



2013 Minerals Yearbook

CLAY AND SHALE [ADVANCE RELEASE]

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In 2013, domestic production of clays remained at levels about 58% of those before the 2008–09 recession. Production decreased by 7% to 24 million metric tons (Mt) valued at \$1.51 billion compared with 25.9 Mt valued at \$1.56 billion in 2012 (table 1). Common clay and shale accounted for 44% of the tonnage, and kaolin accounted for 58% of the value (tables 1, 5, and 8). In 2013, exports decreased by 3% to 4.14 Mt valued at \$892 million compared with 4.27 Mt valued at \$870 million in 2012. Imports of clays were 523,000 metric tons (t) valued at \$106 million in 2013 compared with 524,000 t valued at \$108 million in 2012 (table 1). World production of bentonite was 12 Mt in 2013 compared with 13 Mt in 2012, production of fuller's earth was 3 Mt in 2013, a slight increase from that of 2012, and production of kaolin was 40.3 Mt in 2013 compared with 39.5 Mt in 2012 (tables 16–18).

Increased use of alternative materials to brick for residential construction, a decrease in domestic ceramic tile and sanitaryware manufacturing capacity, increased use of calcium carbonate in paper applications, and increased use of specialized, nonclay refractory products were some of the reasons for the decrease in clay demand during the past 40 years.

Since 2000, U.S. production and apparent consumption decreased. The slowdown in commercial and residential construction just before and during the 2008–09 economic recession accounted for most of the decrease. U.S. exports in 2013 were less than those in 2000 because of factors such as increased competition from other global producers; competition from other minerals, such as calcium carbonate in paper manufacture; and the effects of the 2008–09 global recession. Imports have been relatively unchanged since 2000 because the United States was self-sufficient with regard to clay usage. A slight rebound in exports and imports took place after the recession.

Production

The U.S. Geological Survey (USGS) has six classifications for clays mined in the United States: ball clay, bentonite, common clay, fire clay, fuller's earth, and kaolin. Ball clays consist primarily of kaolinite with minor to major amounts of illite, chlorite, smectite minerals, quartz, and organic materials. Bentonites consist of smectite minerals (usually montmorillonite) with minor amounts of feldspar, biotite, and quartz. Common clays contain illite and chlorite as major components. Fire clay consists of mainly kaolinite, halloysite, and (or) diaspore. Fuller's earth consists primarily of palygorskite (attapulgite) or calcium-rich montmorillonite nonplastic clays with quartz. Kaolin consists of primarily kaolinite or kaolin-group minerals; smectite minerals, mica, quartz, and rutile are a few other components of kaolin deposits.

Mineral composition, plasticity, color, absorption qualities, firing characteristics, and clarification properties are a few of the characteristics used to distinguish between the different clay types.

Approximately 160 companies mined clay and shale in the United States in 2013. The 20 leading companies, many with multiple operations, accounted for 57% of the tonnage and 79% of the value for all types of clay sold or used. The 15 leading producer companies were, in alphabetical order, American Colloid Co. (bentonite); Ash Grove Cement Co. (common clay); BASF SE (bentonite, fuller's earth, and kaolin); Bentonite Performance Minerals, LLC (bentonite); Big River Industries, Inc. (common clay); Black Hills Bentonite, LLC (bentonite); Cemex USA (common clay and shale); Hanson Brick (common clay); Imerys SA (ball clay and kaolin); KaMin LLC (kaolin); M-I L.L.C. (bentonite); Nestlé S.A. (fuller's earth); Oil-Dri Corp. of America (fuller's earth); Thiele Kaolin Co. (kaolin); and Unimin Corp. (ball clay and kaolin).

Clay production was reported in all States except Alaska, Arizona, Delaware, Hawaii, Idaho, Maine, Minnesota, New Hampshire, New Jersey, Rhode Island, Vermont, Washington, and Wisconsin (table 2). Companies that mined clay for uses such as construction fill, landfill caps, and landscaping but did not operate mills or plants were not included in the USGS canvass of the clay and shale industry. These companies operated in most, if not all, States. The 10 leading producer States were, in decreasing order of tonnage, Georgia, Wyoming, Texas, Alabama, Missouri, Tennessee, North Carolina, Oregon, California, and Oklahoma. These 10 States accounted for 76% of U.S. clay production, by quantity (table 2).

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

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 47% of the total clay and shale tonnage sold or used quantity listed in table 1. Production data for the nonrespondents were estimated from preliminary survey data, company reports, trade reports, and (or) reported prior-year production levels adjusted by trends in the industry, employment hours, and other guidelines.

Ball clay

Production.—In 2013, four companies mined ball clay in four States. Production of domestic ball clay increased by 3% to 1 Mt valued at \$42.8 million compared with 973,000 t valued at \$45.1 million in 2012 (table 3). The leading producer State was

Tennessee, followed by, in descending order of tonnage, Texas, Mississippi, and Kentucky. One producer reported production in Indiana, but this probably was fire clay rather than ball clay.

Consumption.—Consumption of ball clay increased in 2013. The two principal domestic markets were, in decreasing order by tonnage, ceramic floor and wall tile (39%) and sanitaryware (17%). Ball clay also was sold to manufacture bricks, electrical porcelain, fine china, pottery, refractory products, roofing granules, and other types of ceramics. Ball clay producers also reported sales for fiberglass and filler, extender, and binder applications; those were likely to have been kaolin mined or purchased by the ball clay producers (table 3).

Domestic sales for ceramic tile manufacture decreased by 7% in 2013 compared with 2012. U.S. shipments of ceramic tile increased by 6% in 2013 compared with those of 2012 (Whitmire, 2014). Based on current markets, some sales for ceramic tile manufacture, possibly as much as 60,000 t, may have been included under “Miscellaneous,” which increased almost fourfold in 2013. It is likely that sales for ceramic floor and wall tile manufacture were in the range of 430,000 to 450,000 t. Some sales for sanitaryware (possibly 10,000 to 20,000 t) and exports (possibly 25,000 to 35,000 t) also may have been reported under “Miscellaneous.” Sales to other markets were relatively unchanged in 2013. Exports accounted for 17% of total ball clay sales (table 3).

Prices.—The average unit value for ball clay reported by domestic producers decreased by 8% to \$43 per metric ton in 2013 from \$46 per ton in 2012; slightly lower values were reported by several producers. The average free alongside ship (f.a.s.) value for exported ball clay was \$127 per ton in 2013 compared with \$60 per ton in 2012. The average Customs value for imported ball clay was \$373 in 2013 compared with \$314 per ton in 2012. For exports and imports, low-tonnage shipments of high-value ball clay resulted in much of the change in unit values from 2012 to 2013.

Foreign Trade.—Ball clay exports were 52,000 t valued at \$6.61 million in 2013 compared with 77,000 t valued at \$4.58 million in 2012, according to the U.S. Census Bureau (table 14). Producers reported exports to be 171,000 t (table 3). Most of the difference between exports reported by producers and the U.S. Census Bureau involved shipments to Mexico, whose trade statistics suggested that Mexico’s imports of ball clay from the United States were reported under Mexico’s Harmonized Tariff Standard (HTS) code for kaolin and other kaolinic clays. Ball clay imports were 468 t valued at \$174,000 compared with 436 t valued at \$137,000 in 2012 (table 15).

Bentonite

Production.—In 2013, 20 companies produced nonswelling and (or) swelling bentonite in 10 States. About 4.35 Mt valued at \$282 million was sold or used in 2013, a 13% decrease in quantity from 4.98 Mt valued at \$311 million of bentonite sold or used in 2012 (table 4).

Production of swelling bentonite decreased by 13% to 4.22 Mt valued at \$272 million in 2013 from 4.84 Mt valued at \$300 million in 2012. Most of the decrease was attributed to decreased sales by producers in Wyoming. Wyoming led

all States in the production of swelling bentonite with 97% of the total production, followed by, in descending order of tonnage, Utah, Texas, California, Oregon, Nevada, Montana, and Colorado.

Production of nonswelling bentonite was 132,000 t valued at \$9.96 million in 2013, a 6% decrease from 140,000 t valued at \$10.7 million in 2012. Alabama led in the production of nonswelling bentonite, followed by, in descending order of tonnage, Mississippi and California.

Rockwood Holdings, Inc. sold its rheological additives operations to ALTANA AG in 2013. Included in the sale was Rockwood’s Southern Clay Products Inc., which produced bentonite from its clay operation near Gonzales, TX. The bentonite was used as a rheological agent in coatings, construction materials, and personal care products. Southern Clay Products will operate as BYK Additives Inc., as part of ALTANA’s BYK Additives & Instruments division (ALTANA AG, 2013; Street, 2013).

Bentonite Performance Minerals, LLC submitted applications to mine bentonite near Belle Fourche in Butte County, SD. The company proposed opening two mines with the bentonite being shipped to its Colony, WY, plant for processing. The application process was pending at yearend (Tschetter, 2013).

IMV Nevada was purchased by Lhoist North America, a subsidiary of Lhoist Group, in late 2012 but will continue operating as IMV Nevada. The company mines calcium bentonite, saponite, and sepiolite at its operation in Amargosa Valley, NV. Lhoist indicated that the products and customer base of IMV Nevada meshed well with Lhoist’s strategic planning for its North American market. The company also is a major supplier of lime, limestone, and ball clay (Lhoist North America, 2012).

Consumption.—In 2013, sales and use of bentonite decreased by 13% to 4.35 Mt from 4.98 Mt in 2012, with decreased sales for drilling mud accounting for a major portion of the decline in sales. In 2013, sales for drilling mud decreased by 22%. Rotary drilling markets served by the bentonite industry decreased by 9% in the United States and 3% globally in 2013 (Baker Hughes Inc., 2014). Increased horizontal drilling and improved gas and oil recovery using hydraulic fracturing also may have negatively affected bentonite sales for drilling mud. Overall sales were probably about 1 Mt with some sales being included under “Miscellaneous,” which more than doubled in 2013 (table 4).

Sales to pet waste absorbents increased by 7% in 2013 compared with those of 2012. The increase probably does not signify resurgence in growth in this market, as it appears to be part of the variability in annual sales observed since 2006.

Domestic sales for foundry sand bond and pelletizing (iron ore) each decreased by 7% in 2013. U.S. industrial output increased in 2013 so some sales of bentonite for foundry sand bond probably were reported under “Miscellaneous.” Foundry sand bond sales of 500,000 to 525,000 t were likely.

There was a 2% decrease in shipments of iron ore in 2013 from those in 2012 (Tuck, 2014b). Most domestic iron ore is pelletized using bentonite prior to shipment so reduced iron ore shipments could affect bentonite sales to that market. Overall sales probably were about 500,000 t with some tonnage reported under “Miscellaneous” in table 4.

Sales for water treatment and filtering and waterproofing and sealing were withheld in 2013, but sales increased compared with 2012. Export sales to the drilling mud market decreased 25% in 2013 (table 4). Although drilling decreased in North America, it increased by 5% elsewhere (Baker Hughes Inc., 2014). It is likely that export sales were in the range of 170,000 to 180,000 t for drilling mud applications.

The leading markets shown in table 4 are representative of those of swelling bentonite, which accounted for 97% of total bentonite sales. Swelling bentonite accounted for more than 99% of bentonite sales for pet waste absorbents, 100% of sales for drilling mud and pelletizing of iron ore, and more than 85% of sales for foundry sand bond. Nonswelling bentonite accounted for more than 50% of sales for water treatment and filtering.

For other uses, swelling bentonite accounted for more than 90% of the bentonite sold for adhesives; animal feed; clarifying, decolorizing, and filtering animal, mineral, and vegetable oils and greases; cosmetics, medical, and pharmaceutical applications; fertilizers; miscellaneous ceramics; miscellaneous fillers and extenders; oil and grease absorbents; paint; and plastics.

Prices.—The average unit value reported by domestic producers for nonswelling bentonite was \$75 per ton in 2013 compared with \$76 per ton in 2012. The average value for swelling bentonite was \$65 per ton in 2013 compared with \$62 per ton in 2012. The average f.a.s. value of exported bentonite was \$177 per ton in 2013 compared with \$160 per ton in 2012. The average Customs value of imported bentonite was \$1,070 per ton in 2013 compared with \$1,273 per ton in 2012. Small shipments of high-value bentonite affected both the unit value for exports and imports.

The price of bentonite that was sold in bulk, crude form for iron ore pelletizing from the mill in Wyoming was \$73 to \$79 per ton; foundry grade that was bagged and shipped in railcars was \$107 to \$137 per ton; pet waste absorbent grade was \$55 to \$66 per ton; and American Petroleum Institute (API)-grade bentonite that was bagged and shipped in railcars was \$99 to \$143 per ton. Crushed, dried, loose in bulk bentonite from India was \$34 to \$38 per ton for pet waste absorbent grade. Foundry grades, crude and dried, in bulk, free on board, Milos, Greece, were \$82 to \$110 per ton (Industrial Minerals, 2013).

Foreign Trade.—Bentonite exports decreased by 14% to 890,000 t valued at \$157 million in 2013 from 1.03 Mt valued at \$164 million in 2012. Canada and Japan accounted for the largest share of the bentonite exports with 49% and 11%, respectively (table 14). Those two countries also accounted for 53% of the decrease in exports in 2013. Domestic bentonite producers reported exports of 833,000 t (table 4). Some discrepancy typically occurs between data reported by producers and the U.S. Census Bureau data because producers often include a portion of the exports destined for Canadian and Mexican markets under domestic sales. In addition, some bentonite is packaged domestically and then exported as a finished product, such as pet waste absorbent. Sales through U.S. mineral brokers, where producers do not know if the bentonite is used domestically or exported, also could contribute to the discrepancy.

Bentonite imports consisted mainly of untreated bentonite clay and chemically or artificially activated materials. Imports of untreated bentonite were 15,000 t valued at \$16.1 million in 2013 compared with 12,000 t valued at \$15.3 million in 2012. Imports of artificially activated material were 28,000 t valued at \$31.5 million in 2013 compared with 31,000 t valued at \$34 million in 2012 (table 15).

Common Clay and Shale

Production.—In 2013, 110 companies produced common clay and shale for manufacturing products in 35 States and Puerto Rico. An undetermined amount of common clay that was used for construction fill, landfill caps, and landscaping was produced in most, if not all, States.

The quantity of common clay and shale sold and used decreased by 11% to 10.6 Mt valued at \$127 million in 2013 compared with 11.9 Mt valued at \$139 million in 2012 (table 5). The 10 leading producing States were, in descending order of tonnage, Texas, Alabama, North Carolina, Oregon, Oklahoma, New York, Ohio, California, Georgia, and Arkansas. These 10 States accounted for 67% of U.S. common clay and shale production. Several large companies with multiple operations may have double counted production in some years prior to 2013. It appears that production in 2012 possibly could be reduced by as much as 500,000 to 600,000 t, nearly all of which would have been used to manufacture brick.

Trinity Industries, Inc. completed the exchange of its 42 ready-mix concrete plants in Arkansas and Texas and its aggregates business for the expanded shale and clay aggregates division owned by Texas Industries, Inc. The expanded shale and clay aggregates division has plants in California, Colorado, and Texas (Texas Industries, Inc., 2013).

General Shale, a subsidiary of Wienerberger AG, purchased the Grover, NC, brick plant owned by Cunningham Brick Co. The purchase expanded General Shale's product lines and provided access to Cunningham Brick's eastern U.S. markets (General Shale, 2013). Two other plants owned by Cunningham Brick in Lexington, NC, and Thomasville, NC, will be permanently closed (Myers, 2013).

Consumption.—In 2013, sales of common clay and shale decreased by 11% to 10.6 Mt from 11.9 Mt in 2012. Brick manufacture remained the leading market for common clay and shale (39% of sales), but sales decreased significantly. Double counting prior to 2013, discussed in the "Production" section of common clay, likely accounted for a significant portion of this decrease. The second leading market for common clay and shale, which accounted for 31% of common clay and shale sales, was for the manufacture of portland cement. This market increased by 17% in 2013, corresponding to an increase in production of portland and blended cements in 2013 (van Oss, 2014). Lightweight aggregate production was the third leading market for common clay and shale sales (23% of sales). Brick, cement manufacture, and lightweight aggregate production accounted for 93% of sales in 2013. Lightweight aggregate sales (2.47 Mt) were subdivided into concrete block (40%), miscellaneous lightweight aggregates (26%), structural concrete (22%), and highway surfacing (12%). Other markets for common clay and shale included civil engineering, ceramic floor

and wall tile, miscellaneous ceramics, heavy-clay (nonbrick) products, and refractory products (table 5).

Housing starts increased 18% in 2013 (U.S. Census Bureau, undated). There was not, however, a corresponding increase in demand for common clay for the manufacture of brick. One factor was that leading national developers focused on building starter homes in 2013 that used less brick and ceramic tile (Boral Ltd., 2013, p. 16). Also, one major U.S. brick producer reported that its company, as well as others, reduced brick inventories, which resulted in reduced brick manufacturing during the year (Wienerberger AG, 2014, p. 98).

Prices.—The average unit value reported by domestic producers for all common clay and shale produced in the United States was \$12 per ton in 2013, slightly higher than that of 2012. The value of clay and shale used to produce lightweight aggregate was estimated to be \$33 per ton in 2013 compared with \$27 per ton in 2012. Average prices for lightweight aggregate produced from clay and shale ranged from \$30 to \$80 per ton for most applications. Unit values for common clay and shale should be used with caution. Most common clay and shale producers do not sell their clay but use it directly to manufacture products and have not established a selling price for their clays.

Fire clay

Production.—Fire clay producers were mostly refractory product manufacturers that used the clays in firebrick and various heavy-clay products. In 2013, four firms mined fire clay in three States. Fire clay production decreased by 17% to 151,000 t valued at \$3.42 million compared with 183,000 t valued at \$4.87 million in 2012 (table 6). Missouri was the leading producing State, followed by, in descending order of tonnage, Colorado and Texas. Lower production was reported by the two leading fire clay producers, and several common clay producers that occasionally mined fire clay indicated that they did not do so in 2013. Year-to-year production of fire clay has become more variable in recent years as common clay producers randomly entered and exited the fire clay market in response to short-term customer demands.

Consumption.—Consumption of fire clay decreased by 17% in 2013. Leading markets for fire clay were, in descending order of tonnage, portland cement, refractory grogs and calcines, ceramic floor and wall tile, and fire brick. Most data were withheld to avoid disclosing company proprietary data (table 6). Fire clay also was sold for common brick, high-alumina brick and specialties, pottery, ramming and gunning mixes, refractory block and mortars, and refractory saggars.

Prices.—In 2013, the average unit value for fire clay reported by domestic producers decreased by 15% to \$23 per ton compared with \$27 per ton in 2012. The average f.a.s. value of exported fire clay was \$153 per ton in 2013 compared with \$163 per ton in 2012. The average Customs value of imported fire clay was \$462 per ton in 2013 compared with \$172 per ton in 2012. Small, high-value shipments for exports and imports affected the overall unit values.

Foreign Trade.—Exports of fire clay and refractory-grade kaolin appear to have been shipped under the same HTS code in recent years. More than 60% of the exports reported by the U.S.

Census Bureau under the HTS 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. In 2013, exports of fire clay and refractory-grade kaolin decreased by 7% to 268,000 t valued at \$41.1 million compared with 289,000 t valued at \$47.2 million in 2012. In 2013, Mexico and Luxembourg accounted for 44% and 20% of U.S. fire clay exports, respectively (table 14). In 2013, imports were 3,000 t valued at \$1.39 million compared with 8,000 t valued at \$1.38 million in 2012. China was the source for 82% of the U.S. import tonnage (table 15).

Fuller's earth

Production.—In 2013, 11 companies produced fuller's earth in 10 States. Fuller's earth deposits consist mainly of palygorskite (attapulgitite) in Florida and southwestern Georgia and montmorillonite in central Georgia and other States. Gellant grades of attapulgitite, used as thickeners in such items as drilling muds and paints, were mined in western Florida and near Attapulgus, GA. Sorbent grades of attapulgitite were mined a little further north near Ochlocknee, GA. To be consistent with past reporting, sorbent grades of attapulgitite were grouped with the montmorillonite-type fuller's earth, whose major market also was sorbent applications.

Gellant-grade attapulgitite was mined or sold in the Florida Panhandle and southwestern Georgia by two companies. Attapulgitite production data were withheld to avoid revealing company proprietary data, but production increased in 2013 compared with that of 2012. Florida led in the production of attapulgitite, followed by Georgia.

Production of the montmorillonite variety of fuller's earth increased slightly to 1.99 Mt valued at \$178 million in 2013 compared with 1.98 Mt valued at \$182 million in 2012 (table 7). Montmorillonite-type fuller's earth was produced, in decreasing order of tonnage, in Missouri, Georgia, Mississippi, Virginia, California, Florida, Tennessee, Kansas, Texas, and Illinois. Georgia, Mississippi, Missouri, and Virginia accounted for 80% of U.S. production.

Oil-Dri Corp. of America acquired most of the assets of MFM Industries Inc. in Florida after MFM filed for bankruptcy. The purchase included customer lists, inventory, mining and manufacturing equipment, and packaging but did not include land or mineral rights. The MFM plant was closed, and MFM customer orders were filled through Oil-Dri's existing plants in Georgia (Oil-Dri Corp. of America, 2014, p. 17–18).

Consumption.—Consumption of fuller's earth (excluding gellant-grade attapulgitite-type fuller's earth) increased slightly in 2013. Pet waste absorbent (64% of sales) was the leading market for the montmorillonite-type and sorbent-grade attapulgitite-type of fuller's earth, followed by miscellaneous (unknown or unspecified uses) (10%); fillers, extenders, and binders (9%); filtering, clarifying, and decolorizing of animal, mineral, and vegetable oils and greases (8%); oil and grease absorbents (6%); exports (3%); and animal feed (1%). Other uses included civil engineering, drilling mud, fertilizer carriers, paint, and pesticide carriers (table 7). The leading market for gellant-grade attapulgitite-type fuller's earth was unknown or unspecified uses; followed by, in decreasing order of tonnage, miscellaneous

fillers, extenders, and binders; paint; drilling mud; fertilizer carriers; animal feed; adhesives; pesticide carriers; plastics; oil and grease absorbents; filtering, clarifying, and decolorizing of animal, mineral, and vegetable oils and greases; and medical, pharmaceuticals, and cosmetics applications.

In 2013, domestic sales of fuller's earth for pet waste absorbents decreased by 5% compared with that of 2012. Sales of fuller's earth for filtering, clarifying, and decolorizing animal, mineral, and vegetable oils and greases increased by 9%. A major producer reported increased U.S. demand for fluid filtration products in 2013 (Oil-Dri Corp. of America, 2014, p. 20). Several fuller's earth producers reported increased sales for filler, extender, and binder applications. Animal feed and oil and grease absorbent applications decreased by 63% and 23%, respectively. Some sales for animal feed, possibly 25,000 to 35,000 t, may have been reported under the "Fillers, extenders, and binders" category, which increased by 52% in 2013. Some sales for oil and grease absorbent, possibly as much as 25,000 t, may have been reported under the "Miscellaneous" category, which increased by 13% in 2013.

Montmorillonite grades dominated sales to most fuller's earth markets, but attapulgite accounted for most of the sales of fuller's earth for adhesives; drilling mud; paint; miscellaneous fillers, extenders, and binders; and plastics.

Prices.—The average unit value of attapulgite-type fuller's earth reported by domestic producers was withheld to avoid disclosing company proprietary data, but the unit value increased slightly in 2013 from that of 2012. The average value of montmorillonite-type fuller's earth was \$90 per ton in 2013 compared with \$92 per ton in 2012. The average f.a.s. value of exported fuller's earth was \$338 per ton in 2013 compared with \$340 per ton in 2012. The average Customs value of imported fuller's earth was \$54 per ton in 2013 compared with \$114 per ton in 2012.

The price of fullers' earth, soda ash-treated, civil engineering grade, ex-works, South Africa, was \$82 to \$115 per ton; pet waste absorbent grade, ex-works, South Africa, was \$45 to \$66 per ton; and foundry grade, ex-works, South Africa, was \$99 to \$140 per ton (Industrial Minerals, 2013).

Foreign Trade.—In 2012, exports decreased by 20% to 86,000 t valued at \$29.1 million in 2013 compared with 107,000 t valued at \$36.3 million in 2012 (table 14). The Netherlands accounted for 27% of the decrease in exports, with the remainder spread among more than 30 other countries. Imports of decolorizing earth and fuller's earth were 8,000 t valued at \$434,000 in 2013 compared with 1,410 t valued at \$160,000 in 2012 (table 15).

Kaolin

Production.—In 2013, 17 firms mined kaolin in 9 States. Domestic production increased slightly to 5.95 Mt valued at \$874 million compared with 5.90 Mt valued at \$881 million in 2012 (table 8). Georgia accounted for 92% of the U.S. kaolin production, followed by, in descending order of tonnage, South Carolina, Alabama, Arkansas, Texas, Nevada, Florida, North Carolina, and California. Kaolin production in Georgia increased slightly to 5.45 Mt valued at \$836 million in 2013 compared with 5.41 Mt valued at \$844 million in 2012 (table 9).

Companies in Georgia accounted for nearly all the pigment-grade calcined kaolin produced in the United States in 2013. A small amount also was produced in Texas. Production in South Carolina, which accounted for 4% of U.S. kaolin production, increased slightly to 257,000 t valued at \$21.8 million in 2013 compared with 256,000 t valued at \$20.6 million in 2012 (table 10).

Imerys, a leading U.S. kaolin producer, purchased PyraMax Ceramics, LLC, which completed construction of a 225,000-metric-ton-per-year ceramic proppants plant in Wrens, GA. The \$235 million purchase included kaolin reserves needed to produce the proppants. Ceramic proppants are used to enhance nonconventional gas and oil extraction (Imerys SA, 2014, p. 7, 17, 230).

Consumption.—Consumption of kaolin increased slightly in 2013 from that of 2012 (table 11). The major domestic markets for kaolin were, in descending order of tonnage, paper coating and filling (38% of domestic sales), refractory products (14%), miscellaneous ceramics (12%), fiberglass and mineral wool (7%), paint (7%), rubber (6%), and catalysts (4%). Smaller but significant domestic markets were adhesives, chemical manufacture, floor and wall tile, heavy-clay products (brick and portland cement), plastics, and sanitaryware. The leading export market for kaolin was paper coating and filling (table 11). A similar market distribution was seen for producers in Georgia (table 9).

The sales distribution for South Carolina kaolin producers was, in descending order of tonnage, rubber, crockery and other earthenware, fiberglass, brick, paper coating, sanitaryware, portland cement, plastics, paint, adhesives, and animal feed. Much of the data for individual markets were withheld to avoid disclosing company proprietary data (table 10).

Paper coating and filling markets accounted for 47% of total (domestic and export) kaolin sales in 2013 compared with 45% in 2012. Domestic sales of kaolin for paper coating markets increased by 18% in 2013. One U.S. producer appears to have reported some 2012 domestic sales for paper coating under exports because paper coating exports increased to greater than expected levels in 2012 and decreased in 2013. Total sales (domestic and export combined) for paper applications increased by 4% in 2013 compared with those of 2012. Refractory products accounted for 10% of total kaolin sales in 2013, with sales decreasing by 15% compared with those of 2012. One producer accounted for a large share of the decrease in sales for refractory products. Decreases in reported sales to several ceramic markets are likely accounted for by a 40% increase in tonnage reported under "Miscellaneous" in the "Ceramics" category. Sales to rubber markets increased by 50% in 2013. One company accounted for most of the increase, suggesting a buildup of stocks by several of its customers (table 11).

Prices.—In 2013, the average unit value of kaolin reported by domestic producers decreased slightly to \$147 per ton for all kaolin grades compared with \$149 per ton in 2012. The average value for airfloat was \$85 per ton in 2013 compared with \$84 per ton in 2012; delaminated, \$150 per ton, unchanged from that of 2012; unprocessed, \$35 per ton in 2013 compared with \$45 per ton in 2012; and water washed, \$158 per ton in 2013, unchanged from that of 2012. All types of calcined kaolin

combined were valued at \$208 per ton in 2013, unchanged from that of 2012. In 2013, the average f.a.s. value of exported kaolin was \$227 per ton compared with \$224 per ton in 2012. The average Customs value of imported kaolin was \$120 per ton, unchanged from that of 2012.

The price of number 1 paper coating grades of kaolin from a plant in Georgia ranged from \$167 to \$217 per ton, and the price of number 2 paper coating grades varied from \$112 to \$173 per ton (Industrial Minerals, 2013).

Foreign Trade.—Exports increased by 4% in 2013 to 2.54 Mt of kaolin valued at \$577 million compared with 2.45 Mt valued at \$549 million in 2012 (table 14). Producers reported exports of 1.71 Mt (table 11). Some of the kaolin exported to Canada and Mexico probably was reported under domestic consumption by U.S. producers. Sales through U.S. mineral brokers, where producers do not know if the kaolin is used domestically or exported, also could explain part of the discrepancy.

Kaolin imports were 468,000 t of kaolin valued at \$56 million in 2013 compared with 472,000 t valued at \$56.8 million in 2012 (table 15). About 96% of kaolin imports were from Brazil and were used primarily in paper coating applications.

World Review

In 2013, world production of bentonite was approximately 12 Mt, an 8% decrease from 13 Mt in 2012 (table 16). Fuller's earth production was 3 Mt in 2013, a slight increase from that of 2012 (table 17). In 2013, kaolin production was about 40.3 Mt, a slight increase from that of 2012 (table 18), including ball clay production reported by Australia, Ukraine, and various other countries, and crude kaolin ore production that was reported by many countries. World sales of processed kaolin were estimated to be between 25 and 27 Mt, after accounting for processing losses and stockpiling and the inclusion of ball clay production as kaolin by some countries. The United States continued to be the leading supplier of processed clay for sale, followed by India and Greece for bentonite, Spain and Senegal for fuller's earth, and Brazil and the United Kingdom for kaolin. Production data for China were not available, but China was thought to be among the leading producers for bentonite and kaolin. Spain led all countries in the production of sepiolite. Senegal was the leading producer of palygorskite (attapulgite), followed by the United States. The rankings above were based on processed clay sold or used and not on crude ore production.

Bulgaria.—Quarzwerke GmbH, with kaolin operations in Germany, Poland, and Ukraine, acquired Kaolin AD, with kaolin operations in Bulgaria (Kaolin AD, 2013).

United Kingdom.—Imerys, the world's leading kaolin producer, completed the purchase of the kaolin operations of Goonvean Ltd. in Cornwall. Goonvean sold kaolin primarily for ceramics and performance minerals markets. The sale was approved by British authorities contingent upon price controls for certain kaolin products sold in the United Kingdom (Imerys SA, 2014, p. 8, 19).

Outlook

Ball clay, common clay and shale, fire clay, attapulgite-type fuller's earth, and kaolin are used to manufacture many

construction-related products, ranging from brick to caulk to paint to sanitaryware to ceramic tile. U.S. shipments of ceramic tile and U.S. tile consumption have increased since 2010 (Whitmire, 2014). Housing starts also have increased every year since 2010. Reported starts for privately owned housing units were 923,000 in 2013 compared with 781,000 in 2012, an 18% increase (U.S. Census Bureau, undated). Despite a decrease in sales of common clay and shale for brick manufacture in 2013, sales of clays to construction-related markets may increase slightly in 2014 owing to the increased construction activity.

Sales of refractory products are expected to increase through 2016 although sales for clay-based refractory products are expected to lag behind other types of refractory products (Brooks, 2014). Consequently, sales of common clay, fire clay, and kaolin for refractory uses may remain unchanged or increase only slightly in 2014.

Since 2006, sales of swelling bentonite and fuller's earth for pet waste absorbent markets have fluctuated around 1 Mt and 1.3 Mt, respectively. Despite the variability in sales from year to year, the underlying trend in sales has been relatively flat for the past 7 years and probably will remain so for the near future.

Hydrocarbon drilling activity in Canada and the United States decreased slightly since 2013 while those outside of North America have increased (Baker Hughes Inc., 2014). North American bentonite sales for drilling mud use may be unchanged or decrease slightly because hydraulic fracturing methods, which increase gas and oil production without requiring additional bentonite drilling mud, continue to dominate the industry. U.S. exports for drilling mud may increase slightly in 2014. Sales of attapulgite-type fuller's earth, which accounts for only a small portion of the overall drilling mud market, may remain unchanged or increase slightly in 2014.

Sales of bentonite are linked to the iron and steel industries because of its use for pelletizing iron ore (swelling bentonite) and as a foundry sand bond (swelling and nonswelling bentonite). Machinery and vehicle manufacture, which use steel and cast metal components, increased in 2013 (Board of Governors of the Federal Reserve System, 2014, p. 7). One supplier of bentonite to the foundry industry expected growth in that industry segment in 2014 (S&B Industrial Minerals S.A., 2014, p. 6, 12). These factors suggest that demand for bentonite for foundry sand bond applications may increase slightly in 2014. In early 2014, domestic shipments of iron ore by U.S. iron ore producers decreased, and imports of pelletized ore increased (Tuck, 2014a). Consequently, bentonite sales for iron ore pelletizing may be unchanged or decrease slightly in 2014.

The continued increase in U.S. commercial and residential construction is expected to result in increased sales of bentonite and common clay and shale used for civil engineering applications, such as waterproofing and sealing and landfill caps and liners. Sales may increase slightly in 2014. Sales of bentonite and fuller's earth as carriers and suspension agents in fertilizers and pesticides may decrease in 2014, based on a reported decrease in sales by a major U.S. supplier in early 2014 (Oil-Dri Corp. of America, 2014, p. 20, 21). Sales of bentonite and fuller's earth for filtering, clarifying, and decolorizing of animal, mineral, and vegetable oils and greases are dependent

on the quality of the oil source, and sales tend to vary annually for that reason rather than following economic trends. A leading U.S. supplier of fuller's earth for fluid purification applications indicated that sales increased through early 2014, suggesting that overall sales for this use may increase in 2014 (Oil-Dri Corp. of America, 2014, p. 20, 21).

The paper market continued to decrease as more information exchange is conducted electronically and economies continue to struggle, which typically affects print publications and, in particular, print advertising. In the United States, industrial production of paper, the leading market for kaolin, decreased 1.4% from the fourth quarter of 2012 to the fourth quarter of 2013 (Board of Governors of the Federal Reserve System, 2014, p. 8). Based on usage trends, domestic sales of kaolin to paper markets may be unchanged or decrease slightly in 2014. Export sales of kaolin, primarily for paper use, may increase slightly, particularly to markets in Asia. Kaolin sales for ceramic proppants were expected to increase in 2014, although sales could be affected if natural gas prices remain low or decrease (CARBO Ceramics Inc., 2014, p. 26; Imerys SA, 2014, p. 47; Ollett, 2013).

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TABLE 1
SALIENT U.S. CLAY STATISTICS^{1,2}

(Thousand metric tons and thousand dollars)

	2009	2010	2011	2012	2013
<u>Domestic clays sold or used by producers:</u>					
Quantity	24,500	25,600	25,700	25,900 ^r	24,000
Value	1,330,000	1,480,000	1,540,000	1,560,000 ^r	1,510,000
<u>Exports:</u>					
Quantity	3,830	4,360	4,240	4,270 ^r	4,140
Value	702,000	862,000	988,000	870,000 ^r	892,000
<u>Imports for consumption:</u>					
Quantity	325	555	593	524	523
Value	104,000	81,200	97,400	108,000	106,000

^rRevised.

¹Does not include Puerto Rico.

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

TABLE 2
CLAYS SOLD OR USED BY PRODUCERS IN THE
UNITED STATES, BY STATE^{1,2}

(Thousand metric tons and thousand dollars)

State ³	2012		2013	
	Quantity	Value	Quantity	Value
Alabama	1,420	22,200	1,420	20,200
Arkansas, Louisiana, and Mississippi	1,200 ^r	42,800 ^r	1,060	41,600
California and Oregon	923 ^r	37,800 ^r	1,380	38,900
Colorado	241	5,100	234	4,970
Georgia	6,580 ^r	893,000 ^r	6,370	882,000
Illinois, Iowa, and Michigan	562 ^r	8,370 ^r	335	7,750
Indiana	392	7,520	325	8,140
Kansas	335	3,280	341	1,830
Kentucky and Tennessee	1,120 ^r	41,200 ^r	1,000	40,100
Missouri	1,150	36,300	1,030	33,300
Nebraska, North Dakota, and South Dakota	251 ^r	1,270 ^r	258	1,380
New York	425	19,000	519	22,100
North Carolina	742	20,600	738	20,400
Ohio	693	13,900	518	10,500
Oklahoma	638	3,010	603	1,990
Pennsylvania	318	2,480	236	1,240
South Carolina	453 ^r	21,700 ^r	401	22,700
Texas	2,250	40,500	1,870	38,000
Utah	464	21,500	428	13,400
Virginia and West Virginia	772 ^r	23,600 ^r	633	24,800
Wyoming	4,540	267,000	4,020	253,000
Other ⁴	423 ^r	30,500 ^r	308	19,900
Total	25,900 ^r	1,560,000 ^r	24,000	1,510,000

^rRevised.

¹Does not include Puerto Rico.

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Publishable totals used to avoid disclosing company proprietary data.

⁴Includes Arizona (2012), Connecticut, Florida, Maine (2012), Maryland, Massachusetts, Montana, Nevada, New Mexico, and Washington (2012).

TABLE 3
BALL CLAY SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY TYPE AND USE¹

(Thousand metric tons and thousand dollars)

Type and use	2012		2013	
	Quantity	Value	Quantity	Value
Type:				
Airfloat	653	29,500	697	27,500
Water-slurried	104	4,860	97	4,780
Unprocessed	215	10,700	209	10,500
Total	973	45,100	1,000	42,800
Use:				
Fillers, extenders, and binders ²	40	NA	34	NA
Floor and wall tile	426	NA	395	NA
Miscellaneous ceramics ³	85	NA	88	NA
Pottery	4	NA	3	NA
Sanitaryware	177	NA	170	NA
Miscellaneous ⁴	37	NA	142	NA
Exports, reported by producers ⁵	202	NA	171	NA
Total	973	45,100	1,000	42,800

NA Not available.

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

²Includes adhesives; asphalt emulsions; fertilizer carriers; paint; rubber; and other fillers, extenders, and binders.

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

⁴Includes heavy-clay products, refractories, and unknown uses.

⁵Includes miscellaneous ceramics and unknown uses.

TABLE 4
BENTONITE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY TYPE AND USE¹

(Thousand metric tons and thousand dollars)

Type and use	2012		2013	
	Quantity	Value	Quantity	Value
Type:				
Nonswelling	140	10,700	132	9,960
Swelling	4,840	300,000	4,220	272,000
Total	4,980	311,000	4,350	282,000
Use:				
Domestic:				
Pet waste absorbents	1,050	NA	1,130	NA
Adhesives	9	NA	10	NA
Animal feed	52	NA	84	NA
Drilling mud	1,190	NA	932	NA
Filler and extender applications ²	77	NA	64	NA
Foundry sand	475	NA	440	NA
Pelletizing (iron ore)	508	NA	470	NA
Waterproofing and sealing	126	NA	W	NA
Miscellaneous civil engineering	136	NA	W	NA
Miscellaneous ³	162	NA	394	NA
Total	3,790	NA	3,520	NA
Exports, reported by producers:				
Drilling mud	176	NA	132	NA
Foundry sand	196	NA	201	NA
Other ⁴	817	NA	500	NA
Total	1,190	NA	833	NA
Grand total	4,980	311,000	4,350	282,000

NA Not available.

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

²Includes asphalt tiles, asphalt emulsions, cosmetics, fertilizers, ink, medical, miscellaneous filler and extender applications, paint, paper coating, paper filling, pesticides and related products, pharmaceuticals, and plastics.

³Includes ceramics, chemical manufacturing, clarifying and decolorizing, heavy-clay products, oil and grease absorbents, refractories, and unknown uses.

⁴Includes absorbents, fillers and extenders, refractories, pelletizing, and unknown uses.

TABLE 5
COMMON CLAY AND SHALE SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY STATE AND USE^{1,2,3}

(Thousand metric tons and thousand dollars)

State and use	2012		2013	
	Quantity	Value	Quantity	Value
State:				
Alabama	1,210	9,070	1,240	8,390
Arkansas, Louisiana, and Mississippi	752 ^r	4,060 ^r	604	3,540
California and Oregon	715 ^r	8,320 ^r	1,170	8,540
Colorado	235 ^r	5,000 ^r	228	4,880
Illinois, Iowa, and Michigan	515 ^r	2,260 ^r	320	1,650
Indiana	369	6,240	294	6,490
Kansas	296	1,750	309	1,800
Kentucky and Tennessee	385 ^r	5,210 ^r	268	4,530
Missouri	409	3,190	344	1,660
Nebraska, North Dakota, and South Dakota	251 ^r	1,270 ^r	258	1,380
New York	425	19,000	519	22,100
North Carolina	732 ^r	20,100 ^r	727	20,000
Ohio	693	13,900	518	10,500
Oklahoma	638	3,010	603	1,990
Pennsylvania	317 ^r	2,480 ^r	236	1,240
South Carolina	197	1,120	144	921
Texas	1,940	13,400	1,520	12,100
Utah	332	12,100	306	11,900
Virginia and West Virginia	529 ^r	2,430 ^r	371	1,500
Other ⁴	930 ^r	5,090 ^r	630	2,100
Total	11,900^r	139,000^r	10,600	127,000
Use:				
Floor and wall tile ⁵	181 ^r	NA	203	NA
Heavy-clay products:				
Brick, extruded	4,360	NA	3,680	NA
Brick, other	943	NA	464	NA
Other ⁶	103	NA	21	NA
Lightweight aggregate:				
Concrete block	1,140 ^r	NA	977	NA
Highway surfacing	661 ^r	NA	290	NA
Structural concrete	655 ^r	NA	545	NA
Miscellaneous	502	NA	653	NA
Portland and other cements	2,800	NA	3,270	NA
Refractories ⁷	247	NA	95	NA
Miscellaneous ⁸	276 ^r	NA	409	NA
Total	11,900^r	139,000^r	10,600	127,000

^rRevised. NA Not available.

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

²Does not include Puerto Rico.

³Includes only production for companies with mills or plants.

⁴Includes Arizona (2012), Connecticut, Florida, Georgia, Maine (2012), Maryland, Massachusetts, Montana, New Mexico, Washington (2012), and Wyoming.

⁵Includes ceramic tile, quarry tile, and miscellaneous floor and wall tiles.

⁶Includes drain tile, flowerpots, flue linings, sewer pipes, structural tile, and miscellaneous clay products.

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

⁸Includes exports reported by producers; miscellaneous civil engineering and sealings; miscellaneous fillers, extenders, and binders; pottery; roofing granules; and unknown uses.

TABLE 6
FIRE CLAY SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USE¹

(Thousand metric tons and thousand dollars)

Use	2012		2013	
	Quantity	Value	Quantity	Value
Production	183	4,870	151	3,420
Use:				
Heavy-clay products and lightweight aggregates ²	73	NA	51	NA
Refractories:				
Firebrick, block, and shapes	4	NA	W	NA
Grog and calcines	W	NA	W	NA
Other refractories ³	W	NA	W	NA
Miscellaneous ⁴	70	NA	101	NA
Total	183	4,870	151	3,420

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 common brick, concrete block, portland cement, and structural concrete.

³Includes kiln furniture, mortar and cement, and miscellaneous refractories.

⁴Includes floor tile, wall tile, and unknown uses.

TABLE 7
FULLER'S EARTH SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY TYPE AND USE¹

(Thousand metric tons and thousand dollars)

Type and use	2012		2013	
	Quantity	Value	Quantity	Value
Type:				
Attapulgite	(2)	(2)	(2)	(2)
Montmorillonite	1,980	182,000	1,990	178,000
Total	1,980	182,000	1,990	178,000
Use:				
Absorbents:				
Oil and grease	153	NA	123	NA
Pet waste	1,340	NA	1,270	NA
Animal feed	58	NA	19	NA
Fillers, extenders, and binders ³	100	NA	152	NA
Filtering, clarifying, and decolorizing ⁴	139	NA	151	NA
Miscellaneous ⁵	184	NA	208	NA
Exports, reported by producers ⁶	10	NA	65	NA
Total	1,980	182,000	1,990	178,000

NA Not available.

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

²Withheld to avoid disclosing company proprietary data. Primarily gellant-grade fuller's earth. More information can be found in the "Fuller's Earth" section of this report.

³Includes asphalt emulsions; medical, pharmaceuticals, and cosmetics; paints; pesticides and products; and related unknown uses.

⁴Includes mineral and vegetable oils and greases.

⁵Includes civil engineering, drilling mud, miscellaneous absorbents, and unknown uses.

⁶Includes oil and grease absorbents, pet waste absorbents, drilling mud, paint, and unknown uses.

TABLE 8
KAOLIN SOLD OR USED BY PRODUCERS IN THE UNITED STATES,
BY STATE AND TYPE¹

(Thousand metric tons and thousand dollars)

State and type	2012		2013	
	Quantity	Value	Quantity	Value
State:				
Georgia	5,410 ^r	844,000 ^r	5,450	836,000
South Carolina	256 ^r	20,600 ^r	257	21,800
Other ²	236	16,900	244	16,600
Total	5,900 ^r	881,000 ^r	5,950	874,000
Type:				
Airfloat	996 ^r	83,700 ^r	996	84,800
Calcined ³	1,370	284,000	1,330	275,000
Delaminated	927	139,000	926	139,000
Unprocessed	349 ^r	16,000 ^r	423	14,900
Water washed	2,260 ^r	358,000	2,270	360,000
Total	5,900 ^r	881,000 ^r	5,950	874,000

^rRevised.

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

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

³Includes pigment-grade kaolin (low-temperature calcined kaolin) and refractory-grade kaolin (high-temperature calcined kaolin).

TABLE 9
 GEORGIA KAOLIN SOLD OR USED BY PRODUCERS, BY TYPE AND USE¹

(Thousand metric tons and thousand dollars)

Type and use	2012		2013	
	Quantity	Value	Quantity	Value
Type:				
Airfloat	747 ^r	60,500 ^r	747	60,300
Calcined ²	1,300	276,000	1,270	268,000
Delaminated	927	139,000	926	139,000
Unprocessed	190 ^r	10,500 ^r	251	9,400
Water washed	2,250	358,000	2,250	360,000
Total	5,410^r	844,000^r	5,450	836,000
Use:				
Domestic:				
Ceramics and glass:				
Catalysts (oil-refining)	W	NA	W	NA
Fiberglass, mineral wool	259 ^r	NA	261	NA
Roofing granules	30 ^r	NA	33	NA
Other ³	514 ^r	NA	594	NA
Fillers, extenders, and binders:				
Adhesives	19	NA	37	NA
Paint	239	NA	267	NA
Paper coating	1,190	NA	1,400	NA
Paper filling	181	NA	221	NA
Plastic	51	NA	59	NA
Rubber	117 ^r	NA	154	NA
Other ⁴	66 ^r	NA	31	NA
Heavy-clay products ⁵	(6)	NA	(6)	NA
Refractories ⁷	(6)	NA	(6)	NA
Undistributed ⁸	807 ^r	NA	693	NA
Total	3,480^r	NA	3,750	NA
Exports, reported by producers:				
Paint	123	NA	114	NA
Paper coating ⁹	1,280	NA	1,150	NA
Paper filling ⁹	231	NA	80	NA
Rubber	58	NA	40	NA
Undistributed ¹⁰	240	NA	312	NA
Total	1,930	NA	1,690	NA
Grand total	5,410^r	844,000^r	5,450	836,000

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

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

²Includes pigment- and refractory-grade calcined kaolin.

³Includes catalysts (oil-refining), electrical porcelain, fine china and dinnerware, pottery, miscellaneous ceramics, and sanitaryware.

⁴Includes animal feed; asphalt tile; fertilizers; medical, pharmaceuticals, and cosmetics; pesticides and related products; and miscellaneous fillers, extenders, and binders.

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

⁶Withheld to avoid disclosing company proprietary data; included in "Domestic: Undistributed."

⁷Includes firebricks, blocks and shapes, grogs and calcines, high-alumina specialties, kiln furniture, and miscellaneous refractories.

⁸Includes chemical manufacturing, floor and wall tiles, heavy-clay products, refractories products, waterproofing seals, and unknown uses.

⁹Some export sales, by producers, may be included with domestic sales.

¹⁰Includes miscellaneous ceramics; miscellaneous fillers, extenders, and binders; and unknown uses.

TABLE 10
SOUTH CAROLINA KAOLIN SOLD OR USED BY PRODUCERS, BY USE¹

(Thousand metric tons and thousand dollars)

Use	2012		2013	
	Quantity	Value	Quantity	Value
Production ²	256 ^r	20,600 ^r	257	21,800
Use:				
Ceramics ³	52 ^r	NA	107	NA
Rubber	57 ^r	NA	109	NA
Other ⁴	146 ^r	NA	41	NA
Total	256 ^r	20,600 ^r	257	21,800

^rRevised. NA Not available.

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

²Includes airfloat, unprocessed, and calcined kaolin.

³Includes catalysts (oil-refining), fiberglass, roofing granules, and sanitaryware.

⁴Includes adhesives, animal feed, brick (common), floor and wall tile, paint, paper coating, plastics, portland cement, and refractories.

TABLE 11
KAOLIN SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USE¹

(Thousand metric tons)

Use	2012	2013
Domestic:		
Ceramics:		
Catalyst (oil and gas refining)	189 ^r	175
Fine china and dinnerware	7	8
Floor and wall tile	82	55
Pottery ²	W	W
Roofing granules	31 ^r	33
Sanitaryware	41 ^r	44
Miscellaneous	369 ^r	515
Chemical manufacture	W	W
Fiberglass, mineral wool	306 ^r	307
Fillers, extenders, and binders:		
Adhesive	31	39
Paint	256	287
Paper coating	1,190	1,410
Paper filling	181	221
Pesticide ³	W	W
Plastic	53 ^r	61
Rubber	175 ^r	263
Miscellaneous	68 ^r	31
Heavy-clay products:		
Brick, common and face	23	26
Portland cement	50 ^r	68
Refractories ⁴	719	609
Miscellaneous applications	151 ^r	85
Total	3,930 ^r	4,240
Exports, reported by producers:		
Ceramics ⁵	W	W
Paint	123 ^r	125
Paper coating	1,280	1,150
Paper filling	W	W
Rubber	86	45
Miscellaneous	486 ^r	393
Total	1,980 ^r	1,710
Grand total	5,900 ^r	5,950

^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.

²Included in "Miscellaneous."

³Included in "Miscellaneous."

⁴Includes miscellaneous refractories.

⁵Included in "Miscellaneous."

TABLE 12
COMMON CLAY AND SHALE USED IN LIGHTWEIGHT AGGREGATE
PRODUCTION IN THE UNITED STATES BY STATE¹

(Thousand metric tons and thousand dollars)

State	Concrete block	Structural concrete	Other ²	Total	
				Quantity	Value ^e
2012: ^f					
Alabama, Louisiana, North Carolina, and Texas	655	275	594	1,520	26,600
California, Colorado, and Utah	121	139	195	455	15,600
Indiana, New York, and Ohio	304	217	197	718	32,400
Kansas, Kentucky, Missouri, Nebraska, and Oklahoma	62	25	177	264	5,590
Total	1,140	656	1,160	2,960	80,200
2013:					
Alabama, Louisiana, North Carolina, and Texas	565	181	239	985	25,800
California, Colorado, and Utah	118	135	196	449	15,500
Indiana, New York, and Ohio	253	205	325	783	36,400
Kansas, Kentucky, Missouri, Nebraska, and Oklahoma	41	24	182	247	3,910
Total	977	545	942	2,460	81,500

^eEstimated.

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

²Includes highway surfacing.

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

(Thousand metric tons and thousand dollars)

State	2012		2013	
	Quantity	Value ^{f,e}	Quantity	Value ^e
Alabama	363	3,130	363	3,180
Arkansas, Louisiana, and Mississippi	410	2,290	251	1,420
California and Utah	170	970	94	1,060
Colorado	94	289	83	245
Georgia and South Carolina	822	4,510	578	2,030
Illinois, Iowa, and Michigan	221	996	153	626
Indiana	86	474	55	293
Kansas and Missouri	65	520	68	559
Kentucky ³ and Tennessee	289	1,670	143	670
Nebraska and North Dakota	125	518	121	777
North Carolina	459	2,150	455	1,960
Ohio	353	4,490	159	877
Oklahoma	418	1,590	417	1,410
Pennsylvania	256	1,420	191	1,040
Texas	411	2,540	509	2,510
Virginia and West Virginia	527	2,410	370	1,500
Other ⁴	230	1,250	132	888
Total	5,300	31,200	4,140	21,000

^eEstimated. ^fRevised.

¹Includes extruded and other brick.

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Extruded brick only.

⁴Includes all other States except Alaska, Nevada, New Hampshire, Rhode Island, Vermont, and Wisconsin.

TABLE 14
U.S. EXPORTS OF CLAYS, BY TYPE¹

(Thousand metric tons and thousand dollars)

Type of clay	2012		2013		Principal destinations in 2013
	Quantity	Value ²	Quantity	Value ²	
Ball clay	77 ^r	4,580	52	6,610	Belgium, 70%; Nicaragua, 15%; Japan, 13%; Costa Rica, 11%.
Bentonite	1,030 ^r	164,000 ^r	890	157,000	Canada, 49%; Japan, 11%; China, 6%.
Fire clay	289	47,200	268	41,100	Mexico, 44%; Luxembourg, 20%; Japan, 11%; Netherlands, 5%.
Fuller's earth	107 ^r	36,300 ^r	86	29,100	Japan, 70%; Brazil, 9%; Italy, 8%; China, 6%; Netherlands, 6%.
Kaolin	2,450	549,000	2,540	577,000	Taiwan, 70%; Mexico, 10%; Japan, 10%; Korea, Republic of, 10%.
Clays ³	315 ^r	68,200 ^r	304	81,200	Japan, 70%; Mexico, 20%; Germany, 5%; Korea, Republic of, 4%.
Total	4,270 ^r	870,000 ^r	4,140	892,000	

^rRevised.

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

²Free alongside ship.

³Not elsewhere classified.

Source: U.S. Census Bureau.

TABLE 15
U.S. IMPORTS FOR CONSUMPTION OF CLAY, BY TYPE¹

(Thousand metric tons and thousand dollars)

Type of clay	2012		2013		Principal sources in 2013
	Quantity	Value ²	Quantity	Value ²	
China clay or kaolin	472	56,800	468	56,000	Brazil, 96%.
Fire clay	8	1,380	3	1,390	China, 82%; United Kingdom, 7%; Hong Kong, 4%.
Ball clay	(3)	137	(3)	174	United Kingdom, 67%; China, 24%; Canada, 5%; Brazil, 4%.
Bentonite	12	15,300	15	16,100	Mexico, 32%; China, 27%; Egypt, 18%; United Kingdom, 16%.
Fuller's earth	1	160	8	434	China, 55%; Japan, 34%; Canada, 11%.
Chamotte or Dina's Earth	(3)	109	(3)	159	United Kingdom, 90%; Germany, 10%.
Artificially activated clay and earth	31	34,000	28	31,500	Mexico, 34%; Germany, 18%; China, 18%; Belgium, 14%.
Total	524	108,000	523	106,000	

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

²Customs value.

³Less than ½ unit.

Source: U.S. Census Bureau; data adjusted by U.S. Geological Survey.

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

(Metric tons)

Country ³	2009	2010	2011	2012	2013 ^e
Algeria ⁴	31,612	34,126	29,000	30,000	30,000
Argentina	148,099	229,301	228,357	193,795 ^r	200,000
Armenia	38,000	1,397	835	4,987	5,000
Australia ^{e,4}	240,000 ^r	230,000 ^r	230,000 ^r	230,000 ^r	230,000
Azerbaijan	10,581	18,073	55,000	60,000 ^e	60,000
Bolivia	323	440	591	745	525
Bosnia and Herzegovina	16,042	314	--	--	18,808 ⁵
Brazil, beneficiated	264,243	531,693	566,267	512,975 ⁵	513,000
Bulgaria	108,000 ⁵	100,000 ^e	54,000	78,000	78,000
Burma ^{e,6}	-- ^r	-- ^r	-- ^r	-- ^r	--
Chile	--	--	1,255	893	358 ⁵
Cyprus	150,000 ^r	150,000 ^r	150,000 ^r	160,180	158,386 ⁵
Czech Republic, includes montmorillonite clays	177,000	183,000	160,000	221,000	226,000 ⁵
Denmark	24,040	23,832	38,300	30,330 ^r	56,355 ⁵
Egypt	32,000 ^r	33,132	30,000 ^r	30,000 ^r	30,000
Georgia ^e	5,000	5,000	4,800	4,900	5,000
Germany	326,461	362,623	375,332	375,000 ^r	375,000
Greece	926,186 ⁵	1,381,643	1,188,442	1,235,105	1,000,000
Guatemala	14,284	22,423	12,270 ^r	131,843	20,000
Hungary	2,839 ^r	2,567 ^r	17,308	1,392 ^r	1,400
India	671,000	561,000	739,000	996,000	1,081,000 ⁵
Indonesia ^e	6,000	6,500	6,500	7,000	6,000
Iran ⁶	387,437	350,208	377,398	400,000 ^e	400,000
Italy	146,318	111,000	110,000 ^{r,e}	110,000 ^r	110,000
Japan	432,000	430,000	425,000 ^e	420,000 ^e	400,000
Kenya ^e	65	70	75	75	80
Macedonia	15,350	12,798	14,466	6,900	26,820 ⁵
Malawi	8,050	2,100	2,450 ^r	-- ^r	--
Mexico	511,429	590,998	563,795	956,224	617,632
Morocco	84,097	110,700	97,071	91,200 ^r	100,000
Mozambique	92,098	11,417	423	24,000	24,000
New Zealand, processed ^e	880	1,216	--	--	--
Pakistan	33,300	42,100	44,500	16,520 ^r	26,077 ⁵
Peru	119,452	44,266	27,534	22,977	47,744 ⁵
Philippines	1,413	1,475	2,087	2,000 ^e	2,000
Poland ⁷	3,000	2,200 ^r	900 ^r	800 ^{r,e}	1,050 ⁵
Romania	13,756	14,000 ^r	17,667 ^r	18,127 ^r	21,051 ⁵
Slovakia	109,000	130,521	119,323	129,930	130,000
South Africa ⁸	40,340	54,311	120,417	120,566	174,786 ⁵
Spain	140,000	157,001	110,271	115,000 ^r	115,000
Turkey	932,487	798,397	471,528 ^r	1,033,568 ^r	1,100,000
Turkmenistan, includes bentonite powder	50,300 ^r	50,300 ^r	50,300 ^r	53,000 ^r	61,480 ⁵
Ukraine ^e	195,000	185,000	211,000	210,000	210,000
United States	3,650,000	4,600,000	4,990,000	4,980,000	4,350,000
Uzbekistan ^e	20,000	20,000	25,000	25,000	25,000
Total	10,200,000 ^r	11,600,000 ^r	11,700,000 ^r	13,000,000 ^r	12,040,000

^eEstimated. ^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.

²Includes data available through August 15, 2014.

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

⁴Includes bentonite clays.

⁵Reported figure.

⁶Year beginning March 21 of that stated.

⁷Montmorillonite-type bleaching clay.

⁸May include other clays.

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

(Metric tons)

Country ³	2009	2010	2011	2012 ^c	2013 ^c
Australia, attapulgite	9,500 ^r	10,000 ^r	10,000 ^r	10,000 ^r	10,000
India	29,000	5,600	5,600	5,600	5,600 ⁴
Italy ^e	3,000	3,000	3,000	3,000	3,000
Mexico	108,139	170,350	107,436	108,000 ^r	108,000
Morocco, smectite	132,110	82,570	103,700	81,800 ^r	85,000
Pakistan	11,055	6,370	8,000 ^{r,c}	9,000	9,942
Senegal, attapulgite	181,000	204,000	181,000	180,000 ⁴	180,000
South Africa, attapulgite	54,418	85,336	14,448	15,850 ^{r,4}	21,680 ⁴
Spain:					
Attapulgite	21,110	27,841	26,021	26,000	26,000
Sepiolite	573,937	557,862	566,270 ^r	567,000	567,000
United States ^{5,6}	2,010,000	2,050,000	1,950,000	1,980,000 ⁴	1,990,000
Total	3,130,000 ^r	3,200,000 ^r	2,970,000 ^r	2,990,000 ^r	3,000,000

^cEstimated. ^rRevised.

¹Does not include centrally planned economy countries and former such countries, some of which presumably produce fuller's earth but for which no information is available. Includes data available through July 15, 2014.

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, Algeria, France, 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.

⁵Sold or used by producers.

⁶Excludes attapulgite.

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

(Metric tons)

Country ³	2009	2010	2011	2012	2013 ^c
Algeria	87,766	71,065	71,000	70,000	70,000
Argentina	78,792	78,722	54,166	66,574 ^r	65,000
Australia, includes ball clay ^e	230,000 ^r	240,000 ^r	240,000 ^r	240,000 ^r	240,000
Austria, marketable	83,980	58,956	56,976	43,174 ^r	45,000
Bangladesh ^{c,4}	8,500	8,500	-- ^r	-- ^r	--
Belgium ^c	300,000	300,000	300,000	300,000	300,000
Bosnia and Herzegovina, crude	148,384	41,808	232,147	149,495	44,940 ⁵
Brazil, beneficiated	1,987,000	2,000,000	1,927,000	2,189,000 ^r	2,200,000
Bulgaria ^c	939,000 ⁵	900,000	900,000	-- ^r	--
Canada	3,000 ^r	5,000 ^r	-- ^r	-- ^r	--
Chile	48,354	62,226	59,912	60,429	60,000
Czech Republic	2,886,000	3,493,000	3,606,000	3,318,000	3,108,000 ⁵
Ecuador	27,767 ^r	41,089	76,660	50,000	50,000
Egypt	523,000	304,200	304,000 ^e	300,000 ^r	300,000
Eritrea ^c	200	210 ^r	240 ^r	250 ^r	250
Ethiopia ^{c,6}	3,534 ⁵	3,600	4,000	3,300	3,300
France, marketable	519,000	315,000	315,000 ^e	300,000 ^r	300,000
Germany	4,513,753	4,560,086	4,898,516	4,900,000 ^r	4,900,000
Guatemala	1,879	2,143	2,000 ^{r,e}	1,866	2,953 ⁷
Hungary, beneficiated	266,408	238,921	248,263	240,000 ^r	240,000
India: ^c					
Processed	96,000 ^r	80,000 ^r	77,000 ^r	76,000 ^r	109,000
Salable crude	1,988,000 ^r	2,718,000 ^r	2,651,000 ^r	3,001,000 ^r	3,570,000
Indonesia ^c	186,010 ⁵	170,000	175,000	180,000	175,000
Iran ^c	907,487 ⁵	1,480,291 ⁵	2,000,000 ^r	1,500,000 ^r	1,500,000
Italy, kaolinitic earth ^c	1,069,938 ^{r,5}	641,000 ^r	640,000 ^r	640,000 ^r	640,000
Japan ^c	12,000	12,000	13,000	13,000	12,000
Jordan	177,470	114,310 ^r	89,903	100,000 ^r	90,000
Kenya ^c	900	980	1,100	1,100	1,200
Korea, Republic of	659,351	764,008	798,690	800,000 ^r	800,000
Kyrgyzstan	NA ^r	NA ^r	108,900 ^r	113,900 ^r	133,500
Madagascar	90	259	260 ^e	260	260
Malaysia	463,732 ^r	530,331	442,550	438,923 ^r	293,480 ⁵
Mexico	78,086	120,094	120,003	163,148	163,000
New Zealand	9,016	10,700	21,545	11,578	12,000
Pakistan	15,318	27,265	26,000 ^r	25,000	27,000
Peru	9,655	16,678	18,169	33,863	32,249 ⁵
Poland, washed	136,000	125,000	164,000 ^r	138,000 ^r	140,000
Portugal	274,925	273,890	322,041 ^r	322,100 ^r	323,000
Romania ^c	1,000	1,000 ^r	1,000 ^r	--	--
Russia, concentrate	90,300	105,000	120,000	120,000	120,000
Saudi Arabia ^c	4,166 ⁵	6,200	5,000	58,000	70,000
Slovakia ^c	44,000	44,000	40,000 ^r	40,000 ^r	40,000
South Africa	31,048	29,929	15,220	20,499	24,655 ⁵
Spain, marketable, crude and washed ⁸	300,000	310,993	302,580	303,000	303,000
Sri Lanka	9,538	8,207	8,000 ^e	7,800 ^r	10,000
Sudan	36,799	32,696	15,096	11,579	26,000 ⁵
Tanzania	18,624	58 ^r	178 ^r	2,161 ^r	1,816
Thailand, beneficiated ^c	160,000	160,000	160,000	160,000	160,000
Turkey	727,649	787,287 ^r	1,229,352 ^r	3,806,083 ^r	3,800,000
Uganda	4,721	27,237	20,883	42,886 ^r	43,000
Ukraine	764,000	1,085,000	1,317,000	1,050,000 ^r	1,100,000
United Kingdom, sales ^{c,9}	1,800,000 ^r	900,000	1,000,000	900,000 ^r	900,000

See footnotes at end of table.

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

(Metric tons)

Country ³	2009	2010	2011	2012	2013 ^e
United States ¹⁰	5,290,000	5,420,000	5,950,000	5,900,000 ^r	5,950,000
Uzbekistan ^e	5,500,000	5,500,000	7,000,000	7,000,000	7,500,000
Vietnam	-- ^r	-- ^r	-- ^r	-- ^r	--
Total	33,500,000 ^r	34,200,000 ^r	38,100,000 ^r	39,200,000 ^r	40,000,000

^eEstimated. ^rRevised. NA Not available. -- Zero.

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

²Includes data available through August 15, 2014.

³In addition to the countries listed, China, Denmark, Morocco, Nigeria, Suriname, and Zambia produced kaolin, but information is inadequate to make reliable estimates of output levels.

⁴Data for year ending June 30 of that stated.

⁵Reported figure.

⁶Data for year ending July 7 of that stated.

⁷Reported figures based on quantities sold.

⁸Includes crude and washed kaolin and refractory clays not further described.

⁹Dry weight.

¹⁰Sold or used by producers.