CEMENT

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Cement is a critical component and economic indicator of the construction industry because it is the binding agent in concrete and mortars. Total U.S. production of portland and masonry cement in 1996 increased by 3.1% to 79.3 million tons,[1] of which 96% was portland cement (see tables 1-3). This record performance reflected near practical capacity output levels of clinker (see table 4) and cement (grinding) facilities. The United States continued to be the world's third largest cement producer (second in terms of high-quality cement); total world output remained in the range of 1.4 billion to 1.5 billion tons.

Apparent U.S. consumption of cement increased by about 5% in 1996 to 90.4 million tons, with the excess demand being met by increased imports and the drawing down of stockpiles. Cement exports also increased but remained a small component of total U.S. cement commerce. Cement prices were higher during the year, and the total ex-plant value reported for shipments from mills and import terminals to final customers increased by about 13% to $6.0 billion. The comparable value for all shipments to final customers, including those from other distribution terminals, is estimated to be $6.6 billion. By using typical cement-in-concrete mixing ratios, the value (delivered) of concrete in the United States in 1996 was estimated to be at least $26 billion.

In this report, cement production refers to finished portland and masonry cements (only) and thus represents the output both of integrated facilities (producing clinker and cement), and dedicated clinker-grinding plants. Hydraulic cements, which are those that will set and harden under water, are overwhelmingly the dominant type of cement manufactured in the United States and worldwide. Portland and masonry cements are the most common forms of hydraulic cements. Other hydraulic varieties, such as pure pozzolan and aluminous cements, cumulatively make up only a tiny fraction of the U.S. cement market and are not covered in this report.

The term "portland cement" properly refers to an interground mixture of portland cement clinker and 3% to 5% gypsum. The clinker comprises mostly calcium silicates and is made by controlled, high-temperature burning of a measured blend of calcareous rocks (usually limestone) with lesser quantities of silicious, aluminous, and ferriferous materials as needed. The blend is adjusted according to the chemical composition of the raw materials and the type of portland cement desired. In the United States, five basic types (Types I through V) of portland cement are recognized, denoting such properties as high sulfate resistance and high early strength. Elsewhere in the world, other designations may be used for similar portland cements. Portland cement is almost always gray, but if care is taken to burn only iron-free raw materials, then a more valuable version, white cement, can be obtained.

Portland cement can be interground with pozzolans to produce a variety of so-called blended cements. Blended cements have similar properties to (true) portland cements and, in common with standard U.S. industry practice, this report includes blended cements within the portland designation. Pozzolans are siliceous materials, such as certain rocks (mainly tuffs) and industrial byproducts (e.g., granulated blast furnace slag, fly ash, silica fume), that exhibit hydraulic cementitious properties when finely ground and interacted with free lime. Blended cements commonly are a major component of cement consumption overseas, particularly in Europe and Asia. As yet, reported U.S. consumption of pozzolans is very small, although the data are incomplete. The largest consumer is the concrete industry, but data for this industry are crude and do not differentiate consumption of pozzolans from similar material used as aggregates. Concrete is a controlled mixture of cement, fine and coarse aggregates, and water that, through complex cement hydration reactions, hardens into a rocklike mass of specifiable properties. The concrete industry uses pozzolans as concrete admixtures. In terms of the resulting cement paste, the distinction between adding pozzolans to the concrete mix or having them introduced to the concrete within a blended cement would appear to be more semantic than real.

The term "masonry cement" is used broadly in this report and includes portland lime and plastic cements. It is the cementing agent in mortar (a mixture of cement, fine aggregate, and water) that is used to bind together building blocks, such as bricks and stones. Masonry cements can be made either from portland cement or directly from clinker; manufacture involves incorporating a high percentage (e.g., 50%) of admixtures—commonly ground limestone or lime. This need not require a high degree of sophistication; in particular, portland-lime cements commonly are mixed at the construction sites, using purchased portland cement and lime. Accordingly, the data in this report, which are for masonry cement produced and sold by cement manufacturers only, underreport the true production and consumption of this material, particularly for some regions of the country.

The bulk of this report, particularly tables 1 through 7, and 10 through 15, incorporates data compiled from U.S. Geological Survey (USGS)[2] annual surveys of individual cement and

[1]All tons are metric in this report unless otherwise stated.

[2]Data prior to 1995 were collected by the former U.S. Bureau of Mines.

clinker manufacturing plants and importers. In 1996, responses were received from 128 of the 134 facilities canvassed, including all but 1 producer; these facilities accounted for more than 99% of total U.S. cement production and shipments. In 1995, responses were received from 124 of the 130 facilities canvassed, recording 99% of production and shipments. Estimates were incorporated for the nonrespondents on the basis of monthly shipments data and/or past annual data. Tables 8 and 9, in contrast, are based on monthly shipments surveys of the cement-producing companies and importers, and for these, the response rate was 100% for both years. The several thousand U.S. concrete producers were not surveyed and, thus, the true production and consumption of pozzolans, and hence of "blended cement," are under represented.

For cases where annual questionnaires were returned incompletely filled out, followup inquiries were made, after which estimates were made and incorporated for any remaining missing data. Estimates for most information categories constituted only very small percentages of the aggregated totals and, thus, the introduced estimation errors are considered to be insignificant. Two important exceptions are the value data (tables 1 and 11-13), where a significant number of companies routinely withhold the information, and the data for portland cement shipments by customer type (table 14), where the cement producers readily admit to having incomplete knowledge.

As in previous years, there is a tonnage discrepancy between the annual shipments totals in tables 1-7 and 10-15 and the larger (monthly based) totals shown in tables 8 and 9. As a measure of cement consumption, the data in tables 8 and 9 are preferred because they are more complete; this will be discussed in more detail in the Consumption of Cement section. Integration of the data from tables 8 and 9 data with those from the other tables has not been done to avoid creating additional internal inconsistencies.

Tables 16 through 21 show nonproprietary trade data from the Bureau of the Census in lieu of the proprietary data collected through the USGS questionnaires. World production data shown in table 22 were derived by USGS country specialists from a variety of sources.

Some data are presented for State groupings or districts—generally corresponding to Census Districts or subsets thereof—where required to protect proprietary individual State data. Certain major cement-producing States have been subdivided along county lines to provide additional market information.[3]

Within the U.S. cement industry, very few significant changes were reported in plant or company ownership during the year. In June, Scancem Industries Inc., of Norway, sold Continental Cement Co.'s Hannibal, MO, plant, plus distribution terminals in St. Louis, Chicago, and Bettendorf, IA, to a group of private investors, mostly from the St. Louis, MO, area; the Chicago terminal was subsequently sold to Holnam, Inc. Scancem retained ownership of Continental Cement Co. of Florida, Inc., which operates two Florida import terminals (International Cement Review, 1996a). Also in June, Holnam purchased Koch Minerals Co., which has granulated blast furnace slag (pozzolan) grinding facilities at Weirton, WV, and Chicago, IL (Rock Products, 1996a). Essroc Corp. announced the acquisition of distribution terminals at Wilder, KY, and Pittsburgh, PA, from Lafarge Corp (Essroc, 1996). Southdown, Inc., announced the purchase of Mitsubishi Cement Corp.'s cement distribution terminal in Phoenix, AZ (Southdown, 1996).

Legislation and Government Programs

Economic Issues.—Federal and State annual proposals and appropriations for public sector construction are ever of concern to the cement industry. Similarly, the industry monitors Government policies that influence the cost of money and other aspects of the general economic climate because these affect private sector construction projects. Because of high transportation costs, cement markets tend to be fairly local. Competition within markets served by more than one cement company can be keen, but similarities of production methods and costs have constrained cement sales price variations among companies. This has led to periodic Government antitrust investigations of the industry, to date without findings against the cement companies. One such investigation was concluded in 1995; none was reported in 1996.

Probably the most significant Government economic actions of recent interest to the cement industry have been regarding trade and stem from the 1980's when various factors led to a flood of cheap cement imports coming onto the U.S. cement market. Subsequent determinations of cement dumping by Japanese, Mexican, and Venezuelan cement companies led to the imposition of antidumping tariffs on imports from Japan and

[3]State subdivisions are as follows:

California, northern.—Counties north of San Luis Obispo and Kern Counties and west of Inyo and Mono Counties.

California, southern.—Inyo, Kern, Mono, San Luis Obispo, and all counties further south.

Chicago, metropolitan.—Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will Counties in Illinois.

Illinois.—All other counties in the State.

New York, eastern.—All counties east of Broome, Chenango, Lewis, Madison, Oneida, and St. Lawrence Counties, but excluding counties within Metropolitan New York.

New York, western.—Broome, Chenango, Lewis, Madison, Oneida, and St. Lawrence Counties, and all those further west.

New York, metropolitan.—The five counties of New York City (Bronx, Kings, New York, Queens, and Richmond) plus Nassau, Rockland, Suffolk, and Westchester Counties.

Pennsylvania, eastern.—All counties east of Centre, Clinton, Franklin, Huntingdon, and Potter Counties.

Pennsylvania, western.—Centre, Clinton, Franklin, Huntingdon, and Potter Counties, and all those further west.

Texas, northern.—All counties north of Burnet, Crockett, Jasper, Jeff Davis, Llano, Madison, Mason, Menard, Milam, Newton, Pecos, Polk, Robertson, San Jacinto, Schleicher, Tyler, Walker, and Williamson Counties.

Texas, southern.—The named counties above and all those further south.

Mexico and to a voluntary restraint agreement with Venezuela. The tariffs have dramatically reduced imports of Japanese cement and clinker into the United States, from 2.1 million tons in 1990 to less than 500 tons in 1996. Anticipation and eventual imposition of tariffs on Mexican imports similarly led to a decline from a peak of 4.5 million tons in 1988 to 0.6 million tons in 1994. The tariffs were under appeal by the main Mexican company involved, and in the meantime, imports from Mexico began growing, totaling 0.85 million tons in 1995 and almost 1.3 million tons in 1996. Administrative reviews of the tariffs conducted by the U.S. Department of Commerce (DOC) on a periodic (12 months beginning August 1) basis for the years 1990 through 1995 have so far confirmed the tariff dumping margins. The latest reviews, covering the fourth and fifth periods (ending September 1995), were released by the DOC in April 1997 (Southern Tier Cement Committee, 1997).

Environmental Issues.—Cement production involves both mining and manufacturing components. About 120 million to 125 million tons per year of nonfuel raw materials are mined, generally from quarries. Environmental issues impacting this activity are common to most surface mines and include problems with dust, increased sediment loads to local streams, chemical changes to local water supplies, and so forth. Of far greater concern are the environmental impacts of the manufacturing process, most of which stem from the manufacture of clinker. Clinker kilns burn large quantities of fossil and/or other organic fuels to thermochemically break down (calcine) calcareous rocks and to instigate other clinker-forming chemical reactions.

In the growing debate over climatic change, the impact of so-called greenhouse gases on atmospheric warming is a major issue. The most common greenhouse gas is carbon dioxide (CO_2), and in the clinker kiln, fuel combustion and carbonate calcination evolve large quantities of this gas. The precise determination of the CO_2 emissions of the U.S. cement industry is difficult because compilations of chemical analyses for the specific types and quantities of raw materials and fuels actually consumed are lacking. Instead, estimates are made separately for calcination and fuel combustion. For CO_2 from calcination, two estimation methods are in common use. The first assigns average carbonate (CO_3^{-2}) contents to the carbonate rock types (tonnages) consumed (see table 5). The main problem with this method is that the carbonate content of limestones and other carbonate rocks vary widely; seldom is a pure calcium carbonate limestone used to make cement. A lesser problem is the small carbonate component of other rocks consumed—particularly shales—that tends to be ignored. The second method uses clinker production data and typical calcium (oxide) analyses of clinker to back-calculate the (calcium) carbonate component of the kiln feed. A problem with this method is that the calcium content of clinker also varies, although not widely as with carbonate rocks. A minor problem is introduced if one assumes, for simplicity, that all the calcium in the clinker is derived from calcium carbonate; in fact, other components of the feed, such as calcium silicates, can contribute calcium. And both methods fail to account for a small component of carbonate escaping, uncalcined or incompletely calcined, as cement kiln dust (CKD). With the first method and the raw materials data in table 5, a rough estimate can be made of CO_2 emissions from calcination in 1996 amounting to about 40 million tons, or about 0.57 ton per ton of clinker. With the second method, assuming a CaO content of clinker of 64% and that all the CaO was derived from $CaCO_3$, the CO_2 emissions from calcination would amount to about 36 million tons (0.51 ton per ton of clinker).

Estimation of CO_2 emissions from the combustion of fuels generally involves assigning carbon contents to the fuels consumed either directly or after calculated conversion to a common fuel (e.g., tons of coal equivalent). The error in both methods is in the assignment of a carbon content to a specific fuel type, such as coal, when a range of carbon contents may be present. This error probably is not large for fossil fuels, but could be significant for waste fuels, given that all sorts of organic substances (generally unspecified), ranging from paper to paint thinners, may be burned as wastes. Another, probably minor, problem is that many carbonate rocks contain organic carbon (kerogen)—some to a significant degree—and this material behaves as a fuel in the kiln. Kerogen would reduce the consumption of exogenous fuels, but its emission of CO_2 is unquantified. The fuel consumption data in table 6 would yield an estimate of CO_2 emissions of about 34 million 35 million tons (0.48-0.50 ton per ton of clinker).

Combustion and calcination combined would, for 1996, yield total CO_2 emissions of about 70 million to 75 million tons. This estimate and its components are probably good to within 10%. The total emissions, as estimated, are equivalent to about 1 ton of CO_2 per ton of clinker produced. The ratio would not change significantly on a cement-produced basis, assuming the cement is "straight" portland (clinker plus 5% gypsum). It would not hold, however, for blended cements, masonry cements, or any cement made by grinding imported clinker (for which the CO_2 emissions would be credited to the clinker source country). The above estimates are in close accord with those presented elsewhere; for example, Cahn and others (1997).

The above estimates do not include the CO_2 equivalent of the electricity consumed by the cement industry. Such emissions are commonly credited to the power industry. For a given plant or region, an estimate, ideally, would require knowledge of the percentage of the electricity sourced from thermal power plants and from what fuels therein. A simple estimate for the U.S. cement industry overall can be made by assuming an average "mix" of power-generation sources. According to 1995 data from the Energy Information Administration (1996), the U.S. industrial sector electricity consumption-to-CO_2 ratio was about 1,700 kilowatt-hours per ton of CO_2. Applied to the 1996 electricity consumption of the cement industry (see table 7), this would yield a CO_2 equivalent of about 7 million tons.

The concern of the cement industry with CO_2 emissions stems mainly from worries that the Government will seek to reduce emissions through the imposition of carbon taxes or emissions quotas. For administrative reasons, carbon taxes would most likely be imposed on the fuels consumed rather than on the emissions themselves. The fear is that the carbon taxes,

especially if high, would significantly raise clinker production costs and would, thus, reduce the price competitiveness of domestic cement against (presumed) cheaper imports. The imports would be cheaper because so-called developing countries, including Mexico, are expected to be exempted, at least for a time, from carbon emissions limits and could, thus, produce cement more cheaply. Many of these same developing countries also have very large and efficient modern plants.

In February, the U.S. Department of Energy (DOE) initiated a study into the economic impacts of carbon taxes on six industries, including cement. The completed study, summarized in Nisbet (1996), noted that energy currently accounts for 30% to 40% of current production costs, that affordable technological options to improve energy efficiencies of existing plants are limited, and that the unit CO_2 emissions from calcination cannot be reduced. In the study, carbon taxes were imposed under two incremental (year 2005 and 2010) price scenarios, wherein the initial tax (2005) doubled in 2010. The cheaper scenario imposed a tax in 2005 of 8.4 mils ($0.0084) per kilowatt-hour of electricity, $40.67 to $44.10 per ton of oil equivalent on fuel oil, $28.77 per ton of oil equivalent of natural gas, and $35.45 per ton of coal. The more-expensive scenario was approximately 50% higher and was projected to increase total energy costs by an average of 151% in 2010. The cost increases would cause domestic cement to become increasingly uncompetitive with foreign cement (sourced from nontax countries), with the result that the industry could lose about 15 million to 24 million tons of production capacity through plant closures, and imports would increase by as much as 100% or more to compensate. However, the study was constrained by boundary conditions set by DOE and, accordingly, did not fully account for the possibility of imposition of protective tariffs, the likelihood that developing countries ultimately would not be excluded from carbon taxes, or that certain parts of the country would remain insulated from imports because of high transportation costs (which also would increase), or the possibility that there would be a large increase in the consumption of nonclinker (i.e., pozzolan) extenders in cement manufacture. Given its widespread use in Europe and Asia, pozzolan (blended) cement consumption is likely to grow in the United States even without carbon taxes, although the market is constrained, to some degree, by cement specifications in existing construction codes.

Another major waste product of clinker manufacturing is CKD, made up of particles of clinker, incompletely reacted raw materials and solid fuels, and material eroded from the kiln's refractory brick lining. Almost all CKD is captured by either electrostatic precipitation or baghouse filtration, either for reuse as kiln feed or as a soil conditioner for farms, or for storage in a landfill. Nevertheless, worries remain regarding unacceptable levels in some CKD of hazardous trace-element or organic contaminants, such as chromium compounds from refractory bricks, and nickel and vanadium from fossil fuels. Objections have been raised by environmental groups and commercial waste-incineration companies to perceived risks of contaminant emissions arising from the increasing use of waste fuels by the cement industry.

Under amendments to the Resource Conservation and Recovery Act (RCRA) in 1980, the U.S. Environmental Protection Agency (EPA) was instructed to study so-called Bevill (amendment) wastes, including CKD, to see if such were to be regulated under the hazardous waste provisions of RCRA. The EPA completed its Report to Congress on CKD late in 1993; in this, CKD was described as posing little environmental or health risk, but some ground-water contamination problems owing to CKD mismanagement were identified (U.S. Environmental Protection Agency, 1993 a,b). The EPA issued an associated regulatory determination in early 1995 that reaffirmed the risk conclusions of the 1993 Report, and proposed, under the authority of RCRA Subtitle C (hazardous wastes), drafting in consultation with interested stakeholders a tailored set of management standards for CKD (U.S. Environmental Protection Agency, 1995). Importantly, the 1995 determination ruled that the standards need not be the stringent ones in Subtitle C; that is, CKD was not ruled to be a hazardous waste. In March 1995, the cement industry, responding to a perceived lack of rigor in the determinations language, presented to the EPA a so-called enforceable agreement that laid out standards for CKD management (American Portland Cement Alliance, 1995). The EPA reviewed the industry proposal but, in November 1995, professed itself uncertain of its authority under RCRA to sign such an agreement (American Portland Cement Alliance, oral commun., 1996). Instead, the EPA began a regulatory development program in April 1996, with a target date for release of a proposed rule in early 1998 (U.S. Environmental Protection Agency, 1996).

Increasingly stringent Government restrictions on fuel-derived emissions of so-called NO_x and SO_x, dioxins and furans, and other contaminants, are of concern to the industry, particularly to the degree that changing emission limits necessitates changes in testing procedures, equipment, and operating practices. These limits also affect the ability of plants to utilize waste fuels cheaply. The Government was moving towards regulating kiln emissions within the regulatory Maximum Achievable Control Technology (MACT) framework and issued an extensive document setting out proposed MACT standards in April 1996. After receiving complaints from the industry that the original review period was too short, the EPA agreed, in December, to an extension, and reevaluated standards are expected to be released late in 1997. Under a MACT framework, the standards adopted for each contaminant are the average emissions levels of the least polluting plants; current proposals involve the least polluting 12% of the plants.

Production

Cement was produced in 1996 in 37 States and in Puerto Rico by 43 companies (other totals are possible depending on ownership splitouts), including 1 that was State owned. All but 7 of the 118 plants that were in operation were integrated facilities producing both clinker and cement. Production and related data are shown in tables 2 through 4. About 65% of

U.S. cement production and capacity was foreign-owned.

Several cement companies were upgrading their plants to reduce operating costs and/or to increase capacity. Some of the projects announced during the year were major. Ash Grove Cement Co. completed a 0.15-million-ton-per-year capacity expansion project at the Leamington, UT, plant at midyear (Grover, 1997). Blue Circle America Inc. announced that it would start work in May to expand capacity at its Harleyville, SC, plant by more than 0.3 million tons per year; the work was expected to be completed by yearend 1997 (Portland Cement Association, 1996a). Holnam Inc. was converting its Devils Slide, UT, plant to dry process technology; the conversion was expected to be completed in late 1997 (International Cement Review, 1996b). Lafarge Corp. was planning to upgrade the kiln line at the Sugar Creek, MO, plant (Rock Products, 1996b). Lehigh Portland Cement Co announced that it was planning a modernization and 50% expansion (to 1.36 millio tons per year) program at its Union Bridge, MD, plant (Portland Cement Association, 1995); a tire-burning system for the kiln was installed as part of this project (U.S. Geological Survey, 1996a). Mountain Cement Co. brought a second dry kiln on line in January 1996 (U.S. Geological Survey, 1996b). North Texas Cement Co. completed construction of a large cement import terminal at Houston, TX, and received its first shipment in December (Wood and Olaveson, 1997). Rinker Materials Corp. announced that it would convert its Miami, FL, plant to dry process technology, thereby increasing capacity to 1 million tons per year (International Cement Review, 1996c); the work was due to be completed in 1999. Roanoke Cement Co. installed a single-string preheater/precalciner on its No. 5 kiln line (U.S. Geological Survey, 1996c). Southdown Inc. was expanding capacity at its Fairborn, OH, plant by 0.1 million tons per year and at Victorville, CA, by 0.3 million tons (Portland Cement Association, 1996c); a new finish mill was completed at Fairborn during the year (U.S. Geological Survey, 1996d).

The only permanent closure during the year was at Hawaiian Cement, which shut its kiln down at the end of August. The facility continued to operate as a grinding plant for imported clinker (Hawaiian Cement, oral commun., 1996).

Portland Cement.—In the United States and Puerto Rico, portland cement was manufactured at 118 plants, including 7 dedicated clinker-grinding facilities. The regional distribution of these plants, cement production and capacities, and yearend cement stockpiles are given in table 2.

Portland cement production rose by 3.4% in 1996 to about 75.8 million tons, a new record. As shown in table 2, increases were noted in all but a few States. The top five portland cement producer States continued to be, in descending order, California, Texas, Pennsylvania, Michigan, and Missouri. Nationwide, calculated cement (grinding) capacity utilization levels were at very high levels—almost 84% for the country. This statistic, however, is misleading in that it compares only the portland cement output with the reported grinding capacity. In reality, the masonry cement tonnage (table 3) should be incorporated, which would increase the overall grinding capacity utilization for the country to almost 88%. Given the fact that the reported capacities exclude downtime for unexpected maintenance, the utilization levels shown are likely very close to practical limits. Whether the 1995-96 changes in capacity utilization or in the capacities themselves are statistically significant for all regions remains unclear. Although a number of plants were involved with capacity improvement projects to one degree or another, some of the changes shown could simply reflect a difference in reporting personnel or in their data rounding from one year to the next.

Yearend portland cement stockpiles were down 0.4 million tons compared with those in 1995, but remained almost 0.7 million tons higher than those at yearend 1994. Although a reduction in 1996 stockpiles is in line with high levels of demand for cement, an analysis of the contribution of cement stockpiles to true consumption is precluded because of the absence of data on stocks of clinker, the intermediate product. As noted in the "Clinker" section, clinker output was inadequate to account for the portland cement production.

Data are not collected on the production of portland cement, by type, but production was probably proportional to the reported shipments, by type, shown in table 15. As in previous years, portland cement Types I and II presumably accounted for about 90% of total output.

Cement producers in the United States ranged from companies having a single plant of less than 0.5% of total U.S. capacity to large multiplant corporations. The largest of these had 13% of total U.S. cement production capacity. The top 10 companies in 1996, combined, accounted for 59.4% and 59.9% of total U.S. portland cement production and capacity, respectively. Their combined grinding capacity utilization averaged 83%. The top 10 companies were, in descending order of production, Holnam, Inc.; Lafarge Corp.; Southdown, Inc.; Ash Grove Cement Co.; Blue Circle Inc.; Essroc Materials, Inc.; Lone Star Industries, Inc.; California Portland Cement Co.; Medusa Corp.; and Lehigh Portland Cement Co.

Masonry Cement.—Reported production of masonry cement, as shown in table 3, declined modestly in 1996 to about 3.5 million tons (about 4% of total U.S. cement output). This was in contrast to increased demand, as evidenced by the shipments data in tables 8 and 12. At least some of the excess demand appears to have been met by drawing down masonry stockpiles; imports, however, may not account for the remainder. The amount of masonry shipments reported as of foreign origin (imports) in table 8 was substantially unchanged in 1996, and the trade data in tables 17 through 21 do not split out this cement type. Masonry cement continued to be produced by 32 companies at 84 plants, all but 1 of which also produced portland cement. Although not shown in table 3, of the masonry cement produced, 89% was made directly from clinker (vs. from portland cement) in 1996 and 93% was so derived in 1995.

Clinker.—Table 4 provides district-level information on clinker production and capacity. Including the facilities in Puerto Rico, clinker was produced by 111 integrated cement plants, operating 207 kilns. Almost two-thirds of the kilns used dry-process technology. Clinker production increased in 1996 by

0.5% to about 70.4 million tons, and calculated capacity utilization increased slightly to almost 95%. After excluding the clinker needed to make masonry cement (not reported, but estimated to be about 2.1 million tons), the remaining clinker (about 68.3 million tons) would be adequate to account for about 71.9 million tons of portland cement—about 3.9 million tons less than that actually produced. The clinker deficit (estimated to be about 3.7 million tons) was only partially compensated for by clinker imports [2.1 million tons (table 5) or 2.5 million tons (table 21)], leaving a 0.6 million to 1.6 million ton deficit that implies a significant drawdown of clinker stockpiles during the year. Although quantitative data were lacking, a number of cement companies orally reported a decline in their yearend clinker stockpiles. Ultimately, evaluation of the significance of a yearend decline would be difficult, as clinker stockpiles commonly show significant seasonal variations, especially with respect to planned kiln maintenance periods.

The increase in the total U.S. capacity utilization rate could be artificial as it is dependent on reported daily and calculated annual capacities, both of which declined about 2% in 1996. The capacity declines were unexpected as the 1996 data include a small plant in Nevada that was not incorporated in the 1995 data, as well as a new dry kiln in Wyoming. Further, the 1996 capacity data include Hawaiian Cement, despite the fact that it permanently shut its kiln in August; its inclusion, however, does not significantly affect the U.S. declines shown. There were no permanent shutdowns in 1995 that could have decreased the 1996 capacity basis. Past surveys have revealed inconsistencies for some plants in the reporting of scheduled vs. unscheduled downtime; only the scheduled downtime influences the calculated annual capacities. Accordingly, the total capacity declines for 1996 may include a measure of reporting or definitional errors. Notwithstanding these problems, the data indicate that U.S. cement kilns clearly operated at essentially full practicable capacity, as in 1995. The average operational plant capacity was about 0.36 million tons, slightly below that reported in 1995 but subject to the uncertainties given above. As shown in table 6, (entirely) dry-process plants accounted for 71.5% of total clinker production; wet plants for 25.8%; and combination plants for the remainder.

The top five clinker-producing States continued to be, in descending order, California, Texas, Pennsylvania, Missouri, and Michigan. The top 5 companies had about 38% of total U.S. clinker production and capacity, and the top 10 companies had about 59% of both. The top 10 companies were, in declining order of clinker output, Holnam, Inc.; Lafarge Corp.; Southdown, Inc.; Ash Grove Cement Co.; Blue Circle Inc.; Lone Star Industries, Inc.; Essroc Materials, Inc.; Medusa Corp.; California Portland Cement Co.; and Lehigh Portland Cement Co.

Consumption of Raw Materials and Energy.—The nonfuel raw materials used to produce cement, most of which were consumed in clinker manufacturing, are shown in table 5. As normal, about 85% of the raw materials mix was limestone and other calcareous rocks. The small decline in limestone consumption appeared to have been balanced, in terms of CaO credits, by the large increase in the consumption of cement rock (impure limestone). The cement rock also would have added significant silica credits that, together with the higher consumption of clay, could have more than offset the reduced consumption of shale, sand, and sandstone. Similarly, any iron and aluminum deficits from reduced shale consumption appeared to have been more than offset by the cement rock and increased consumption of clay, iron ore, and similar materials.

The increase in gypsum consumption shown is almost exactly proportional to that in cement production. Likewise, the modest increase in slag consumption is proportional to that in blended (with slag) cement sales shown in Table 15, assuming that the sales mirror the production and that, as seems likely, the slag was all used as a cement extender. In contrast, the fly ash consumption shown in table 5 clearly exceeds that used in fly ash blended cements (per sales in table 15) and indicates that most of the fly ash was being used as kiln feed.

Consumption of fuels, by kiln process, is shown in table 6. The table differs from that in previous editions of this report in that coke and petroleum coke are now listed separately from coal. Overall, coal consumption increased modestly, although part of this increase was offset by a decline in petroleum coke use. The burning of waste tires and other solid waste fuels increased. Most of the solid fuel consumption increases were at dry-process plants. Fuel oil consumption increased 52%, especially by wet-process plants (up 121%). Liquid waste fuel consumption also increased, also mostly by wet plants. In contrast, natural gas consumption fell by about one-third at both types of plants, indicating that coal and oil were being substituted for gas, probably because of the more than 50% average unit price increase for gas during the year (Oil & Gas Journal, 1997a). Although not shown in table 6, estimates may be made of the energy content of the fuels consumed by using standard heat conversions. For the waste fuels (undifferentiated), however, the energy content assignment error may be significant. The analysis further assumes the same heat content for the same fuel type in both years. On this basis, it was estimated that wet kilns used about 4% less total energy in 1996 than in 1995 and that dry kilns showed no significant change. Given that clinker output by wet kilns fell by 1.5% in 1996, and output by dry kilns increased by 1.4%, the estimated reduction in energy consumption suggests that most of the kilns, especially the wet-process lines, showed improved fuel consumption efficiencies in 1996.

Table 7 shows electricity consumption by integrated cement plants, by kiln-process type. The table differs from previous versions in that the unit consumption is now calculated for total finished cement (including masonry) instead of just for portland; for 1995, this revision has caused the average consumption to drop by 4 kilowatt hours per ton. Electricity consumption at integrated plants is dominated by the raw meal and finished cement comminution circuits. In modern dry lines, significant amounts of electricity also are used to operate various fans and blowers in preheater and precalciner equipment. Thus, dry-process kiln lines—at least those equipped with preheaters and/or precalciners—consume more electricity than equivalent

capacity wet-process lines. For 1996, unlike the fuel consumption decreases noted above, per-ton (cement) electricity consumption showed no change for wet-process lines and increased by 1% and 2% for the dry- and the combined-process lines, respectively. The average cement-to-clinker production tonnage ratio increased by 2.9% to 1.08. This suggests that the higher unit electricity consumption in 1996 reflects increased electricity use by the finished cement grinding circuits. Raw materials crushing, or the kiln lines, may also have used proportionately more electricity in 1996. Unfortunately, data to evaluate this are not available.

Consumption of Cement

Data for cement shipments to final customers are accepted as being a proxy for true consumption levels in the United States. In contrast, shipments by one cement producer to another, whether or not of the same company, are not counted until, ultimately, the cement is sold to a final customer. The determination of what is and is not a "final customer" is left to the reporting cement producer. "Final customer" is understood to include concrete manufacturers, building supply dealers, construction contractors, and the like. The designation ignores the possibility that a customer might put some cement into stockpiles extending beyond yearend (to be "consumed" the following year) or might resell cement to other users. There are no data on such storage or transfers, but they are believed to be small—probably no more than 5% of any 1-month's shipments—and would likely balance out over a period of months.

Cement shipments data and derivations therefrom are given in tables 8 through 15. These tables reflect two data-collection methodologies. Tables 8 and 9 contain the annualized shipments data that are collected monthly from the cement-producing companies and from the cement importers. The monthly surveys commonly are returned on a consolidated basis—one form representing a company's entire cement shipment activities. Importantly, these surveys capture the activities of a company's importation and distribution terminals. Tables 10 through 15, in contrast, are based on annual surveys sent to all of the cement-producing plants and certain independently-owned import terminals. The annual forms are not returned on a consolidated-operations basis. A plant may report the shipment (to final customers) activities of a distribution terminal only to the extent that activities of the terminal are known to the plant. If the terminal acts partly or totally independently of the reporting plant, then some of the shipments from the terminal may remain unreported to the USGS.

Not surprisingly over the years, differences in the totals from the two survey types have been significant. For example, table 8 (monthly surveys) shows portland cement shipments to final customers (excluding exports) of about 82.9 million tons in 1995 and 87.6 million tons in 1996. Table 11 (annual surveys) shows shipments of 75.0 million tons in 1995 and 81.5 million tons in 1996. Both surveys include cement made from imported clinker and imported cement shipped out by the reporting entity. The difference in shipments—7.9 million tons in 1995 and 6.1 million tons in 1996—most likely reflects the cement importing activities of terminals not captured in the annual surveys (e.g., table 11). Accordingly, the preferred consumption data are those based on the complete monthly data; that is, tables 8 and 9.

Comparison of tables 8 and 9 with tables 11 and 12 also reveal differences on a State or district level. Tables 11 and 12 show a mix of State and district data where needed to conceal proprietary data. The mix is necessary because the annual surveys collect data from producers, and the regions shown are the originating districts, not the destinations, of the shipments. Except for masonry cement shipments for a small number of States, this precaution is not necessary for the shipments by destination data in table 8. The distinction between "origins" and "destinations" of shipments also explains why State data in table 8 differ from individual State data (where shown) in table 11. For example, table 8 shows Alabama as being the destination (consumer) of 1.47 million tons of portland cement in 1996, but table 11 shows Alabama as being the origin of 4.14 million tons of portland sold to final customers. Clearly, Alabama cement producers sold material to final customers outside of Alabama. Table 8 shows North Texas as having consumed 4.37 million tons of portland cement in 1996, but table 11 shows North Texas plants as shipping only 3.56 million tons. Clearly, North Texas consumers brought in cement from outside the region.

Although the monthly-based data in tables 8 and 9 are the preferred consumption data, no attempt has been made to reconcile these data with the annual data on shipments by type of cement, by mode of transportation, or by value, or the like. To maintain internal consistency, the annual shipment totals (e.g., tables 11 and 12) are used wherever these other annual data are presented.

National Consumption.—Table 8 shows that overall U.S. portland cement consumption increased by 5.6% in 1996 to about 87.6 million tons. Of the total shipments, those representing imports decreased slightly, but the change is partly administrative. A change was made in the reporting methodology for shipments in 1996 wherein all cement ground from imported clinker was to now be credited as having originated in the United States. For 1995 and prior years, some companies had reported this cement as being of foreign origin. It was, however, impractical to adjust the pre-1996 data. Imports of finished cement (all years) were unaffected by the reporting change. Consumption reflected a largely countrywide increase in construction. According to Bureau of Census data quoted by the Portland Cement Association (1996b), total construction spending grew by 1.9% in 1996 to $495.8 billion (1992-basis dollars). Within this, the largest gains were seen in residential construction: single-family housing construction spending grew by 6.6% to $135.5 billion, and multiple-family housing grew by 10.2% to $17.3 billion. In 1995, this interest-rate-sensitive sector had declined in line with modest increases in mortgage rates. The mortgage rates continued to increase, although remaining at modest levels, until the fourth quarter of

1996, when they declined somewhat. The residential construction increase in 1996 thus appears to reflect an overall stronger economy and pent-up demand. These factors also appeared to have helped private nonresidential construction, which grew by 3.0% to $123.4 billion. Public sector spending was, overall, stagnant at $123.9 billion. Within this, public building construction grew by 4.1% to $55.6 billion, but the important highway/street construction sector fell by 1.4% to $34.4 billion.

As shown in tables 8 and 9, most States and all regions showed consumption increases for the year, although there were some monthly regional declines (not shown) due to poor weather conditions. The largest growth regions were the Midwest and the West, notwithstanding the fact that the Mountain district within the West also had the majority of the (few) States nationwide that showed declines for the year. The declines were more than offset by strong increases in Arizona, Colorado, and Nevada, all of which were experiencing high population growth. Nevada also continued to see growth in consumption by the mining industry. For the country, the five largest portland-cement-consuming States continued to be, in declining order, Texas, California, Florida, Ohio, and Georgia. The South was again the largest cement-consuming region.

Reported masonry cement consumption increased by 6.7% overall, although, as noted in the definitions section of the introduction, the data likely underrepresent the true consumption of this type of cement. The increase largely reflects that in the residential construction sector.

Table 10 shows portland cement shipments to final customers in terms of transportation method. As in 1995, most shipments were directly from the plant to the customer and were mainly of bulk cement. Truck transport dominated deliveries to final customers, but not of deliveries from plant to distribution terminals.

Prices.—The price or value data shown in tables 11 through 13 represent ex-plant valuations by the mill of cement shipments to final customers. Although the plants are asked to provide annual portland cement shipment data, by tonnage and type (table 15), they are not asked for details concerning the value of the sales, by type, in recognition of some companies' misgivings about providing any value data at all. Instead, the values are queried only as totals for all shipments—one total for gray portland cement (all types), another for white portland cement, and another for masonry cement. Even with this accommodation, about one-fourth of the respondents did not provide value data for the 1996 survey, about the same as in previous years. In such cases, the values supplied by other plants in the same market area were averaged and applied; the number of plants so averaged varied regionally. The unit values shown are calculated averages for the whole year and do not reveal temporal variations. Further, the values represent the combined total or average of bulk and container (bag) shipments. In reality, the unit price difference between the two forms of shipments (bulk being cheaper) is significant. These and other variables preclude detailed error analysis of the results. The reader is cautioned that the value data are merely estimates, despite the fact that, to preserve a time series with previous editions of this report, they are presented unrounded. The data should be viewed solely as regional price indicators, suitable only for crude comparisons among districts and years. Although the data are thus not actual prices for specific type(s) of cement, the values shown for portland cement in tables 11 and 13 may be assumed to be dominated by the Types I and II varieties.

The ex-plant value of portland cement shipments to final domestic customers is shown in table 11. The total value rose almost by 14% in 1996 to about $5.7 billion, reflecting increased sales volume and, within the aforementioned data constraints, an ex-plant unit price (indicator) increase of almost 5%. If the average price shown is applied to the shipments data in table 8, then the total rises to almost $6.2 billion. Ignoring price-indicator changes of less than $0.50 per ton (which are almost certainly of no statistical significance), district unit price increases were seen in all except a few districts. The largest decreases (Maine-New York and Alaska-Hawaii-Oregon-Washington) appear to be, at least in part, aberrations reflecting incomplete reporting in one or both years. Average price (including freight) data for regional imports of hydraulic cement plus clinker (see table 18) suggest that some of the decreases shown (Oregon, Hawaii, Maine, New York, and possibly Florida) could partly reflect import price decreases. However, although far less detailed, the gray portland import data in table 19 suggest that the decreases seen in table 18 may be due more to clinker than to cement. Although not shown in the tables, the change in these districts in the consumption of expensive portland cements (such as white cement) was insufficient to account for the value decreases shown.

In table 12, masonry cement values show a total increase of more than 14% to almost $323 million and an average 6.0% price increase. In contrast to portland cement, if the average masonry unit value shown is applied to the consumption data in table 8, then the total value decreases to about $312 million. This decrease reflects the lower tonnage in table 8; a similar relation was seen for 1995 relative to 1994. A possible explanation for this tonnage difference, which is the reverse of that expected from the data-collection methodologies, is that the table 12 tonnages may include late-year shipments from plants that were destined for final customers, but that were not invoiced until the following year, or shipments that wound up in stockpiles at terminals. A summary of average cement ex-plant values, by major type, is given in table 13.

The only data for domestic delivered prices for cement are those for Type I portland (per short ton) and masonry cement (per 70-pound bag) published monthly by the journal *Engineering News Record*. The data represent a survey of customers (likely to be ready mixed concrete producers for portland cement and building supply depots for masonry) in 20 cities in the United States. The 20-city average delivered price in 1996 for Type I portland converts to $80.35 per metric ton, up by 6% from the 1995 price, with a range over the year of only $2.54 per ton. Prices showed a general increase from January to December ($81.32). The city data show a number of

regional price differences, some of which differ significantly from those shown in table 11. The variations could reflect regional differences in shipping methods and costs. The prices for some cities covered, however, did not vary at all over the year, making their validity and that of the national average questionable. The 20-city average masonry cement price for the year was $4.47 per bag (literally converts to $140.78 per ton) and ranged only $0.11 per bag over the year.

Cement Customer Types.—Table 14 presents data on portland cement shipments to final customers broken out by customer type. Although presented in unrounded form, these data are less reliable than any of the other data collected in the annual survey, with the exception of the value data, as explained earlier. Unlike the value data, however, the main problem with the customer-type data is not a lack of survey responses, but the fact that the questionnaire asks for more details on customer types than many cement companies are able to provide. Even for companies tracking their customers' usages in detail, the assignment of cement sales tonnages to the 15 use(r) categories on the questionnaire can still be a problem. For example, a company may know that a certain ready-mixed concrete customer used X tons of cement (in ready-mixed concrete) for road paving contracts. The dilemma, then, is whether to register those tons under the ready-mixed category or the road paving category. Another example would be the "Government agencies" use category on the questionnaire—Government use could include ready-mixed concrete, or road paving, or other duplicative use(s). The "Other" category on the questionnaire, which is intended to mean "miscellaneous," is used by some cement plants use as a catch-all. Further, although generally listed as exact tonnages, some company responses calculate to simple (broad) percentages of the total shipments—the breakdown being the "best guess" of that cement plant. In a few instances, the apportioning appears to have been guided by past published breakdowns. Ultimately, then, the problem is partly interpretational: "type of customer" is not exactly the same thing as "type of use."

Notwithstanding these limitations, the data in table 14 clearly indicate that the dominant customer type for portland cement in 1996 continued to be ready-mixed concrete producers. As listed, cement for ready-mixed concrete (customers) accounted for about 60% of total cement shipments (61% in 1995). Of the total shipments listed under "Government and miscellaneous," however, 50% to 60% likely were used for ready-mixed concrete, which would have then accounted for about 70%. Similarly, the (footnoted) breakout of the "Contractors" category probably understates true consumption for road paving—some cement for this purpose no doubt resides under the "Government and miscellaneous" and the "Ready-mixed concrete" categories. In contrast, the data for concrete products manufacturers, buildings materials dealers, and oil well cement uses are probably fairly accurate. Overall, the relative usage breakdowns are very similar to those of 1995. The largest relative (tonnage) change was in "Oilwell, mining, waste," which increased by almost 24%. The category includes a 43% increase in cement purchases by oil-well drillers (the tonnage is slightly less than that shown for oil-well cement sales in table 15). The "oil well" increase is in accord with heightened drilling activity during the year, as evidenced by a much higher drill rig count (Oil & Gas Journal, 1997b) and the increased consumption of barite by the petroleum exploration industry (Searls, 1997). Although the cement customer types are shown in table 14 on a District basis, the data reflect the origins of the cement, not the locations of the customers, and are thus only an indirect regional indicator of portland cement usage.

Types of Portland Cement Consumed.—As shown in table 15, portland cement consumption in the United States remained dominated by general-use Types I and II. Within the broad use of the portland term, Types I through V accounted for more than 96% of total shipments. Of these main varieties, Type V cement, which is resistant to so-called sulfate attack, showed the largest relative increase during the year. Of the less common varieties, oil-well cement showed a large relative increase in shipments owing to an increase in drilling activity during the year, as discussed above. White cement (all varieties) showed a large relative increase in sales during the year, owing to a strong residential construction market but remained less than 1% of total U.S. cement consumption. After increasing significantly in 1995, blended cement consumption was surprisingly stagnant in 1996. An increase had been expected, given the common industry perception of a growing market for blended cements. Unfortunately, regional consumption data for blended cements are unavailable; market growth is perhaps present but geographically restricted. As noted above, the true level of "blended" cement consumption is unknown because concrete manufacturers can independently add pozzolans to their concrete mixes to yield, in effect, a blended product. Within the two blended cement categories in table 15, that which includes portland-slag cements can completely accommodate the blast furnace slag consumption noted in table 5. However, the second category, which includes portland-fly ash blends, cannot begin to accommodate the fly ash indicated in table 5. Thus, most of that fly ash must be consumed as kiln feed.

Foreign Trade

Trade data from the Bureau of the Census are shown in tables 16 through 21; tables have been added to the present report to show the splitout of imports of gray portland and white cements. As shown in table 16, total exports of hydraulic cement (all types) and clinker rose almost by 6% in tonnage and almost by 10% in value in 1996; nevertheless, these exports remained but a tiny fraction of total U.S. cement commerce. An estimate of the cement component of the exports can be calculated from those of portland and masonry cement in table 8; such exports amounted to 0.486 million tons in 1995 and 0.461 million tons in 1996. Assuming that exports of other forms of hydraulic cement were substantially nil, the table 8 (portland plus masonry cement) exports are equivalent to 64% and 57% of the total table 16 exports for 1995 and 1996, respectively. Accordingly, clinker (a cheaper product than cement) exports showed a decline in 1996, and thus, the higher overall export value in

1996 must reflect higher cement prices. As in previous years, the bulk of the exports went to Canada.

Table 17 shows total imports of hydraulic cement and clinker for 1995 and 1996. Total imports increased by only 2% in 1996, compared with a 1995-over-1994 increase of almost 23%. On a monthly basis, imports in 1996 were below 1995-levels through November, although there was a surge from September onwards (U.S. Geological Survey, 1996e). Despite steadily rising monthly demand, high domestic cement production levels throughout 1996 and the ability to draw from stockpiles of cement and clinker, appear to have been the main constraints on imports during the year.

The cement component of imports (data in table 17 minus the clinker imports in table 21) was 11.6 million tons, up by 5.6% over that of 1995. The import component of total cement sales shown in table 8 amounts to 11.9 million tons—the higher figure in table 11 probably includes imported material sold from stockpiles. Gray portland cement imports increased by 6.3% in 1996 to 10.1 million tons. As shown in table 19, the landed value (including freight) of gray portland imports averaged $53.82 per ton, up by 3.2%, and substantially below the average value for U.S. sales shown in table 13. Canada continued to be the largest source of portland imports, which increased by 10.9% (tonnage). Imports from Mexico increased by 50.4% from the depressed levels of 1995, notwithstanding high antidumping tariffs (which were under appeal) imposed on imports from that country. White cement imports (see table 20) declined by 10.6% in 1996, although the value rose by 15.4% to $120.65 per ton—well below the domestic sales value indicated in table 13. The imports were equivalent to almost 58% of the white cement sales shown in table 15; imports were equivalent to 72% of white cement sales in 1995. The decline in the apparent import component of sales in 1996 could represent either an increase in domestic production of white cement or greater sourcing of cement from stockpiles during the year.

Clinker import tonnage fell by almost 11%, but increased by 15.5% in value to $48.40 per ton (table 21). Canada remained by far the largest source, although imports declined almost 9%.

World Review

World hydraulic cement production is shown in table 22. Informal, but credible, commentary on past editions of this table suggests the strong possibility that the production numbers reported by some countries may, in fact, include exports of clinker. The countries involved and the degree to which this may be true are not known, but the clinker export component could be significant for some countries. Such a regrettable reporting practice would necessarily lead to overcounting (estimated to be less than 5%) within the world totals because the entire production of some countries, and the partial production of many others, includes cement ground in-country from imported clinker. Given this uncertainty, (unrelated) revisions to past data, and the inclusion within the unrounded world totals of production estimates for a number of countries, the 2.8% increase for 1996 world cement output probably has no statistical significance.

Within the world cement output of about 1.4 billion tons, China remained, by far, the largest producer, with about one-third of the total. The remaining top 10 producers were, in descending order, Japan, the United States, India, the Republic of Korea, Germany, Thailand, Italy, Turkey, and Russia. Comparison of production levels among some countries can be misleading, however, unless they are made for output of similar-quality cements. For example, throughout the world, portland and related cements from clinkers manufactured in large rotary kilns are considered to be generally of high quality. Cements from clinker made in small vertical (shaft) kilns, in contrast, may be of lesser quality; unsuitable for modern highways, bridges, large dams, tall buildings, and the like, or for exports, but perhaps entirely adequate for local demand for small, single-family residences and similar buildings and other low-strength applications. Shaft kilns for cement have been replaced almost entirely by rotary kilns in the so-called developed world but remain common in a number of less-developed countries. Thus, according to recent reviews (e.g., Hargreaves, 1997; Rong and others, 1997), China's cement production would be better viewed as comprising about 50 million tons of high- or export-quality cement from a relatively small number of medium and large rotary kilns and about 440 million tons of cement of uncertain quality from several thousand small shaft kilns (many of which are being phased out).

Even a cursory review of the 1996 cement trade literature (e.g., *International Cement Review*, *Rock Products Cement Edition*, *World Cement*) reveals the fact that new cement plant projects abound in most parts of the developing world; by comparison, the cement industries many of the major western industrial countries seem almost stagnant. The new cement plants being constructed or planned in the developing countries commonly are large and state of the art. Many are owned by the same giant European cement companies that dominate production in Europe and North America; likewise, most of the plant equipment and engineering services were being supplied by European and North American manufacturers.

As in 1995, much of the growth in the international cement market and in production in 1996 was in Asia, particularly in Southeast Asia and China. China is experiencing rapid growth in infrastructural spending and is seeking to replace its multitude of small, village-scale cement plants with large, modern facilities serving larger regions. In some countries in Asia, particularly Indonesia, planned capacity increases appear to be well in excess of anticipated domestic demand and would argue for growth in cement and/or clinker exports. A number of new projects were underway in various countries of the Middle East, and some of these, too, appeared to be geared towards export opportunities. Although activity in Western Europe was largely confined to modest upgrades of existing plants, major upgrade investments (by Western European companies) were underway at recently privatized existing plants in Eastern Europe. New plants and/or plant upgrades were underway in a number of Latin American countries, particularly Brazil. Africa, in contrast, had fewer major projects underway, most of which

were in Egypt.

Outlook

World cement demand and production is anticipated to grow steadily at about 2% per year during the next decade, with the developing world generating and absorbing much of the increase. This is in line with predictions of continued high rates of general economic growth but assumes continued availability of venture capital for such high-cost projects as new cement plants.

Data through the third quarter of 1997 yield a projection of U.S. cement consumption for the year 4-5% higher than 1996 levels—somewhat higher than had been expected. Consumption in the medium term was expected to grow more modestly. Cement production in 1997 is predicted to increase only by about 2%, largely owing to the majority of plants already being operated at full practical capacity. Although several million tons of additional domestic production capacity was expected to be available by the year 2000, imports were anticipated to continue to play a major role in the U.S. cement market, at least in the short term. Indeed, cumulative imports, as of midyear 1997, were more than 25% higher than for the same period in 1996. As always, market growth could be constrained by higher interest rates, which especially affect the residential construction market. And public sector construction funding levels will continue to be important.

An important constraint on future domestic cement production increases will be any imposition of restrictive environmental legislation, particularly that requiring a majority of plants to reduce emissions to match that of their larger and more-modern competitors, and to restrict the ability of the industry to cheaply use waste fuels. If restrictions or taxes on CO_2 emissions are imposed, then the U.S. industry would find itself at a competitive disadvantage to imports from countries exempted from similar restrictions or taxes; absent protective tariffs, some shutdowns of domestic capacity could take place. Environmental cost increases could partly be mitigated by increasing the utilization of nonclinker components of cement, such as pozzolan or inert extenders.

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TABLE 1
SALIENT CEMENT STATISTICS 1/ 2/

(Thousand metric tons unless otherwise specified)

	1992	1993	1994	1995	1996
United States: 3/					
Production 3/ 4/	69,585	73,807	77,948	76,906	79,266
Shipments from mills 3/ 5/	69,203	72,770 r/	79,087 r/	78,518 r/	84,955
Value 3/ 5/ thousands	$3,779,286	$4,174,819 r/	$4,844,869 r/	$5,329,187 r/	$6,044,944
Average value per ton 3/ 6/	$54.61	$55.65 r/	$61.26 r/	$67.87 r/	$71.15
Stocks at mills, 3/ Dec. 31	5,272	4,788	4,701 r/	5,886 r/	5,488
Exports 7/	746	625	633	759	803
Imports for consumption:					
Cement 8/	4,582	5,532	9,074 r/	10,969	11,565
Clinker	1,532	1,507	2,206 r/	2,789	2,401
Total	6,114 r/	7,040 r/	11,280 r/	13,758 r/	13,967
Consumption, apparent 9/	74,158 r/	79,198 r/	86,476 r/	85,931 r/	90,426
World: Production e/ 10/	1,123,143 r/	1,292,379 r/	1,372,427 r/	1,443,689 r/	1,484,564

e/ Estimated. r/ Revised.

1/ Portland and masonry cement only, unless otherwise indicated.

2/ Excludes Puerto Rico.

3/ Includes cement made from imported clinker.

4/ Shipments are to final customers. Includes imported cement. Data are based on annual survey of plants; may differ from tables 8 and 9, which are based on consolidated monthly shipments data from companies.

5/ Plant valuation (f.o.b.) of portland (all types, including white) and masonry cement shipments from mills to final customers. Although presented unrounded, the data contain estimates for some plants.

6/ Total plant valuation (f.o.b.) of cement shipments to final customers divided by total tonnage of same. Although presented unrounded, the data contain estimates for some plants.

7/ Hydraulic cement (all types) plus clinker.

8/ Hydraulic cement, all types.

9/ Production (including that from imported clinker) of hydraulic cement plus imports of cement minus exports of cement minus change in stocks.

10/ Total hydraulic cement. May incorporate clinker exports for some countries. Includes estimates for some countries.

TABLE 2
PORTLAND CEMENT PRODUCTION, CAPACITY, AND STOCKS IN THE UNITED STATES, BY DISTRICT 1/

(Thousand metric tons unless otherwise specified)

	1995 2/					1996 3/				
			Capacity 4/		Stocks 5/			Capacity 4/		Stocks 5/
District	Plants active	Production 6/	Finish grinding	Percent utilized	at mills, Dec. 31	Plants active	Production 6/	Finish grinding	Percent utilized	at mills, Dec. 31
Maine, New York	4	2,937	3,937	74.6	317	4	2,966	3,348	88.6	234
Pennsylvania, eastern	8	4,045	5,019	80.6	355	7	4,057	5,152	78.7	243
Pennsylvania, western	4	1,565	2,009	77.9	146	4	1,615	2,009	80.4	105
Illinois	4	2,559	3,379	75.7	210	4	2,619	2,871	91.2	149
Indiana	4	2,328	2,597	89.6	253	4	2,347	2,731	85.9	185
Michigan	5	5,399	6,999	77.1	336	5	5,387	6,999	77.0	295
Ohio	3	1,049	1,588	66.1	94	3	1,054	1,588	66.4	62
Iowa, Nebraska, South Dakota	5	3,724	5,576	66.8	364	5	3,931	5,489	71.6	322
Kansas	4	1,725	1,774	97.2	185	4	1,725	1,783	96.7	149
Missouri	5	4,362	5,059	86.2	395	5	4,531	5,150	88.0	410
Florida	6	3,166	4,382	72.3	195	6	3,445	4,667	73.8	280
Georgia, Virginia, West Virginia	5	2,426	3,700	65.6	243	5	2,473	3,700	66.8	219
Maryland	3	1,670	1,837	90.9	192	3	1,609	1,837	87.6	105
South Carolina	3	2,210	3,067	72.1	111	3	2,368	3,075	77.0	85
Alabama	5	4,091	4,755	86.0	261	5	4,326	4,804	90.0	271
Kentucky, Mississippi, Tennessee	4	2,107	2,474	85.2	216	4	2,216	2,474	89.6	187
Arkansas, Oklahoma	4	2,544	2,717	93.6	202	4	2,553	2,889	88.4	191
Texas, northern	6	3,807	4,512	84.4	229	6	3,906	4,712	82.9	270
Texas, southern	5 7/	4,285	4,717	90.8	227	5	4,332	4,726	91.7	218
Arizona, New Mexico	3	2,061	2,333	88.3	47	3	2,217	2,140	103.6	63
Colorado, Wyoming	4	1,851	2,377	77.9	90	4	2,031	2,377	85.4	125

See footnotes at end of table.

TABLE 2
PORTLAND CEMENT PRODUCTION, CAPACITY, AND STOCKS IN THE UNITED STATES, BY DISTRICT 1/

(Thousand metric tons unless otherwise specified)

	1995 2/					1996 3/				
			Capacity 4/		Stocks 5/			Capacity 4/		Stocks 5/
District	Plants active	Production 6/	Finish grinding	Percent utilized	at mills, Dec. 31	Plants active	Production 6/	Finish grinding	Percent utilized	at mills, Dec. 31
Idaho, Montana, Nevada, Utah	7 r/	2,206	2,445	90.2	155	7	2,216	2,696	82.2	209
Alaska, Hawaii	1	357	499	71.5	56	1	312	499	62.5	45
California, northern	3	2,554	2,867	89.1	107	3	2,610	2,880	90.6	125
California, southern	8	6,808	7,899	86.2	250	8	7,297	7,943	91.9	279
Oregon, Washington	3	1,467	1,796	81.7	124	4	1,655	1,960	84.4	133
Total or average 8/	116 r/	73,303	90,316	81.2	5,359	116	75,797	90,497	83.8	4,959
Puerto Rico	2	1,414	2,004	70.6	40	2	1,552	2,004	77.4	37

r/ Revised.
1/ Includes Puerto Rico.
2/ Includes data for three white cement facilities as follows: California, Pennsylvania, and Texas. Includes data for grinding plants as follows: California, Florida (2), Iowa, Michigan, Ohio, Pennsylvania, and Texas.
3/ Includes data for three white cement facilities as follows: California, Pennsylvania, and Texas. Includes data for grinding plants as follows: Florida (2) Michigan (2), Ohio, Virginia, and Washington.
4/ Grinding capacity based on fineness necessary to grind Types I and II cement, making allowance for downtime required for routine maintenance.
5/ Includes imported cement.
6/ Includes cement produced from imported clinker.
7/ Excludes one additional plant that was operational January through April.
8/ Data may not add to totals shown because of independent rounding.

TABLE 3
MASONRY CEMENT PRODUCTION AND STOCKS IN THE UNITED STATES, BY DISTRICT 1/

(Thousand metric tons unless otherwise specified)

	1995			1996		
District	Plants active	Production 2/	Stocks 3/ at mills, Dec. 31	Plants active	Production 2/	Stocks 3/ at mills, Dec. 31
Maine, New York	4	100	18	4	102	16
Pennsylvania, eastern	6	186	38	6	170	31
Pennsylvania, western	4	81	13	4	105	16
Illinois	1	--	--	1	--	--
Indiana	4	W	W	4	W	W
Michigan	5	229	26	5	232	28
Ohio	2	W	W	2	W	W
Iowa, Nebraska, South Dakota	4	51	17	4	W	6
Kansas	3	31	10	3	24	9
Missouri	1	W	W	1	W	W
Florida	4	383	31	4	422	26
Georgia, Virginia, West Virginia	4	319	34	4	376	32
Maryland	2	W	W	2	W	W
South Carolina	2	W	W	2	286	W
Alabama	5	306	45	5	309	37
Kentucky, Mississippi, Tennessee	3	108	15	3	W	W
Arkansas, Oklahoma	4	110	19	4	117	21
Texas, northern	4	W	8	4	W	8
Texas, southern	5	98	7	5	100	7
Arizona, New Mexico	3	W	W	3	W	W
Colorado, Wyoming	2	W	W	2	W	W
Idaho, Montana, Nevada, Utah	4	W	W	4	W	W
Alaska, Hawaii	1	5	1	1	5	1
California, northern	1	W	W	1	W	W
California, southern	3	149	W	3	160	W
Oregon, Washington	3	W	W	3	W	W
Total or average 4/	84	3,603	455	84	3,469	380

W Withheld to avoid disclosing company proprietary data; included in "Total or average."
1/ Excludes Puerto Rico (did not produce any masonry cement).
2/ Includes cement made from imported clinker.
3/ Includes imported cement.
4/ Data may not add to totals shown because of independent rounding.

TABLE 4
CLINKER CAPACITY AND PRODUCTION IN THE UNITED STATES IN 1996, BY DISTRICT

District	Active plants 1/ Process used: Wet	Dry	Both	Total	Number of kilns	Daily capacity (thousand metric tons)	Average number of days routine maintenance	Apparent annual capacity 2/ (thousand metric tons)	Production 3/ (thousand metric tons)	Percent utilized
Maine, New York	3	1	--	4	5	9	60	2,911	2,741	94.2
Pennsylvania, eastern	2	5	--	7	14	13	37	4,360	3,869	88.7
Pennsylvania, western	3	1	--	4	8	6	44	1,823	1,669	91.6
Illinois	--	4	--	4	8	8	33	2,655	2,557	96.3
Indiana	2	2	--	4	8	8	29	2,865	2,355	82.2
Michigan	1	2	--	3	8	13	29	4,434	4,116	92.8
Ohio	1	1	--	2	3	3	W	W	W	88.4
Iowa, Nebraska, South Dakota	--	4	1	5	9	13	48	4,195	3,635	86.7
Kansas	2	2	--	4	11	4	34	1,364	1,619	118.7
Missouri	2	3	--	5	7	14	32	4,410	4,195	95.1
Florida	2	2	--	4	7	9	35	2,961	2,957	99.9
Georgia, Virginia, West Virginia	1	2	1	4	12	9	46	3,019	2,432	80.6
Maryland	1	2	--	3	7	5	55	1,692	1,562	92.3
South Carolina	2	1	--	3	7	7	25	2,507	2,175	86.8
Alabama	--	5	--	5	6	12	33	3,892	3,886	99.8
Kentucky, Mississippi, Tennessee	2	2	--	4	5	6	27	2,153	2,054	95.4
Arkansas, Oklahoma	2	2	--	4	10	8	20	2,756	2,506	90.9
Texas, northern	3	3	--	6	14	13	43	4,015	3,834	95.5
Texas, southern	--	4	1	5	6	13	31	4,286	4,208	98.2
Arizona, New Mexico	--	3	--	3	9	6	25	2,256	2,110	93.5
Colorado, Wyoming	1	3	--	4	7	6	45	2,066	1,828	88.5
Idaho, Montana, Nevada, Utah	4	3	--	7	10	7	34	2,093	2,079	99.3
Alaska, Hawaii	--	1	--	1	1	1	15	260	124	47.7
California, northern	--	3	--	3	3	9	56	2,637	2,509	95.1
California, southern	--	8	--	8	17	20	32	6,429	7,034	109.4
Oregon, Washington	1	2	--	3	3	4	W	W	W	127.2
Total or average 4/	35	71	3	109	205	228	36	74,155	70,361	94.9
Puerto Rico	--	2	--	2	2	5	6	1,797	1,345	74.8

W Withheld to avoid disclosing company proprietary data; included in "Total or average."
1/ Includes white cement plants.
2/ Calculated on the basis of individual company data using 365 days minus reported days for routine maintenance multiplied by the reported unrounded daily capacity.
3/ Includes production reported for plants that shut down during the year.
4/ Data may not add to totals shown because of independent rounding.

TABLE 5
RAW MATERIALS USED IN PRODUCING CEMENT
IN THE UNITED STATES 1/ 2/ 3/

(Thousand metric tons)

Raw materials	1995	1996
Calcareous:		
Limestone (includes aragonite, marble, chalk)	80,142	80,016
Cement rock (includes marl)	24,164	25,746
Coral	680	682
Aluminous:		
Clay	4,294	4,747
Shale	4,378	4,202
Other (includes staurolite, bauxite, aluminum dross, alumina, volcanic material, other)	967	1,127
Siliceous:		
Sand and calcium silicate	2,210	2,153
Sandstone, quartzite, other	741	640
Ferrous: Iron ore, pyrites, millscale, other	1,523	1,691
Other:		
Gypsum and anhydrite	3,997	4,126
Clinker, imported 4/	2,635	2,133
Blast furnace slag	130	133
Fly ash	1,396	1,261
Other, n.e.c.	82	56
Total 5/	127,339	128,713

1/ Includes Puerto Rico.
2/ Nonfuel materials only.
3/ Includes portland and masonry cement.
4/ Outside purchases by producing plants; excludes purchases of domestic clinker.
5/ Data may not add to totals shown because of independent rounding.

TABLE 6
CLINKER PRODUCED AND FUEL CONSUMED BY THE CEMENT INDUSTRY 1/
IN THE UNITED STATES, 2/ BY PROCESS

	Clinker produced			Fuel consumed					Waste fuel		
Kiln process	Plants active	Quantity (thousand metric tons)	Percentage of total	Coal (thousand metric tons)	Coke (thousand metric tons)	Petroleum coke (thousand metric tons)	Oil (thousand liters)	Natural gas (thousand cubic meters)	Tires (thousand metric tons)	Solid (thousand metric tons)	Liquid (thousand liters)
1995:											
Wet	35	18,775	26.3	2,351 3/	110	503	13,624	327,798	31	62	626,436
Dry	72	50,529	70.9	5,664 3/	346	943	28,190	635,786	122	6	258,150
Both	3	1,953	2.7	225 3/	--	28	--	105,459	5	--	--
Total 4/	110	71,257	100.0	8,241 3/	455	1,475	41,814	1,069,044	158	68	884,586
1996:											
Wet	35	18,502	25.8	2,343	101	492	30,158	223,986	42	54	649,978
Dry	73	51,240	71.5	6,140	357	776	33,558	411,323	142	18	260,175
Both	3	1,964	2.7	281	--	28	--	74,343	7	--	--
Total 4/	111	71,706	100.0	8,764	458	1,295	63,716	709,652	191	72	910,153

1/ Includes portland and masonry cement. Excludes grinding plants.
2/ Includes Puerto Rico.
3/ Revised to exclude coke and petroleum coke.
4/ Data may not add to totals shown because of independent rounding.

TABLE 7
ELECTRIC ENERGY USED AT CEMENT PLANTS
IN THE UNITED STATES, 1/ BY PROCESS

	Electric energy used							Average consumption (kilowatt-hours per ton of cement produced)
	Generated by cement plants		Purchased		Total		Finished cement 2/ produced (thousand metric tons)	
Kiln process	Number of plants	Quantity (million kilowatt-hours)	Number of plants	Quantity (million kilowatt-hours)	Quantity (million kilowatt-hours)	Percentage		
1995:								
Wet	--	--	34	2,682	2,682	24.6	19,595 r/	137 r/
Dry	5	574	70	7,355	7,930	72.7	53,389 r/	149 r/
Both	--	--	3	298	298	2.7	2,014 r/	148 r/
Total 3/	5	574	107	10,335 r/	10,909 r/	100.0	74,998 r/	145 r/
Percent of total electric energy used	--	5	--	95	--	--	--	--
Adjustments 4/	--	--	2 r/	--	--	--	1,094 r/	--
1996:								
Wet	--	--	34	2,700	2,700	24.0	19,778	137
Dry	4	500	72	7,847	8,347	68.3	55,610	150
Both	--	--	3	320	320	2.6	2,123	151
Total 3/	4	500	109	10,867	11,368	100.0	77,512	147
Percent of total electric energy used	--	4	--	96	--	--	--	--
Adjustments 4/	--	--	2	--	--	--	1,059	--

r/ Revised.
1/ Includes Puerto Rico. Excludes grinding plants.
2/ Includes portland and masonry cement.
3/ Data may not add to totals shown because of independent rounding.
4/ Tonnage of cement by two plants that did not report any electricity consumption.

TABLE 8
CEMENT SHIPMENTS TO FINAL CUSTOMER, BY DESTINATION AND ORIGIN 1/ 2/

(Thousand metric tons)

	Portland cement		Masonry cement	
Destination and origin	1995	1996	1995	1996
Destination:				
Alabama	1,389	1,474	121	133
Alaska	108	100	W	W
Arizona	2,266	2,516	W	W
Arkansas	937	905	54	56
California, northern	2,984	3,226	2	4
California, southern	5,118	5,239	W	W
Colorado	1,634	1,891	21	21
Connecticut 3/	607	654	13	12
Delaware 3/	223	240	9	9

See footnotes at end of table.

TABLE 8-Continued
CEMENT SHIPMENTS TO FINAL CUSTOMER, BY DESTINATION AND ORIGIN 1/ 2/

(Thousand metric tons)

Destination and origin	Portland cement		Masonry cement	
	1995	1996	1995	1996
District of Columbia 3/	107	115	(4/)	1
Florida	5,769	6,082	465	538
Georgia	3,045	3,179	214	233
Hawaii	358	313	5	5
Idaho	463	449	1	1
Illinois, excluding Chicago	1,439	1,538	31	35
Chicago, metropolitan 3/	1,864	1,943	45	43
Indiana	1,859	1,947	92	93
Iowa	1,429	1,601	12	12
Kansas	1,339	1,527	15	16
Kentucky	1,195	1,258	91	93
Louisiana 3/	1,747	1,751	50	53
Maine	210	212	5	5
Maryland	1,092	1,179	79	73
Massachusetts 3/	1,036	1,074	26	24
Michigan	2,712	2,992	126	143
Minnesota 3/	1,579	1,605	32	32
Mississippi	865	931	52	56
Missouri	2,234	2,269	44	41
Montana	274	273	1	1
Nebraska	982	994	9	10
Nevada	1,483	1,803	(4/)	1
New Hampshire 3/	256	275	7	7
New Jersey 3/	1,410	1,471	57	61
New Mexico	708	747	7	8
New York, eastern	491	484	29	21
New York, western	754	759	31	31
New York, metropolitan 3/	1,078	1,203	39	42
North Carolina 3/	2,218	2,259	263	273
North Dakota 3/	310	300	3	4
Ohio	3,533	3,725	181	190
Oklahoma	1,105	1,145	38	41
Oregon	1,027	1,165	(4/)	(4/)
Pennsylvania, eastern	1,806	1,840	57	60
Pennsylvania, western	1,002	1,035	66	68
Rhode Island 3/	117	111	3	3
South Carolina	1,035	1,160	106	116
South Dakota	302	333	4	4
Tennessee	1,805	1,965	193	211
Texas, northern	4,115	4,373	146	162
Texas, southern	4,225	4,413	91	90
Utah	1,286	1,267	2	3
Vermont 3/	105	111	3	3
Virginia	1,757	1,794	138	149
Washington	1,669	1,722	6	6
West Virginia	412	443	30	29
Wisconsin	1,838	2,013	35	38
Wyoming	215	196	1	1
U.S. total 5/	82,925	87,588	3,150	3,361
Foreign countries 6/	393	355	93	106
Puerto Rico	1,405	1,555	--	--
Total shipments 5/	84,724	89,498	3,243	3,467
Origin:				
United States 7/	71,750	75,995	3,185	3,416
Puerto Rico	1,405	1,555	--	--
Foreign 8/	11,568	11,948	57	51
Total shipment 5/	84,724	89,498	3,243	3,467

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

1/ Includes cement produced from imported clinker and imported cement shipped by domestic producers, Canadian cement manufacturers, and other importers.

2/ Data are developed from monthly consolidated surveys of shipments by company and may differ from data in tables in 1, 10, 11, 12, 14, and 15, which are from annual surveys of individual plants.

3/ Has no cement plants.

4/ Less than 1/2 unit.

5/ Data may not add to totals shown because of independent rounding.

6/ Includes shipments to U.S. possessions and territories. Includes States indicated by the symbol W.

7/ Includes cement produced by domestic producers from imported clinker.

8/ Imported cement distributed in the United States by domestic producers, Canadian cement manufacturers, and other importers.

TABLE 9
CEMENT SHIPMENTS, BY DESTINATION (REGION AND CENSUS DISTRICT) 1/ 2/

Region and Census District	Portland cement: Thousand metric tons 1995	Portland cement: Thousand metric tons 1996	Portland cement: Percentage of grand total 1995	Portland cement: Percentage of grand total 1996	Masonry cement: Thousand metric tons 1995	Masonry cement: Thousand metric tons 1996	Masonry cement: Percentage of grand total 1995	Masonry cement: Percentage of grand total 1996
Northeast:								
New England 3/	2,330	2,438	3	3	56	54	2	2
Middle Atlantic 4/	6,540	6,792	8	8	278	282	9	8
Total 5/	8,870	9,230	11	11	334	336	11	10
South:								
South Atlantic 6/	15,658	16,452	19	19	1,303	1,421	41	42
East South Central 7/	5,255	5,627	6	6	457	493	15	14
West South Central 8/	12,129	12,587	15	14	379	402	12	12
Total 5/	33,042	34,666	40	39	2,139	2,316	68	68
Midwest:								
East North Central 9/	13,245	14,159	16	16	511	541	16	16
West North Central 10/	8,174	8,628	10	10	120	118	4	4
Total 5/	21,419	22,787	26	26	631	659	20	20
West:								
Mountain 11/	8,330	9,140	10	10	32	35	1	1
Pacific 12/	11,264	11,765	14	13	12	14	(13/)	(13/)
Total 5/	19,594	20,905	24	23	44	49	1	1
Grand total 5/	82,925	87,588	100	100	3,150	3,361	100	100

1/ Includes imported cement shipped by importers. Excludes Puerto Rico and exported cement.

2/ Data are developed from monthly consolidated surveys of shipments by company and may differ from data in tables 1, 10, 11, 12, 14, and 15, which are from annual surveys of individual plants.

3/ New England includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

4/ Middle Atlantic includes New Jersey, New York, and Pennsylvania.

5/ Data may not add to totals shown because of independent rounding.

6/ South Atlantic includes Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia.

7/ East South Central includes Alabama, Kentucky, Mississippi, and Tennessee.

8/ West South Central includes Arkansas, Louisiana, Oklahoma, and Texas.

9/ East North Central includes Illinois, Indiana, Michigan, Ohio, and Wisconsin.

10/ West North Central includes Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota.

11/ Mountain includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming.

12/ Pacific includes Alaska, California, Hawaii, Oregon, and Washington.

13/ Less than 1/2 unit.

TABLE 10
SHIPMENTS OF PORTLAND CEMENT FROM MILLS IN THE UNITED STATES, 1/ IN BULK AND IN CONTAINERS, BY TYPE OF CARRIER

(Thousand metric tons)

	Shipments from plant to terminal: In bulk	Shipments from plant to terminal: In containers 2/	Shipments to final domestic consumer: From plant to consumer: In bulk	Shipments to final domestic consumer: From plant to consumer: In containers 2/	Shipments to final domestic consumer: From terminal to consumer: In bulk	Shipments to final domestic consumer: From terminal to consumer: In containers 2/	Total shipments to consumer 3/ 4/
1995:							
Railroad	10,388	64	2,396	377	951	78	3,803
Truck	2,763	222	43,917	1,922	25,964	645	72,449
Barge and boat	7,898	--	105	26	32	--	162
Other 5/	1,853	--	--	--	--	--	--
Total 3/	22,902	286	46,418	2,325	26,947	723	76,414
1996:							
Railroad	10,527	54	5,036	433	520	53	6,042
Truck	3,143	147	43,990	1,708	29,027	870	75,594
Barge and boat	7,021	--	565	3	810	--	1,378
Other 5/	1,811	--	--	--	14	2	16
Total 3/	22,502	201	49,592	2,144	30,370	927	83,033

1/ Includes Puerto Rico. Includes imported cement and cement made from foreign clinker.

2/ Includes bags and jumbo bags.

3/ Data may not add to totals shown because of independent rounding.

4/ Shipments calculated based on annual survey of plants; may differ from tables 8 and 9, which are based on consolidated company monthly data.

5/ Includes cement used at plant.

TABLE 11
PORTLAND CEMENT SHIPPED BY PRODUCERS IN THE UNITED STATES, BY DISTRICT 1/ 2/

District	1995 3/ Quantity (thousand metric tons) 6/	1995 3/ Value 5/ Total (thousands)	1995 3/ Value 5/ Average per ton	1996 4/ Quantity (thousand metric tons) 6/	1996 4/ Value 5/ Total (thousands)	1996 4/ Value 5/ Average per ton
Maine, New York	2,916	$230,337	$78.99	3,118	$189,942	$60.92
Pennsylvania, eastern	3,899	241,352	61.90	4,095	307,830	75.17
Pennsylvania, western	1,486	99,139	66.72	1,612	112,747	69.94
Illinois	1,651	109,030	66.04	2,653	183,736	69.26
Indiana	2,510	154,462	61.54	2,570	168,032	65.38
Michigan	5,098	340,461	66.78	5,470	403,465	73.76
Ohio	985	68,237	69.28	1,013	74,100	73.15
Iowa, Nebraska, South Dakota	3,790	262,662	69.30	3,966	302,254	76.21
Kansas	1,703	107,345	63.03	1,859	128,848	69.31
Missouri	4,778	295,352	61.81	5,141	332,715	64.72
Florida	4,199	309,231	73.64	4,575	325,302	71.10
Georgia, Virginia, West Virginia	2,471	181,915	73.62	2,644	193,907	73.34
Maryland	1,796	108,230	60.26	1,924	118,832	61.76
South Carolina	2,291	161,390	70.45	2,463	193,115	78.41
Alabama	3,910	272,509	69.70	4,138	311,819	75.36
Kentucky, Mississippi, Tennessee	2,346	156,550	66.73	2,712	197,788	72.93
Arkansas, Oklahoma	2,506	158,566	63.27	2,545	170,721	67.08
Texas, northern	3,556	228,525	64.26	3,562	242,030	67.95
Texas, southern	4,908	293,380	59.78	5,152	320,441	62.20
Arizona, New Mexico	2,309	160,069	69.32	2,238	172,938	77.27
Colorado, Wyoming	1,841	149,462	81.19	2,001	160,521	80.22
Idaho, Montana, Nevada, Utah	2,432	185,221	76.16	2,398	190,588	79.48
Alaska, Hawaii, Oregon, Washington	1,520	136,986	90.09	1,493	125,137	83.79
California, northern	2,032	139,534	68.67	2,151	147,089	68.38
California, southern	6,212	357,611	57.57	6,897	415,781	60.28
Total 7/ 8/ 9/ or average	75,009	5,028,616	67.04	81,478	5,722,113	70.23
Puerto Rico	1,405	W	W	1,555	W	W

W Withheld to avoid disclosing company proprietary data.

1/ Includes cement produced from imported clinker.

2/ Includes imported cement shipped by producers.

3/ Includes data for three white cement facilities as follows: California, Pennsylvania, and Texas. Includes data for grinding plants as follows: California, Florida (2), Iowa, Michigan, Ohio, Pennsylvania, and Texas.

4/ Includes data for three white cement facilities as follows: California, Pennsylvania, and Texas. Includes data for grinding plants as follows: Florida (2) Michigan (2), Ohio, Virginia, and Washington.

5/ Values represent ex-plant (f.o.b - plant) data collected for total shipments to final customers, not for shipments by cement type. Although presented unrounded, the data incorporate estimates for some plants. Accordingly, the data should be viewed as cement value indicators.

6/ Shipments calculated based on annual survey of plants; may differ from tables 8 and 9, which are based on consolidated company monthly data.

7/ Data may not add to totals shown because of independent rounding.

8/ Does not include cement consumed at plant.

9/ Total includes imports shipped by independent importers.

TABLE 12
MASONRY CEMENT SHIPPED BY PRODUCERS IN THE UNITED STATES, BY DISTRICT 1/

District	1995 2/ Quantity (thousand metric tons) 5/	1995 2/ Value 4/ Total (thousands)	1995 2/ Value 4/ Average per ton	1996 3/ Quantity (thousand metric tons) 5/	1996 3/ Value 4/ Total (thousands)	1996 3/ Value 4/ Average per ton
Maine, New York	87	$6,986	$80.30	102	$8,440	$82.75
Pennsylvania, eastern	180	13,211	73.39	181	17,783	98.25
Pennsylvania, western	80	7,394	92.43	99	10,861	109.71
Illinois, Indiana, Ohio	500	42,857	85.67	498	42,756	85.93
Michigan	224	16,369	73.08	254	22,271	87.68
Iowa, Nebraska, South Dakota	45	4,116	91.47	46	5,075	110.33
Kansas, Missouri	159	8,562	53.95	155	8,691	56.03
Florida	415	38,023	91.62	418	34,901	83.50
Georgia, Virginia, West Virginia	303	30,073	99.25	366	40,174	109.77
Maryland, South Carolina	341	28,909	84.89	400	34,901	87.19
Alabama	302	30,277	100.25	311	32,240	103.67
Kentucky, Mississippi, Tennessee	117	9,476	80.99	113	10,391	91.96
Arkansas, Oklahoma	102	7,945	77.89	110	9,487	86.25
Texas	207	16,423	87.26	215	18,289	93.89
Arizona, Colorado, Idaho, Montana New Mexico, Nevada, Utah, Wyoming	122	9,099	74.30	135	11,186	83.08
Alaska, Hawaii	5	495	99.00	4	454	113.50
California, Oregon, Washington	177	11,793	66.78	219	14,729	67.40
Total 6/ 7/ or average	3,229 r/	282,805 r/	87.58 r/	3,477	322,832	92.85

r/ Revised.

1/ Excludes Puerto Rico (did not produce any masonry cement).

2/ Includes data for three white cement facilities as follows: California, Pennsylvania, and Texas. Includes data for grinding plants as follows: California, Florida (2), Iowa, Michigan, Ohio, Pennsylvania, and Texas.

3/ Includes data for three white cement facilities as follows: California, Pennsylvania, and Texas. Includes data for grinding plants as follows: Florida (2) Michigan (2), Ohio, Virginia, and Washington.

4/ Values represent ex-plant (f.o.b - plant) data collected for total shipments to final customers, not for shipments by cement type. Although presented unrounded, the data incorporate estimated for some plants. Accordingly, the data should be viewed as cement-value indicators.

5/ Shipments calculated on the basis of annual survey of plants; may differ from tables 8 and 9, which are based on consolidated company monthly data.

6/ Data may not add to totals shown because of independent rounding.

7/ Total includes imports shipped by independent importers.

TABLE 13
AVERAGE MILL VALUE OF CEMENT IN THE UNITED STATES 1/

(Dollars per metric ton)

Year	Gray portland cement	White portland cement	All portland cement	Prepared masonry cement	All classes of cement
1995	66.25 r/	174.66	67.04 r/	85.64	67.84
1996	69.37	183.08	70.23	92.84	71.15

r/ Revised.

1/ Excludes Puerto Rico. Mill value is the actual value of sales to customers, f.o.b. plant, less all discounts and allowances, less all freight charges from producing plant to distribution terminal if any.

TABLE 14
PORTLAND CEMENT SHIPMENTS IN 1996, BY DISTRICT OF ORIGIN AND TYPE OF CUSTOMER

(Thousand metric tons)

District of origin	Ready mixed concrete	Concrete product manufacturers 1/	Contractors 2/	Building material dealers	Oil well, mining, waste 3/	Government and miscellaneous 4/	Total 5/ 6/
Maine, New York	602	206	--	70	1	2,239	3,118
Pennsylvania, eastern	1,682	620	132	206	21	1,435	4,095
Pennsylvania, western	973	183	162	78	17	199	1,612
Illinois	2,035	256	163	13	187	--	2,653
Indiana	2,080	330	41	101	10	10	2,570
Michigan	2,246	660	230	277	16	2,041	5,470
Ohio	352	109	22	62	6	460	1,013
Iowa, Nebraska, South Dakota	2,824	530	372	89	57	96	3,966
Kansas	1,154	174	252	28	23	227	1,859
Missouri	3,332	448	565	140	--	657	5,141
Florida	2,737	643	276	267	--	650	4,575
Georgia, Virginia, West Virginia	1,761	456	236	183	8	--	2,644
Maryland	1,046	243	120	11	--	503	1,924
South Carolina	1,856	417	82	59	--	48	2,463
Alabama	1,765	443	222	268	--	1,440	4,138
Kentucky, Mississippi, Tennessee	1,656	252	59	29	2	715	2,712
Arkansas, Oklahoma	1,450	72	256	22	70	675	2,545
Texas, northern	1,800	351	503	101	370	437	3,562
Texas, southern	2,974	275	505	177	221	1,000	5,152
Arizona, New Mexico	1,453	316	261	66	33	107	2,238
Colorado, Wyoming	1,596	203	116	64	22	--	2,001
Idaho, Montana, Nevada, Utah	1,934	197	107	19	58	83	2,398
Alaska, Hawaii	264	21	63	21	--	--	369
California, northern	1,605	335	141	38	2	31	2,151
California, southern	4,964	1,025	149	162	82	515	6,897
Oregon, Washington	655	91	87	52	--	238	1,124
Total 5/ 6/ 7/	49,137	9,217	5,177	2,735	1,212	14,001	81,478
Puerto Rico	803	140	29	580	--	3	1,555

1/ Concrete product manufacturers include, in thousand metric tons, brick/ block,--1,655; precast,--1,138; pipe,--750; and others,--5,814. Remainder includes unspecified amounts of brick/ block, precast, and pipe.

2/ Contractors in thousand metric tons include road paving,--1,827; soil cement,--763 and other,--2,389. Remainder includes unspecified amounts of road paving, and soil cement.

3/ Oil well, mining, and waste included in thousand metric tons oil well drilling,--1,022; mining,--89; and waste stabilization,--101.

4/ Includes shipments designated as going to "unspecified" customers.

5/ Shipments calculated on the basis of annual survey of plants; may differ from tables 8 and 9, which are based on consolidated company monthly data.

6/ Data may not add to totals shown because of independent rounding.

7/ Includes imports shipped by independent importers.

TABLE 15
PORTLAND CEMENT SHIPPED FROM PLANTS IN THE
UNITED STATES TO DOMESTIC CUSTOMERS, 1/ 2/ BY TYPE

Type	1995 Quantity (thousand metric tons)	1996 Quantity (thousand metric tons)
General use and moderate heat (Types I and II), (Gray)	69,247	75,014
High early strength (Type III)	2,658	2,942
Sulfate resisting (Type V)	1,694	2,000
Block	493	416
Oil well	750	1,041
White	549	615
Blended:		
Portland-slag and portland pozzolan	754	770
Other blended cement 3/	63	63
Expansive and regulated fast setting	60	81
Miscellaneous 4/	147	89
Total 5/ 6/	76,414	83,033

1/ Includes Puerto Rico. Includes imported cement.

2/ Shipments calculated based on annual survey of plants; may differ from tables 8 and 9, which are based on consolidated company monthly data.

3/ Includes blends with fly ash and silica fume.

4/ Includes waterproof and low heat (Type IV).

5/ Data may not add to totals shown because of independent rounding.

6/ Does not include cement consumed at plant.

TABLE 16
U.S. EXPORTS OF HYDRAULIC CEMENT AND CLINKER, 1/ BY COUNTRY

(Thousand metric tons and thousand dollars)

Country of destination	1995		1996	
	Quantity	Value 2/	Quantity	Value 2/
Canada	582	40,434	611	42,193
China	2	348	17	816
Germany	15	593	22	1,814
Hong Kong	26	1,290	20	1,042
Korea, Republic of	1	89	10	536
Marshall Islands	--	6	9	400
Mexico	17	1,871	30	4,805
United Kingdom	8	513	10	539
Other	108 r/	7,831 r/	74	6,007
Total 3/	759	52,975	803	58,152

r/ Revised

1/ Includes portland and masonry cement.

2/ Free alongside ship (f.a.s.) value. The value of exports at the U.S. seaport or border port of export based on the transaction price, including inland freight, insurance, and other charges incurred in placing the merchandise alongside the carrier at the U.S. port of exportation. The value excludes the cost of loading.

3/ Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

TABLE 17
U.S. IMPORTS FOR CONSUMPTION OF HYDRAULIC CEMENT AND CLINKER, 1/ BY COUNTRY

(Thousand metric tons and thousand dollars)

Country of origin	1995			1996		
		Value			Value	
	Quantity	Customs 2/	C.i.f. 3/	Quantity	Customs 2/	C.i.f. 3/
Bulgaria	222	5,831	9,198	148	4,433	6,274
Canada	4,886	198,056	217,926	5,351	246,694	270,198
China	337	13,183	18,138	394	15,771	19,714
Colombia	804	30,993	38,026	924	36,520	46,872
Denmark	327	15,116	21,649	399	17,593	26,393
Greece	1,245	44,326	61,549	1,098	40,803	52,046
Italy	362	14,440	20,044	209	8,432	11,751
Mexico	850	31,938	39,491	1,272	47,736	59,390
Norway	347	12,896	17,863	226	8,181	11,032
Spain	1,501	56,336	71,906	1,595	63,274	83,739
Sweden	529	16,495	23,165	765	24,337	33,495
Venezuela	1,435	56,965	71,317	1,517	58,424	73,536
Other	1,002 r/	44,489 r/	59,253 r/	257	20,051	24,116
Total 4/	13,848	541,064	669,525	14,154	592,249	718,556

r/ Revised.

1/ Includes portland, masonry, and other hydraulic cements. Includes Puerto Rico.

2/ Customs value--price actually paid or payable for merchandise when sold for exportation to the United States, excluding U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise to the United States.

3/ C.i.f. (Cost, insurance, and freight)--import value represents the customs value plus insurance, freight, and other delivery charges to the first port of entry.

4/ Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

TABLE 18
U.S. IMPORTS FOR CONSUMPTION OF HYDRAULIC CEMENT AND CLINKER,
BY CUSTOMS DISTRICT AND COUNTRY

(Thousand metric tons and thousand dollars)

Customs district and country	1995			1996		
		Value			Value	
	Quantity	Customs 1/	C.i.f. 2/	Quantity	Customs 1/	C.i.f. 2/
Anchorage:						
Canada	4	165	289	5	138	309
China	64	2,489	3,469	59	2,413	3,443
United Kingdom	(4/)	4	5	--	--	--
Total 3/	67	2,657	3,763	64	2,551	3,752
Baltimore:						
Brazil	(4/)	36	41	--	--	--
Greece	112	4,064	5,272	38	1,447	1,643
Netherlands	(4/)	25	29	--	--	--
Spain	42	1,482	1,482	15	551	551
United Kingdom	(4/)	130	174	(4/)	18	27
Venezuela	48	2,366	2,366	131	5,421	5,421
Total 3/	203	8,104	9,365	184	7,437	7,642
Boston: Netherlands	(4/)	23	27	--	--	--
Buffalo: Canada	651	32,703	35,358	740	37,270	39,996
Charleston:						
Germany	(4/)	13	17	--	--	--
Netherlands	--	--	--	(4/)	19	20
Spain	--	--	--	(4/)	36	39
United Kingdom	(4/)	75	103	(4/)	91	126
Venezuela	93	3,863	5,197	66	2,689	3,639
Total	93	3,951	5,317	67	2,835	3,824
Chicago:						
Japan	(4/)	80	96	(4/)	59	69
Netherlands	(4/)	6	24	--	--	--
Sweden	(4/)	4	6	--	--	--
Total 3/	(4/)	90	126	(4/)	59	69
Cleveland:						
Canada	504	17,496	18,237	497	25,320	26,051
Denmark	(4/)	2	3	--	--	--
Germany	(4/)	12	15	--	--	--
Netherlands	(4/)	76	91	(4/)	12	15
United Kingdom	--	--	--	(4/)	13	16
Total 3/	504	17,587	18,346	497	25,345	26,081
Columbia Snake:						
China	273	10,682	14,654	335	13,330	16,238
Colombia	11	385	385	18	685	867
France	(4/)	1	2	--	--	--
Total 3/	285	11,068	15,040	353	14,015	17,105
Dallas-Fort Worth: United Kingdom	--	--	--	(4/)	6	7
Detroit:						
Canada	1,518	60,156	65,627	1,647	79,423	84,419
Netherlands	--	--	--	(4/)	135	162
Taiwan	(4/)	3	3	--	--	--
Total 3/	1,518	60,159	65,629	1,647	79,559	84,581
Duluth: Canada	208	7,963	9,108	332	13,559	15,562
El Paso: Mexico	268	8,937	11,798	467	14,980	20,287
Great Falls:						
Canada	242	7,162	8,258	274	11,548	13,435
Japan	--	--	--	(4/)	2	6
United Kingdom	(4/)	15	19	(4/)	16	25
Total 3/	242	7,178	8,277	275	11,566	13,465
Honolulu:						
Australia	114	4,534	6,177	42	1,499	2,141
Belgium	--	--	--	(4/)	15	19
France	(4/)	12	17	(4/)	21	26
New Zealand	22	680	1,043	--	--	--
Venezuela	--	--	--	115	3,491	5,792
Total	137	5,227	7,237	157	5,027	7,977

See footnotes at end of table.

TABLE 18--Continued
U.S. IMPORTS FOR CONSUMPTION OF HYDRAULIC CEMENT AND CLINKER,
BY CUSTOMS DISTRICT AND COUNTRY

(Thousand metric tons and thousand dollars)

Customs district and country	1995			1996		
		Value			Value	
	Quantity	Customs 1/	C.i.f. 2/	Quantity	Customs 1/	C.i.f. 2/
Houston-Galveston:						
Colombia	24	884	1,380	46	1,739	2,729
Denmark	--	--	--	30	1,067	1,438
France	--	--	--	(4/)	83	99
Japan	(4/)	65	77	(4/)	46	55
Spain	574	19,985	25,750	675	24,872	32,188
United Kingdom	(4/)	50	63	(4/)	41	55
Venezuela	--	--	--	27	899	1,120
Total	598	20,984	27,270	780	28,748	37,684
Laredo:						
China	(4/)	3	4	--	--	--
Mexico	51	4,755	5,211	69	7,121	7,590
Total	52	4,758	5,215	70	7,121	7,590
Los Angeles:						
Croatia	1	165	251	--	--	--
Denmark	--	--	--	(4/)	3	5
Japan	(4/)	70	79	--	--	--
Mexico	225	8,229	10,049	382	13,945	17,027
New Zealand	(4/)	265	332	--	--	--
United Kingdom	(4/)	5	8	--	--	--
Total 3/	227	8,734	10,719	382	13,948	17,031
Miami:						
Belgium	3	251	340	2	251	340
Brazil	(4/)	5	5	--	--	--
Canada	--	--	--	24	871	1,153
Colombia	224	9,221	11,509	--	--	--
Denmark	22	1,119	1,949	44	1,942	3,290
Germany	(4/)	9	12	--	--	--
Portugal	--	--	--	(4/)	23	24
Spain	350	15,732	19,364	435	19,166	27,430
Sweden	337	10,044	14,118	441	13,529	18,471
United Kingdom	--	--	--	(4/)	1	1
Venezuela	63	2,170	3,040	189	7,439	9,913
Total 3/	999	38,550	50,337	1,136	43,223	60,622
Milwaukee: Canada	188	6,361	6,561	219	9,069	10,279
Minneapolis: Germany	(4/)	11	13	(4/)	12	13
Mobile:						
Bulgaria	162	4,315	6,811	122	3,368	4,863
Canada	--	--	--	163	5,087	6,948
France	63	1,936	2,064	--	--	--
Greece	69	2,086	2,947	73	2,446	3,317
Tunisia	25	695	1,055	--	--	--
Venezuela	82	2,705	3,601	25	819	1,007
Total 3/	401	11,737	16,478	383	11,721	16,135
New Orleans:						
Austria	--	--	--	(4/)	6	8
Bulgaria	35	874	1,338	--	--	--
Canada	145	4,293	5,745	88	3,065	4,047
China	--	--	--	(4/)	28	33
Colombia	169	6,414	8,528	120	5,131	6,768
Croatia	5	605	885	5	605	873
France	400	15,359	20,497	10	1,576	1,906
Greece	359	12,560	17,385	282	10,601	13,993
Italy	362	14,440	20,044	208	8,431	11,745
Netherlands	(4/)	6	8	--	--	--
Norway	103	3,548	5,180	--	--	--
Spain	37	1,360	1,771	9	340	438
Sweden	39	1,302	1,887	236	7,837	10,906
Tunisia	52	1,462	2,111	--	--	--
Turkey	213	6,530	9,702	34	1,271	1,592

See footnotes at end of table.

TABLE 18--Continued
U.S. IMPORTS FOR CONSUMPTION OF HYDRAULIC CEMENT AND CLINKER,
BY CUSTOMS DISTRICT AND COUNTRY

(Thousand metric tons and thousand dollars)

Customs district and country	1995			1996		
		Value			Value	
	Quantity	Customs 1/	C.i.f. 2/	Quantity	Customs 1/	C.i.f. 2/
New Orleans--Continued:						
Venezuela	6	278	369	--	--	--
Total 3/	1,928	69,033	95,448	993	38,889	52,309
New York:						
France	(4/)	5	6	--	--	--
Greece	182	6,652	8,952	206	7,455	8,215
Italy	--	--	--	(4/)	1	6
Japan	--	--	--	(4/)	7	7
Netherlands	(4/)	79	83	(4/)	226	241
Norway	245	9,348	12,684	226	8,181	11,032
Spain	218	8,246	10,472	236	10,465	13,136
United Kingdom	(4/)	50	61	--	--	--
Total 3/	645	24,379	32,258	668	26,335	32,637
Nogales: Mexico	303	9,733	12,117	351	11,189	13,944
Norfolk:						
Croatia	(4/)	4	9	--	--	--
Denmark	236	9,366	12,245	214	8,460	11,079
France	45	7,294	8,282	45	8,103	8,914
Greece	492	17,908	25,466	438	16,756	22,029
Netherlands	(4/)	144	161	(4/)	87	97
United Kingdom	(4/)	8	11	(4/)	124	173
Venezuela	--	--	--	5	208	213
Total 3/	773	34,725	46,175	703	33,737	42,504
Ogdensburg:						
Canada	353	12,446	13,752	260	8,789	9,679
Netherlands	--	--	--	(4/)	56	69
United Kingdom	(4/)	12	12	--	--	--
Total	354	12,458	13,764	261	8,845	9,748
Pembina: Canada	167	7,024	8,104	143	6,812	7,724
Philadelphia:						
Germany	(4/)	76	89	(4/)	23	23
Japan	(4/)	54	65	(4/)	12	15
New Zealand	(4/)	66	85	--	--	--
United Kingdom	--	--	--	(4/)	10	22
Total	(4/)	196	239	(4/)	44	60
Portland: Canada	8	410	526	10	478	581
Providence: Spain	35	1,247	1,464	--	--	--
San Diego: Mexico	3	281	312	4	501	542
San Francisco:						
France	(4/)	30	34	--	--	--
Germany	--	--	--	(4/)	11	15
Japan	(4/)	36	44	(4/)	49	63
New Zealand	1	1,138	1,417	1	703	852
United Kingdom	(4/)	15	16	--	--	--
Total 3/	1	1,220	1,512	1	764	929
San Juan:						
Belgium	12	931	1,582	4	341	583
Canada	26	937	1,578	--	--	--
Colombia	42	1,720	1,872	--	--	--
Denmark	9	754	1,260	16	1,314	2,293
Luxembourg	--	--	--	5	439	764
Mexico	(4/)	3	4	--	--	--
Netherlands	(4/)	28	49	--	--	--
Spain	(4/)	8	11	119	4,044	4,863
Venezuela	(4/)	2	2	43	1,890	2,332
Total 3/	90	4,383	6,358	188	8,029	10,836
Savannah:						
Bahamas, The	6	244	247	--	--	--
Bulgaria	24	643	1,049	26	1,064	1,410
Canada	--	--	--	78	2,389	3,335
Colombia	--	--	--	19	1,027	1,181

See footnotes at end of table.

TABLE 18--Continued
U.S. IMPORTS FOR CONSUMPTION OF HYDRAULIC CEMENT AND CLINKER,
BY CUSTOMS DISTRICT AND COUNTRY

(Thousand metric tons and thousand dollars)

Customs district and country	1995			1996		
		Value			Value	
	Quantity	Customs 1/	C.i.f. 2/	Quantity	Customs 1/	C.i.f. 2/
Savannah--Continued:						
Denmark	3	162	298	13	852	1,420
Greece	30	1,056	1,525	--	--	--
Ukraine	--	--	--	--	--	--
United Kingdom	30	749	1,246	64	2,310	2,460
Venezuela	91	3,274	3,691	106	3,801	5,134
Total 3/	184	6,127	8,057	307	11,443	14,939
Seattle:						
Canada	762	36,158	38,719	744	36,518	38,962
China	(4/)	9	11	--	--	--
Colombia	149	5,457	5,540	198	7,769	11,244
Japan	(4/)	46	54	(4/)	20	24
Total 3/	911	41,671	44,323	942	44,307	50,230
St. Albans:						
Canada	110	4,780	6,065	99	5,327	6,271
Netherlands	(4/)	117	136	(4/)	123	143
Total 3/	110	4,897	6,201	100	5,450	6,413
Tampa:						
Canada	--	--	--	27	1,032	1,445
Colombia	184	6,911	8,812	520	20,019	23,916
Denmark	58	3,712	5,894	83	3,955	6,870
France	(4/)	3	3	--	--	--
Greece	--	--	--	61	2,099	2,849
Spain	244	8,275	11,591	105	3,800	5,095
Sweden	152	5,147	7,154	88	2,970	4,118
Turkey	--	--	--	34	1,201	1,595
Venezuela	883	34,960	43,529	751	29,388	36,197
Total 3/	1,522	59,008	76,983	1,669	64,463	82,086
U.S. Virgin Islands:						
British Virgin Islands	--	--	--	1	98	118
Colombia	--	--	--	3	150	167
Netherlands Antilles	2	64	67	5	167	183
Panama	4	73	98	--	--	--
Trinidad and Tobago	--	--	--	3	114	119
Venezuela	32	1,628	1,847	59	2,378	2,769
Total 3/	38	1,765	2,012	70	2,907	3,356
Wilmington:						
Netherlands	(4/)	7	13	(4/)	6	12
Venezuela	139	5,719	7,675	--	--	--
Total 3/	139	5,726	7,688	(4/)	6	12
Grand total 3/	13,848	541,064	669,525	14,154	592,249	718,556

1/ Customs value- price actually paid or payable for merchandise when sold for exportation to the United States, excluding U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise to the United States.

2/ C.i.f. (Cost, insurance, and freight)--import value represents the customs value plus insurance, freight, and other delivery charges to the first port of entry. It is computed by adding "freight" to the "customs value."

3/ Data may not add to totals shown because of independent rounding.

4/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 19
U.S. IMPORTS FOR CONSUMPTION OF GRAY PORTLAND CEMENT 1/, BY COUNTRY

(Thousand metric tons and thousand dollars)

Country	1995			1996		
		Value			Value	
	Quantity	Customs 2/	C.i.f. 3/	Quantity	Customs 2/	C.i.f. 3/
Canada	3,342	136,923	152,131	3,953	182,457	198,857
China	337	13,170	18,123	393	15,743	19,682
Colombia	645	25,404	31,358	685	27,734	35,737
Denmark	238	9,529	12,543	303	11,803	16,000
Greece	1,140	41,018	56,839	983	36,949	46,822
Italy	362	14,440	20,044	208	8,432	11,751
Mexico	784	25,527	32,414	1,178	37,470	48,367
Norway	315	11,349	15,851	218	7,410	10,176
Spain	1,426	49,986	64,756	1,428	53,769	72,737
Sweden	529	16,492	23,159	765	24,337	33,495
Turkey	138	4,443	6,560	68	2,471	3,187
Venezuela	924	37,833	48,002	944	38,556	46,530
Other	327	11,571	15,281	41	1,816	1,999
Total 4/	10,507	397,685	497,061	11,167	448,947	545,340

1/ Includes imports into Puerto Rico.

2/ Customs value--price actually paid or payable for merchandise when sold for exportation to the United States, excluding U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise to the United States.

3/ C.i.f. (Cost, insurance, and freight)--import value represents the customs value plus insurance, freight, and other delivery charges to the first port of entry.

4/ Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

TABLE 20
U.S. IMPORTS FOR CONSUMPTION OF WHITE CEMENT 1/, BY COUNTRY

(Thousand metric tons and thousand dollars)

Country	1995			1996		
		Value			Value	
	Quantity	Customs 2/	C.i.f. 3/	Quantity	Customs 2/	C.i.f. 3/
Belgium	14	1,176	1,915	6	591	923
Canada	167	13,888	14,603	135	12,170	12,700
Colombia	20	805	834	--	--	--
Denmark	89	5,585	9,103	96	5,787	10,389
Luxembourg	--	--	--	6	439	764
Mexico	63	6,095	6,721	91	9,995	10,732
Norway	7	707	794	8	771	856
Spain	76	6,342	7,139	48	5,425	6,101
Other	(4/)	256	298	(4/)	228	244
Total 5/	436	34,854	41,407	390	35,406	42,709

1/ Includes imports into Puerto Rico.

2/ Customs value--price actually paid or payable for merchandise when sold for exportation to the United States, excluding U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise to the United States.

3/ C.i.f. (Cost, insurance, and freight)--import value represents the customs value plus insurance, freight, and other delivery charges to the first port of entry.

4/ Less than 1/2 unit.

5/ Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

TABLE 21
U.S. IMPORTS FOR CONSUMPTION OF CLINKER, 1/ BY COUNTRY

(Thousand metric tons and thousand dollars)

Country	1995			1996		
		Value			Value	
	Quantity	Customs 2/	C.i.f. 3/	Quantity	Customs 2/	C.i.f. 3/
Australia	114	4,534	6,177	42	1,499	2,141
Bulgaria	222	5,831	9,198	148	4,433	6,274
Canada	1,375	46,658	50,560	1,253	50,345	56,695
Colombia	139	4,785	5,834	239	8,785	11,135
France	163	8,062	10,061	53	8,065	9,039
Greece	104	3,308	4,709	115	3,854	5,224
Spain	--	--	--	119	4,044	4,863
Tunisia	78	2,157	3,166	--	--	--
Turkey	75	2,087	3,142	--	--	--
Venezuela	503	18,377	22,501	572	19,861	26,996
Other	83 r/	2,875 r/	4,394 r/	6	635	906
Total 4/	2,858	98,674	119,742	2,547	101,521	123,273

r/ Revised.

1/ For all types of hydraulic cement. Includes imports into Puerto Rico.

2/ Customs value-- price actually paid or payable for merchandise when sold for exportation to the United States, excluding U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise to the United States.

3/ C.i.f. (Cost, insurance, and freight)-- import value represents the customs value plus insurance, freight, and other delivery charges to the first port of entry.

4/ Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

TABLE 22
HYDRAULIC CEMENT: WORLD PRODUCTION BY COUNTRY 1/

(Thousand metric tons)

Country	1992	1993	1994	1995	1996 e/
Afghanistan e/	115	115	115	115	116
Albania e/	200	200	200	200	200
Algeria	6,400	6,400 e/	6,060	6,822 r/	7,000
Angola e/	300	250	300	300	300
Argentina	5,051	5,647	6,306	5,447 r/	5,117 2/
Armenia	400	200	100	228 r/	282 2/
Australia e/	5,412 2/	5,500	6,500 r/	6,500 r/	6,500
Austria	5,031	4,941	4,828 r/	3,843 r/	4,000
Azerbaijan	800	600	500	200	200 2/
Bahrain	220	225	225 e/	197 r/	193 2/
Bangladesh 3/	273	275	280 e/	280 e/	285
Barbados	175 e/	62	78	80 e/	80
Belarus	2,300	1,900	1,488	1,235	1,467 2/
Belgium	8,073	7,612	8,000 e/	8,000 e/	8,000
Benin e/	370	380	380	380	380
Bhutan	116	108	120 e/	140 e/	160
Bolivia	600	654	768 r/	869 r/	934 2/
Bosnia and Herzegovina e/	150	150	150	150	200
Brazil	23,903	24,843	25,330 r/	28,256 r/	34,597
Brunei	--	--	--	--	100
Bulgaria	2,132	2,007	2,200	2,070 r/	2,100
Burma	464	400	470	517	505 2/
Cameroon e/	620 r/	620 r/	620 r/	620 r/	600
Canada	5,698	6,672	10,584	10,440 r/	11,050 p/
Chile	2,645	3,021	2,995	3,275 r/	3,634 2/
China	308,220	367,880	421,180	475,910 r/	490,000 2/
Colombia	6,807	7,930	9,322	9,624	8,346 2/
Congo e/	115 2/	114	114	100	100
Costa Rica	700 e/	860	940	990 e/	990
Côte d'Ivoire e/	510	500	500	500	500
Croatia	1,768	1,683	2,055 r/	1,708 r/	1,842 2/
Cuba	2,000 e/	1,049	1,081	1,524 r/	1,453 2/

See footnotes at end of table.

TABLE 22--Continued
HYDRAULIC CEMENT: WORLD PRODUCTION BY COUNTRY 1/

(Thousand metric tons)

Country	1992	1993	1994	1995	1996 e/
Cyprus	1,131	1,089	1,053	1,021	1,025
Czech Republic 4/	XX	5,393	5,303	4,825	5,011 2/
Czechoslovakia 5/	8,500	XX	XX	XX	XX
Denmark (sales)	2,072	2,270	2,430	2,584 r/	2,629 2/
Dominican Republic	1,365	1,271	1,276	1,453	1,500
Ecuador	2,250 e/	2,098	2,164	2,300 e/	2,677 2/
Egypt	17,000	16,000	16,000 e/	17,665 r/	18,000
El Salvador	419	861	850	875 e/	948 2/
Eritrea e/ 6/	XX	30	30 r/	50 r/ 2/	41 2/
Estonia	600 e/	500 e/	402	417	400
Ethiopia	300	270 e/	260	611	600
Fiji	84	80	94	91 r/	92
Finland	1,129	835	864	907 r/	947 2/
France	21,165	20,464	21,296	19,692	20,000
Gabon	116	132	126 e/	130 e/	130
Georgia	500	300	100	100 e/	100
Germany	37,529	36,649	40,380	40,000 e/	40,000
Ghana	1,024	1,203	1,346	1,400 e/	1,400
Greece	10,668	12,618	12,636	12,000 e/	12,000
Guadeloupe e/	235	230	230	230	230
Guatemala	1,400 e/	1,119	1,200 r/	1,200 r/ e/	1,090 2/
Haiti e/	200	100	75	50	50
Honduras	650 e/	723	1,100 r/ e/	1,140 r/	960
Hong Kong	1,643	1,712	1,927	1,913	2,027 2/
Hungary	2,236	2,533	2,813	2,875 r/	2,776 2/
Iceland	100	86	81	82	80
India e/	50,000	53,812 2/	57,000 r/	62,000 r/	76,220 2/
Indonesia	17,280	18,934	21,907 r/	23,129 r/	25,000
Iran e/	15,200	16,000	16,000	16,300	16,500
Iraq e/	2,000 r/	2,000 r/	2,000 r/	2,108 r/ 2/	2,100
Ireland e/	1,600	1,600	1,550	1,500	1,500
Israel	3,960 r/	4,536 r/	4,800 r/	4,800 r/ e/	4,800
Italy	41,347	34,771	33,192	33,715 r/	34,000
Jamaica	475	451	445	523	555
Japan	88,253	88,046	91,624	90,474	94,492 2/
Jordan	3,134	3,514	4,000 e/	3,508 r/	3,500
Kazakstan	6,400	4,000	2,000	2,616 r/	2,500
Kenya	1,508	1,417	1,420 e/	1,500 e/	1,500
Korea, North e/	17,000	17,000	17,000	17,000	17,000
Korea, Republic of	44,444	47,313	50,730	55,130	57,334 2/
Kuwait	533	500 e/	1,000 e/	1,950 r/	2,000
Kyrgyzstan	1,100	700	400	300	500 2/
Laos e/	7	7	10	10	10
Latvia	400 e/	300 e/	244	203 r/	270 2/
Lebanon e/	1,500	3,000 r/	3,450 r/	3,538 r/ 2/	3,500
Liberia e/	8 2/	8	--	--	--
Libya	2,300	2,300 e/	2,700 r/ e/	3,210 r/	3,550 2/
Lithuania	1,500 e/	1,000 e/	736	649	600
Luxembourg e/	600	600	620	600	600
Macedonia	516	499	486	524 r/	550
Madagascar e/	60	60	60	60	60
Malawi	112	127	122	139	140
Malaysia	8,366	8,797	9,928	10,713 r/	12,335 2/
Mali e/	20	20	20	20	20
Martinique e/	240	220	225	225	225
Mauritania	122	111	374	120 r/	120
Mexico	26,880	27,120	29,700	23,366 r/	22,829 2/
Moldova	700	100	39	49	70 2/
Mongolia	133	82	86	109	106 2/
Morocco	6,340	6,350 e/	6,500 e/	6,401 r/	6,400
Mozambique e/	30	20	20	20	30
Nepal	238 r/	274 r/	316 r/	327 r/	343 2/
Netherlands e/	3,300 2/	3,400	3,400	3,400	3,300
New Caledonia e/	90 2/	90	90	100	100

See footnotes at end of table.

TABLE 22--Continued
HYDRAULIC CEMENT: WORLD PRODUCTION BY COUNTRY 1/

(Thousand metric tons)

Country	1992	1993	1994	1995	1996 e/
New Zealand e/	579 2/	800 r/	1,000 r/	1,000 r/	1,000
Nicaragua	277	255	309	350 e/	350
Niger e/	29 2/	29	30	30	30
Nigeria e/	3,500	3,500	2,600 2/	3,000 r/ e/	3,000
Norway	1,266	1,344	1,444	1,613 r/	1,600
Oman	970	1,000 e/	1,200 e/	1,177 r/	1,200
Pakistan	7,793	8,321	8,100	8,586	8,900
Panama	250 e/	571	615	350 e/	350
Paraguay	325 r/ e/	490	570	635 r/	620 2/
Peru e/	2,090 r/	2,500 r/	3,000 r/	3,000 r/	3,848 2/
Philippines	6,667	7,962	10,400 r/ e/	10,600 r/	12,000
Poland	11,908	12,228	13,834	13,884	13,879 2/
Portugal	7,638	7,570 r/	7,780 r/	7,770 r/	8,300
Qatar	544	550 r/ e/	600 r/ e/	667 r/	690 2/
Romania	6,271	6,240	5,998	6,842 r/	6,858 2/
Russia	61,700	49,900	37,200	36,500 r/	27,800 2/
Rwanda e/	60	60	10	5 2/	10
Saudi Arabia	15,324	15,300 e/	15,000 r/ e/	15,773 r/	16,437 2/
Senegal	601	590	590 e/	590 e/	590
Serbia and Montenegro	2,036	1,088	1,612	1,696	2,205 2/
Singapore e/	1,900	2,980 r/	3,100 r/	3,200 r/	3,300
Slovakia e/ 4/	XX	2,500	2,500	2,500	2,500
Slovenia	801 r/	707 r/	898 r/	991 r/	1,000
Somalia e/	25	25	25	25	30
South Africa	7,028	7,356	7,905	9,071	9,400
Spain (including Canary Islands)	24,615	22,878	25,150	26,423 r/	25,157 2/
Sri Lanka	817	676	925	900 e/	905
Sudan e/	250	250	250	391 r/ 2/	380
Suriname e/	50	50	50	50	50
Sweden	2,289	2,200	2,100 e/	2,539 r/	2,447 2/
Switzerland e/	4,260 2/	4,000	4,300 r/	4,400 r/	4,400
Syria	3,700	4,500	4,500 r/ e/	4,463 r/	4,100
Taiwan	21,644	23,971	22,722	22,478	21,537 2/
Tajikistan	400	300	200	100	50 2/
Tanzania e/	540	540	490	800	800
Thailand	21,832	26,870	29,900 r/ e/	34,900 r/ e/	35,000
Togo e/	350	350	350	350	350
Trinidad and Tobago	482	528 r/	583	559 r/	617 2/
Tunisia	3,999	4,269	4,606 r/	4,938 r/	4,567 2/
Turkmenistan	1,100	1,100	700	437 r/	451 2/
Turkey	28,607	31,241	29,493	33,143 r/	32,500
Uganda e/	50	50	125	90 r/	100
Ukraine	20,100	15,000	11,400	7,600 r/	5,000 2/
United Arab Emirates	3,800	4,000 e/	5,000 e/	5,918 r/	6,000
United Kingdom	11,006	11,039	12,493	11,805 r/	11,600
United States (including Puerto Rico) 7/	70,883	75,117	79,353	78,320	80,818 2/
Uruguay e/	500	500	700	600 2/	685 2/
Uzbekistan	5,900	5,300	4,800	3,400 r/	5,000 2/
Venezuela	6,585	6,842	7,100 r/ e/	7,200 r/ e/	7,300
Vietnam e/	4,000 r/	4,200 r/	4,700 r/	5,200 r/	5,700
Yemen	800	800 e/	800 e/	1,088 r/	1,040 2/
Zaire	174	149	50 r/ e/	25 r/ e/	10
Zambia	347	350 e/	280	250 r/ e/	350
Zimbabwe e/	900	1,000	1,070 r/ 2/	1,000	1,150 2/
Total e/ 8/	1,231,143 r/	1,292,379 r/	1,372,427 r/	1,443,689 r/	1,484,564

e/ Estimated. p/ Preliminary. r/ Revised. XX Not applicable.

1/ Table includes data available through Aug. 4, 1997. Data may include clinker exports for some countries.

2/ Reported figure.

3/ Data are for the year ending June 30 of that stated.

4/ Formerly part of Czechoslovakia; data were not reported separately until 1993.

5/ Dissolved Dec. 31, 1992.

6/ Eritrea became an independent country in May 1993.

7/ Portland and masonry cement only.

8/ Data may not add to totals shown because of independent rounding.