-burned dolomite	84.00	76.20	86.70	78.70
Average all types	61.30	55.60 r	62.60	56.80
Sold:				
High-calcium quicklime	57.90	52.60	58.50	53.10
Dolomite quicklime	58.70	53.20	59.80	54.20
Average quicklime	58.00	52.70	58.70	53.30
High-calcium hydrate	76.70	69.60	86.20	78.20
Dolomite hydrate	99.20	90.00	97.40	88.40
Average hydrate	80.80	73.30	88.60	80.40
Dead-burned dolomite	92.30	83.80	94.30	85.50
Average all types	61.50	55.80	62.30	56.50

[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]	1998	1999	2000	2001	2002e
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]	1,750	1,750	1,750	1,750	1,750
Brazil	6,229	6,137	6,273	6,300 r	6,300
Bulgaria	1,000 e	1,068	1,388	1,100 e	1,100
Canada	2,514	2,565	2,525 r	2,221 r	2,220 p
Chile[e]	1,000	1,000	1,000	1,000	1,000
China[e]	21,000	21,500	21,500	22,000	22,500
Colombia[e]	1,300	1,300	1,300	1,300	1,300
Czech Republic	1,151	1,142	1,202	1,200 e	1,200
France[e]	2,400	2,500	2,500	2,400	2,500
Germany[e]	7,000	6,440	6,850 4	7,000	7,000
Iran	2,737	2,138	2,200 e	2,000 e	2,000
Italy[e, 5]	3,500	3,500	3,500	3,500	3,000
Japan, quicklime only	7,646	7,594	8,106	8,100 e	8,050
Mexico[e]	6,500	6,500	6,500	6,500	6,500
Poland	2,406	2,299	2,376	1,954 r	2,000
Romania	1,813	1,623	1,480	1,742 r	1,800
Russia[e]	7,000	7,000	8,000	8,000	8,000
South Africa, burnt lime sales	1,523	1,419	1,391	1,615 r	1,601 4
Spain[e]	1,500	1,500	1,500	1,500	1,500
Turkey[6]	1,066	975	914	900 e	1,000
United Kingdom[e]	2,500	2,500	2,500	2,500	2,000
United States, including Puerto Rico, sold or used by producers	20,100	19,700	19,500 r	18,900	17,900 4
Vietnam	939	1,026	1,024	1,100	1,050
Other[e]	9,310 r	9,070 r	9,500 r	9,230 r	9,300
Total	117,000	116,000	118,000	117,000 r	116,000

[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 4, 2003.
[3]In addition to the countries listed, Argentina, Iraq, 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]Reported figure.
[5]Includes hydraulic lime.
[6]Lime produced for steel production; does not include the widespread artisanal production of lime for whitewash and sanitation purposes.