

CLAYS

By Robert L. Virta

The amount of clay sold or used by domestic producers remained unchanged from the 1996 levels of 43.1 million metric tons valued at \$1.7 billion. Production of common clay increased while all other clay types decreased. Common clays accounted for 61% of the tonnage. Kaolin accounted for 64% of the value of clays produced. Imports increased to 44,600 tons valued at \$21 million. Exports increased to 4.83 million tons valued at \$825 million. (*See table 1.*)

Legislation and Government Programs

Clay mining has an environmental impact because of the disturbance to the land. Overburden is moved and clays are removed, leaving a depression or pit. State laws usually require leveling or recontouring of the disturbed area and planting trees or grasses to prevent or minimize erosion. For processing, the impoundment of slimes and dust control are usually required. The rules for disposal of coarse tailings are similar to or included with those laws governing reclamation of the mined area.

The Environmental Protection Agency issued proposed revisions to its standards of performance for new stationary sources for nonmetallic mineral processing plants (40 Code of Federal Regulations part 60, subpart 000). The proposed revisions affect the designation of affected facility, the definition of "wet screening operation," the particulate matter standard, test methods and procedures, and reporting and recording (Environmental Protection Agency, 1996).

The Food and Drug Administration issued a proposed rule for the permanent listing of color additive lakes. Lakes are water-insoluble pigments composed of a water-soluble straight color adsorbed onto an insoluble substrate through the use of a precipitant. The agency tentatively concluded that kaolin meeting U.S. Pharmacopoeia specifications is safe for use as a substrate in lakes for drug and cosmetic use (Food and Drug Administration, 1996).

An International Agency for Research on Cancer panel evaluated the health risk posed by exposure to crystalline and amorphous silica, palygorskite, sepiolite, wollastonite, some natural and synthetic zeolites (other than erionite), and coal dust and para-aramid fibrils. The panel concluded that "crystalline silica inhaled in the form of quartz or cristobalite from occupational sources was classified as carcinogenic to humans (Group 1)." The conclusion was reached on "the basis of a relatively large number of epidemiological studies that together provided sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica under the conditions specified" (International Agency for Research on Cancer, 1996).

Production

Approximately 280 companies operating 739 clay pits or mines mined clays in 1996; of these, 50 companies, many with multiple operations, accounted for approximately 76% of the tonnage and 83% of the value for all types of clay produced and sold or used. Clay production was reported in most States and Puerto Rico except Alaska, Delaware, Hawaii, Rhode Island, Vermont, Wisconsin, and the District of Columbia.

The leading producer States, in descending order, were Georgia, Wyoming, Alabama, Texas, North Carolina, Ohio, California, South Carolina, Indiana, and Missouri. (*See table 2.*)

Most of the clay was mined by open pit methods. Less than 1% of U.S. clay output was from underground mines in 1996. Most of the underground production was in Ohio, Pennsylvania, and West Virginia, where the clays are mainly underclays associated with coal and suitable for refractory uses.

Domestic production data for clays were developed by the U.S. Geological Survey (USGS) from a voluntary survey of U.S. operations. Of the 681 operations covered by the survey, 481 responded, representing 71% of the total clay and shale production sold or used shown in table 1. Production data for the nonrespondents were estimated from reported prior-year production levels adjusted by trends in the industry and other guidelines.

Ball Clay.—The ball clay industry was small, with 6 producers operating 33 mines in 6 States. Three of the producers were large, diversified firms with widespread foreign and domestic mineral interests.

Production of domestic ball clay decreased to 973,000 tons valued at \$43.1 million. Tennessee supplied 70% of the Nation's output, followed by, in descending order of production, Texas, Mississippi, Kentucky, Indiana, and Missouri. Production increased in Tennessee, was unchanged in Indiana, Mississippi, and Texas, and decreased in Kentucky. Water-slurried ball clay was produced only in Kentucky and Tennessee. Air-float ball clay was produced in all six ball clay producing States. (*See table 3.*)

Bentonite.—Twenty firms producing bentonite operated 57 mines in 10 States. Four producers were large, diversified firms with international mineral operations; three of the firms had interests in other types of clay in the United States.

The quantity and value of all varieties of bentonite sold or used decreased to 3.74 million tons valued at \$134 million. Production of nonswelling bentonite decreased to 461,000 tons valued at \$21.9 million. Alabama led all States in the production of nonswelling bentonite, followed by Mississippi, California, Arizona, Oregon, Utah, Colorado, Nevada, and

Montana.

Production of swelling bentonite decreased to 3.28 million tons valued at \$112 million. Wyoming led all States in the production of swelling bentonite, followed by Montana, Utah, California, Oregon, and Nevada. (See table 5.)

American Colloid Co. sold its acid-activated clay operation to Engelhard Corp. American Colloid indicated that the acid-activated clay business no longer met the long-term goals of the company. The company will close its Aberdeen, MI, calcium bentonite facility. Acid-activated clay was used in petrochemical processes and in clarifying mineral and vegetable oils (North American Minerals News, 1996a).

Laporte PLC announced plans to build a \$4 to \$12 million synthetic silicate plant at its Southern Clay Products in Gonzales, TX. The U.S. market for the sodium magnesium lithium silicate thickener has grown about 400% in the past 4 years (Chemical Week, 1996b).

Common Clay and Shale.—Two hundred firms operated 439 pits in 42 States and Puerto Rico in 1996. Most of these companies also were manufacturers of structural clay products such as clay pipe, sewer pipe, lightweight aggregates, and cement. Less than 10% of the total output usually is sold. Some companies owned and operated several clay pits and plants to cover a large market area.

Domestic sales or use of common clay and shale increased to 26.2 million tons, valued at \$144 million. The major producing States were North Carolina, Alabama, Texas, Ohio, Georgia, Indiana, California, South Carolina, Arkansas, and Virginia, in descending order of tonnage. (See table 7.)

Fire Clay.—Fire clay producers were mostly refractories manufacturers that used the clays in firebrick and other refractories. Forty-two mines were operated in 1996 by 19 firms in 9 States.

Fire clay sold or used by domestic producers decreased to 505,000 tons valued at \$10.7 million. Missouri, was the leading producing State, followed by Ohio, California, Alabama, South Carolina, Oklahoma, Arkansas, New Mexico, and Montana. (See table 9.)

Christy Minerals Co. announced plans to expand its Missouri refractory minerals and investment casting minerals plant. The company will increase its storage and screening capacities and add mills and classifiers (North American Minerals News, 1996b).

Fuller's Earth.—Eighteen companies produced fuller's earth from 32 mines in 12 States. Six of the mines were in the attapulgite-type fuller's earth areas of Florida and Georgia; these two States accounted for most of the domestic attapulgite production. Most producers were small, independent firms, but four were large, diversified corporations with international mineral interests.

Production of fuller's earth decreased to 2.60 million tons valued at \$278 million. Production of attapulgite-type fuller's earth was 871,000 tons valued at \$116 million. Over one-half of this production came from Georgia, followed by Florida, and Nevada. Production in Nevada was of sepiolite-type fuller's

earth.

Production of montmorillonite-type fuller's earth was 1.73 million tons valued at \$161 million. Mississippi led all States in production, followed by Illinois, Missouri, California, Georgia, Florida, Tennessee, Kansas, Virginia, Texas, and Utah, in decreasing order of production. (See table 11.)

Laporte PLC sold Waverly Minerals Products Co. to Süd-Chemie AG. The purchase was made to allow Süd-Chemie to enter the North American absorbents market. Waverly Minerals produces fuller's earth (calcium bentonite) for cat litter and other applications (Industrial Minerals, 1996e).

Engelhard Corp. increased the capacity of its fuller's earth plant in Jackson, MS. The company produces activated bleaching earths at this location for the fats and oils industry (Chemical Market Reporter, 1996).

Ralston Purina Co. purchased and leased land near Richmond, VA, from the VA Clay Co. The clay will be used at Ralston Purina's new \$20 million facility to produce kitty litter (Rock Products, 1996).

Oil Dri Corp. reported increased net sales of cat box absorbents in 1996 with increases in brand and private label products (Oil Dri Corp., 1997).

Kaolin.—Thirty-three firms operated 154 kaolin mines in 12 States. Domestic production was 9.12 million tons valued at \$1.1 billion. Georgia was the largest kaolin producer, followed by South Carolina, Alabama, Arkansas, California, North Carolina, Florida, Tennessee, Texas, Nevada, Pennsylvania, and Colorado, in decreasing order of production. (See table 13.)

Approximately 48% of the kaolin produced was water-washed; followed by calcined, 18%; delaminated, 17%; air-floated, 13%; and unprocessed, 5%. (See table 14.) Production of low-temperature (pigment) and high-temperature (refractory) calcined kaolin was 708,000 and 957,000 tons, respectively. (See table 15.)

Kaolin production in Georgia was 8.04 million tons valued at \$1.05 billion. Over one-half of the production was sold as water-washed, followed by delaminated, calcined, airfloat, and unprocessed. (See table 16.) Production in South Carolina was 387,000 tons valued at \$18.1 million, all of which was airfloat or unprocessed. (See table 18.) Unprocessed kaolin was sold or used in most States in what may be considered to be common clay applications (i.e., brick, cement, pottery, etc.)

Engelhard Corp. reported lower earnings from paper pigments because of a depressed paper market. The company, however, introduced several kaolin-based products that compete with more costly alternative pigments and work better on high-speed papermaking machines. Additionally, the company commercialized a new brightening agent for use in coatings, inks, and plastics (Engelhard Corp., 1997).

Cytec Industries Inc. sold its calcining plant and ore reserves in Georgia to GEO Specialty Chemicals Inc. The plant, which has a calcining capacity of 145,000 tons, supplies all of the kaolin required for Cytec's alum industry. The reserves, located near Andersonville, Georgia, contain 30 million tons of kaolin, bauxitic clay, and bauxite (Industrial Minerals, 1996c).

C-E Minerals Inc. invested \$10 million to install a new sizing line and upgrade an existing sizing line at its Andersonville, GA, plant. The plant gets its raw materials from mines in Andersonville, GA, and Eufaula, AL (Ceramic Industry, 1996).

Consumption

Ball Clay.—The principal domestic ball clay markets were floor and wall tile, pottery, and sanitaryware. (See table 4.) Consumption decreased slightly in 1996. Decreased sales for floor and wall tile and pottery were accompanied by increased exports and a larger percentage of sales being placed under the miscellaneous category in table 4.

Bentonite.—Major markets for bentonite were drilling mud, foundry sand, iron ore pelletizing, and pet waste absorbents. Consumption increased 3%, in 1996, mainly for absorbent, foundry sand, pelletizing, and pet waste absorbent applications. Sales and use decreased for ceramic (sanitaryware), drilling mud, and filler and extender (paint and paper) applications. As in previous years, an estimated 100,000 tons of the bentonite reported under domestic consumption was exported to the Canadian iron ore industry. (See table 6.)

With regard to the sales of swelling versus nonswelling bentonite, most of the data were concealed to avoid disclosing company proprietary data. More than two-thirds of the bentonite sold for pet waste absorbent applications was swelling bentonite as was the bentonite sold for oil and grease absorbent applications. Only swelling bentonite was sold for adhesives applications. For animal feed applications, more than 60% of bentonite sold was the swelling variety. The bulk of the bentonite sold for ceramics was swelling bentonite and essentially all of the bentonite used in drilling mud applications was the swelling variety. Only swelling bentonite was sold for filler and extender applications. More than two-thirds of the bentonite sold for foundry sand applications was swelling bentonite. All of the bentonite sold for filtering, clarifying, and decolorizing applications was swelling. Bentonite sold for pelletizing iron ore was exclusively swelling bentonite. Most of the bentonite used for civil engineering, waterproofing and sealing was swelling bentonite.

The major uses for swelling bentonite were in iron ore pelletizing, pet waste absorbent, drilling mud, foundry sand, waterproofing and sealing, and animal feed, in decreasing order of consumption. The major uses for nonswelling bentonite were in foundry sand, absorbents, miscellaneous refractories, animal feed, in decreasing order of consumption.

Common Clay and Shale.—Common clay was used most frequently in the manufacture of heavy clay products, including (1) building brick, flue linings, sewer pipe, drain tile, structural tile, and terra cotta; (2) portland cement clinker; and (3) lightweight aggregate. (See table 8.) Consumption increased 2%. Large gains were made in sales for civil engineering and sealing, construction (brick and cement), and refractory applications while those for lightweight aggregates lagged.

Fire Clay.—Fire clays were used in refractory products such

as firebrick and block, grogs and calcines, high-alumina brick and specialties, saggars, refractory mortars and mixes, and ramming and gunning mixes. Fire clays also were used to produce such items as brick, ceramic tile, portland cement, and pottery.

Consumption of fire clay decreased 13%. Major markets for fire clay were firebrick, followed by refractory mortar and cement, common brick, grogs and calcines, ceramic tile, and pottery, in decreasing order of consumption. (See table 10.) Declining sales for the production of portland cement and grogs and calcines accounted for the bulk of the decrease in overall sales of fire clay.

Fuller's Earth.—The major uses for attapulgite-type and montmorillonite-type of the fuller's earths were as pet waste absorbents; pesticide carriers; and oil and grease absorbents, in decreasing order of consumption. (See table 12.) Overall consumption of fuller's earth decreased 2% in 1996. While sales of attapulgite-type fuller's earth increased, there was a slightly larger decrease in sales and use of montmorillonite-type fuller's earth.

Consumption declined slightly for the major end uses except pet waste absorbents. Oil and grease absorbents and pesticides accounted for most of the decrease.

With regard to the sales of attapulgite-type fuller's earth versus montmorillonite-type fuller's earth, most of the data were concealed to avoid disclosing company proprietary data. Less than one-half of the fuller's earth sold for oil and grease absorbents and pet waste absorbents was attapulgite. Attapulgite accounted for the bulk of the sales for miscellaneous absorbents, less than 25% of animal feed sales, more than 75% of the drilling mud sales, and most of the fertilizer sales. Over one-half of the fuller's earth used as pesticide carriers was montmorillonite.

Kaolin.—The major markets were in paper coating, paper filler, firebrick, fiber glass, catalyst, paint, common brick, rubber, and grogs and calcines, in decreasing order of consumption. (See table 20.) Consumption decreased 4% in 1996. The largest gains were made by the fiberglass market while the largest decline was in refractories, where major changes were occurring in several of the producing companies. Major domestic markets for kaolin from Georgia were paper coating, paper filling, refractories, fiberglass, and paint, in decreasing order of consumption. The major market for kaolin from South Carolina was brick manufacture, followed by rubber, catalyst, fiber glass, roofing granules, firebrick, adhesives, sanitaryware, pesticide, paper coating, paper filling, and plastics, in decreasing order of consumption. (See tables 17 and 19.)

Absorbent Uses.—Absorbent uses for clays accounted for about 2.54 million tons. Pet waste absorbents accounted for approximately 84% of absorbent consumption, followed by oil and grease absorbents (13%), and miscellaneous absorbent applications (3%). Demand for absorbents increased in 1996 corresponding to the growth in the pet litter market. Fuller's earth was the principal clay used for absorbent purposes,

followed by bentonite. (See tables 6 and 12.)

The cat-litter market has contributed significantly to the increased sales of absorbents. Sales of bentonite and fuller's earth for cat-litter applications have increased worldwide. With increasing competition in the cat-litter market, specifications have become more important. Manufacturers must consider many factors when developing new products. Characteristics such as product density, absorption, granule size, odor control, dust formation, color, and material strength influence the choice of material for the product. The scoopable cat litters, composed primarily of sodium bentonite have increased significantly in popularity, accounting for about 30% of the market. Other clays used in cat litter include fuller's earth, sepiolite, attapulgite, and moler clays. Nonclay cat litters are composed of zeolites, gypsum, hydrated calcium silicate, and organic materials such as alfalfa pellets, peanut shells, and waste-paper pellets (Austin and Mojtabai, 1996).

Ceramics.—All varieties of clays were used in ceramics. Total demand for clay in the manufacture of ceramics, ranging from china to sanitaryware to tile to roofing granules, was approximately 1.62 million tons. The largest ceramics market was in ceramic floor and wall tile, followed by sanitaryware, catalyst, pottery, roofing granule, quarry tile, fine china, electrical porcelain, and glaze application. Ball clay accounted for 37% of the clay used in ceramics, followed by kaolin (31%) and common clay and shale (31%). Small amounts of bentonite, fire clay, and fuller's earth also were used in the manufacture of ceramics. With regard to individual ceramics markets, ball clay dominated the electrical porcelain, glazing, pottery, and sanitaryware markets. Common clay and shale was the predominant clay used in roofing granules. Kaolin dominated the catalyst, crockery, and fine china markets. Common clay and shale and ball clay were the predominant clays used in floor and wall tile manufacture. (See tables 4, 8, 10, and 20.)

Construction.—Common clays and shales were used to manufacture a wide variety of construction materials such as expanded aggregates, hydraulic cement, and structural clay products.

Expanded Clay and Shale.—Approximately 4.06 million tons of clays was used in the production of lightweight aggregate. Nearly all of the clay used to manufacture lightweight aggregate was common clay and shale. Lightweight aggregates were used in concrete block, structural concrete, and highway surfacing, in decreasing order of consumption. (See tables 8 and 21.)

Hydraulic Cement.—Clays provide the alumina and silica required to manufacture hydraulic cements. Approximately 7.20 million tons of clays was consumed. Common clays, kaolin, fuller's earth, and fire clay, in decreasing order of consumption, were used in cement products. Approximately 99% of the clay consumed by the cement industry was common clay and shale. (See tables 8 and 20.)

Metakaolin has been used in walls and roadway and bridge overlays on a limited scale since becoming available in 1994. The metakaolin is highly reactive and reacts with the cement's

free lime. The metakaolin supposedly promotes low permeability, good compressive strength, and improved chemical resistance (Engineering News Record, 1996).

Structural Clay Products.—Approximately 14.0 million tons of clays was used in the manufacture of structural clay products such as building brick, drain tile, flue linings, roofing tile, sewer pipe, and terra cotta. Common and face brick accounted for 95% of this total. Other markets, in decreasing order of consumption, were sewer pipe, flue linings, flower pots, structural tile, roofing tile, drain tile, and terra cotta. Approximately 98% of the clay used in these applications was common clay and shale. (See tables 8, 20, and 22.)

The Bureau of the Census reported shipments of building and face brick to be 7.62 billion bricks valued at \$1.24 billion. Shipments of clay floor and wall tile were 580 million square meters valued at \$776 million. Shipments of vitrified clay and sewer pipe fittings were 138,000 tons valued at \$36.2 million.

Drilling Mud.—Reported demand for clays in drilling muds was 611,000 tons. Swelling-type bentonite remained the principal clay used in drilling mud mixes (95%). Fuller's earth, used mostly in saltwater drilling techniques, accounted for 4% of the total. Some ball clay and kaolin also were used. (See tables 6 and 12.)

Filler.—Approximately 5.11 million tons of clays was used as fillers and extenders. Clays are used as binders, extenders, and fillers in a wide variety of products, ranging from adhesives to flooring products to paint to paper to rubber. Paper coating and filling accounted for 72% of the filler and extender market consumption, followed by paint (6%), pesticides (6%), animal feed (4%), and rubber (4%).

Kaolin accounted for approximately 86% of the clay used in filler and extender applications, followed by fuller's earth (9%), bentonite (2%), ball clay (2%), common clay and shale (1%), and minor amounts of fire clay. (See tables 4, 6, 12, and 20.) Ball clay dominated the asphalt emulsion market. Bentonite was the predominant clay used for ink applications. Fuller's earth was the predominant clays used in asphalt tile, fertilizer, gypsum product, and pesticide applications. Kaolin dominated the adhesive, linoleum, paint, paper, rubber, plastics, textile, and wallboard markets.

Glass.—Approximately 458,000 tons of kaolin was used in fiberglass and mineral wool. (See table 20.)

Iron Ore Pelletizing.—Demand increased to 685,000 tons in 1996. Almost all of the clay used in pelletizing was bentonite. (See table 6.) Small amounts of common clay and shale also were used.

Paper Products.—Kaolin accounted for essentially all of the clay used for paper coating (2.81 million tons) and all of the clay used for paper filling (854,000 tons). (See table 20.) Small amounts of ball clay were used in paper coating applications.

Refractories.—Approximately 2.60 million tons of clays was used for the manufacture of refractories. The largest markets were foundry sand (30%), firebrick (31%), high alumina specialties (26%), refractory mortar and cement (12%), grogs and calcines (9%), and high alumina brick (4%). Ball clay,

bentonite, common clay and shale, fire clay, and kaolin accounted for 3%, 30%, 20%, 14%, and 33%, respectively, of the refractories markets. Fire clay dominated the high aluminum specialties market, bentonite dominated the foundry sand market, kaolin dominated the firebrick and grog, calcine, and high alumina brick markets, and common clay dominated the refractory mortar and cement market. (See tables 4, 6, 8, 10, and 20.)

The Bureau of the Census reported shipments of clay refractories to be valued at \$944 million in 1996, a slight increase from 1995. Shipments of refractory brick and shapes were 815,000 tons (280 million bricks) valued at \$559 million. Shipments of fire clay brick and shapes were 386,000 tons (128 million bricks) valued at \$209 million in 1996; high alumina brick and shapes, 371,000 tons (100 million bricks) valued at \$286 million; and insulating brick and shapes, 57,000 tons valued at \$64 million. Shipments of unshaped clay refractories included refractory bonding mortars, 648,000 tons valued at \$332 million and plastic refractories, 144,000 tons valued at \$76.8 million. Shipments of castable refractories were 292,000 tons valued at \$166 million. Shipments of fire clay gunning mixes were 164,000 tons valued at \$61.7 million.

Prices

Ball Clay.—The average value for ball clay reported by domestic producers was \$44.34 per ton. The average value of imported ball clay was \$156.35. The average value of exported ball clay was \$62.81 per ton.

Bentonite.—The average value reported by domestic producers for nonswelling bentonite was \$47.57 per ton. The average value for swelling bentonite was \$34.15 per ton. The average value for all types of bentonite was \$35.80 per ton. The average value of imported bentonite was \$271.06 per ton. The average value of exported bentonite was \$102.38 per ton.

Common Clay and Shale.—The average value for all common clay and shale produced in the United States and Puerto Rico was \$5.48 per ton. The average value of clay and shale used in lightweight aggregate was \$12.11 per ton.

Fire Clay.—The average value for fire clay reported by domestic producers was \$21.17 per ton. The average of imported fire clay was \$456.77 per ton. The average value of exported fire clay was \$102.60 per ton.

Fuller's Earth.—The average value of attapulgitic fuller's earth reported by domestic producers was \$133.74 per ton. The average value of montmorillonite fuller's earth was \$93.11 per ton. The average value of all types of fuller's earth was \$106.71 per ton. The average value of imported fuller's earth was \$344.39 per ton. The average value of exported fuller's earth was \$143.63 per ton.

Kaolin.—The average value of kaolin was \$120.19 per ton for all kaolin grades. The average value for air-float kaolin was \$54.68 per ton; for high-temperature calcined kaolin, \$18.88 per ton; for low-temperature calcined kaolin, \$411.50 per ton; for all types of calcined kaolin, \$185.79 per ton; for

delaminated kaolin, \$125.79 per ton; for water-washed kaolin, \$120.92 per ton; and for unprocessed kaolin, \$18.74 per ton. The average value of the imported kaolin was \$239.14 per ton. The average value of exported kaolin was \$172.27 per ton.

Foreign Trade

Ball Clay.—Ball clay exports decreased 80,000 tons valued at \$5.27 million, according to the Bureau of the Census. (See table 23.) Domestic ball clay producers reported that 129,000 tons of ball clay was exported in 1996. The exports were used mainly for floor and wall tile production and sanitaryware production. Other major uses are asphalt emulsions, china, dinnerware, and filler and extender applications.

Discrepancies were observed between the export tonnage reported by the Bureau of the Census and that reported by producers. One reason is that the producers may not control the final sale and movement of the clays, as when a mineral broker is involved. Some clays originally destined for export may be sold domestically and vice-versa without the knowledge of the producer. Another reason is that some clay may be exported under an export code other than that corresponding to ball clay. In 1996 imports were 1,400 tons of ball clay valued at \$337,000. (See table 24.)

Bentonite.—Bentonite exports increased slightly to 746,000 tons valued at \$80.6 million. Domestic bentonite producers reported exports of 426,000 tons. This discrepancy is partially explained by the inclusion of an estimated 100,000 tons of bentonite for Canadian iron ore pelletizing under domestic sales. Also see the discussion under ball clay concerning discrepancies between export data reported by producers and those reported by the Bureau of the Census. (See tables 6 and 23.)

Bentonite imports consisted mainly of untreated bentonite clay and chemically or artificially activated materials. Imports of untreated bentonite were 7,510 tons valued at \$1,760,000. Imports of chemically activated material were 18,600 tons valued at \$11.0 million. (See table 24.)

Fire Clay.—Exports of fire clay were 295,000 tons valued at \$28.5 million. According to the Bureau of the Census, 355 tons valued at \$230,000 was imported in 1996. (See tables 23 and 24.)

Fuller's Earth.—Approximately 112,000 tons of fuller's earth valued at \$13.2 million were exported. Domestic producers reported more than 164,000 tons exports in 1996. Discrepancies between producers' and Bureau of the Census reports for exports are similar to the situation with ball clay. Also, some of the exports reported by producers may have been classified as pet litter by the Bureau of the Census rather than as fuller's earth. (See table 12.) Approximately 368 tons of decolorizing and fuller's earth valued at \$159,000 were imported in 1996. (See tables 12, 23, and 24.)

Kaolin.—The Bureau of the Census reported that 3.24 million tons of kaolin valued at \$555 million were exported in 1996. Producers reported exports of 2.43 million tons. Discrepancies between producers' and Bureau of the Census

reports for exports are similar to the situation with ball clay. (See tables 20 and 23.) Kaolin imports increased to 13,700 tons valued at \$5.84 million. (See table 24.)

World Review

World production of bentonite was 9.19 million tons, fuller's earth production was 3.66 million tons, and kaolin production was 38.6 million tons. The United States continued to be the leading producer of all three clay types, followed by the former Soviet Union for bentonite, Germany for fuller's earth, and Uzbekistan for kaolin. Spain led all countries in the production of sepiolite. (See tables 25, 26, and 27.)

Australia.—Comalco announced plans to close its kaolin operations in Queensland. The current production rate of 11,000 tons per year was not adequate to remain economical viable (Tait, 1996).

Brazil.—Dry Branch Kaolin Co. (DBK), based in Dry Branch, GA, increased its holdings in Rio Capim Caulim to 49%. DBK had acquired a 24.5% share of Rio Capim in late 1995. The company has invested about \$110 million and equipment in the project, which was scheduled to begin operations in mid-1996 (Industrial Minerals, 1996d).

Caulim Da Amazonia S.A. completed a \$47.9 million expansion of its facilities, increasing its capacity to 800,000 tons per year. The company also announced plans for further expansion to 1 million tons per year at a cost of \$29 million (Industrial Minerals, 1996b).

Canada.—A large kaolinitic clay and silica sand deposit in Nova Scotia was investigated by the Department of Natural Resources. The deposit consists of layers of white to red kaolinitic clay, massive gray kaolin with pyrite, gray kaolinitic silica sand, and black organic-rich kaolinitic clay. Brightnesses of 91.2% were achieved through calcining (North American Minerals News, 1996c).

India.—American Colloid Co. entered into a joint venture with Ashapura Minechem Ltd. to mine bentonite in Gujarat. American Colloid owns 49% of the shares. The companies initially plan to limit their market to cat litter and activated fuller's earth. The operation eventually will be expanded to include such products as geosynthetic liners, organophillic clays, speciality binders, and animal feed (Industrial Minerals, 1996a).

Indonesia.—Watts, Blake, and Bearne Group (WBB) formed a joint venture with WBB subsidiary Pacific Clays Pte. Ltd. and PT Clayindo Cakra Jaya (CCJ) to produce blended ball clay products. The new company, called WBB Clayindo, has taken over the operations of CCJ at Capkala and new clay blending, noodling, and storage facilities are being developed. Initially, the company will supply ball clay to the Indonesian ceramics industry (The American Ceramic Society Bulletin, 1996).

Thailand.—ECC International announced a joint venture with Banpu Co. Ltd. The new company, MRD-ECC Co. Ltd., will mine ball clay deposits in northern Thailand and kaolin from southern Thailand. Production will be 100,000 tons per

year with most going into the ceramics markets (ECC International, 1996).

Ukraine.—Dnipro Kaolin, a joint venture between Engelhard Co. and Prosyanoye Mining and Enrichment Combine of the Ukraine, will mine and sell kaolin to the European paper and paperboard industry. The company will produce 100,000 tons per year and anticipates adding calcined products in the future (Chemical Week, 1996a).

United Kingdom.—Tolsa SA acquired the bentonite and absorbents portion of Redland Minerals. The new company, Steeley Bentonite and Absorbents Ltd., will promote its cat litters as well as other industrial products. Mining and processing will continue at the company's Bedfordshire, South Humberside, and Cleveland locations (Industrial Minerals, 1996f).

Outlook

U.S. clay demand between 1982 and 1996 has rebounded slowly from 32 million tons to 43 million tons. Fueling the increase are the generally improved building and construction industry (for brick, cement, ceramics, etc.), growing paper industry (paper coating and filler), growth in the pet litter market (pet waste absorbents), and concerns over seepage from landfills and waste dumps (civil engineering and sealing applications). Most of these markets can be expected to grow over the next few years.

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TABLE 1
SALIENT U.S. CLAY STATISTICS 1/ 2/

(Thousand metric tons and thousand dollars)

	1992	1993	1994	1995	1996
Domestic clays sold or used by producers:					
Quantity	40,200	40,700	42,000	43,100	43,100
Value	\$1,470,000	\$1,470,000	\$1,590,000	\$1,730,000	\$1,710,000
Exports:					
Quantity	4,160	4,150	4,620	4,680	4,830
Value	\$663,000	\$670,000	\$739,000	\$812,000	\$825,000
Imports for consumption:					
Quantity	41	39	36	35	45
Value	\$15,500	\$17,600	\$14,900	\$16,000	\$21,000

1/ Excludes Puerto Rico.

2/ Data are rounded to three significant digits.

TABLE 2
CLAYS SOLD OR USED BY PRODUCERS IN THE UNITED STATES IN 1996, BY STATE 1/ 2/

(Thousand metric tons and thousand dollars)

State	Ball clay	Bentonite	Common clay and shale	Fire clay	Fuller's earth	Kaolin	Total	Total value
Alabama	--	166	2,290	52	--	254	2,760	25,000
Arizona	--	W	104	--	--	--	104	W
Arkansas	--	--	939	W	--	161	1,100	2,390
California	--	148	1,340	60	224	W	1,770	26,500
Colorado	--	1	317	--	--	6	324	2,340
Connecticut	--	--	W	--	--	--	W	W
Florida	--	--	W	--	377	35	412	62,600
Georgia	--	--	1,660	--	739	8,040	10,400	1,150,000
Illinois	--	--	155	--	330	--	486	736
Indiana	38	--	1,510	--	--	--	1,550	3,500
Iowa	--	--	478	--	--	--	478	1,180
Kansas	--	--	548	--	64	--	611	2,250
Kentucky	70	--	823	--	--	--	893	3,680
Louisiana	--	--	382	--	--	--	382	548
Maine	--	--	W	--	--	--	W	W
Maryland	--	--	304	--	--	--	304	874
Massachusetts	--	--	W	--	--	--	W	W
Michigan	--	--	652	--	--	--	652	3,410
Minnesota	--	--	11	--	--	--	11	W
Mississippi	73	145	534	--	379	--	1,130	40,500
Missouri	13	--	849	223	283	--	1,370	6,470
Montana	--	W	34	W	--	--	34	W
Nebraska	--	--	277	--	--	--	277	1,140
Nevada	--	6	--	--	W	25	31	580
New Hampshire	--	--	3	--	--	--	3	16
New Jersey	--	--	74	--	--	--	74	125
New Mexico	--	--	32	W	--	--	32	165
New York	--	--	652	--	--	--	652	14,000
North Carolina	--	--	2,400	--	--	W	2,400	12,400
North Dakota	--	--	59	--	--	--	59	W
Ohio	--	--	1,960	103	--	--	2,060	10,700
Oklahoma	--	--	799	23	--	--	822	4,090
Oregon	--	33	213	--	--	--	247	1,690
Pennsylvania	--	--	753	--	--	14	767	3,230
South Carolina	--	--	1,260	24	--	387	1,670	23,000
South Dakota	--	--	147	--	--	--	147	W
Tennessee	679	--	W	--	W	32	710	29,000
Texas	101	--	2,290	--	W	28	2,420	15,000
Utah	--	W	298	--	W	--	334	5,940
Virginia	--	--	883	--	46	--	929	3,220
Washington	--	--	218	--	--	--	218	1,070
West Virginia	--	--	199	--	--	--	199	369
Wyoming	--	3,030	29	--	--	--	3,060	98,400
Total	973	3,740	26,200	505	2,600	9,120	43,100	1,710,000

W Withheld to avoid disclosing company proprietary data; included in "Total."

1/ Excludes Puerto Rico.

2/ Data are rounded to three significant digits; may not add to totals shown.

TABLE 3
BALL CLAY SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE 1/

(Thousand metric tons and thousand dollars)

State	Airfloat		Water-slurried		Unprocessed		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1995:								
Tennessee	291	15,600	156	6,930	217	6,410	663	29,000
Other 2/	192	10,700	(3/)	(3/)	137	5,830	329	16,600
Total	483	26,300	156	6,930	354	12,200	993	45,500
1996:								
Tennessee	255	13,900	187	8,270	236	6,870	679	29,000
Other 2/	155	8,240	(3/)	(3/)	139	5,920	294	14,200
Total	411	22,100	187	8,270	375	12,800	973	43,100

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes Indiana, Kentucky, Mississippi, Missouri (1996), and Texas.

3/ Included with "Unprocessed."

TABLE 4
BALL CLAY SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY USE 1/

(Metric tons)

Use	1995	1996
Filler, extenders, and binders 2/	114,000	109,000
Floor and wall tile	251,000	223,000
Miscellaneous ceramics 3/	62,200	45,500
Pottery	128,000	118,000
Refractories 4/	70,800	78,900
Sanitaryware	208,000	207,000
Miscellaneous 5/	48,900	63,500
Exports 6/	110,000	129,000
Total	993,000	973,000

1/ Data are rounded to three significant digits, may not add to totals shown.

2/ Includes adhesives, animal feed, asphalt emulsions, paper, pesticides, plastics, rubber, and other filler, extenders and binders.

3/ Includes crockery, electrical porcelain, fine china/dinnerware, glazes, and miscellaneous ceramics.

4/ Includes firebrick, blocks, and shape, high-alumina brick and specialties, and miscellaneous refractories.

5/ Includes absorbents, brick (common), flue lining, glazes, waterproofing seals, drilling mud, and other uses unknown.

6/ Includes ceramics and glass, fillers, extenders and binders, floor and wall tile, and other uses unknown.

TABLE 5
BENTONITE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE 1/

(Thousand metric tons and thousand dollars)

State	Nonswelling		Swelling		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1995:						
California	W	W	W	W	149	14,000
Colorado	(2/)	9	--	--	(2/)	9
Mississippi	164	6,510	--	--	164	6,510
Nevada	W	W	W	W	6	477
Oregon	W	W	W	W	17	917
Wyoming	--	--	2,940	89,900	2,940	89,900
Other 3/	216	10,000	324	16,300	540	26,300
Total	510	27,600	3,310	111,000	3,820	138,000
1996:						
California	W	W	W	W	148	13,900
Colorado	1	19	--	--	1	19
Mississippi	145	4,480	--	--	145	4,480
Nevada	W	W	W	W	6	580
Oregon	W	W	W	W	33	1,530
Wyoming	--	--	3,030	9,850	3,030	9,850
Other 3/	315	17,400	251	102,000	566	120,000
Total	461	21,900	3,280	112,000	3,740	134,000

W Withheld to avoid disclosing company proprietary data; included in "Total."

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

3/ Includes Alabama, Arizona, Montana, Texas, and Utah.

TABLE 6
BENTONITE SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY USE 1/

(Metric tons)

Use	1995	1996
Domestic:		
Absorbents:		
Pet waste absorbents	574,000	607,000
Other absorbents	88,400	90,500
Adhesives	W	11,200
Animal feed	97,800	65,200
Ceramics (except refractories) 2/	W	W
Drilling mud	627,000	572,000
Filler and extender applications 3/	69,900	33,500
Filtering, clarifying, decolorizing: Animal oils, minerals oils and greases, and vegetable oils	W	W
Foundry sand	745,000	772,000
Pelletizing (iron ore)	646,000	674,000
Miscellaneous refractories and kiln furniture 4/	21,800 r/	16,700
Miscellaneous 5/	288,000	242,000
Waterproofing and sealing	228,000	227,000
Total	3,390,000	3,310,000
Exports:		
Drilling mud	86,500	102,000
Foundry sand	256,000	278,000
Other 6/	89,100	46,400
Total	431,000	426,000
Grand total	3,820,000	3,740,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous."

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes floor and wall tile, and pottery.

3/ Includes medical, pharmaceutical, and cosmetics, paint, pesticides and related products, plastics, asphalt emulsions, ink, and miscellaneous fillers and extenders applications.

4/ Includes kiln furniture, plugs, taps, wads, and miscellaneous refractories.

5/ Includes chemical manufacturing, filtering and clarifying oils, heavy clay products, and other uses unknown.

6/ Includes absorbents, waterproofing and sealing, fillers and extenders, and pelletizing refractories.

TABLE 7
COMMON CLAY AND SHALE SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY STATE 1/ 2/

(Thousand metric tons and thousand dollars)

State	1995		1996	
	Quantity	Value	Quantity	Value
Alabama	2,080	18,600	2,290	17,100
Arkansas	973	2,920	939	2,390
California	1,430	14,500	1,340	12,600
Georgia	1,660	11,200	1,660	11,200
Indiana	877	3,350	1,510	3,500
Kansas	573	2,390	548	2,250
Kentucky	786	3,430	823	3,680
Michigan	623	3,430	652	3,410
Mississippi	616	6,080	534	3,610
Missouri	972	4,810	849	3,250
New York	563	12,500	652	14,000
North Carolina	2,430	12,500	2,400	12,400
Ohio	1,840	7,560	1,960	7,450
Oklahoma	674	3,580	799	4,090
Pennsylvania	736	2,430	753	2,420
South Carolina	1,220	4,910	1,260	4,860
Texas	2,320	15,500	2,290	15,000
Virginia	844	3,200	883	3,220
Other 3/	4,350	18,300	4,060	17,500
Total	25,600	151,000	26,200	144,000

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Excludes Puerto Rico.

3/ Includes all other States except; Alaska, Delaware, Hawaii, Idaho, Nevada, Rhode Island, Vermont, and Wisconsin.

TABLE 8
COMMON CLAY AND SHALE SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY USE 1/ 2/

(Metric tons)

Use	1995	1996
Ceramics and glass 3/	139,000	142,000
Civil engineering and sealing	180,000	279,000
Floor and wall tile:		
Ceramic	301,000	293,000
Other 4/	73,000	61,900
Heavy clay products:		
Brick, extruded	11,200,000	11,300,000
Brick, other	1,640,000	1,730,000
Drain tile and sewer pipe	136,000	123,000
Flowerpots	48,600	47,400
Flue linings	59,800	45,200
Structural tile	21,500	21,500
Other 5/	503,000	505,000
Lightweight aggregate:		
Concrete block	2,530,000	2,450,000
Highway surfacing	248,000	245,000
Structural concrete	869,000	887,000
Miscellaneous 6/	521,000	471,000
Portland and other cements	6,400,000	7,000,000
Refractories 7/	459,000	519,000
Miscellaneous 8/	268,000	117,000
Total	25,600,000	26,200,000

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Excludes Puerto Rico.

3/ Includes pottery and roofing granules.

4/ Includes quarry tile and miscellaneous floor and wall tiles.

5/ Includes roofing tile, sewer pipe, and miscellaneous clay products.

6/ Includes miscellaneous lightweight aggregates.

7/ Includes firebrick, blocks and shapes, grogs and calcines, mortar and cement, and miscellaneous refractories.

8/ Includes asphalt emulsions, pelletizing (iron ore), exports, and other uses unknown.

TABLE 9
FIRE CLAY SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY STATE 1/ 2/

(Thousand metric tons and thousand dollars)

State	1995		1996	
	Quantity	Value	Quantity	Value
Alabama	80	3,120	52	2,800
Missouri	359	5,480	223	3,220
Ohio	88	3,140	103	3,230
Other 3/	56	1,060	127	1,450
Total	583	12,800	505	10,700

1/ Refractory uses only.

2/ Data are rounded to three significant digits; may not add to totals shown.

3/ Includes Arkansas, California, Montana, New Mexico, Oklahoma (1996), and South Carolina.

TABLE 10
FIRE CLAY SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY USE 1/

(Metric tons)

Use	1995	1996
Ceramics and glass 2/	W	W
Heavy clay products and lightweight aggregates 3/	104,000	78,800
Refractories:		
Firebrick, block and shapes	168,000	166,000
Other refractories 4/	232,000	188,000
Miscellaneous	78,400	72,800
Exports	--	W
Total	583,000	505,000

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

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes pottery.

3/ Includes portland cement, terra cotta, and other uses unknown.

4/ Includes common brick, flue linings, foundry sand, grogs and calcines, mortar and cement, plug, tap and wad, and other uses unknown.

TABLE 11
FULLER'S EARTH SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY STATE 1/

(Thousand metric tons and thousand dollars)

State	Attapulgitite		Montmorillonite		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1995:						
Florida	388	50,800	(2/)	(2/)	388	50,800
Georgia	744	90,100	(2/)	(2/)	744	90,100
Southern States 3/	--	--	542	37,800	542	37,800
Western States 4/	(5/)	(5/)	964	89,900	964	89,900
Total	1,130	141,000	1,510	128,000	2,640	269,000
1996:						
Florida	377	58,900	(2/)	(2/)	377	58,900
Georgia	739	89,200	(2/)	(2/)	739	89,200
Southern States 3/	--	--	504	38,500	504	38,500
Western States 4/	(5/)	(5/)	981	91,100	981	91,100
Total	1,120	148,000	1,490	130,000	2,600	278,000

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Included with "Attapulgitite."

3/ Includes Mississippi, Tennessee, and Virginia.

4/ Includes California, Illinois, Kansas, Missouri, Nevada, Texas, and Utah (1996).

TABLE 12
FULLER'S EARTH SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY USE 1/

(Metric tons)

Use	1995	1996
Absorbents:		
Oil and grease absorbent	285,000	258,000
Pet waste absorbent	1,530,000	1,530,000
Miscellaneous absorbent	W	W
Animal feed	72,700	89,600
Drilling mud	23,200	24,000
Fertilizers	50,800	48,900
Fillers, extenders, binders 2/	75,000	76,600
Filtering, clarifying, decolorizing: Animal, mineral, and vegetable oils, and greases	9,070	8,170
Pesticides and related products	302,000	261,000
Miscellaneous 3/	130,000	145,000
Exports 4/	161,000	164,000
Total	2,640,000	2,600,000

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

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes adhesives, asphalt tiles, gypsum products, medical, pharmaceutical and cosmetics, paint, plastics, asphalt emulsions, textiles, and other uses unknown.

3/ Includes catalysts (oil-refining), electrical porcelain, roofing granules, chemical manufacturing, portland cement, refractories, and other uses unknown.

4/ Includes absorbents, fillers, extenders and binders, floor and wall tiles, refractories, and other uses unknown.

TABLE 13
KAOLIN SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY STATE 1/

(Thousand metric tons and thousand dollars)

State	1995		1996	
	Quantity	Value	Quantity	Value
Arkansas	182	4,890	161	W
Florida	33	3,510	35	3,760
Georgia	8,240	1,060,000	8,040	1,050,000
South Carolina	373	16,800	387	18,100
Other 2/	657	23,700	496	23,400
Total	9,480	1,110,000	9,120	1,100,000

W Withheld to avoid disclosing company proprietary data.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes Alabama, California, Colorado, Minnesota, Nevada, North Carolina, Pennsylvania, Tennessee, Texas, and items indicated by symbol W.

TABLE 14
KAOLIN SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY KIND 1/

(Thousand metric tons and thousand dollars)

Kind	1995		1996	
	Quantity	Value	Quantity	Value
Airfloat	1,240	68,500	1,150	62,900
Calcined 2/	1,850	296,000	1,670	309,000
Delaminated	1,570	187,000	1,520	191,000
Unprocessed	457	10,400	450	8,430
Water-washed	4,380	547,000	4,340	525,000
Total	9,480	1,110,000	9,120	1,100,000

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes both low-temperature filler and high-temperature refractory grades.

TABLE 15
CALCINED KAOLIN SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY STATE 1/

(Thousand metric tons and thousand dollars)

State	High-temperature		Low-temperature	
	Quantity	Value	Quantity	Value
1995:				
Alabama and Georgia	1,090	55,300	542	226,000
Other 2/	112	6,140	105	8,880
Total	1,200	61,400	648	235,000
1996:				
Alabama and Georgia	858	13,900	670	285,000
Other 2/	99	4,190	38	6,580
Total	957	18,100	708	291,000

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes Arkansas, California, Colorado, Pennsylvania, South Carolina, and Texas.

TABLE 16
GEORGIA KAOLIN SOLD OR USED
BY PRODUCERS, BY KIND 1/

(Thousand metric tons and thousand dollars)

Kind	1995		1996	
	Quantity	Value	Quantity	Value
Airfloat	953	47,700	832	38,300
Calcined 2/	1,260	274,000	1,270	293,000
Delaminated	1,540	187,000	1,500	191,000
Unprocessed	154	6,250	133	5,220
Water-washed	4,330	545,000	4,300	523,000
Total	8,240	1,060,000	8,040	1,050,000

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes both low-temperature filler and high-temperature refractory grades.

TABLE 17
 GEORGIA KAOLIN SOLD OR USED BY PRODUCERS, BY USE 1/ 2/

(Metric tons)

Use	1995	1996
Domestic:		
Ceramics and glass:		
Catalysts (oil-refining)	W	W
Electrical porcelain	W	5,930
Fiber glass	292,000	418,000
Roofing granules	13,800	9,660
Sanitaryware	60,000	64,200
Other 3/	213,000	234,000
Fillers, extenders, and binder:		
Adhesives	61,500	78,400
Paint	267,000	262,000
Paper coating	2,790,000	2,800,000
Paper filling	846,000	847,000
Plastic	36,900	31,000
Rubber	103,000	112,000
Other 4/	117,000	86,500
Heavy clay products 5/	21,800	20,900
Refractories 6/	677,000	523,000
Undistributed 7/	262,000	150,000
Total	5,760,000	5,650,000
Exports:		
Paint	67,700	66,300
Paper coating	2,040,000	2,000,000
Paper filling	145,000	142,000
Rubber	17,700	8,570
Undistributed 8/	209,000	185,000
Total	2,480,000	2,400,000
Grand total	8,240,000	8,040,000

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

1/ Includes high-temperature calcined, low-temperature calcined, and delaminated.

2/ Data are rounded to three significant digits; may not add to totals shown.

3/ Includes crockery/earthenware, fine china/dinnerware, glazes, glass, and enamels, pottery, and miscellaneous ceramics.

4/ Includes asphalt emulsion, asphalt tile, fertilizers, gypsum products, medical, pharmaceutical and cosmetics, pesticides and related products, textiles and miscellaneous fillers, extenders and binders, and ink.

5/ Includes brick (common and face), portland cement, and miscellaneous clay products.

6/ Includes firebrick, blocks and shapes, grogs and calcines, high-alumina specialties, kiln furniture, and miscellaneous refractories.

7/ Includes chemical manufacturing, civil engineering and sealings, drilling mud, filtering, clarifying, and decolorizing, floor and wall tiles, pet waste absorbents, and other uses unknown.

8/ Includes fiber glass, sanitaryware, ink, miscellaneous fillers, extenders and binders, and other uses unknown.

TABLE 18
 SOUTH CAROLINA KAOLIN SOLD OR USED BY PRODUCERS,
 BY KIND 1/

(Thousand metric tons and thousand dollars)

Kind	1995		1996	
	Quantity	Value	Quantity	Value
Airfloat	219	14,900	220	16,600
Unprocessed 2/	153	1,870	167	1,460
Total	373	16,800	387	18,100

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes high-temperature and low-temperature calcined and delaminated.

TABLE 19
SOUTH CAROLINA KAOLIN SOLD OR USED
BY PRODUCERS, BY KIND AND USE 1/

(Metric tons)

Kind and use	1995	1996
Adhesives	W	W
Animal feed and pet waste absorbent	W	W
Ceramics 2/	90,100 r/	93,600
Fertilizers, pesticides and related products	5,140	5,220
Fiber glass	W	W
Paper coating and filling	8,290	8,290
Plastics	W	W
Rubber	91,100	79,300
Refractories 3/	W	10,200
Other uses 4/	159,000 r/	172,000
Exports 5/	18,700	18,500
Total	373,000	387,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes crockery and earthenware, fine china/dinnerware, floor and wall tile, pottery, and roofing granules.

3/ Includes refractory calcines and grogs, firebrick, blocks and shapes, refractory mortar and cement, and high-alumina refractories.

4/ Includes brick (face and common), catalysts (oil refining), asphalt emulsion, gypsum products, and unknown uses.

5/ Includes paint, paper filling, and rubber.

TABLE 20
KAOLIN SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USE 1/

(Metric tons)

Use	1995	1996
Domestic:		
Ceramics:		
Catalyst (oil and gas refining)	213,000 r/	212,000
Electrical porcelain	7,600	12,300
Fine china and dinnerware	26,400	26,400
Floor and wall tile	38,300	31,800
Pottery	20,600	25,700
Roofing granules	24,900	21,300
Sanitaryware	67,900	72,100
Miscellaneous	152,000	100,000
Chemical manufacture	130,000	W
Civil engineering	W	7,780
Glass fiber, mineral wool	402,000	458,000
Filler, extender, and binder:		
Adhesive	71,600	88,100
Fertilizer	W	W
Medical, pharmaceutical cosmetic	W	W
Paint	270,000	288,000
Paper coating	2,800,000	2,810,000
Paper filling	853,000	854,000
Pesticide	11,200	16,700
Plastic	39,500	36,300
Rubber	194,000	191,000
Miscellaneous	155,000 r/	93,300
Heavy clay products:		
Brick, common and face	230,000	214,000
Portland cement	W	W
Refractories:		
Firebrick, block and shapes	26,800	565,000
Grogs and calcines	190,000	173,000
High alumina brick, specialties, and kiln furniture	885,000	86,800
Foundry sand, mortar, cement, and miscellaneous refractories	145,000	78,000
Miscellaneous applications	19,900 r/	231,000
Total	6,970,000	6,690,000

See footnotes at end of table.

TABLE 20--Continued
KAOLIN SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USE 1/

(Metric tons)

Use	1995	1996
Exports:		
Ceramics	187,000	179,000
Foundry sand, grogs and calcines; other refractories	20,700	W
Paint	67,700	66,300
Paper coating	2,040,000	2,000,000
Paper filling	145,000	142,000
Rubber	36,300	26,900
Miscellaneous	20,900	19,900
Total	2,510,000	2,430,000
Grand total	9,480,000	9,120,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous" or "Miscellaneous applications."

1/ Data are rounded to three significant digits; may not add to totals shown.

TABLE 21
COMMON CLAY AND SHALE USED IN LIGHTWEIGHT AGGREGATE PRODUCTION IN THE UNITED STATES BY STATE 1/

(Thousand metric tons and thousand dollars)

State	Concrete block	Structural concrete	Highway surfacing	Other	Total	Total value e/
1995:						
Alabama and Arkansas	857	115	23	72	1,070	14,200
California	141	104	--	76	321	7,540
Florida and Indiana	153	36	--	60	249	1,650
Kansas, Kentucky, Louisiana	295	128	--	95	518	1,180
Mississippi and Missouri	15	1	2	126	145	1,690
New York and Montana	238	201	--	--	440	11,700
North Carolina	301	52	--	8	361	4,050
Ohio, Oklahoma, Pennsylvania	187	26	--	(2/)	214	1,430
Texas	49	157	222	31	459	2,520
Utah and Virginia	298	48	1	52	399	4,570
Total	2,530	869	248	521	4,170	50,500
1996:						
Alabama and Arkansas	792	103	21	67	983	13,200
California	141	104	--	76	321	7,540
Florida and Indiana	153	36	--	60	249	1,650
Kansas, Kentucky, Louisiana	295	128	--	86	509	1,180
Mississippi and Missouri	15	1	2	116	134	1,560
New York and Montana	265	235	--	--	500	13,200
North Carolina	301	52	--	--	353	4,050
Ohio, Oklahoma, Pennsylvania	187	26	--	--	213	1,430
Texas	49	157	222	31	459	2,520
Utah and Virginia	255	45	--	35	335	4,850
Total	2,450	887	245	471	4,060	51,200

e/ Estimated.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

TABLE 22
COMMON CLAY AND SHALE USED IN BUILDING BRICK
PRODUCTION IN THE UNITED STATES, BY STATE 1/ 2/

(Thousand metric tons and thousand dollars)

State	1995		1996	
	Quantity	Value	Quantity	Value
Alabama	646	2,690	860	2,160
Arkansas	449	893	448	375
California	318	1,460	288	1,390
Colorado	261	1,930	295	2,190
Connecticut, New Jersey, 3/ New York 3/	280	1,160	287	1,370
Georgia	1,210	8,920	1,250	8,950
Illinois	469	685	128	634
Indiana and Iowa	364	1,720	383	1,180
Kentucky 3/ and Tennessee 3/	752	2,030	760	2,080
Maryland and West Virginia 4/	264	817	277	706
Mississippi and Missouri	521	2,010	541	2,210
North Carolina	1,990	7,370	1,970	7,310
Ohio	874	4,140	835	3,990
Oklahoma	330	1,790	445	2,260
Pennsylvania	602	1,790	654	2,140
South Carolina	789	3,450	819	3,290
Texas	1,090	7,090	1,120	7,840
Virginia	632	2,010	671	2,030
Other 5/	948	3,910	966	3,860
Total	12,800	55,900	13,000	56,000

1/ Includes extruded and other brick.

2/ Data are rounded to three significant digits; may not add to totals shown.

3/ Extruded brick only.

4/ Includes other brick only.

5/ Includes Arizona, Maine, Minnesota, New Mexico, North Dakota, and Wyoming.

TABLE 23
U.S. EXPORTS OF CLAYS IN 1996, BY COUNTRY 1/

(Thousand metric tons and thousand dollars)

Country	Ball clay		Bentonite		Fire clay		Fuller's earth	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Argentina	(2/)	3	(2/)	252	(2/)	3	--	--
Australia	--	--	2	696	27	2,720	(2/)	17
Belgium	--	--	3	1,010	(2/)	7	(2/)	47
Brazil	1	21	10	2,040	(2/)	105	(2/)	11
Canada	--	--	191	13,600	5	1,010	71	6,020
Finland	1	81	2	200	--	--	(2/)	18
France	2	53	54	2,990	(2/)	61	(2/)	16
Germany	(2/)	9	22	2,050	(2/)	79	1	110
Indonesia	(2/)	8	5	1,080	2	190	1	75
Italy	(2/)	8	2	710	--	--	3	690
Japan	1	97	147	13,100	37	3,940	1	61
Korea, Republic of	(2/)	22	14	4,970	5	1,180	(2/)	16
Malaysia	--	--	20	1,360	--	--	9	1,250
Mexico	42	2,630	21	2,340	84	6,410	1	173
Netherlands	(2/)	34	14	2,300	113	10,100	10	1,220
Singapore	2	27	3	1,040	(2/)	11	1	167
South Africa	(2/)	3	1	206	(2/)	78	2	351
Taiwan	9	652	23	3,190	10	676	(2/)	14
Thailand	--	--	26	2,830	--	--	(2/)	10
United Kingdom	(2/)	19	83	7,160	1	135	1	461
Venezuela	12	871	29	2,970	(2/)	162	1	184
Other	10	732	74	14,400	11	1,620	10	2,260
Total	80	5,270	746	80,600	295	28,500	112	13,200
	Kaolin		Clays, n.e.c. 3/		Total			
	Quantity	Value	Quantity	Value	Quantity	Value		
Argentina	17	3,930	2	979	20	5,160		
Australia	17	9,270	5	2,920	52	15,600		
Belgium	29	10,200	4	5,890	36	17,100		
Brazil	13	3,120	2	2,200	26	7,500		
Canada	601	77,600	186	32,300	1,050	131,000		
Finland	358	53,300	1	217	361	53,800		
France	6	1,290	4	1,820	65	6,230		
Germany	35	10,500	9	4,270	67	17,000		
Indonesia	51	10,400	1	1,540	59	13,300		
Italy	167	26,500	1	1,000	173	28,900		
Japan	854	165,000	19	12,700	1,060	195,000		
Korea, Republic of	162	26,700	6	5,740	188	38,600		
Malaysia	3	727	1	1,050	33	4,390		
Mexico	149	15,300	12	4,390	308	31,200		
Netherlands	305	41,100	15	9,340	458	64,100		
Singapore	3	737	3	3,130	12	5,110		
South Africa	15	4,420	3	1,520	21	6,580		
Taiwan	136	19,600	5	2,560	184	26,700		
Thailand	24	5,670	2	1,770	52	10,300		
United Kingdom	46	4,920	27	19,600	158	32,300		
Venezuela	21	4,290	9	2,700	72	11,200		
Other	223	61,000	47	24,600	374	105,000		
Total	3,240	555,000	364	142,000	4,830	825,000		

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

3/ Also includes chamotte or dinas earth, activated clays and earths, and artificially activated clays.

Source: Bureau of the Census.

TABLE 24
U.S. IMPORTS FOR CONSUMPTION OF CLAY IN 1996, BY KIND 1/

Kind	Quantity (metric tons)	Value (thousands)
China clay or kaolin:		
Brazil	502	\$107
China	499	235
Mexico	4,370	1,650
New Zealand	1,470	929
United Kingdom	6,500	2,680
Other	394	236
Total	13,700	5,840
Fire clay:		
Spain	64	61
United Kingdom	288	161
Other	3	7
Total	355	230
Decolorizing earths and fuller's earth:		
China	16	5
France	352	154
Total	368	159
Bentonite:		
Canada	3,060	594
Japan	766	87
Mexico	2,260	260
United Kingdom	1,230	663
Other	203	153
Total	7,510	1,760
Common blue clay and other ball clay:		
Germany	321	72
Mexico	15	4
United Kingdom	1,060	261
Total	1,400	337
Other clay:		
Canada	622	230
Germany	136	137
Netherlands	101	44
South Africa	195	236
United Kingdom	1,310	734
Other	154	217
Total	2,520	1,600
Chamotte or dina's earth:		
Brazil	3	5
Canada	36	32
Total	39	37
Artificially activated clay and activated earth:		
Austria	555	732
Canada	1,580	1,220
Germany	1,660	2,500
Mexico	14,000	5,200
Other	820	1,350
Total	18,600	11,000
Grand total	44,600	21,000

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 25
BENTONITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1992	1993	1994	1995	1996 e/
Algeria 4/	31,019	20,833	20,215	20,000 e/	20,000
Argentina	97,531	96,706	117,095 r/	113,760 r/	110,000
Armenia e/	50	50	100	110 5/	2,750 5/
Australia e/ 4/	35,000	35,000	35,000	35,000	35,000
Bosnia and Herzegovina e/	1,000	800	800	800	800
Brazil (beneficiated)	131,180	113,215	145,000 r/	130,000 r/	130,000
Bulgaria	75,000 e/	78,000	76,300	125,800	118,212 5/
Burma	693	200	795	2,655 r/	2,600
Chile	1,081	989	1,213 r/	1,000 r/ e/	1,000
Croatia	10,000 e/	10,000 e/	10,391 r/	7,327 r/	9,728 5/
Cyprus	58,840	51,689	46,530	50,000 e/	50,000
Egypt	4,215	6,013	2,379	2,500 e/	3,000
France e/	6,000 5/	6,000	7,000	-- r/	--
Germany	581,169	473,102	475,000 e/	500,000 e/	500,000
Greece	600,083	677,578	697,773	1,115,119 r/	1,000,000
Guatemala e/	12,600	12,300	4,408 5/	4,500 r/	4,500
Hungary	23,000	9,404	14,700	22,792 r/	15,376 5/
Indonesia	17,960	13,707	14,409	26,057	26,000
Iran 6/	47,659	85,000	84,000	85,000 e/	85,000
Italy	150,503	327,000	386,000	402,000 r/	400,000
Japan	534,472	517,389	484,115	478,056 r/	468,728 5/
Macedonia e/	40,000	35,000	30,000	30,000	30,000
Mexico	135,993	94,600	100,000 e/	72,599 r/	72,600
Morocco	8,137	10,811	24,919	29,308 r/	29,881 5/
Mozambique	20	100 e/	3,349	3,000 e/	3,000
New Zealand (processed)	--	1,613	930 r/	3,699 r/	3,500
Pakistan	6,057	7,991	11,180	5,759	15,290 5/
Peru	14,210	10,250	27,682	26,961 r/	18,592 5/
Philippines	7,428	5,050	25,000 e/	20,000 e/	20,000
Poland	20,700 r/	19,800 r/	19,900 r/	20,000 e/	20,000
Romania	100,000 r/ e/	50,000 r/ e/	41,056 r/	42,277 r/	43,540 5/
Serbia and Montenegro	200 r/	110 r/	215 r/	192 r/	95 5/
South Africa 7/	43,977	50,441	71,773	70,927	48,076 5/
Spain	157,301 r/	162,405 r/	179,233 r/	143,794 r/	150,000
Tanzania e/	70	70	70	70	70
Turkey	123,516	456,597	516,187	602,499 r/	600,000
Turkmenistan e/	50,000	50,000	50,000	50,000	50,000
U.S.S.R. e/ 8/	2,000,000	1,600,000	1,300,000	1,300,000	1,200,000
United States	2,950,000	2,870,000	3,290,000	3,820,000	3,740,000 5/
Zimbabwe 7/	82,956	83,000 e/	169,097	169,487 r/	165,509 5/
Total	8,160,000 r/	8,040,000 r/	8,480,000 r/	9,530,000 r/	9,190,000

e/ Estimated. r/ Revised.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through July 9, 1997.

3/ In addition to the countries listed, Canada and China are believed to produce bentonite, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

4/ Includes bentonitic clays.

5/ Reported figure.

6/ Year beginning Mar. 21 of that stated.

7/ May include other clays.

8/ Dissolved in Dec. 1991; however, information is inadequate to formulate reliable estimates for individual countries, except Armenia and Turkmenistan.

TABLE 26
FULLER'S EARTH: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1992	1993	1994	1995	1996 e/
Algeria	3,656	3,229	4,550	4,500 e/	4,500
Argentina e/	1,500	1,600	1,600	1,600	1,500
Australia (attapulgitite) e/	15,000	15,000	15,000	15,000	15,000
Germany (unprocessed)	673,000	670,000 e/	498,000	600,000 r/ e/	600,000
Italy e/	28,000 4/	30,000	30,000	30,000	30,000
Mexico	41,111	36,068	21,377	15,755 r/	15,800
Morocco (smectite)	38,098	38,680	22,782	15,027 r/	16,623 4/
Pakistan	22,042	20,941	15,335	12,862	13,415 4/
Senegal (attapulgitite) e/	112,336 4/	119,000	119,000	120,000	120,000
South Africa (attapulgitite)	8,235	7,030	10,230	8,049	14,318 4/
Spain (attapulgitite)	94,546 r/	98,336 r/	91,124 r/	93,829 r/	90,000
United Kingdom 5/	189,400	187,100	134,000	132,300 r/	135,000
United States 6/	2,410,000	2,450,000	2,640,000	2,640,000	2,600,000 4/
Total	3,640,000 r/	3,680,000 r/	3,600,000 r/	3,690,000 r/	3,660,000

e/ Estimated. r/ Revised.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Excludes centrally planned economy countries and former such countries, some of which presumably produce fuller's earth, but for which no information is available. Table includes data available through July 9, 1997.

3/ In addition to the market economy countries listed, France, India, Iran, Japan, and Turkey have reportedly produced fuller's earth in the past and may continue to do so, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

4/ Reported figure.

5/ Saleable product.

6/ Sold or used by producers.

TABLE 27
KAOLIN: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1992	1993	1994	1995	1996 e/
Algeria	20,844	12,586	16,984	24,068	24,000
Argentina	43,722	42,052	50,471 r/	40,000 r/	40,000
Australia (includes ball clay) e/	180,000	180,000	200,000	210,000	210,000
Austria (marketable)	64,733	64,381	65,000 r/	57,000 r/	60,000
Bangladesh 4/	7,300 e/	7,500	3,283 r/	6,541 r/	7,000
Belgium e/	325,000	300,000	300,000	300,000	300,000
Bosnia and Herzegovina e/	3,000	3,000	3,000	3,000	3,000
Brazil (beneficiated)	810,976 r/	900,000 r/	953,000 r/	1,070,301 r/	1,000,000
Bulgaria	104,000	111,000	115,000	115,000 e/	115,000
Burundi e/	9,688 5/	5,000	5,000	1,000	1,000
Chile	59,083	66,939	73,081	70,000 e/	70,000
Colombia (includes common clay)	2,050,000 e/	2,097,491	6,700,000	7,300,000	7,500,000
Czech Republic 6/	XX	2,336,000	2,522,000 r/	2,890,000 r/	3,320,000 5/
Czechoslovakia (marketable) 7/	700,000 e/	XX	XX	XX	XX
Denmark (sales) e/	3,503 5/	3,500	3,500	3,500	3,000
Ecuador	6,380	12,000	6,883	8,000 r/	7,000
Egypt	203,473	184,004	180,000 e/	180,000 e/	180,000
Eritrea	XX	XX	5,231	3,185 r/	2,620 5/
Ethiopia e/ 8/	420	500	--	--	--
France (marketable)	334,000	295,000 e/	327,000	345,000 r/	350,000
Germany e/	1,190,000	981,000	1,631,000 5/	600,000 r/	600,000
Greece	201,705	200,000 e/	117,254	125,000 e/	125,000
Guatemala e/	2,860 5/	3,000	3,000	3,100	3,100
Hungary (processed)	7,000	15,000	5,000 r/	4,847 r/	5,000
India:					
Processed	124,000	129,271	134,000	160,000 r/	160,000
Saleable crude	514,000	518,629	548,000	552,000 r/	550,000
Indonesia	230,550	42,365	53,236	14,373 r/	15,000
Iran	264,083	254,413	250,000 e/	250,000 e/	250,000
Israel e/	53,000	40,000 5/	40,000	40,000	40,000

See footnotes at end of table.

TABLE 27--Continued
KAOLIN: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1992	1993	1994	1995	1996 e/
Italy:					
Crude	33,017	--	--	--	--
Kaolinitic earth e/	15,000	15,000	7,000 r/	10,000	10,000
Japan	122,948	110,318	138,412	182,122 r/	141,230 5/
Korea, Republic of	1,856,157	2,328,921	2,675,485	2,792,139 r/	2,800,000
Madagascar e/	756 5/	1,000 r/	1,200 r/	1,545 r/ 5/	1,500
Malaysia	244,573	249,852	252,628	211,182	209,562 5/
Mexico	144,121	216,000	193,034	221,685 r/	251,302 5/
New Zealand	27,520	26,543	40,720 r/	13,662 r/	15,000
Nigeria e/	1,300	1,300	105,000	100,000	100,000
Pakistan	37,444	37,179 r/	47,894	30,746	54,860 5/
Paraguay e/	74,000	74,000	74,000	66,300 r/ 5/	74,000
Peru	5,500	5,100 r/	5,100 r/	8,445 r/	14,295 5/
Poland	42,400	47,900 r/	52,000 r/	53,000 r/	55,000
Portugal e/	194,190 r/ 5/	178,000 r/	180,000 r/	150,000 r/	150,000
Romania	50,000 r/ e/	50,000 r/ e/	47,566 r/	49,024 r/	45,200 5/
Serbia and Montenegro:					
Crude	111,782	37,627	69,927 r/	56,926 r/	55,000
Washed	9,300	4,800	7,110 r/	4,900 r/	5,000
Slovakia 6/	--	25,000	24,100 r/	13,300 r/	23,240 5/
Slovenia: e/					
Crude	15,000	10,000	10,000	10,000	10,000
Washed	5,000	4,000	4,000	4,000	7,000
South Africa	131,765	147,349	131,863	146,587	146,496 5/
Spain (marketable): 9/ Crude and washed	379,591	284,382 r/	337,339 r/	399,248 r/	400,000
Sri Lanka e/	6,759 5/	7,000	7,500	7,500	7,500
Sweden e/	100	100	100	100	100
Taiwan e/	100,000	100,000	100,000	100,000	100,000
Tanzania e/	1,360	-- r/	-- r/	-- r/	--
Thailand (beneficiated)	301,035	397,330	417,064	460,629	450,000
Turkey	134,416	210,356	179,775	489,635 r/	400,000
Ukraine	1,200,000 e/	1,100,000 e/	1,015,000	950,000	900,000
United Kingdom (sales) 10/	2,502,224	2,577,160	2,653,918 r/	2,585,881 r/	2,650,000
United States 11/	8,740,000	8,830,000	8,770,000	9,480,000	9,120,000 5/
Uzbekistan e/	7,000,000	5,500,000	5,500,000 r/	5,500,000 r/	5,500,000
Venezuela	37,000	22,000	10,345	3,020	9,000 p/
Vietnam e/	800	800	1,000	1,000	1,000
Zimbabwe	83	90 e/	462	57 r/	50
Total	31,000,000	31,400,000 r/	37,400,000 r/	38,500,000 r/	38,600,000

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

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through July 9, 1997.

3/ In addition to the countries listed, China, Morocco, and Suriname may also have produced kaolin, but information is inadequate to make reliable estimates of output levels.

4/ Data for year ending June 30 of that stated.

5/ Reported figure.

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

7/ Dissolved Dec. 31, 1992.

8/ Data for year ending July 7 of that stated.

9/ Includes crude and washed kaolin and refractory clays not further described.

10/ Dry weight.

11/ Kaolin sold or used by producers.