

2005 Minerals Yearbook

CLAY AND SHALE

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The amount of clay sold or used by domestic producers in 2005 was 41.7 million metric tons (Mt) valued at \$1.65 billion (excluding the tonnage and value of attapulgite-type fuller's earth) compared with 41.2 Mt valued at \$1.68 billion in 2004 (table 1). Common clay and shale accounted for 59% of the tonnage, and kaolin accounted for 52% of the value (tables 1, 5, and 8). Imports of clays were 301,000 metric tons (t) valued at \$59.4 million. Exports were 5.62 Mt valued at \$929 million (table 1).

Major domestic and exports markets, in decreasing order by tonnage, for ball clay were floor and wall tile (40%), sanitaryware (25%), and pottery and miscellaneous ceramics (12%); for bentonite, absorbents (26%), foundry sand bond (23%), drilling mud (22%), and iron ore pelletizing (13%); for common clay and shale, brick (61%), lightweight aggregate (16%), and portland cement (15%); for fire clay, heavy-clay products (54%) and refractory products (46%); for fuller's earth, absorbents (86%); and for kaolin, paper coating and filling (61%).

Production

About 220 companies mined clay and shale in the United States in 2005. The 20 leading companies, many with multiple operations, accounted for 49% of the tonnage and 78% of the value for all types of clay produced and sold or used. Clay production was reported in all States except Alaska, Delaware, Hawaii, Idaho, New Hampshire, Rhode Island, Vermont, and Wisconsin (table 2). Companies not participating in the U.S. Geological Survey (USGS) canvass of the clay and shale industry probably mined clay for construction uses in States for which no production was reported.

The 10 leading producer States were, in decreasing order of tonnage, Georgia, Wyoming, Texas, Alabama, North Carolina, Missouri, South Carolina, Ohio, Arkansas, and Mississippi.

The 10 leading producer companies were, in alphabetical order, Acme Brick Co. (common clay and shale); American Colloid Co. (bentonite); Engelhard Corp. (bentonite, fuller's earth, and kaolin); General Shale Products Corp. (common clay and shale); Glen Gery Corp. (common clay and shale); Imerys (ball clay and kaolin); J.M. Huber Corp. (kaolin); Oil-Dri Corp. (fuller's earth); Thiele Kaolin Co. (kaolin); and Unimin Corp. (ball clay and kaolin).

Most clay mining in the United States was by open pit methods; less than 1% of U.S. clay output was from underground mines. All underground production was in Ohio, where the clays are mainly underclays associated with coal.

Domestic production data for clays were developed by the USGS from a voluntary survey of U.S. operations. Responses to the survey and company production data available from other

sources accounted for approximately 65% of the total clay and shale tonnage sold or used quantity listed in table 1. Most nonrespondents were producers of common clay and shale. Production data for the nonrespondents were estimated from reported prior year production levels adjusted by trends in the industry and other guidelines.

Ball Clay.—In 2005, 4 companies mined ball clay in 4 States. Production of domestic ball clay was estimated to be 1.21 Mt valued at \$52.9 million in 2005 versus 1.22 Mt valued at \$54.1 million in 2004 (table 3). The production tonnage was essentially unchanged from that of 2004 although the value declined about 2% as more lesser-valued airfloat product and less slurried product were sold or used in 2005 than in 2004. Operations in Tennessee supplied 61% of the Nation's output, followed by, in descending order of tonnage, Texas, Mississippi, and Kentucky. One producer reported a small amount of production in Indiana, but this probably was fire clay rather than ball clay.

Bentonite.—In 2005, 20 companies produced bentonite in 11 States. About 4.71 Mt valued at \$215 million of bentonite was sold or used in 2005 compared with 4.55 Mt valued at \$206 million in 2004 (table 4). Production of nonswelling bentonite decreased to 300,000 t valued at \$14.4 million in 2005 versus 320,000 t valued at \$14.2 million in 2004. Mississippi led in the production of nonswelling bentonite, followed by, in descending order of tonnage, Alabama, Arizona, Nevada, California, and Colorado.

Production of swelling bentonite increased to 4.41 Mt valued at \$201 million in 2005, an increase from 4.23 Mt valued at \$192 million in 2004. The increase was distributed among many producers. Wyoming led in the production of swelling bentonite, followed by Montana, Utah, Texas, California, Oregon, and Nevada.

Süd-Chemie AG sold its rheological additives line to Rockwood Holdings, Inc. The sale includes bentonite, organoclay, and activated clay products used in coatings, ink, paint, and personal care products as well as production facilities in Germany and Kentucky. Rockwood Holdings will sell these products through its subsidiary, Southern Clay Products, Inc. (Süd-Chemie AG, 2005; Rockwood Holdings, Inc., 2006).

After BPM Minerals LLC increased its capacity by 20% for granular bentonite products at its Lovell, WY, operation in 2004, BPM completed a similar expansion at its Colony, WY, plant. BPM indicated that strong global growth in animal feed supplements and beverage clarification, and U.S. growth in environmental lining and consumer sorbent markets prompted the expansion (BPM Minerals LLC, 2005§¹).

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

Common Clay and Shale.—In 2005, 155 companies produced common clay and shale in 41 States and Puerto Rico. In States not reporting production, common clay and shale probably was mined and sold for construction uses by companies not participating in the USGS canvass of the clay and shale industry.

Domestic sales or use of common clay and shale decreased to 24.5 Mt valued at \$176 million in 2005 compared with 24.6 Mt valued at \$173 million in 2004 (table 5). The increase in value probably will be viewed with caution because many producers do not sell their clay but use it to manufacture their heavy-clay products. Consequently, producers often have difficulty assigning a value to the clay used in their production of such products as clay brick, flower pots, flue linings, roofing tile, and sewer pipe. The major producing States were, in descending order of tonnage, Texas, Alabama, North Carolina, Georgia, Ohio, Arkansas, Kentucky, South Carolina, California, and Oklahoma.

Boral USA (a subsidiary of Boral Ltd.) announced plans to construct a \$55 million brick plant in Terre Haute, IN. The plant will have a capacity of 120 million bricks per year and will serve customers in the Midwest (Boral USA, 2005).

Carolina Ceramics Brick Co. completed a \$25 million expansion, doubling its brick manufacturing capacity to 80 million metric tons per year (Mt/yr) (Ceramic Industry, 2005).

Palmetto Brick Co. opened a \$28 million manufacturing plant in Cheraw, SC. The plant will expand the company's production capacity to 150 million bricks per year from 100 million bricks per year (Palmetto Brick Co., 2005).

Fire Clay.—Fire clay producers were mostly refractory product manufacturers that used the clays in firebrick and various heavy-clay products. In 2005, five firms mined fire clay in three States. Fire clay sold or used by domestic producers increased to 353,000 t valued at \$10.7 million versus 307,000 t valued at \$8.51 million in 2004 (table 6). The increase was primarily the result of increased sales for the manufacture of heavy-clay products rather than refractory applications. Missouri was the leading producing State, followed by, in descending order of tonnage, Ohio and South Carolina.

Fuller's Earth.—In 2005, 15 companies produced fuller's earth (attapulgite and montmorillonite varieties) in 11 States. The fuller's earth deposits grade from attapulgite in Florida to montmorillonite further northward in Georgia. Only those clays with attapulgite as the major clay component are classified as attapulgite. These basically are the gellant-grade fuller's earths in Florida and the southernmost part of Georgia. Going northward into Georgia, the attapulgite content of the fuller's earth declines, and montmorillonite becomes the dominant clay present. This is classified under montmorillonite although it contains minor to trace amounts of attapulgite.

The attapulgite variety of fuller's earth was mined in the Florida Panhandle and southwestern Georgia. Attapulgite production increased in 2005 but data were concealed to avoid revealing company proprietary data. Production in 2004 was 237,000 t valued at \$30.1 million (table 7). Georgia led in the production of attapulgite, followed by Florida.

Production of the montmorillonite variety of fuller's earth declined to 2.99 Mt valued at \$302 million in 2005 compared

with 3.02 Mt valued at \$299 million in 2004 (table 7). Montmorillonite was produced, in decreasing order of tonnage, in Georgia, Missouri, Mississippi, Virginia, Illinois, California, Florida, Tennessee, Texas, and Kansas.

Sepiolite, although not a fuller's earth, was produced in Nevada. Sepiolite was included in the total for attapulgite to avoid disclosing company proprietary data.

Süd-Chemie Group sold its fuller's earth operation (Waverly Mineral Products, Co., Meigs, GA) to Mid-Florida Mining Industries, Inc. (MFM) of Florida. Production at the Georgia operation is about 70,000 metric tons per year (t/yr). About 80% is sold for oil and grease absorbent applications. The purchase of the Süd-Chemie operation allowed MFM to focus sales of fuller's earth from its Florida operation on pet litter applications (Industrial Minerals, 2005c).

Kaolin.—In 2005, 21 firms mined kaolin in 10 States. Domestic production was reported to be 7.8 Mt valued at \$860 million compared with 7.76 Mt valued at \$936 million in 2004 (table 8). One and possibly two producers appear to have undervalued their kaolin in 2005 on the USGS survey. When adjustments were made to the value data, production was valued at about \$910 million. While kaolin production increased elsewhere, the combined total for the four leading producer of paper-grade kaolin in Georgia declined. The leading producer State was Georgia, followed by, in descending order of tonnage, South Carolina, Alabama, Arkansas, California, Texas, Nevada, Florida, North Carolina, and Tennessee.

Of the 7.8 Mt mined in 2005, 4.07 Mt was reported as water washed, 1.31 Mt was calcined, 1.01 Mt was delaminated, 1.27 Mt was airfloat, and 139,000 t was unprocessed (table 8). This compares with 3.87 Mt of water washed, 1.40 Mt of calcined, 1.24 Mt of delaminated, 1.15 Mt of airfloat, and 101,000 t of unprocessed in 2004. One producer appears to have reported delaminated kaolin as water-washed kaolin in 2005. Adjusting for this error gives a production of about 3.8 Mt water washed and 1.28 Mt delaminated, more in-line with that produced in 2004. There was a small decline in the U.S. production of refractory-grade (high-temperature) calcined kaolin. Of the calcined kaolin, 837,000 t was pigment-grade (low-temperature calcined kaolin). Companies in Georgia accounted for nearly all the pigment-grade calcined kaolin produced in 2005. A small amount also was produced in Texas. The remainder was refractory-grade (high-temperature calcined kaolin) (table 8).

Kaolin production in Georgia was reported to be 7.19 Mt valued at \$825 million in 2005 compared with 6.78 Mt valued at \$889 million in 2004. The 2005 value probably will be increased to about \$875 million because of the undervaluing of some kaolin products. Approximately 3.97 Mt of Georgia kaolin production was reported as sold as water washed, 1.01 Mt was delaminated, 1.19 Mt was calcined (high- and low-temperature calcined kaolin), and 1.01 Mt was airfloat (see the preceding paragraph for comments on the reporting of delaminated and water-washed kaolin production data; table 9). This compares with 3.78 Mt water washed, 1.24 Mt delaminated, 906,000 t calcined, and 851,000 t airfloat in 2004. The change in airfloat kaolin production is attributable mainly to one company, which reported incorrectly in 2003 and 2004. Airfloat kaolin production probably was nearer 1.0 Mt in 2004.

Calcined kaolin production did not increase as significantly as indicated in table 9. In the past, one producer reported the bulk of prior year refractory-grade calcined kaolin production at its Alabama, rather than Georgia, operation. Giving consideration to these two problems, estimated production in Georgia in 2004 probably was closer to 7 or 7.1 Mt than to 6.78 Mt. Production in South Carolina was 287,000 t valued at \$17.7 million in 2005 compared with 296,000 t valued at \$19.6 million in 2004 (table 10).

J.M. Huber Corp. was negotiating to acquire 600,000 t of crude kaolin from Sparta Kaolin Corp. (a subsidiary of Kaoclay Resources Inc.). Details of the negotiations were not available (Kaoclay Resources Inc., 2005).

Imerys, a French investment group, announced further reductions in the Dry Branch, GA, processing plant. One calciner will be shut down and plant capacity will be reduced by 45,000 t/yr. Some of the paper- and specialty-grade kaolin products will be discontinued (Industrial Minerals, 2005b). Imerys also concentrated its production of kaolin for fiberglass markets at its Sandersville, GA, plant (Imerys, 2006, p. 12).

Oglebay Norton Co. completed the sale of its subsidiary (Oglebay Norton Specialty Minerals, Inc.) to Zemex Corp. The \$15 million purchase included all the Kings Mountain, NC, operation (Oglebay Norton Co., 2005).

i-minerals inc., continued its testing of kaolin from the Helmer-Bovill property in Idaho. The crude ore is composed primarily of quartz with halloysite, kaolinite clays, muscovite, and microcline as accessory minerals. Products with 80% of particles less than 2 micrometers (μm) in diameter are composed of halloysite and kaolinite; those with 90% less than 2 μm are primarily kaolinite with minor halloysite and quartz (i-minerals inc., 2005).

Consumption

Ball Clay.—The principal domestic ball clay markets were, in decreasing order, floor and wall tile, sanitaryware, and miscellaneous ceramics (table 3). Sales and use, including exports, were 1.21 Mt, essentially unchanged from those of 2004.

Bentonite.—Domestic sales and use were estimated to be 4.31 Mt and total sales (domestic and export) were 4.71 Mt in 2005 compared with domestic sales of 4.09 Mt and total sales of 4.55 Mt in 2004 (table 4). Major domestic markets for bentonite were, in decreasing order by tonnage, pet waste absorbent, drilling mud, foundry sand, and iron ore pelletizing. Total sales (domestic and exports) of bentonite were approximately 1.1 Mt for foundry sand bond (more than 85% was swelling bentonite), 1.26 Mt for pet waste absorbent (all swelling bentonite), 1.02 Mt for drilling mud (all swelling bentonite), and 595,000 t for pelletizing iron ore (all swelling bentonite).

Data for other bentonite markets were concealed to avoid disclosing company proprietary data. However, swelling bentonite accounted for more than 90% of the bentonite sold for absorbents, animal feed, civil engineering, drilling mud, miscellaneous chemical manufacture applications, medical, paint, pelletizing iron ore, and waterproofing and more than 70% of the bentonite sold for foundry sand, and miscellaneous

filler and extender applications. More than 50% of the bentonite sold for clarifying, decolorizing, and filtering of oils and greases was the nonswelling variety.

The major domestic markets for swelling bentonite were, in decreasing order, pet waste absorbents, drilling mud, foundry sand, iron ore pelletizing, and sealing and waterproofing. Major export markets for swelling bentonite were, in decreasing order, foundry sand, drilling mud, and iron ore pelletizing. The major domestic uses for nonswelling bentonite were, in descending order of tonnage, water treatment and filtering; foundry sand bond; clarifying, decolorizing, and filtering of oils and greases; waterproofing and sealing; adhesives; and animal feed.

Common Clay and Shale.—Common clay and shale was used most frequently in the manufacture of heavy-clay products (such as building brick, drain tile, flue linings, and terra cotta), lightweight aggregate, portland cement, sewer pipe, and structural tile (table 5). Consumption of common clay and shale decreased slightly to 24.5 Mt in 2005, almost unchanged from that of 2004. Brick manufacture remained the leading market for common clay and shale, followed by, in descending order of tonnage, lightweight aggregate and portland cement. Residential and nonresidential construction, on which the common clay and shale industry is dependent, increased in value to \$1.12 trillion in 2005 from \$1.03 trillion in 2004 (U.S. Census Bureau, 2006§).

Fire Clay.—Fire clays were used in grogs and calcines; high-alumina brick and specialties; ramming and gunning mixes; refractory products, such as firebrick and block; mortars and mixes; and saggers. Fire clays also were used to produce such items as brick and pottery.

Consumption of fire clay increased to 353,000 t in 2005 from 307,000 t in 2004 as a result of increased sales for heavy-clay product manufacture (table 6). Markets for fire clay were, in descending order of tonnage, portland cement, refractory mortar and cement, miscellaneous refractory product, and common brick applications.

Fuller's Earth.—Consumption of montmorillonite-type fuller's earth was 2.99 Mt in 2005 versus 3.02 Mt in 2004. Major domestic markets for montmorillonite were, in descending order of tonnage, pet waste absorbents; oil and grease absorbents; portland cement; clarifying, decolorizing, and filtering of oils and greases; pesticide carrier; miscellaneous fillers, extenders, and binders; animal feed; asphalt tile, miscellaneous absorbents; miscellaneous refractory products; and fertilizer carrier. The leading export market was pet waste absorbent (table 7).

Major markets for attapulgite were, in decreasing order, fertilizer carrier; miscellaneous filler and extender applications; drilling mud; absorbents; animal feed; miscellaneous refractory products; paint; clarifying, decolorizing, and filtering of mineral oils and greases; gypsum products; cosmetic, medical, pharmaceutical applications; and adhesives. Sales data were concealed to avoid disclosing company proprietary data.

Sales of the montmorillonite variety of fuller's earth accounted for more than 80% of sales of fuller's earth for asphalt tile; portland cement manufacture; clarifying, decolorizing, and filtering of oils and greases; oil and grease absorbents; pesticide carriers; pet waste absorbents; and

exported products. Attapulgite accounted for most of the sales for adhesives; cosmetic, medical, and pharmaceutical applications; drilling mud; fertilizer carriers; gypsum products; and paint.

Kaolin.—Consumption of kaolin increased to 7.80 Mt in 2005 from 7.76 Mt in 2004 (table 8). The major domestic markets for kaolin were, in descending order of tonnage, paper coating and filler, refractory products, paint, fiberglass, rubber, miscellaneous fillers and extenders, catalyst manufacture, and plastic (table 11). Major domestic markets for kaolin from Georgia were, in descending order by tonnage, paper coating, paper filling, other ceramics, paint, refractory products, fiberglass, rubber, miscellaneous fillers and extenders, plastics, and catalyst manufacture. The major export market for Georgia kaolin was in paper applications (table 9). Owing to the reporting errors discussed in the "Kaolin" portion of the production section of this report, the domestic sales total in Georgia in 2004 should be increased by about 500,000 t. Major domestic markets for kaolin from South Carolina were, in descending order of tonnage, rubber, catalyst, brick, fiberglass, plastics, adhesives, and roofing granules (table 10). The major export market for kaolin from South Carolina was rubber applications.

Uses.—By application, consumption of clays was as follows: Absorbent Uses.—Sales reported by producers for absorbent uses were 3.92 Mt in 2005. Fuller's earth accounted for 68% of the clay used for absorbents, followed by bentonite and a small amount of kaolin. Pet waste absorbents accounted for 90% of absorbent consumption, followed by miscellaneous absorbent applications and oil and grease absorbents.

Ceramics.—All varieties of clays were used in ceramics. Demand for clay in the manufacture of ceramics, ranging from china to sanitaryware to roofing granules, was 2.31 Mt in 2005. The leading ceramics markets were ceramic floor and wall tile (43%), sanitaryware (18%), miscellaneous ceramics (13%), roofing granules (12%), catalyst (8%), pottery (2%), quarry tile (1%), electrical porcelain (1%), and fine china (1%). Ball clay accounted for 47% of the clay used in ceramics, common clay and shale, 27%; and kaolin, 25%. Small amounts of bentonite also were used in the manufacture of ceramics. Ball clay dominated the electrical porcelain and sanitaryware markets. Common clay and shale was the predominant category of clay used in quarry tile and roofing granules. Kaolin dominated the catalyst market. Ball clay and common clay and shale were the predominant clays used in floor and wall tile manufacture, and ball clay and kaolin dominated the fine china market.

In 2005, apparent consumption of clay floor and wall tile in the United States was 303 million square meters valued at \$3.08 billion compared with 293 million square meters valued at \$2.86 billion in 2004. Domestic producers shipped 61.1 million square meters (658 million square feet) of clay floor and wall tile in 2005 compared with 64.6 million square meters (695 million square feet) in 2004. In 2005, exports were 3.44 million square meters valued at \$31.5 million compared with 3.24 million square meters valued at \$26.9 million in 2004. Imports of clay floor and wall tile were 245 million square meters valued at \$2.26 billion in 2005, compared with 231 million square meters valued at \$2.01 billion in 2004 (U.S. Census Bureau, 2006a, p. 12).

The U.S. Department of Commerce, International Trade Administration (2006§) reported that 31.5 million square meters valued at \$218 million of glazed and unglazed ceramic tile with sides measuring less than 7 centimeters was imported compared with 29.2 million square meters valued at \$198 million in 2004. Brazil, Italy, and Spain were the major sources of imported tile of these dimensions.

Imports of ceramic baths, bidets, flush tanks, lavatories, sinks, toilet bowls, and other ceramic sanitary fixtures increased in 2005. The U.S. Department of Commerce, International Trade Administration (2006§) reported imports to be 35.1 million units compared with 31.2 million units in 2004. China and Mexico were the major sources of imported sanitaryware.

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

Expanded Clay and Shale.—Approximately 3.85 Mt of clay and shale was used in the production of lightweight aggregates in 2005 (table 12). All the clay used to manufacture lightweight aggregates was common clay and shale. Lightweight aggregates were used in concrete block, structural concrete, and highway surfacing, in decreasing order of tons consumed.

Hydraulic Cement.—Clays provide the alumina and silica required to manufacture hydraulic cements. In 2005, approximately 4.09 Mt of clays was consumed in the production of cement. In descending order of tonnage, common clay and shale, fuller's earth, fire clay, and kaolin were used in the manufacture of portland cement clinker. About 90% of the clay consumed by the cement industry was common clay and shale.

Structural Clay Products.—Approximately 15.4 Mt of clays was used in the manufacture of structural clay products, such as building brick, roofing tile, and sewer pipe. Common and face brick accounted for about 98% of this total (tables 5 and 13). Other markets were, in descending order of tonnage, flue linings, miscellaneous clay products, flower pots, sewer pipe, structural tile, and drain tile. About 99% of the clay used to manufacture structural clay products was common clay and shale. Small amounts of ball clay, bentonite, fire clay, and kaolin also were used.

In 2005, domestic producers shipped 9.42 billion building and face bricks compared with 9.39 billion bricks in 2004. About 175,000 t of vitrified clay sewer pipe and fittings valued at \$72 million was shipped in 2005 compared with 148,000 t valued at \$61.8 million in 2004 (U.S. Census Bureau, 2006a, p. 12).

Drilling Mud.—Sales of clays for drilling mud applications were 993,000 t (domestic) and 75,800 t (exported). Swelling-type bentonite accounted for 95% of the clay used in drilling mud. Fuller's earth also was used in drilling mud applications. Sales of drilling muds increased slightly in 2005 as the result of increased oil drilling activity. The average number of rotary rigs in Canada and the United States operating in 2005 was 1,840 per month compared with 1,560 per month in 2004 (Baker Hughes Inc., 2006§).

Fillers, Extenders, and Binders.—Clays are used as fillers, extenders, and binders in a wide variety of products, such as adhesives, flooring products, paint, paper, and rubber. About 4.62 Mt of clays was sold for use as fillers, extenders, and

binders in the United States. An additional 1.98 Mt of clays was exported for filler and extender applications. Paper coating and filling accounted for 62% of domestic sales, followed by miscellaneous filler and extenders (11%), paint (11%), rubber (6%), and plastics (3%). Adhesives; animal feed; asphalt emulsion; cosmetic, medical, pharmaceutical; and fertilizer and pesticide carriers each accounted for less than 2% of the fillers and extenders markets.

Kaolin accounted for approximately 90% of the clay used in domestic and export filler and extender applications, followed by fuller's earth (5%), common clay and shale (3%), bentonite (2%), and ball clay (1%). Bentonite was the predominant clay used for cosmetic, medical, and pharmaceutical applications; fuller's earth dominated in fertilizer and pesticide applications. Kaolin was the predominant clay used for adhesives, asphalt emulsion, paint, paper, plastics, and rubber markets.

The U.S. Census Bureau (2006b) reported shipments of paint and coatings for 2005 to be 5.79 billion liters (1.53 billion gallons), unchanged from that of 2004. Of this amount, architectural paints, the major market for paint-grade fillers, was 3.01 billion liters (795 million gallons) in 2005 compared with 3.04 billion liters (804 million gallons) in 2004.

Fiberglass.—Sales, including exports, to the fiberglass and mineral wool industry were 407,000 t. Most of the clay used for fiberglass was kaolin. While industry statistics are not available on fiberglass production, industrial sand (ground and unground) used for the production of fiberglass was 1.66 Mt in 2005 compared with 1.74 Mt in 2004 (T.P. Dolley, physical scientist, U.S. Geological Survey, written commun., September 7, 2006).

Iron Ore Pelletizing.—Sales of clays for iron ore pelletizing applications reported by producers were 595,000 t (579,000 t used domestically and 15,500 t exported). Swelling bentonite was the only type of clay used for this application.

Paper Products.—Kaolin accounted for all the clay sales used for paper coating (2.31 Mt sold domestically and 1.74 Mt exported) and essentially all the clay used for paper filling (574,000 t sold domestically and 121,000 t exported).

Refractory Products.—Producers reported that 2.49 Mt of clays was used for the manufacture of refractory products in 2005 (1.39 Mt with foundry sand excluded). This compares with 2.77 Mt and 1.62 Mt, respectively, in 2004. Foundry sand accounted for 39% of domestic sales and all export sales under the refractory category. Other refractory markets for clays were firebrick; grogs and calcines; high-alumina brick and kiln furniture; plug, tap, and wad products; and refractory mortar and cement. About 205,000 t was exported for refractory applications.

Bentonite accounted for 1.1 Mt of refractory sales (893,000 t domestic and 205,000 t exported), followed by common clay and shale (696,000 t), kaolin (498,000 t), fire clay (163,000 t), and ball clay and fuller's earth combined (37,300 t).

The U.S. Census Bureau (2006c) reported clay refractory shipments valued at \$855 million in 2005 compared with \$781 million in 2004. Fireclay, high alumina, and insulating brick shapes accounted for \$403 million of the shipments (642,000 t), followed by unshaped clay refractory bonding mortars (597,000 t valued at \$358 million). The remainder was other

refractory clay raw materials and refractory materials sold in lump or ground form.

Prices

Increased energy and other operating costs continued to affect kaolin producers. Energy costs doubled or tripled between 2002 and 2005 (McGinley, 2005§). Consequently, major clay producers again announced price increases for ball clay, fuller's earth, and kaolin products. Several of the unit values given below for specific clay types are slightly lower than in 2004 despite announcements of energy surcharges and price increases by many producers. Some producers may have underreported their sales values in 2005; unit values lower than those of 2004 probably should be increased by 3% to 5% to account for energy surcharges instituted in 2005.

Ball Clay.—The average value for ball clay reported by domestic producers was \$43.67 per metric ton. The average values for exported and imported ball clay were \$63 per ton and \$283 per ton, respectively.

Bentonite.—The average value reported by domestic producers for nonswelling bentonite was \$47.94 per ton. The average value for swelling bentonite was \$45.53 per ton. The average value for all bentonite was \$45.68 per ton. The average value of exported bentonite was \$116 per ton. The average value of imported bentonite was \$355 per ton.

The price, ex-works, Wyoming, crude, bulk, railcars, was \$33 to \$69 per ton; foundry-grade, bagged, railcars, \$55 to \$84 per ton; and American Petroleum Institute (API)-grade, bagged, railcars, \$47 to \$58 per ton. The price for bentonite, India, crushed, dried, loose in bulk, was \$43 to \$53 per ton for API-grade; \$32 to \$40 per ton for pet litter grade; and \$59 to \$76 per ton for foundry grade (Industrial Minerals, 2005a).

Common Clay and Shale.—The average value for all common clay and shale produced in the United States and Puerto Rico was \$7.21 per ton. The average value of clay and shale used in lightweight aggregate was \$22.17 per ton. The value for lightweight aggregate is an estimate of the clay value. Average prices for lightweight aggregate produced from clay and shale ranged from \$30 to \$50 per ton for most applications.

Fire Clay.—The average value for fire clay reported by domestic producers was \$30.22 per ton. The average value of exported fire clay was \$94 per ton. The average of imported fire clay was \$310 per ton.

Fuller's Earth.—The average value of attapulgite-type fuller's earth was concealed to avoid revealing company proprietary data but increased slightly in 2005. The average value of montmorillonite-type fuller's earth was \$101.22 per ton. The average value of exported fuller's earth was \$246 per ton. The average value of imported fuller's earth was \$143 per ton

Kaolin.—The average value of kaolin was \$110.25 per ton for all kaolin grades. The average value for airfloat was \$64.53 per ton; refractory-grade (high-temperature calcined), \$31.31 per ton; pigment-grade (low-temperature calcined), \$299.20 per ton; all types of calcined, \$202.34 per ton; delaminated, \$111.90 per ton; water washed, \$97.66 per ton; and unprocessed, 5.30

per ton. Adjusting for delaminated and water washed kaolin reporting error, as discussed in the kaolin portion of the "Production" section, results in an average value of about \$115 per ton for delaminated kaolin and \$109 per ton for waterwashed kaolin. The average value of exported kaolin was \$168 per ton. The average value of the imported kaolin was \$153 per ton.

The price, ex-works, Georgia, filler, bulk, was \$88 to \$110 per ton; coating, bulk, \$94 to \$204 per ton; sanitaryware-grade, bagged, \$72 to \$83 per ton; tableware-grade, bagged, \$138 per ton; and calcined, bulk, \$353 to \$413 per ton (Industrial Minerals, 2005a).

Foreign Trade

Ball Clay.—Ball clay exports increased to 141,000 t valued at \$8.84 million in 2005 compared with 107,000 t valued at \$8.2 million in 2004, according to the U.S. Census Bureau (table 14). Producers reported exports of 204,000 t. Some of the extra tonnage reported by ball clay producers was likely accounted for by shipments to Mexico. Exports to Mexico reported by the U.S. Census Bureau typically are less than indicated by ball clay producers. The water weight of slurry shipments (about 30% to 35% of the shipment weight) may also account for a portion of the extra tonnage reported by producers. Imports were 667 t of ball clay valued at \$261,000 (table 15).

Bentonite.—Bentonite exports decreased to 847,000 t valued at \$98.5 million in 2005 from 915,000 t valued at \$105 million in 2004 (table 14). Exports increased by 51,000 t to Canada, but decreased by 95,000 t to Japan, 26,000 t to the United Kingdom and 20,000 t to Taiwan. Exports to several countries increased by small amounts. Domestic bentonite producers reported exports of 434,000 t (table 4). The large discrepancy between data reported by producers and the U.S. Census Bureau resulted from producers including most of the exports destined for Canadian and Mexican markets (372,000 t) under domestic sales. In addition, some bentonite is packaged domestically and then exported as a finished product, such as cat litter. Sales through U.S. mineral brokers, where producers do not know if the bentonite is used domestically or exported, could also explain part of the discrepancy.

Bentonite imports consisted mainly of untreated bentonite clay and chemically or artificially activated materials. Imports of untreated bentonite were 10,400 t valued at \$3.55 million. Imports of chemically activated material were 16,000 t valued at \$10.3 million (table 15).

Fire Clay.—In 2005, exports increased to 368,000 t valued at \$34.4 million compared with 332,000 t valued at \$32.3 million in 2004 (table 14). About 49% of the exports reported by the U.S. Census Bureau under the Harmonized Tariff Schedule of the United States code for fire clay was thought to be refractory-grade kaolin rather than fire clay based on the locations of ports from which the material was exported. Imports were 429 t valued at \$156,000 (table 15).

Fuller's Earth.—In 2005, exports increased to 54,700 t valued at \$13.5 million compared with 49,000 t valued at \$10.3 million in 2004 (table 14). Imports of decolorizing earth and fuller's earth were 2,450 t valued at \$286,000 (table 15).

Kaolin.—In 2005, 3.58 Mt of kaolin valued at \$601 million was exported compared with 3.64 Mt valued at \$600 million in 2004 (table 14). Producers reported exports of 2.15 Mt (table 11). Of the 1.43 Mt difference, probably much of the 641,000 t destined for Canada and 346,000 t for Mexico was reported under domestic consumption. Sales through U.S. mineral brokers, where producers do not know if the kaolin is used domestically or exported, could also explain part of the discrepancy.

Kaolin imports increased to 262,000 t valued at \$40.2 million in 2005 compared with 205,000 t valued at \$38.6 million in 2004 (table 15). About 93% of the kaolin was imported from Brazil followed by the United Kingdom. Imports from Brazil were primarily for paper coating applications, and those from the United Kingdom were primarily for paper filler applications.

World Review

World production of bentonite was approximately 11.7 Mt (table 16). Fuller's earth production was estimated to be 5.61 Mt. This tonnage excludes U.S. attapulgite-type fuller's earth production and production data from Israel, which is thought to have been misclassified as fuller's earth in 2002 through 2005 (table 17). Production of bentonite and fuller's earth combined for Israel is probably less than 5,000 t/yr, based on trade industry reports. Kaolin production was 44.7 Mt (table 18). The world production data for kaolin including common clay from Colombia, ball clay from Australia, and crude kaolin ore production tonnages from many other countries. Sales of processed kaolin were estimated to be about 24.6 Mt, after excluding 8.4 Mt of common clay from the total for Colombia and 4 Mt for Uzbekistan, 3.4 Mt for the Czech Republic, 3.1 Mt for Germany, 600,000 t for Iran, 300,000 t for Mexico, 200,000 t for Egypt, and 100,000 t for Australia to account for processing losses. The United States continued to be the leading supplier of processed clay for sale, followed by Greece, Turkey, and the Commonwealth of Independent States for bentonite; Spain for fuller's earth; and the United Kingdom and Brazil for kaolin. Fuller's earth production reported for Germany probably represents double counting of bentonite as fuller's earth. Spain led all countries in the production of sepiolite.

Denmark.—NCC Group, a Swedish construction company, began construction of a 60,000-t/yr processing plant near Svendborg. NCC mined calcium bentonite and sold unprocessed bentonite for civil engineering applications. The company decided to construct the new plant so it can sell processed bentonite for such applications as foundry sand, pet litter, and other specialty markets (Mining Engineering, 2005).

Outlook

Construction-oriented markets for clay-base products, such as brick, cement, ceramic tile, lightweight aggregate, and whiteware, remain strong, although there are signs of a slowdown of housing sales in the United States. Increase in the sales of ball clay and common clay probably will slow slightly in the coming years, but no significant declines in sales are anticipated. Sales of fire clay probably will decline for refractory

products, but use of fire clay for the manufacture of cement and heavy-clay products may enable sales to rebound from the declines in recent years.

The overall market for fuller's earth may increase slightly in the next couple of years. Demand for fuller's earth increased in 2005 for clarifying, decolorizing, and filtering greases and oils, and this trend is expected to continue for the short term. Other markets for fuller's earth such as agriculture and pet litter are variable from year-to-year, but pet litter, the largest market for fuller's earth, continues to exhibit an upward trend, likely to continue for at least the next 2 to 3 years.

The International Iron and Steel Institute indicated that world production of steel increased 8.8% in 2004. With about 25% of world iron ore pelletized, demand for bentonite for pelletizing has also increased. In 2004, pelletizing accounted for about 15% and 21% of total bentonite demand in the United States and Europe, respectively. Despite increased sales for pelletizing in 2004 and 2005, sales eventually are expected to decline with the phasing in of new refining technologies that do not require the use of pelletized iron ore (Burke, 2005a).

Continued high levels of drilling for oil are expected to result in the continued high demand for bentonite for drilling mud applications for the near future. Despite this, long-term demand is expected to decline because prices for drilling-grade bentonite have remained low; a significant portion of new drilling has focused on improving petroleum recovery in existing deposits (which does not require bentonite-base drilling muds); many new polymer drilling fluid additives are designed to remove formation clays, and that excludes the use of bentonite in the drilling fluid; and use of more environmentally friendly synthetic drilling muds discourages the use of bentonite drilling fluids (Burke, 2005b). The gradual increase in sales of bentonite for pet litter markets is anticipated to continue for the near future. Other markets for bentonite have been unchanged for the past few years and are likely to remain so for the short term.

Construction-oriented markets for kaolin such as ceramic tile, fiberglass, paint, and sanitaryware probably will maintain sales in the next few years because of the continuing strength of the U.S. housing market. The largest markets for kaolin, paper coating and filling, are beginning to stabilize after several years of significant declines. The paper filler market declined largely because of competition from calcium carbonate from about 1990 to 2000. Paper coating also suffered to a lesser extent from the competition from calcium carbonate but also from a slumping paper industry. Shipments of paper have increased in the past couple of years, and paper capacity is more in-line with demand in the North American market. These factors should result in a more stable paper market for domestic producers. However, domestic producers continue to face stiff competition from kaolin imports from Brazil (including from some of their own affiliates) to the North American paper market. Sales by domestic producers to the paper industry may decline only slightly for the next year or two. Overall sales of kaolin by U.S. producers for all markets probably are going to remain relatively unchanged during the next couple of years.

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 $\label{eq:table 1} \textbf{TABLE 1} \\ \textbf{SALIENT U.S. CLAY STATISTICS}^{1,\,2}$

	2001	2002	2003	2004	2005
Domestic clays sold or used by producers:					
Quantity	39,600	39,300	40,000	41,200	41,700
Value	1,510,000	1,580,000	1,660,000	1,680,000	1,650,000
Exports:					
Quantity	4,970	4,960	5,130	5,630	5,620
Value	836,000	817,000	859,000	936,000	929,000
Imports for consumption:					
Quantity	148	217	279	251	301
Value	33,900	39,400	51,200	61,700	59,400

¹Excludes Puerto Rico.

²Data are rounded to no more than three significant digits.

TABLE 2 CLAYS SOLD OR USED BY PRODUCERS IN THE UNITED STATES IN 2005, BY STATE $^{\rm I,\,2}$

(Thousand metric tons and thousand dollars)

	200)4	200	5
State	Quantity	Value	Quantity	Value
Alabama	2,220	32,700	2,470	34,600
Arizona	W	W	80	1,720
Arkansas	1,150	1,510	1,280	2,760
California	1,260	23,300	1,260	44,300
Colorado	249	1,510	258	1,680
Connecticut	87	W	89	337
Florida	31	3,280	312	43,300
Georgia	9,720	1,040,000	10,100	981,000
Illinois	465	1,390	344	26,200
Indiana	729	8,910	823	14,500
Iowa	325	1,150	630	4,740
Kansas	621	7,460	680	5,620
Kentucky	978	4,510	1,150	8,930
Louisiana	399	11,000	416	13,100
Maine	49	W	50	127
Maryland	262	571	317	686
Massachusetts	36	W	37	327
Michigan	605	3,070	334	514
Minnesota	20	22	20	22
Mississippi	992	37,900	1,270	50,800
Missouri	911	3,290	1,460	38,300
Montana	102	8,400	135	5,460
Nebraska	133	W	160	606
Nevada	25	4,520	67	6,110
New Jersey	W	122	83	133
New Mexico	34	177	36	221
New York	756	10,900	785	11,700
North Carolina	2,290	13,600	2,210	14,400
North Dakota	W	189	76	279
Ohio	1,360	7,480	1,360	9,180
Oklahoma	1,150	2,410	903	2,520
Oregon	W	450	79	1,090
Pennsylvania	822	3,270	705	3,460
South Carolina	1,330	22,500	1,360	22,200
South Dakota	188	743	183	744
Tennessee	1,130	37,500	1,210	41,000
Texas	2,160	8,890	2,680	28,600
Utah	515	5,600	541	8,990
Virginia	994	4,640	1,240	32,200
Washington	W	W	87	211
West Virginia	161	441	186	524
Wyoming	3,550	151,000	4,220	190,000
Total	41,200	1,680,000	41,700	1,650,000

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

¹Excludes Puerto Rico.

 $^{^2\}mathrm{Data}$ are rounded to no more than three significant digits; may not add to totals shown.

TABLE 3 BALL CLAY SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY TYPE^1

	20	004	2005	
	Quantity	Value	Quantity	Value
Type:				
Airfloat	537	28,600	677	31,700
Water-slurried	205 ^r	9,790 ^r	145	7,090
Unprocessed	482 ^r	15,700 ^r	388	14,100
Total	1,220	54,100	1,210	52,900
Use:				
Fillers, extenders, binders ²	86	NA	51	NA
Floor and wall tile	428	NA	485	NA
Miscellaneous ceramics ³	203	NA	132	NA
Pottery	26	NA	18	NA
Refractories ⁴	W	NA	W	NA
Sanitaryware	322	NA	297	NA
Miscellaneous ⁵	45	NA	23	NA
Exports ⁶	114	NA	204	NA
Total	1,220	54,100	1,210	52,900

^rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Miscellaneous."

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes adhesives, animal feed, asphalt tile, asphalt emulsions, gypsum, paper filling, pesticides and related products, plastics, rubber, and other fillers, extenders, and binders.

³Includes catalysts, electrical porcelain, fiberglass, fine china/dinnerware, glass, mineral wool, roofing granules, and miscellaneous ceramics.

⁴Includes firebrick, blocks, shapes, high-alumina specialties, and kiln furniture.

⁵Includes heavy clay products, waterproofing seals, other unknown uses and data represented by symbol W.

⁶Includes ceramics and glass and floor and wall tile.

TABLE 4 BENTONITE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY TYPE AND USE $^{\rm l}$

(Thousand metric tons and thousand dollars)

	2	2004		2005	
	Quantity	Value	Quantity	Value	
Type:					
Nonswelling	320	14,200	300	14,400	
Swelling	4,230 ^r	192,000 ^r	4,410	201,000	
Total	4,550 ^r	206,000 ^r	4,710	215,000	
Use:					
Domestic:					
Absorbents:					
Pet waste absorbents	1,040 ^r	NA	1,240	NA	
Other absorbents	W	NA	W	NA	
Adhesives	2	NA	2	NA	
Animal feed	51 ^r	NA	53	NA	
Ceramics (except refractories) ²	W	NA	W	NA	
Drilling mud	847 ^r	NA	945	NA	
Filler and extender applications ³	39	NA	61	NA	
Filtering, clarifying, decolorizing	W	NA	W	NA	
Foundry sand	891 ^r	NA	893	NA	
Pelletizing (iron ore) ⁴	614 ^r	NA	579	NA	
Miscellaneous refractories		NA		NA	
Miscellaneous ⁵	412 ^r	NA	356	NA	
Waterproofing and sealing	193	NA	176	NA	
Total	4,090 ^r	NA	4,310	NA	
Exports:					
Drilling mud	59 ^r	NA	76	NA	
Foundry sand	258 ^r	NA	205	NA	
Other ⁶	151 ^r	NA	123	NA	
Total	468 ^r	NA	404	NA	
Grand total	4,550 ^r	206,000 r	4,710	215,000	

^rRevised. NA Not available. W Withheld to avoid disclosing company proprietry data; included with

[&]quot;Miscellaneous." -- Zero.

¹Data are rounded to no more than three significant digits, may not add to totals shown.

²Includes catalysts and pottery.

³Includes asphalt tiles, cosmetics, ink, medical, miscellaneous fillers and extenders applications, paint, paper coating, paper filling, pesticides and related products, pharmaceuticals, and plastics.

 $^{^4}$ Excludes shipments to Canada. Total sales in North America were 682,000 metric tons (t) in 2004 and 595,000 metric tons (t) in 2005.

⁵Includes chemical manufacturing, heavy clay products, other unknown uses and data represented by symbol W.

⁶Includes absorbents, fillers and extenders, miscellaneous refractories, pelletizing, and other unknown uses.

TABLE 5 COMMON CLAY AND SHALE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE AND USE $^{\rm 1,2}$

	200)4	2005	
	Quantity	Value	Quantity	Value
State:				
Alabama	2,120	29,600	2,280	29,000
Arkansas	1,150	1,510	1,210	1,900
California	1,230	20,700	1,010	16,600
Georgia	1,550	8,710	1,530	8,730
Indiana	729	8,910	809	13,500
Kansas	621	7,460	654	4,590
Kentucky	978	4,510	1,060	4,370
Michigan	605	3,070	334	514
Mississippi	610	2,700	642	2,860
Missouri	911	3,290	822	3,400
New York	756	10,900	785	11,700
North Carolina	2,260	12,900	2,180	13,900
Ohio	1,360	7,480	1,310	6,880
Oklahoma	1,150	2,410	903	2,520
Pennsylvania	822	3,270	705	3,460
South Carolina	1,040	2,860	1,020	3,610
Texas	2,160	8,890	2,340	8,680
Virginia	994	4,640	982	4,690
Other ³	3,520 ^r	29,400	3,900	35,500
Total	24,600	173,000	24,500	176,000
Use:				
Ceramics and glass ⁴	405	NA	217	NA
Floor and wall tile:	_			
Ceramic	370	NA	374	NA
Other ⁵	39	NA	35	NA
Heavy clay products:	_			
Brick, extruded	12,700	NA	13,200	NA
Brick, other	1,650	NA	1,680	NA
Other ⁶	237	NA	273	NA
Lightweight aggregate:	_			
Concrete block	2,160	NA	1,950	NA
Highway surfacing	323	NA	325	NA
Structural concrete	758	NA	903	NA
Miscellaneous	522	NA	666	NA
Portland and other cements	4,200	NA	3,690	NA
Refractories ⁷	- 749	NA	696	NA
Miscellaneous ⁸	458	NA	446	NA
Total	24,600	173,000	24,500	176,000

^rRevised. NA Not available.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Excludes Puerto Rico.

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

⁴Includes pottery and roofing granules.

⁵Includes quarry tile and miscellaneous floor and wall tiles.

 $^{^6}$ Includes drain tile, flower pots, roofing tile, sewer pipe, structural tile, and miscellaneous clay products.

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

⁸Includes exports; miscellaneous civil engineering and sealings; miscellaneous fillers,

 ${\rm TABLE}~6$ FIRE CLAY SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE AND USE $^{\rm I}$

(Thousand metric tons and thousand dollars)

	200	4	2005	
	Quantity	Value	Quantity	Value
Production	307	8,510	353	10,700
Use:				
Heavy clay products and lightweight aggregates ²	142	NA	190	NA
Refractories:				
Firebrick, block, shapes		NA		NA
Other refractories ³	165	NA	163	NA
Miscellaneous ⁴	r	NA		
Total	307	8,510	353	10,700

^rRevised. NA Not available. -- Zero.

TABLE 7 FULLER'S EARTH SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY TYPE AND USE $^{\rm l}$

(Thousand metric tons and thousand dollars)

	20	004	20	05
	Quantity	Value	Quantity ²	Value ²
Type:				
Attapulgite ³	237	30,100	W	W
Montmorillonite	3,020	299,000	2,990	302,000
Total	3,260	329,000	2,990	302,000
Use:				
Absorbents:				
Oil and grease absorbent	295	NA	283	NA
Pet waste absorbent	2,250	NA	2,295	NA
Animal feed	(4)	NA	(4)	NA
Fertilizers	46	NA	(4)	NA
Fillers, extenders, binders ⁵	127	NA	66	NA
Filtering, clarifying, and decolorizing animal, mineral, and	_			
vegetable oils and greases	67	NA	(4)	NA
Pesticides and related products	(4)	NA	(4)	NA
Miscellaneous ⁶	477	NA	376	NA
Exports ⁷	(4)	NA	(4)	NA
Total	3,260	329,000	2,990	302,000

NA Not available. W Withheld to avoid disclosing company proprietary data.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes common brick, miscellaneous lightweight aggregates, portland cement, and terra cotta (2004).

³Includes foundry sand, grogs and calcines, kiln furniture (2005), mortar and cement, and miscellaneous refractories.

⁴Includes miscellaneous lightweight aggregates, and other unknown uses.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Excludes attapulgite-type fuller's earth.

³Primarily gellant-grade fuller's earth. More information can be found in the "Fuller's Earth" portion of the production section of this report.

⁴Withheld to avoid disclosing company proprietary data; included under "Miscellaneous."

⁵Includes adhesives, asphalt emulsions, asphalt tiles, gypsum products, medical, pharmaceuticals and cosmetics, paints, paper coating, textiles, and other unknown uses in 2004 and asphalt tile and other unknown uses in 2005.

⁶Includes animal feed, drilling mud, fertilizers, filtering, pesticides, portland cement, refractories, roofing granules, and other unknown uses in 2004 and animal feed, fertilizers, filtering, pesticides, portland cement and refractories in 2005 and exports.

⁷Includes absorbents; fillers, extenders, and binders; floor and wall tiles; and refractories in 2004 and pet waste absorbents in 2005.

TABLE 8 KAOLIN SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE AND KIND^1

	200)4	200:	5
	Quantity	Value	Quantity	Value
State:				
Georgia	6,780	889,000	7,190	825,000
South Carolina	296	19,600	287	17,700
Other ²	684	27,200	326	17,100
Total	7,760	936,000	7,800	860,000
Kind:				
Airfloat	1,150	62,400	1,270	81,900
Calcined: ³				
Pigment-grade	853	250,000	837	250,000
Refractory-grade	547	16,500	474	14,800
Total	1,400	267,000	1,310	265,000
Delaminated	1,240	156,000	1,010 4	113,000 4
Unprocessed	101	1,850	139	2,130
Water washed	3,870	449,000	4,070 4	398,000 4
Grand total	7,760	936,000	7,800	860,000

¹ Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes Alabama, Arkansas, California, Florida, Nevada, North Carolina, Tennessee, and Texas.

³Pigment-grade kaolin is low-temperature calcined kaolin, and refractory-grade kaolin is high-temperature calcined kaolin.

⁴Some delaminated kaolin production included under "Waterwashed." More information can be found in the "Kaolin" portion of the production section of this report.

${\it TABLE~9}$ GEORGIA KAOLIN SOLD OR USED BY PRODUCERS, BY ${\it KIND}^1$

(Thousand metric tons and thousand dollars)

	20	04	2005		
	Quantity	Value	Quantity	Value	
Kind:					
Airfloat	851	41,300	1,010	61,700	
Calcined ²	906	245,000	1,190	255,000	
Delaminated	1,240	156,000	1,010	113,000	
Unprocessed	W	W	W	W	
Water washed	3,780	447,000	3,970	396,000	
Total	6,780	889,000	7,180	826,000	
Use:					
Domestic:					
Ceramics and glass:					
Catalysts (oil-refining)	(3)	NA	(3)	NA	
Fiberglass	290	NA	348	NA	
Roofing granules	(3)	NA	(3)	NA	
Sanitaryware	(3)	NA	(3)	NA	
Other ⁴	399 ^r	NA	425	NA	
Fillers, extenders, binders:					
Adhesives	40	NA	18	NA	
Paint	273	NA	423	NA	
Paper coating	2,470	NA	2,310	NA	
Paper filling	465	NA	574	NA	
Plastic	85	NA	139	NA	
Rubber	95	NA	206	NA	
Other ⁵	78	NA	180	NA	
Heavy clay products ⁶	(7)	NA	(7)	NA	
Refractories ⁸	266	NA	413	NA	
Undistributed ⁹	51 ^r	NA	85	NA	
Total	4,510	NA	5,120	NA	
Exports:					
Paint	73	NA	55	NA	
Paper coating ¹⁰	1,920	NA	1,740	NA	
Paper filling ¹⁰	129	NA	121	NA	
Rubber		NA	14	NA	
Undistributed ¹¹	126	NA	135	NA	
Total	2,260	NA	2,070	NA	
Grand total	6,780	889,000	7,190	825,000	

NA Not applicable. ^rRevised. W Withheld to avoid disclosing company proprietary data.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes pigment- and refractory-grade calcined kaolin.

³Withheld to avoid disclosing company proprietary data; included in Domestic: "Ceramics and glass: Other."

⁴Includes catalysts (oil-refining), electrical porcelain, fine china/dinnerware, pottery, miscellaneous ceramics, roofing granules, and sanitaryware.

⁵Includes animal feed, asphalt tile, fertilizers, gypsum products, medical, pharmaceuticals and cosmetics, pesticides and related products, textiles, and miscellaneous fillers, extenders, and binders.

⁶Includes brick (common and face), portland cement, and miscellaneous clay products.

⁷Withheld to avoid disclosing company proprietary data; included in "Domestic: Undistributed."

⁸Includes firebricks, blocks and shapes, grogs and calcines, high-alumina specialties, kiln furniture, and miscellaneous refractories.

⁹Includes absorbents, chemical manufacturing, floor and wall tiles, heavy clay products, waterproofing seals, and other unknown uses.

 $^{^{10}\}mbox{Some}$ export sales may be included under domestic sales.

¹¹Includes adhesives, catalysts (oil-refining), fiberglass, sanitaryware: miscellaneous fillers.

${\it TABLE~10}$ SOUTH CAROLINA KAOLIN SOLD OR USED BY PRODUCERS, BY ${\it USE}^1$

(Thousand metric tons and thousand dollars)

	200)4	200)5
	Quantity	Value	Quantity	Value
Kind:				
Airfloat ²	296	19,600	287	17,700
Unprocessed ³	W	W	W	W
Total	296	19,600	287	17,700
Use:				
Adhesives	16	NA	10	NA
Ceramics ⁴	107	NA	86	NA
Rubber	88	NA	87	NA
Refractories ⁵	6	NA	2	NA
Other uses ⁶	52	NA	78	NA
Exports ⁷	27	NA	24	NA
Total	296	19,600	287	17,700

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Airfloat."

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes unprocessed kaolin.

³Includes calcined kaolin.

⁴Includes catalysts (oil-refining), fine china/dinnerware, glazes, glass, and enamels, pottery, roofing granules, sanitaryware, and miscellaneous ceramics.

⁵Includes firebrick, blocks and shapes, and miscellaneous refractories.

⁶Includes asphalt tile; brick (common and face); catalysts (oil refining); chemical manufacturing; civil engineering and sealings; drilling mud; fillers, extenders, and binders; heavy clay products; lightweight aggregates; paints; and plastics.

⁷Includes refactories and fillers, extenders, and binders.

${\rm TABLE~11}$ KAOLIN SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY ${\rm USE}^{\rm l}$

(Thousand metric tons)

Use	2004	2005
Domestic:		
Ceramics:		
Catalyst (oil and gas refining)	182 ^r	180
Electrical porcelain	W	W
Fine china and dinnerware	25	13
Floor and wall tile	71	97
Pottery	9	6
Roofing granules	71	65
Sanitaryware	33	48
Miscellaneous	W	106
Chemical manufacture	60	84
Civil engineering	W	W
Fiberglass, mineral wool	317	367
Fillers, extenders, binders:		
Adhesive	56	28
Fertilizer	W	W
Medical, pharmaceutical, cosmetic	1	1
Paint	313	445
Paper coating	2,470	2,310
Paper filling	465	574
Pesticide	W	W
Plastic	104	152
Rubber	183	290
Miscellaneous	79	182
Heavy clay products:		
Brick, common and face	97	118
Portland cement	57	80
Refractories ²	732	498
Miscellaneous applications	142	5
Total	5,470 ^r	5,650
Exports:		- /
Ceramics	(3)	(3)
Paint	73	72
Paper coating	1,920	1,740
Paper filling	129	121
Rubber	38	38
Miscellaneous	128	176
Total	2,290	2,150
Grand total	7,760	7,800

^rRevised. W Withheld to avoid disclosing company proprietary data; included in "Domestic: Ceramics: Miscellaneous applications."

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes firebrick (blocks and shapes), grogs and calcines, high-alumina kaolin (brick and specialties), kiln furniture, and miscellaneous refractories.

³Withheld to avoid disclosing company proprietary data; included in "Exports: miscellaneous."

 $\label{thm:common} TABLE~12$ COMMON CLAY AND SHALE USED IN LIGHTWEIGHT AGGREGATE PRODUCTION IN THE UNITED STATES BY STATE $^{\rm I}$

	Concrete	Structural		Tot	
State	block	concrete	Other ²	Quantity	Value ^e
2004:					
Alabama	759	54	90	904	24,200
Arizona		17		17	19
Arkansas	425			425	704
California	39	214		253	11,200
Florida ^e	68	23		91	1,280
Indiana ^e	130	35	71	236	7,500
Kansas			67	67	931
Kentucky ^e	109	36		145	557
Louisianae	136	43	94	273	10,500
Missouri			101	101	1,500
New York ^e	82	96		178	7,840
North Carolina ^e	144		10	154	1,940
Ohio ^e	149	8		157	764
Oklahoma ^e	22	3		25	659
Texas ^e	49	157	253	459	2,520
Utah	49	71	159	279	5,210
Total	2,160	758	845	3,760	77,300
2005:	_				
Alabama	575	42	78	695	22,900
Arkansas	417			417	1,010
California	21	265		286	14,100
Indiana ^e	113	36	91	240	11,400
Kansas			70	70	972
Kentucky ^e	143	48	48	239	683
Louisiana ^e	140	32	125	297	12,600
Missouri			113	113	1,680
Nebraska			(3)	(3)	2
New York	220	233		454	8,900
North Carolina ^e			10	10	11
Ohio ^e	134	8	17	159	701
Oklahoma ^e	43	6		49	1,300
Texas ^e	49	162	265	476	2,730
Utah	96	71	173	340	6,330
Total	1,950	903	990	3,850	85,300

^eEstimated. -- Zero.

 $^{^{\}mathrm{l}}\mathrm{Data}$ are rounded to no more than three significant digits; may not add to totals shown.

²Included highway surfacing.

³Less than ½ unit.

TABLE 13 ${\rm COMMON~CLAY~AND~SHALE~USED~IN~BUILDING~BRICK~PRODUCTION~IN~THE~UNITED~STATES,~BY~STATE}^{1,\,2}$

(Thousand metric tons and thousand dollars)

	200)4	2005		
State	Quantity	Value ^e	Quantity	Value	
Alabama	568	1,820	1,290	6,290	
Arkansas	460	518	480	548	
California	314	1,010	307	1,000	
Colorado	199	1,320	222	1,460	
Georgia	1,390	7,640	1,370	7,660	
Illinois	240	1,310	W	508	
Kentucky ³	464	2,070	429	1,660	
Maryland	194	264	248	374	
Mississippi	534	2,570	565	2,730	
North Carolina	2,030	6,200	2,120	13,800	
Ohio	826	4,550	752	4,320	
Oklahoma	834	1,310	788	1,030	
Pennsylvania	768	3,070	643	3,270	
South Carolina	760	1,400	810	2,300	
Texas	967	4,060	1,140	3,500	
Other ⁴	4,040 r	20,300	4,000	17,700	
Total	14,600 ^r	59,500	15,200	68,100	

^eEstimated. ^rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other."

¹Includes extruded and other brick.

 $^{^2\}mathrm{Data}$ are rounded to no more than three significant digits; may not add to totals shown.

³Extruded brick only.

⁴Includes all other States except Alaska, Arizona, Connecticut, Maine, Nevada, New Hampshire, Rhode Island, Vermont, and Wisconsin and data represented by symbol W.

$\label{eq:table 14} \text{U.S. EXPORTS OF CLAYS IN 2005, BY KIND}^1$

(Thousand metric tons and thousand dollars)

	20	2004 2005		05	
Material	Quantity	Value	Quantity	Value	Principal destinations, 2005
Ball clay	107	8,200	141	8,840	Canada, 27%; Mexico, 22%; Finland, 16%.
Bentonite	915	105,000	847	98,500	Canada, 40%; Japan, 17%; Saudi Arabia, 6%.
Fire clay	332	32,300	368	34,400	Mexico, 50%; Luxembourg, 27%.
Fuller's earth	49	10,300	55	13,500	Netherlands, 20%; Canada, 13%; Mexico, 5%.
					Colombia, 4%.
Kaolin	3,640	600,000	3,580	601,000	Japan, 23%; Canada, 17%; China, 8%; Finland, 6%.
					Mexico,10%; Taiwan, 6%.
Clays, n.e.c.	586	181,000	634	173,000	Canada, 55%; Mexico, 9%; Japan, 6%.
Total	5,630	936,000	5,620	929,000	XX

XX Not applicable.

Source: U.S. Census Bureau.

 ${\rm TABLE~15}$ U.S. IMPORTS FOR CONSUMPTION OF CLAY IN 2005, BY ${\rm KIND}^1$

(Thousand metric tons and thousand dollars)

	2004		2005		
Material	Quantity	Value	Quantity	Value	Principal sources, 2005
China clay or kaolin	205	38,600	262	40,200	Brazil, 93%; United Kingdom, 6%.
Fire clay	6	1,680	(2)	156	Canada, 92%.
Decolorizing earths and fuller's earth	(2)	48	2	286	China, 80%; Germany, 20%.
Bentonite	9	3,360	10	3,550	Canada, 37%; Greece, 35%; Mexico, 18%.
Common blue clay and other ball clay	1	218	1	261	United Kingdom, 96%.
Other clay	5	3,650	7	4,660	France, 42%; Canada, 25%; Germany, 13%; Mexico, 8%.
Chamotte or Dina's Earth	(2)	2	(2)	9	Germany, 100%.
Artificially activated clay and activated earth	25	14,200	16	10,300	Mexico, 61%; Germany, 26%; Canada, 7%.
Total	251	61,800	298	59,400	XX

XX Not applicable.

Source: U.S. Census Bureau.

¹Data are rounded to no more than three significant digits.

¹Data are rounded to no more than three significant digits.

²Less than ½ unit.

 $\label{eq:table 16} \textbf{TABLE 16}$ BENTONITE: WORLD PRODUCTION, BY COUNTRY $^{1,\,2}$

(Metric tons)

Country ³	2001	2002	2003	2004	2005 ^e
Algeria ⁴	21,286	27,178	25,346	30,319	29,029 5
Argentina	135,450	120,006	146,845	163,028	160,000 5
Armenia ^e	1,000	258 5	642	561	732 5
Australia ^{e, 4}	180,000	200,000	200,000	200,000	200,000
Bolivia	159	216	227	548	550
Bosnia and Herzegovina	5 e	9,829	13,050	16,500 e	17,000
Brazil, beneficiated	178,610	184,909	198,981 ^r	226,874 ^r	226,900 5
Bulgaria	320,000 ^e	212,000	146,000	150,000 e	150,000
Burma	634 ^r	600 r	600 ^r	500 ^r	500
Chile	1,695	632	748	101 ^r	
Commonwealth of Indepedent States ^{e, 6}	750,000	750,000	750,000	750,000	750,000
Croatia	10,580	12,102	13,568	13,500 ^e	13,000
Cyprus	126,600	128,400	144,859	155,717 ^r	150,000
Czech Republic	224,000 e	174,000	199,000 r, e	201,000 ^r	200,000
Egypt ^e	50,000	50,000	50,000	50,000	50,000
Georgia ^e	7,000	7,000	9,700	1,800 5	1,800 5
Germany	447,913 ^r	495,310 ^r	478,796 ^r	404,549 ^r	410,000 5
Greece ^e	950,000	950,000	950,000	950,000	950,000
Guatemala	3,000 e	4,436	6,438	81,688 ^r	135,451 5
Hungary	5,200 ^e	3,700	87,290 ^r	87,300 ^r	85,000
Indonesia ^e	5,000	5,000	5,000	5,000	5,000
Iran ⁷	113,299 ^r	125,510 ^r	140,528 ^r	193,046 ^r	200,000
Italy ^e	500,000	500,000	500,000	500,000	500,000
Japan	405,738	437,772 ^r	425,945	455,282 ^r	450,000
Kenya ^e	50 ⁵	50	50	50	50
Macedonia ^e	30,000	25,000	25,000	25,000	25,000
Mexico	415,133	488,215	464,056	564,015 ^r	425,630 5
Morocco	71,741	58,754	67,700 ^r	85,400 ^r	85,400
Mozambique	1,357			3,336	5
New Zealand, processed ^e	10,000	7,800	7,800 5	7,800	7,800
Nicaragua ^e	6,000	6,000	6,300	6,300	6,300
Pakistan	27,000 ^e	28,000	28,000 ^e	6,316 ^r	15,671 5
Peru	18,217	20,760	14,980 ^r	18,471	18,500 ^p
Philippines	5,128	5,500	5,000 e	5,000 e	5,000
Poland ⁸	29,000	26,200	31,648 ^r	66,143 ^r	65,000
Romania	24,779	15,389	17,637	18,161 ^r	18,000
Serbia and Montenegro ^e	75	75 ⁵	75	75	75
Slovakia	82,915	66,128	74,938	73,273 ^r	70,000
South Africa ⁹	108,300 ^r	101,100 ^r	145,060	55,859	139,833 5
Spain ^e	150,000	150,000	150,000	150,000	150,000
Turkey	674,178 ^r	559,224	831,146	850,000 °	925,000
Turkmenistan ^e	50,000	50,000	50,000	50,000	50,000
Ukraine ^e	300,000	300,000	300,000	300,000	300,000
United States	3,970,000	3,970,000	3,770,000 ^r	4,550,000 ^r	4,710,000 5
Zimbabwe ⁹	2,247 ^r	3,780 ^r	e	500 r, e	500
Total	10,400,000	10,300,000	10,500,000 r	11,500,000 ^r	11,700,000

See footnotes at end of table.

TABLE 16—Continued BENTONITE: WORLD PRODUCTION, BY COUNTRY^{1, 2}

TABLE 17 FULLER'S EARTH: WORLD PRODUCTION, BY COUNTRY^{1, 2}

(Metric tons)

2001	2002	2003	2004	2005 ^e
				831 4
	*		· · · · · · · · · · · · · · · · · · ·	
1,500	1,500	1,500	1,500	1,500
5,600	6,000	6,000 e	6,000 e	6,000
500,000	500,000	500,000	500,000	500,000
	998,193	892,658	850,000	850,000
30,000	30,000	30,000	30,000	30,000
148,194	147,064	152,917	129,502 ^r	107,265 4
40,664	43,243	14,944	15,000 e	15,000
15,000	15,000 4	15,000	15,000	15,000
121,200	138,400	194,900	200,000 r, e	200,000
9,229	13,288 ^r	14,585 ^r	20,419	34,241 4
24,477	22,918	18,975	19,000 e	20,000
673,600	733,134	690,395	700,000 ^e	700,000
140,000	140,000	140,000	140,000	140,000
2,890,000	2,730,000	3,600,000	3,260,000	2,990,000 4,7
4,600,000	5,520,000	6,280,000 ^r	5,890,000 ^r	5,610,000
	500,000 30,000 148,194 40,664 15,000 121,200 9,229 24,477 673,600 140,000 2,890,000	3,254 3,521 1,500 1,500 5,600 6,000 500,000 500,000 998,193 30,000 30,000 148,194 147,064 40,664 43,243 15,000 15,000 4 121,200 138,400 9,229 13,288 F 24,477 22,918 673,600 733,134 140,000 140,000 2,890,000 2,730,000	3,254 3,521 2,573 1,500 1,500 1,500 5,600 6,000 6,000 c 500,000 500,000 500,000 998,193 892,658 30,000 30,000 30,000 148,194 147,064 152,917 40,664 43,243 14,944 15,000 15,000 4 15,000 121,200 138,400 194,900 9,229 13,288 r 14,585 r 24,477 22,918 18,975 673,600 733,134 690,395 140,000 140,000 140,000 2,890,000 2,730,000 3,600,000	3,254 3,521 2,573 2,284 1,500 1,500 1,500 1,500 5,600 6,000 6,000 ° 6,000 ° 500,000 500,000 500,000 500,000 998,193 892,658 850,000 30,000 30,000 30,000 30,000 148,194 147,064 152,917 129,502 ° 40,664 43,243 14,944 15,000 ° 15,000 15,000 ° 15,000 15,000 121,200 138,400 194,900 200,000 °, ° 9,229 13,288 ° 14,585 ° 20,419 24,477 22,918 18,975 19,000 ° 673,600 733,134 690,395 700,000 ° 140,000 140,000 140,000 140,000 2,890,000 2,730,000 3,600,000 3,260,000

^eEstimated. ^rRevised. -- Zero.

^eEstimated. ^pPreliminary. ^rRevised. -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through August 21, 2006.

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

⁴Includes bentonitic clays.

⁵Reported figure.

⁶Information is inadequate to formulate reliable estimates for individual countries, except Armenia, Georgia, Turkmenistan, and Ukraine.

⁷Year beginning March 21 of that stated.

⁸Montmorillite type bleaching clay.

⁹May include other clays.

¹Excludes 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 August 21, 2006.

²World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown. ³In 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.

⁴Reported figure.

⁵Salable product.

⁶Sold or used by producers.

⁷Includes only montmorillonite-type fuller's earth; sales use of attapulgite-type fuller's earth was withheld to avoid disclosing company proprietary data.

$\label{eq:table 18} \text{KAOLIN: WORLD PRODUCTION, BY COUNTRY}^{1,\,2}$

(Metric tons)

Country ³	2001	2002	2003	2004	2005 ^e
Algeria	13,356	9,505	16,591	24,299	34,386 4
Argentina	13,584	13,865	19,219	27,883	30,000
Australia, includes ball claye	220,000	230,000	230,000	230,000	230,000
Austria, marketable ^e	50,000	50,000	50,000	50,000	50,000
Bangladesh ^{e, 5}	8,000	8,100	8,200	8,300	8,400
Belgium ^e	300,000	300,000	300,000	300,000	300,000
Bosnia and Herzegovina, crude	13,000	6,500			
Brazil, beneficiated	1,734,359	1,757,488	2,081,039	2,197,920 ^r	2,198,000 p, 4
Bulgaria	150,000	160,000	170,000	180,000 ^r	150,000
Chile	5,300	6,164	11,500	7,133 ^r	15,183 4
Colombia, includes common clay ^e	8,500,000	8,500,000	8,500,000	8,500,000	8,500,000
Czech Republic	5,543,000	3,650,000	4,155,000	3,862,000 ^r	4,000,000
Denmark, sales ^e	2,500	2,500	2,500	2,500	2,500
Ecuador	703	8,483	11,883 ^r	5,646 ^r	5,928 ^{p, 2}
Egypt ^e	300,000	300,000 4	300,000	300,000	300,000
Eritrea	588	250	281 ^r	101 ^r	100
Ethiopia	1,800 e	3,534	3,088	4,251 ^r	4,300
France, marketable ^e	300,000	300,000 4	300,000	300,000	300,000
Germany	3,763,798 ^r	3,666,405 ^r	3,467,435 ^r	3,752,000	3,750,000
Greece ^e	60,000	60,000 4	60,000	60,000	60,000
Guatemala	227	372	1,497	r	4,107 4
Hungary, processed ^e	8,000	4,300	13,250 r, 4	13,300 r, 4	13,000
India:e					
Processed	170,000	170,000 4	180,000	180,000	190,000
Salable crude	540,000	540,000 4	550,000	550,000	560,000
Indonesia ^e	15,000	15,000 4	15,000	15,000	15,000
Iran	635,888 ^r	553,782 ^r	484,507 ^r	531,109 ^r	500,000
Italy, kaolinitic earth ^e	10,000	10,000	10,000	10,000	10,000
Japan	17,240 ^r	11,756	12,409	11,553 ^r	115,000
Jordan	24,124 ^r	100,000 r, e	179,153	216,566	220,000 4
Kazakhstan ^e	70,000	70,000	70,000	70,000	70,000
Kenya	700	710 ^r	730 ^r	750 ^r	750
Korea, Republic of	2,306,083 ^r	2,727,481 ^r	3,009,245 ^r	2,780,020 ^r	2,767,091 4
Kyrgyzstan ^e	200,000	237,100 4	381,100 4	400,000	400,000
Madagascar ^e	170	170 ^r	170	170	170
Malaysia	364,458	323,916	425,942 ^r	326,928 ^r	350,000
Mexico	681,709	745,498	798,407	654,711 ^r	877,147 4
New Zealand	15,000	16,000	16,000 e	16,000 e	16,000
Nigeria ^e	209,478 4	200,000	200,000	210,000	210,000
Pakistan ^e	50,000	50,000	50,000	25,204 r, 4	37,732 4
Paraguay ^e	66,500 ^r	66,700 ^r	66,600 ^r	66,600 ^r	66,600
Peru	5,532	1,934	2,653	2,720	2,720 4
Poland, washed	101,200	113,500	169,034 ^r	191,312 ^r	190,000
Portugal ^e	175,000	175,000	175,000	175,000	175,000
Romania	21,867	22,514	25,741 ^r	22,337 ^r	22,000
Russia, concentrate ^e	45,000	45,000 4	45,000	45,000	45,000
Serbia and Montenegro:					
Crude	60,900	60,000	60,000 ^e	60,000 ^e	60,000
Washed ^e	10,000	10,000	10,000	10,000	10,000
Slovakia	35,000	33,000	24,800 ^r	89,424 ^r	85,000
South Africa	85,556	86,700 ^r	86,365 ^r	81,901	60,072 4
Spain, marketable, crude and washed ^{e, 6}	350,000	350,000	350,000	350,000	350,000
Sri Lanka	9,403	8,613	9,073	9,200 °	9,400

See footnotes at end of table.

TABLE 18—Continued KAOLIN: WORLD PRODUCTION, BY COUNTRY^{1, 2}

(Metric tons)

Country ³	2001	2002	2003	2004	2005 ^e
Thailand, beneficiated	168,063	127,132	184,562	200,761 ^r	201,000
Turkey	574,550	372,344	370,455	536,008 ^r	580,000
Uganda	90	178	r	537 ^r	31,000
Ukraine ^e	225,000	225,000 4	225,000	225,000	225,000
United Kingdom, sales ^{e, 7}	2,400,000	2,400,000 4	2,400,000	2,400,000	2,400,000
United States ⁸	8,110,000	8,010,000	7,680,000	7,760,000	7,800,000 4
Uzbekistan ^e	5,500,000	5,500,000	5,500,000	5,500,000	5,500,000
Venezuela ^e	10,000	10,000	10,000	10,000	10,000
Vietnam ^e	600,000	600,000	650,000	650,000	650,000
Zambia ^e	200	200	200	200	200
Total	44,900,000 ^r	43,000,000 ^r	44,100,000 ^r	44,200,000 ^r	44,700,000

^eEstimated. ^pPreliminary. ^rRevised. -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through August 21, 2006.

³In 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.

⁴Reported figure.

⁵Data for year ending June 30 of that stated.

⁶Includes crude and washed kaolin and refractory clays not further described.

⁷Dry weight.

⁸Kaolin sold or used by producers.