



2008 Minerals Yearbook

CLAY AND SHALE

CLAY AND SHALE

By Robert L. Virta

Domestic survey data and tables were prepared by Danielle L. Militello, statistical assistant, and Maria Arguelles, statistical assistant; and the world production tables were prepared by Linder Roberts, international data coordinator.

The amount of clay sold or used by domestic producers in 2008 was 33.2 million metric tons (Mt) valued at \$1.67 billion compared with 36.7 Mt valued at \$1.75 billion in 2007 (table 1). Common clay and shale accounted for 53% of the tonnage, and kaolin accounted for 54% of the value (tables 1, 5, and 8). In 2008, exports were 4.79 Mt valued at \$978 million compared with 5.65 Mt valued at \$928 million in 2007. Imports of clays were 239,000 metric tons (t) valued at \$119 million in 2008 compared with 231,000 t valued at \$73.9 million in 2007 (tables 1, 14, 15).

Production

About 180 companies mined clay and shale in the United States in 2008. The 20 leading companies, many with multiple operations, accounted for 56% of the tonnage and 82% 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, Virginia, Ohio, Mississippi, and Arkansas. The 10 leading producer companies were, in alphabetical order, American Colloid Co. (bentonite); BASF Corp. (bentonite, fuller's earth, and kaolin); General Shale Products Corp. (common clay and shale); Imerys SA (ball clay and kaolin); KaMin LLC (formerly J.M. Huber Corp., kaolin); Nestle Purina PetCare Co. (bentonite); Oil-Dri Corp. of America (fuller's earth); Texas Industries Inc. (common clay and shale); Thiele Kaolin Co. (kaolin); and Unimin Corp. (ball clay and kaolin).

Most clay was mined in the United States by open pit methods; less than 1% of U.S. clay output originated from underground mines. All underground production was in Ohio, from underclays associated with subterranean 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 60% 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 published reports, preliminary survey information, or reported prior-year production levels adjusted by trends in the industry and employment hours as reported by the Mine Safety and Health Administration.

Ball Clay.—In 2008, four companies mined ball clay in four States. Production of domestic ball clay was 967,000 t valued

at \$44.3 million compared with 1.07 Mt valued at \$49.0 million in 2007 (table 3). Operations in Tennessee supplied 59% of the production, 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. Ball clay sales declined because of reduced demand for ceramic tile and sanitaryware by the slumping building industry.

Bentonite.—In 2008, 21 companies produced bentonite in 11 States. About 5.03 Mt valued at \$247 million was sold or used compared with 4.82 Mt valued at \$252 million of bentonite sold or used in 2007 (table 4). Production of nonswelling bentonite decreased to 172,000 t valued at \$10.4 million in 2008 from 219,000 t valued at \$11.1 million in 2007. Alabama led in the production of nonswelling bentonite, followed by, in descending order of tonnage, Mississippi, Arizona, California, Colorado, and Nevada.

Production of swelling bentonite was 4.86 Mt valued at \$237 million in 2008, an increase from 4.60 Mt valued at \$241 million in 2007. Wyoming led in the production of swelling bentonite, followed by Montana, Utah, Texas, California, Oregon, and Nevada. Sales increased primarily because of higher demand for bentonite for drilling mud and pet litter applications.

Elementis Specialties Inc. (a division of Elementis plc) announced plans to expand its capacity for spray dry products at its Newberry Springs, CA, facility. The spray dryer and associated equipment was scheduled to be installed in 2009. The expansion permits Elementis to expand production of its organoclays (Elementis Specialties Inc., 2008).

Rock Springs Mineral Processing, Inc. and U.S. Bentonite Processing, Inc. received a \$10 million loan from the U.S. Department of Agriculture Rural Development division to build two processing plants in Arminto and Bucknam, WY. The plants were to employ 100 workers when completed (U.S. Department of Agriculture, 2008).

ZEOX Corp. increased its holdings in ZEOX Performance Materials, LLC (ZPM) by acquiring an additional 8% of shares from Cheto Partners, LLC. With the acquisition, ZEOX controlled 59% of ZPM. ZPM mines saponite from a Burro Creek, AZ, deposit for use in water treatment and rheology control applications (ZEOX Corp., 2008).

Common Clay and Shale.—In 2008, 129 companies produced common clay and shale in 43 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 17.5 Mt valued at \$202 million in 2008 compared with 20.6 Mt

valued at \$216 million in 2007 (table 5). The major producing States were, in descending order of tonnage, Texas, Alabama, North Carolina, Ohio, Georgia, Arkansas, Virginia, Oklahoma, New York, and Indiana. The tonnage of common clay and shale sold or used declined because of decreased building activity in 2008.

Boral Bricks Inc. opened a brick manufacturing plant in Terra Haute, IN. The plant, fueled using methane from a nearby landfill, had the capacity to produce 120 million bricks per year and featured robotic setting and packaging. The plant used shale from a nearby coal mining property in the manufacturing process (Boral Bricks Inc., 2008).

Acme Brick Co. purchased Ochs Brick Co., which operated a 60-million-brick-per-year plant in Springfield, MN. The purchase provided Acme Brick with the opportunity to expand its operations into the Midwest brick market (Ceramic Industry, 2008).

Fire Clay.—Fire clay producers were mostly refractory product manufacturers that used the clays in firebrick and various heavy-clay products. In 2008, six firms mined fire clay in four States. Fire clay sold or used by domestic producers decreased to 447,000 t valued at \$17.7 million from 565,000 t valued at \$23.8 million in 2007 (table 6). Missouri was the leading producing State, followed by, in descending order of tonnage, California, Ohio, and South Carolina. There was a significant decline in production because of reduced sales of fire clay for the manufacture of products used by the building market.

Fuller's Earth.—In 2008, 15 companies produced fuller's earth in 11 States. Fuller's earth deposits occur in grades ranging from palygorskite (attapulgite) in western Florida to montmorillonite, further northward into southwestern Georgia. Gellant grades of attapulgite, used as thickeners in such items as drilling muds and paints, are in western Florida and southwestern Georgia. Absorbent grades of attapulgite are further north in Georgia. Absorbent grades of attapulgite are grouped with the montmorillonite variety of fuller's earth in table 7 to be consistent with past reporting.

Gellant-grade attapulgite was mined or sold in the Florida Panhandle and southwestern Georgia by two companies. Attapulgite production was withheld to avoid revealing company proprietary data but production decreased in 2008 from 245,000 t valued at \$36.5 million in 2007 (table 7). Florida led in the production of attapulgite, followed by Georgia. Sepiolite, although not a fuller's earth, was mined in Nevada and included in the total for gellant-grade attapulgite to avoid disclosing company proprietary data.

Production of the montmorillonite variety of fuller's earth decreased slightly to 2.35 Mt valued at \$231 million in 2008 compared with 2.36 Mt valued at \$211 million in 2007 (table 7). Montmorillonite-type fuller's earth was produced, in decreasing order of tonnage, in Georgia, Missouri, Mississippi, Virginia, California, Illinois, Tennessee, Florida, Kansas, Nevada, and Texas.

Kaolin.—In 2008, 16 firms mined kaolin in 9 States. Domestic production was 6.74 Mt valued at \$900 million compared with 7.11 Mt valued at \$959 million in 2007 (table 8). Declines were seen in several markets, although the largest

losses were in sales to the paper filler and coating markets. The leading producer State was Georgia, followed by, in descending order of tonnage, South Carolina, Alabama, Arkansas, Nevada, Texas, Florida, North Carolina, and California.

Of the 6.74 Mt sold or used in 2008, 3.08 Mt was reported as water washed, 1.39 Mt was calcined, 1.13 Mt was airfloat, 1.07 Mt was delaminated, and 78,000 t was unprocessed (table 8). This compares with 3.26 Mt of water washed, 1.39 Mt of calcined, 1.18 Mt of airfloat, 1.14 Mt of delaminated, and 135,000 t of unprocessed in 2007 (table 8). Pigment-grade (low-temperature calcined kaolin) accounted for more than 50% of the tonnage of the total calcined kaolin sales. Companies in Georgia accounted for nearly all the pigment-grade calcined kaolin produced in 2008. A small amount also was produced in Texas.

Kaolin production in Georgia was reported to be 6.29 Mt valued at \$872 million in 2008 compared with 6.57 Mt valued at \$924 million in 2007. Approximately 3.00 Mt of Georgia kaolin production was sold as water washed, 1.36 Mt was calcined (high- and low-temperature calcined kaolin), 1.07 Mt was delaminated, and 859,000 t was airfloat in 2008. This compares with 3.19 Mt water washed, 1.29 Mt calcined, 1.14 Mt delaminated, and 948,000 t airfloat in 2007 (table 9). Production in South Carolina was 199,000 t valued at \$11.3 million in 2008 compared with 297,000 t valued at \$17.6 million in 2007 (table 10). Decreased sales to paper- and construction-related markets affected sales in Georgia. Decreased sales to rubber- and construction-related markets affected sales in South Carolina.

IMin Partners, a private equity capital fund, purchased the kaolin operations of Huber Engineered Materials (a subsidiary of J.M. Huber Corp). Huber Engineering produced kaolin for paper and industrial customers. The company operated as KaMin LLC (KaMin LLC, 2008a).

KaMin announced plans to restructure its kaolin operations in Georgia and to reduce its hydrous production capacity and eliminate selected paper grades at its Sandersville, GA, operation. The reduction was in response to reduced demand from the paper market (Industrial Minerals, 2008f; KaMin, 2008b).

Imerys SA idled its calcined kaolin capacity at its Dry Branch, GA, facility and transferred its calcined kaolin operations to Sandersville. The Imerys facility at Sandersville, in turn, was restructured with some reduction in product capacities and staff, in response to changing market conditions. Imerys also added a refractory clay calciner at its Andersonville, GA, facility (Imerys SA, 2008b, 2009, p. 6; Industrial Minerals, 2008e).

Imerys North America Ceramics sold its Edgar, FL, facility to Edgar Minerals, Inc. Imerys will be the sole marketing agent of the specialty kaolin products produced at the Edgar plant (Imerys, 2008a).

Active Minerals International, LLC (AMI) purchased Southeastern Kaolin Co., which had a mine and mill near Aiken, GA. AMI planned to expand sales in Asia and North America. The purchase of Southeastern Kaolin, combined with AMI's 2003 purchase of Wilkinson Kaolin Associates, LLC, gave AMI a total production capacity of more than 600,000 metric tons per year (t/yr) (Active Minerals International, LLC, undated).

Golden Gate Capital completed its acquisition of U.S. Silica Co. from Harbinger Capital Partners. U.S. Silica produced kaolin and silica from its operation in Kosse, TX; feldspar from its Montpelier, VA, operation; and silica from several other operations throughout the eastern and central United States. U.S. Silica sells its products into the ceramics, foundry, and filtration markets (Golden Gate Capital, 2008; Industrial Minerals, 2009).

BASF announced a reduction in greenhouse emissions and energy costs at its McIntyre, GA, facility. The company upgraded insulation on process equipment, reduced electrical consumption on its compressed air circuits, and, by reducing the water content of its process slurries, cut energy costs associated with heating the slurries. The company estimated that its energy needs were reduced by 582 billion British thermal units per year (Btu/yr), equivalent to reducing CO₂ emissions by 57,300 t/yr. Modifications to calcining, centrifugation, burners, and spray drying units and improved heat recovery were expected to reduce energy consumption by an additional 740 billion Btu/yr (BASF Corp., 2008).

Beta Minerals Inc. acquired the kaolin assets of Erdene Materials Corp. (EMC) near Sparta, GA. In exchange, Erdene Resource Development Corp. (the parent company of EMC) received about 72% of shares issued by Beta Minerals. Deepstep Kaolin Co. LLC, a partner of EMC in the venture, held 6% of shares in Beta Minerals. The kaolin reserves controlled by Beta Minerals were 24.7 Mt. The company expected to focus sales in ceramic markets. After completion of the deal in February 2009, Beta Minerals became Advanced Primary Minerals Corp. (Beta Minerals Inc., 2008; Industrial Minerals, 2008c, e; Erdene Resources Development Corp., 2009).

Daleco Resources Corp. filed a plan of operation with the U.S. Forest Service for its Sierra County, NM, operation. The company continued to work on technology for processing its kaolin and tested the suitability of trial hydrous and calcined kaolin grades in paint formulations. The company determined the grades were suitable for flat interior latex paints (Daleco Resources Corp., 2007, 2008).

Consumption

Ball Clay.—Ball clay sold or used in 2008, including exports, was 967,000 t, a decrease from 1.07 Mt in 2007. The principal domestic ball clay markets were, in decreasing order by tonnage, floor and wall tile and sanitaryware (table 3). Other uses for ball clay, in decreasing order by tonnage, were miscellaneous ceramics; fillers, extenders, and binders; fiberglass; electric porcelain; roofing granules; pottery; catalysts; firebrick; fine china; animal feed; miscellaneous refractory products; rubber; brick; and adhesives. Sales to markets such as adhesives, catalysts, fiberglass, and rubber may include kaolin mined or purchased by the ball clay producers.

Bentonite.—In 2008, domestic sales and use were 4.13 Mt and total sales (domestic and export) were 5.03 Mt compared with domestic sales of 3.96 Mt and total sales of 4.82 Mt in 2007 (table 4). Major domestic markets for bentonite were, in decreasing order by tonnage, pet waste absorbent, drilling mud, iron ore pelletizing, and foundry sand. Total sales (domestic and exports) of bentonite were approximately 849,000 t for foundry sand bond (more than 95% was swelling bentonite).

In addition to domestic sales of 1.00 Mt of swelling bentonite for pet waste absorbent and 717,000 t for pelletizing iron ore, significant quantities (which were concealed in table 4) of swelling bentonite also were exported to these same end-use markets. Other markets for bentonite were, in decreasing order by tonnage, miscellaneous civil engineering and sealing; waterproofing and sealing; water treatment and filtering; animal feed; oil and grease absorbents; paint; adhesives; miscellaneous fillers, extenders, and binders; miscellaneous chemical manufacturing; fiber glass; cosmetic, medical, and pharmaceutical; pesticide carrier; filtering, clarifying, and decolorizing minerals, oils, and greases; fertilizer carrier; miscellaneous refractory products; and miscellaneous ceramics.

The major domestic markets for swelling bentonite were, in decreasing order, pet waste absorbents, drilling mud, iron ore pelletizing, foundry sand, civil engineering and sealing, waterproofing and sealing, and water treatment. Major export markets for swelling bentonite were, in decreasing order, foundry sand, pet waste absorbent, drilling mud, and iron ore pelletizing. The major domestic use for nonswelling bentonite was in water treatment and filtering.

For the smaller markets, swelling bentonite accounted for more than 95% of the bentonite sold for animal feed, cosmetics, fertilizers, miscellaneous ceramics, miscellaneous chemical manufacturing applications, medical, oil and grease absorbents, paint, and waterproofing but less than 30% of the bentonite sold for pesticide carriers and water treatment and filtering.

Common Clay and Shale.—Consumption of common clay and shale decreased to 17.5 Mt from 20.6 Mt in 2007. Brick manufacture remained the leading market for common clay and shale, followed by, in descending order of tonnage, lightweight aggregate and portland cement (table 5). Other lesser markets, in descending order of tonnage, were refractory mortar and cement, ceramic floor tile, roofing granules, flue linings, miscellaneous refractory products, civil engineering, drain tile, flower pots, sewer pipe, and fire brick.

Sales of common clay and shale declined by 15% in response to reduced demand by the commercial and residential building industries. Residential and nonresidential construction, on which the common clay and shale industry is dependent, decreased in value to \$1.08 trillion in 2008 from \$1.14 trillion in 2007 (U.S. Census Bureau, 2009a).

Fire Clay.—Consumption of fire clay decreased to 447,000 t in 2008 from 565,000 t in 2007. Demand from the construction industry for heavy-clay products manufactured using fire clay declined (table 6). Fire clays were used in grogs and calcines; high-alumina brick and specialties; ramming and gunning mixes; refractory products, such as firebrick and block; mixes and mortars; and saggars. Fire clays also were used to produce such items as brick and pottery. Markets for fire clay were, in descending order of tonnage, portland cement, refractory calcines and grogs, lightweight aggregate, floor and wall tile, refractory mortar and cement, common brick applications, pottery, and miscellaneous clay applications.

Fuller's Earth.—Consumption of montmorillonite-type fuller's earth was 2.35 Mt in 2008 compared with 2.36 Mt in 2007 (table 7). Data for attapulgite-type fuller's earth was withheld in 2008 to avoid disclosing company proprietary data.

Domestic markets for montmorillonite-type fuller's earth were, in descending order of tonnage, pet waste absorbents; oil and grease absorbents; miscellaneous absorbents; miscellaneous civil engineering and sealing; filler, extender, and binder uses; pesticide carrier; clarifying, decolorizing, and filtering of oils and greases; animal feed; and fertilizer carrier; paint; adhesives; cosmetic, medical, and pharmaceutical uses; waterproofing and sealing; and water treatment. Absorbent applications accounted for more than 60% of sales of montmorillonite-type fuller's earth. The leading export market was pet waste absorbents.

Domestic markets for attapulgite-type fuller's earth were, in decreasing order, filler, extender, and binder uses; miscellaneous absorbents; drilling mud; clarifying, decolorizing, and filtering of mineral oils and greases; pesticide carrier; animal feed; adhesives; paint; oil and grease absorbents; fertilizer carrier; desiccant; cosmetic, medical, and pharmaceutical applications; and waterproofing and sealing. The first three applications accounted for more than 60% of sales of attapulgite. The major export markets were pesticide carriers, paint, and drilling mud.

Montmorillonite grades accounted for more than 75% of sales of fuller's earth for animal feed; clarifying, decolorizing, and filtering of oils and greases; miscellaneous civil engineering; 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; and paint.

Kaolin.—Consumption of kaolin decreased to 6.74 Mt in 2008 from 7.11 Mt in 2007 (table 8). The major domestic markets for kaolin were, in descending order of tonnage, paper coating and filling, refractory products, catalyst manufacture, fiberglass, paint, rubber, heavy-clay products (brick and portland cement), miscellaneous ceramics, and ceramic floor and wall tile. Major export markets were paper coating and filling, paint, and rubber (table 11).

Paper coating and filling markets accounted for 59% of kaolin sales in 2008 but also accounted for the bulk of the decline in kaolin sales in 2008. Catalysts markets increased with the growth in petroleum refining. Construction-related markets, such as fiberglass, paint, portland cement, and sanitaryware declined in 2008 in response to weak housing markets. Paint and rubber markets were affected negatively by a decline in automotive sales. The increase in refractory sales appears to be the result of better accounting by a major producer in 2008 rather than an actual increase in sales. Refractory markets probably declined with the decline in demand for aluminum, cement, glass, lime, and steel, all large users of clay-based refractory products, by yearend 2008.

Sales of kaolin from Georgia were 6.29 Mt in 2008 compared with 6.57 Mt in 2007. Major domestic markets for kaolin from Georgia were, in descending order by tonnage, paper coating, refractory products, other ceramics, fiberglass, paper filling, paint, catalyst manufacture, rubber, floor and wall tile, and plastics. The major export market for Georgia kaolin was in paper applications (table 9). Sales of kaolin from South Carolina were 199,000 t in 2008 compared with 297,000 t in 2007 (table 10). Major domestic markets for kaolin from South Carolina were, in descending order of tonnage, catalyst manufacture, rubber, brick, fiberglass, paper, plastics, pesticide carrier,

portland cement, adhesives, sanitaryware, roofing granules, firebrick, pottery, and animal feed. 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 3.17 Mt in 2008 compared with 3.22 Mt in 2007. Sales of bentonite and fuller's earth for absorbent applications decreased slightly in 2008. Production within the heavy manufacturing industries declined so oil and grease absorbent demand decreased slightly.

Fuller's earth accounted for 58% of the clay used for absorbents, followed by bentonite. Pet waste absorbents accounted for 77% of absorbent consumption, followed by oil and grease absorbents (13%), and miscellaneous absorbent applications (10%). Fuller's earth was the predominant clay used for oil and grease absorbent applications. Bentonite accounted for 51% of pet waste absorbent sales and fuller's earth accounted for 49%.

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 1.91 Mt in 2008 compared with 2.12 Mt in 2007. The leading ceramics markets were ceramic floor and wall tile (35%), miscellaneous ceramics (18%), catalyst (16%), roofing granules (13%), sanitaryware (12%), and pottery, electrical porcelain, and fine china (1% each). Ball clay accounted for 41% of the clay used in ceramics; kaolin, 33%; and common clay and shale, 24%. A small amount of bentonite also was 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 roofing granules. Kaolin dominated the catalyst market. Ball clay, common clay and shale, and kaolin were the predominant clays used in floor and wall tile manufacture, and ball clay and kaolin dominated the fine china market.

In 2008, apparent consumption of clay floor and wall tile in the United States was 197 million square meters valued at \$2.29 billion compared with 157 million square meters valued at \$1.83 billion in 2007. Because stocks are not taken into consideration, the increase in apparent consumption may not have been as great as calculated. Domestic producers shipped 45.1 million square meters of clay floor and wall tile in 2008 compared with 50.6 million square meters in 2007. In 2008, exports of clay floor and wall tile were 4.69 million square meters valued at \$43.5 million compared with 4.41 million square meters valued at \$41.9 million in 2007. Imports of clay floor and wall tile were 157 million square meters valued at \$1.62 billion in 2008, compared with 111 million square meters valued at \$1.07 billion in 2007. Although apparent consumption of clay floor and wall tile increased by 25% in 2008 compared with that of 2007, consumption remained well below the level of 2006 because of reduced commercial and residential housing construction in the United States in 2007 and 2008 (table 5; U.S. Census Bureau, 2009b).

The U.S. International Trade Commission (undated) reported that 10.8 million square meters of glazed and unglazed ceramic tile with sides measuring less than 7 centimeters [Harmonized Tariff Schedule (HTS) of the United States Codes 6907.10.00, 6908.10.10, 6908.10.20, and 6908.10.50] valued at \$108 million

was imported in 2008 compared with 19.9 million square meters valued at \$154 million in 2007. Brazil, China, Italy, Mexico, and Spain were the major sources of all varieties of imported ceramic tile.

Imports of ceramic baths, bidets, flush tanks, lavatories, sinks, toilet bowls, and other ceramic sanitary fixtures decreased in 2008. The U.S. International Trade Commission (undated) reported imports to be 28.7 million units compared with 34.0 million units in 2007. China and Mexico were the major sources of imported sanitaryware, supplying 77% of the units imported into the United States.

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

Expanded Clay and Shale.—Approximately 3.93 Mt of clay and shale was used in the production of lightweight aggregates in 2008, the same as in 2007 (table 12). More than 99% of clay used to manufacture lightweight aggregates was common clay and shale. A small amount of fire clay also was used. 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 2008, approximately 2.90 Mt of clays was consumed in the production of cement compared with 3.25 Mt in 2007. Reduced construction activity in 2008 caused the large decline in sales for cement manufacture. In descending order of tonnage, common clay and shale, fire clay, and kaolin were used in the manufacture of portland cement clinker. About 94% of the clay consumed by the cement industry was common clay and shale.

Structural Clay Products.—Approximately 9.37 Mt of clays was used in the manufacture of structural clay products, such as building brick, roofing tile, and sewer pipe compared with 12.2 Mt in 2007. Common and face brick accounted for about 97% of this total. Other markets were, in descending order of tonnage, flue linings, flower pots, drain tile, and sewer pipe. About 99% of the clay used to manufacture structural clay products was common clay and shale. Small amounts of ball clay, fire clay, and kaolin also were used.

In 2008, domestic producers shipped 5.05 billion building and face bricks compared with 7.24 billion bricks in 2007. About 81,600 t of vitrified clay sewer pipe and fittings valued at \$34.1 million was shipped in 2008 compared with 122,000 t valued at \$55.7 million in 2007 (U.S. Census Bureau, 2009b, p. 2).

Drilling Mud.—Sales of bentonite for drilling mud applications were 954,000 t (domestic) and 223,000 t (exported) compared with 912,000 t and 204,000 t in 2007, respectively. Attapulgite-type fuller's earth also was sold for drilling mud applications. Swelling-type bentonite accounted for more than 95% of the clay used in drilling mud. Bentonite is used most commonly with rotary rig drilling. The average number of rotary rigs in Canada and the United States operating at yearend 2008 increased slightly to 2,257 compared with 2,111 in 2007 (Baker Hughes Inc., 2009).

Fiberglass.—Sales of clays, including exports, to the fiberglass and mineral wool industry were 297,000 t in 2008

compared with 362,000 t in 2007. Most of the clay used for fiberglass was kaolin. For comparison, sales of ground industrial sand for fiberglass manufacture declined to 805,000 t in 2008 from 968,000 t in 2007. Sales of unground industrial sand for fiberglass manufacture were withheld for 2008 to avoid revealing company proprietary data but sales in 2007 were 530,000 t (Dolley, 2009). The declines were associated with decreased sales of fiberglass for commercial and housing construction and product manufacturing.

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 3.53 Mt of clays was sold for use as fillers, extenders, and binders in the United States compared with 4.10 Mt in 2007. An additional 2.02 Mt of clays was exported for filler and extender applications in 2008 compared with 2.02 Mt in 2007. Paper coating and filling accounted for 61% of domestic sales, followed by paint (9%), rubber (5%), animal feed (4%), pesticide carriers (3%), and adhesives and plastics (2% each). Cosmetic, medical, and pharmaceutical and fertilizer carrier each accounted for less than 2% of the domestic fillers and extenders markets. Decreased sales to paper coating and filling markets and rubber in 2008 accounted for most of the decline in sales to fillers, extenders, and binder markets. Sales to construction-related filler markets such as caulk, joint compounds, and paint also declined.

Kaolin accounted for approximately 85% of the clay used in domestic and export filler and extender applications, followed by fuller's earth (6%), common clay and shale (5%), bentonite (4%), and ball clay (less than 1%). Bentonite was the predominant clay used for cosmetic, medical, and pharmaceutical applications; fuller's earth dominated in fertilizer and pesticide applications. Bentonite and fuller's earth dominated sales for animal feed. Kaolin was the predominant clay used for adhesives, paint, paper, plastics, and rubber markets.

The U.S. Census Bureau (2009c) reported shipments of paint and coatings for 2008 to be 4.62 billion liters (1.22 billion gallons) compared with 5.11 billion liters (1.35 billion gallons) in 2007. Of this amount, architectural paints, the major market for paint-grade fillers, was 2.58 billion liters (682 million gallons) in 2008 compared with 2.94 billion liters (777 million gallons) in 2007.

Iron Ore Pelletizing.—Sales of clays for iron ore pelletizing applications reported by producers were 786,000 t (717,000 t used domestically and 69,400 t exported) in 2008 compared with 747,000 t in 2007. The world economic recession began to adversely affect production of iron ore in mid- to late-2008 (Jorgenson, 2009). However, iron ore pelletizing operations continued to purchase bentonite through yearend 2008. Swelling bentonite was the only type of clay used for this application.

Paper Products.—Total sales for paper declined to 4.00 Mt in 2008 from 4.40 Mt in 2007 owing to the impact of the global economic recession on the paper industry. Declines in advertising in magazines and newspapers contributed to reduced paper demand as did reduced product shipments with lesser demand for packaging. Kaolin accounted for all the clay sales used for paper coating (1.89 Mt sold domestically and 1.76

Mt exported), and essentially all the clay used for paper filling (250,000 t sold domestically and 110,000 t exported).

Refractory Products.—Producers reported that 2.43 Mt of clays was used for the manufacture of refractory products in 2008 (1.58 Mt with foundry sand excluded) compared with 2.31 Mt in 2007 (1.41 Mt with foundry sand excluded). Foundry sand accounted for 35% 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; and refractory mortar and cement. About 259,000 t were exported for refractory applications.

Kaolin accounted for 804,000 t of refractory sales, followed by bentonite (853,000 t), common clay and shale (596,000 t), fire clay (data withheld), and ball clay (data withheld).

The U.S. Census Bureau (2009e) reported the value of apparent consumption of clay refractory products was \$1 billion in 2008 compared with \$965 million in 2007. Clay refractory shipments were valued at \$1 billion in 2008 compared with \$965 million in 2007. Shipments of unshaped clay refractory bonding mortars were 664,000 t valued at \$459 million compared with 668,000 t valued at \$418 million in 2007. Shipments of unshaped clay refractory products were followed by fireclay, high alumina, and insulating brick shapes (totaling 436,000 t valued at \$501 million in 2008 compared with 490,000 t valued at \$513 million in 2007). The remainder was other refractory clay raw materials and refractory materials sold in lump or ground form.

Prices

All of the major producers of specialty clays announced price increases in response to increasing material, energy, and freight costs. Announced increases ranged from 5% to 15%. The increased cost of sulfuric acid resulted in BASF Catalysts LLC (a division of BASF SE) to increase prices of some of its sulfuric acid-based bleaching earth products by 25% to 35%. In addition to these increases, a 25% to 35% sulfuric-acid surcharge was added to all acid-activated mineral adsorbent products produced at its Jackson, MS, plant (Chemical Week, 2008).

Ball Clay.—The average value for ball clay reported by domestic producers was \$46 per metric ton. The average value for exported ball clay was \$70 per metric ton. The average value for imported ball clay was \$179 per ton.

Bentonite.—The average value reported by domestic producers for nonswelling bentonite was \$60 per ton. The average value for swelling bentonite was \$49 per ton. The average value for all bentonite was \$49 per ton. The average value of exported bentonite was \$148 per ton. The average value of imported bentonite was \$443 per ton.

The price of crude Wyoming bentonite, shipped in bulk quantities in railcars, was \$44 to \$100 per ton; foundry-grade, bagged, railcars, \$70 to \$90 per ton; and American Petroleum Institute (API)-grade, bagged, railcars, \$70 to \$100 per ton. The price for bentonite, India, crushed, dried, loose in bulk, was \$43 to \$53 per ton for API-grade; \$36 to \$38 per ton for pet litter grade; and \$59 to \$76 per ton for foundry grade (Industrial Minerals, 2008h).

Common Clay and Shale.—The average value for all common clay and shale produced in the United States was \$12 per ton. The unit value of clay and shale used to produce lightweight aggregate was \$27 per ton. Average prices for lightweight aggregate produced from clay and shale ranged from \$30 to \$70 per ton for most applications.

Fire Clay.—The average value for fire clay reported by domestic producers was \$40 per ton. The average value of exported fire clay was \$126 per ton. The average value of imported fire clay was \$94 per ton.

Fuller's Earth.—The average value of attapulgite-type fuller's earth was withheld in 2008 to avoid revealing company proprietary data but the value decreased from \$149 in 2007. The average value of montmorillonite-type fuller's earth was \$98 per ton, an increase from \$89 in 2007. The average value for all fuller's earth was concealed in 2008 but increased slightly from \$95 per ton in 2007. The average value of exported fuller's earth was \$347 per ton. The average value of imported fuller's earth was \$100 per ton.

Kaolin.—The average value of kaolin was \$134 per ton for all kaolin grades. The average value for airfloat was \$71 per ton; delaminated, \$135 per ton; unprocessed, \$20 per ton; and water washed, \$134 per ton. Values for refractory-grade (high-temperature calcined) and pigment-grade (low-temperature calcined) kaolin were withheld to avoid revealing company proprietary data. Refractory-grade (high-temperature calcined) kaolin was valued at slightly less than \$39 per ton in 2007; pigment-grade (low-temperature calcined) kaolin was valued at slightly more than \$289 per ton in 2007; and all types of calcined kaolin combined were valued at \$187 per ton compared with \$201 per ton in 2007. More lower-valued refractory-grade kaolin was sold in 2008, resulting in a lower combined value than in 2007. The average value of exported kaolin was \$205 per ton. The average value of the imported kaolin was \$238 per ton.

The price of filler-grade kaolin from Georgia, shipped in bulk, was \$80 to \$100 per ton; coating, bulk, \$95 to \$185 per ton; sanitaryware-grade, bagged, \$65 to \$75 per ton; tableware-grade, bagged, \$125 per ton; and calcined, bulk, \$320 to \$375 per ton (Industrial Minerals, 2008h).

Foreign Trade

Ball Clay.—Ball clay exports were 65,000 t valued at \$4.58 million in 2008 compared with 83,000 t valued at \$5.61 million in 2007, according to the U.S. Census Bureau (table 14). Producers reported exports of 255,000 t. Most of the difference in exports reported by ball clay producers and the U.S. Census Bureau was likely accounted for by shipments to Mexico. 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 2,000 t valued at \$358,000 (table 15).

Bentonite.—As reported by the U.S. Census Bureau, bentonite exports decreased to 1.09 Mt valued at \$161 million in 2008 from 1.43 Mt valued at \$158 million in 2007 (table 14). Exports to Canada, Japan, and the Netherlands declined

significantly, partially in response to the global recession. Changes in trade with other countries were relatively minor. Domestic bentonite producers reported exports of 819,000 t (table 4). Much of the discrepancy between data reported by producers and that reported by the U.S. Census Bureau probably resulted from producers including a large portion of the exports destined for Canadian and Mexican markets (419,000 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. brokers, where producers are unaware if the bentonite is used domestically or exported, could also explain this discrepancy.

Bentonite imports consisted mainly of untreated bentonite clay and chemically or artificially activated materials. Imports of untreated bentonite were 7,000 t valued at \$3.10 million. Imports of chemically activated material were 29,000 t valued at \$23.4 million (table 15).

Fire Clay.—In 2008, exports decreased to 393,000 t valued at \$49.6 million compared with 425,000 t valued at \$47.7 million in 2007 (table 14). At least 59% 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. Imports were 92 t valued at \$94,000 (table 15).

Fuller's Earth.—In 2008, exports decreased to 127,000 t valued at \$44.1 million compared with 134,000 t valued at \$37.7 million in 2007 (table 14). Exports to Japan increased and those to other countries declined or remained unchanged. Imports of decolorizing earth and fuller's earth were 1,000 t valued at \$100,000 in 2008 (table 15).

Kaolin.—In 2008, 2.96 Mt of kaolin valued at \$606 million was exported compared with 3.30 Mt valued at \$615 million in 2007 (table 14). Producers reported exports of 2.09 Mt (table 11). Much of the 445,000 t destined for Canada and 264,000 t for Mexico probably was reported under domestic consumption. Sales through U.S. brokers, where producers are unaware if the kaolin is used domestically or exported, also could explain this discrepancy.

Kaolin imports were an estimated 194,000 t of kaolin valued at \$46.1 million in 2008 compared with 194,000 t valued at \$48.5 million in 2007 (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 3.52 Mt (table 17). Kaolin production was about 36.3 Mt (table 18); this includes ball clay from Australia and crude kaolin ore production tonnages from many other countries. World sales of processed kaolin were estimated to be between 22 and 24 Mt, after excluding 4 Mt for Uzbekistan, 3.1 Mt for Germany, 2.9 Mt for the Czech Republic, 1.4 Mt each for Bulgaria and Ukraine, 300,000 t each for Turkey and Vietnam, 200,000 t for Egypt, and 100,000 t each for Australia and Iran, 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 Brazil and the United Kingdom for kaolin. Spain led all countries in the production of sepiolite. The United States remained the leading producer of attapulgite, followed by Senegal.

Belgium.—Imerys partnered with Sea-invest to build a 1 Mt/yr seaport terminal in Antwerp. The \$126 million seaport was designed to handle 600,000 t/yr of kaolin in bulk, dry, or slurry form. Imerys backed the development of the terminal when it curtailed production of paper coating-grades of kaolin in the United Kingdom and began supplying European markets from its operations in Brazil (Industrial Minerals, 2008d).

Brazil.—Companhia Vale do Rio Doce (Vale) announced reductions in production at its two subsidiary kaolin operations in Brazil. CADAM S.A., in the State of Amapá, reduced production by 30%. Pará Pigmentos S.A. reduced production at its operations in the State of Pará by 200,000 t/yr. These reductions were effective on January 1, 2009. The reductions were in response to weak market demand (Companhia Vale do Rio Doce, 2009, p. 18).

Bulgaria.—Kaolin Plc, one of Bulgaria's leading industrial minerals producers, announced plans for staff reductions of 10% owing to reduced global demand for kaolin and other industrial minerals. The company also reduced output of some products to reduce expenditures (Kaolin AD, 2008).

Canada.—Whitemud Resources Inc. commissioned its \$50 million, 200,000 t/yr metakaolin plant in Saskatchewan. The company processed kaolin from its Gollier Creek Mine to produce metakaolin for use in concrete for construction applications. The company indicated that metakaolin can replace up to 20% of the portland cement used to manufacture concrete (Industrial Minerals, 2008k; Whitemud Resources Inc., 2008).

China.—Production data for bentonite is not generally available for China because of the lack of a comprehensive producer survey. Production was estimated to be about 3.1 Mt in 2007, the last year for which such information was available. About 50% was thought to be used in foundry applications, 25% for drilling muds, 8% for iron ore pelletizing, 3% for pet litter, and the remainder for civil engineering and other applications (Wan, 2008).

India.—Ashapura Minechem Ltd., the leading bentonite producer in India, was developing a kaolin mine and building a processing plant near Thiruvananthapuram, in the State of Kerala. The company was stockpiling raw kaolin from its mine and local suppliers while its 200,000 t/yr plant was under construction. The plant was scheduled to reach full capacity in 2009. Ashapura planned to produce air float kaolin for ceramics and refractories; lump kaolin for ceramics; and hydrous and hydrous calcined kaolin for paper applications. Ashapura also mined kaolin in the State of Gujarat (Industrial Minerals, 2008a).

Italy.—Süd-Chemie AG and IMIC SpA formed a joint venture (Süd-Chemie IMIC Italia Srl) to supply the foundry and construction industries with bentonite products. IMIC, which has processing plants in Milan and Pavia with a combined capacity of 100,000 t/yr, transferred its foundry and construction operations into the joint venture. Süd-Chemie held a 75% controlling share (Industrial Minerals, 2008j).

Morocco.—S&B Industrial Minerals SA continued work on its \$44 million, 150,000-t/yr plant in the Nador. The plant was to be operated as S&B Industrial Minerals Morocco S.A.R.L. and conduct the initial processing of white bentonite from nearby mines. Product from the Nador plant will be shipped to another S&B facility in Neuss, Germany, for additional processing. The bentonite was to be sold for detergent, paint, and paper applications. When completed, the plant could supply the total world consumption of white bentonite, which was estimated to be 150,000 t/yr (Industrial Minerals, 2008i).

Russia.—AMCOL International Corp. acquired a minority share in Bentonit Group, the leading Russian producer of bentonite for drilling mud, foundry sand bond, and iron ore pelletizing applications. Bentonit Group has bentonite reserves in the Siberian and Ural regions of Russia and Azerbaijan (AMCOL International Corp., 2008).

Turkey.—Laviosa Chimica Mineraria SpA announced plans to build a 50,000 t/yr plant in north-central Turkey. The plant was expected initially to produce dried, granulated bentonite, some of which could be further processed at one of Laviosa's processing plants in Italy. Sales were to focus on cat litter, detergent, and paper markets in Asia and Europe (Industrial Minerals, 2008b, g)

Turkmenistan.—A kaolin plant began operations in the Balkan province of Djebel. The plant processed kaolin from nearby mines, supplying finished product for ceramics and refractory products and had a capacity of 20,000 t/yr (Turkmenistan.ru, 2008).

Outlook

The clay and shale industries were greatly affected by the world recession that began in 2008. Sales of ball clay, common clay and shale, and fire clay have experienced the most negative impact as demand for brick and ceramic products used in home construction declined following the collapse of the U.S. housing market, which began in 2006 (tables 3, 5; U.S. Census Bureau, 2009d). Kaolin was affected not only by reduced sales to its construction segment but also by the continued decline in demand from the paper industry. The impact of the recession did not affect as many of the markets for bentonite and fuller's earth as it did other clay types until late 2008 or early 2009. The markets for bentonite and fuller's earth were relatively unchanged from those of 2007.

Economic analysts suggested that the U.S. recession was easing in the financial sector, but construction and manufacturing industries continued to operate at reduced levels, and unemployment remained problematic through much of 2009. Some indices indicated that housing may have begun at least a weak recovery in late 2009, but there continue to be concerns about the viability of many Alternative-A and option adjustable rate (Option ARM) mortgages, which tended to be larger mortgages. Defaults on Alternative-A mortgages had begun to increase, and many Option ARM rates started to reset in late 2009 (Condon, 2009; Dunphy, 2009; McDonald, 2009; Rooney, 2009; Aversa, 2010; Kilgore, 2010).

In 2008, privately owned housing starts in the United States were 904,000 units compared with 1.36 million units in 2007, a 33% decline. This is the third year of decline from the record

set in 2005 (U.S. Census Bureau, 2009d). Although starts increased slightly in early 2009, they were still far below the record setting pace seen prior to 2005. Defaults on existing mortgages continued to be high, with more predicted as the job market continued to remain poor. Tightened credit for loans also continued to hamper growth in industry and housing. All of these factors probably will continue to adversely affect sales to construction-oriented markets for clay-based products such as adhesives, clay brick, drain tile, portland cement, ceramic tile, lightweight aggregate, paint, fiberglass, roofing granules, sanitaryware, and sewer pipe. As a result, sales of ball clay, common clay and shale, and kaolin, for construction-oriented applications may decline again in 2009. Use of fire clay for the manufacture of portland cement and heavy-clay products also may decline. With indications of a slight rebound in housing starts beginning to appear in mid-2009, sales of these construction materials may increase very slightly in 2010.

Absorbent markets, particularly pet waste absorbents, usually a relatively safe haven for the bentonite and fuller's earth industries, were beginning to show signs of weakening. Pet waste absorbent sales declined for fuller's earth in 2008, and major bentonite and fuller's earth producers indicated decreases in sales in the first half of 2009 as a result of reduced consumer spending. Oil absorbent use also may decline slightly as heavy manufacturing industries continue to operate at reduced levels in response to the continuing downturn in the overall world economy.

Drilling for oil increased slightly worldwide in 2008, but demand for bentonite and fuller's earth for drilling mud applications declined in 2009 as oil prices decreased. If the global recession continues, this trend may persist, resulting in little growth in drilling mud sales in 2010.

A slackened worldwide demand for steel for construction and industrial manufacturing, as a result of fiscal crisis, could result in decreased sales of bentonite for pelletizing iron ore in 2009. Similarly, sales of bentonite and fuller's earth for foundry applications could decline in 2009 because heavy industry did not appear to have begun its recovery from the economic recession until late in 2009. Sales of fire clay for refractory products, which declined slightly through 2008 owing to idling of many industrial manufacturing furnaces and other high-temperature equipment in such industries as cement, glass, lime, and steel, during the economic recession, may decline again in 2009. With the turnaround in the world economies moving at a slow pace, little or no growth in sales were expected in 2010.

The leading markets for kaolin, paper coating and filling, continued to be affected by a slow paper industry in the United States and foreign competition in overseas markets. In North America, shipments of printing and writing paper declined 8.2% (Pulp and Paper Network, LLC, 2009a). The Confederation of European Paper Industries member countries indicated that its output of board and paper declined 4% from that of 2007 (Pulp and Paper Network, LLC, 2009b). Sales of kaolin for paper applications were expected to decline slightly through 2010.

References Cited

- Active Minerals International, LLC, [undated], History: Huntsville, MD, Active Minerals International, LLC, 2 p. (Accessed January 7, 2010, at <http://www.stream-data.com/activeminerals/about/history.php>.)
- AMCOL International Corp., 2008, AMCOL International announces investment in Russian bentonite companies: Arlington Heights, IL, AMCOL International Corp. press release, June 6, 1 p.
- Aversa, Jeannine, 2010, Fed says recovery not helping jobless: Manufacturing Net, January 13, 1 p. (Accessed January 14, 2010, at <http://www.manufacturing.net/article.aspx?id=236004>.)
- Baker Hughes Inc., 2009, Worldwide rig count: Houston, TX, Baker Hughes Inc., September 21. (Accessed April 20, 2009, via http://investor.shareholder.com/bhi/rig_counts/rc_index.cfm.)
- BASF Corp., 2008, BASF invests to drive down energy costs, reduce greenhouse gas emissions at kaolin mine and processing operation in Georgia: McIntyre, GA, BASF Corp. press release, March 26, 1 p.
- Beta Minerals Inc., 2008, Beta executes securities exchange agreement to complete reverse takeover to acquire kaolin assets: Vancouver, British Columbia, Canada, Beta Minerals Inc. press release, July 17, 5 p.
- Boral Bricks Inc., 2008, Boral Bricks opens largest brick manufacturing facility: Roswell, GA, Boral Bricks Inc. press release, March 13, 1 p.
- Ceramic Industry, 2008, Acme acquires assets of Ochs Brick, McFarlane Stone: Ceramic Industry, v. 158, no. 5, May, p. 36.
- Chemical Week, 2008, BASF Catalysts boosts prices, implements surcharge: Chemical Week, v. 170, no. 12, April 14/21, p. 35.
- Companhia Vale do Rio Doce, 2009, Form 20-F—2008: U.S. Securities and Exchange Commission, April 28, 167 p.
- Condon, Bernard, 2009, Mortgage crisis shuffles toward fancier neighborhoods: Forbes.com, October 7. (Accessed May 7, 2010, at <http://www.forbes.com/2009/10/07/real-estate-mortgages-foreclosures-personal-finance-crisis.html>.)
- Daleco Resources Corp., 2007, Daleco Resources Corporation's Sierra Kaolin™ paint pigment product development trial results: Daleco Resources Corp. press release, September 24, 2 p.
- Daleco Resources Corp., 2008, Daleco Resources Corporation reports Sierra Kaolin project mining permit application: Daleco Resources Corp. press release, April 25, 1 p.
- Dolley, T.P., 2009, Silica, in *Metals and minerals: U.S. Geological Survey Minerals Yearbook, 2008*, v. 1, p. 66.1–66.16. (Accessed January 15, 2010, at <http://minerals.usgs.gov/minerals/pubs/commodity/silica/myb1-2008-silic.pdf>.)
- Dunphy, Harry, 2009, IMF—Economic woes could linger: Manufacturing Net, April 16, 1 p. (Accessed June 11, 2009, at <http://www.manufacturing.net/article.aspx?id=194478>.)
- Elementis Specialties Inc., 2008, Capital expansion announced for Newberry Springs, CA: Newberry Springs, CA, Elementis Specialties Inc. press release, May 31, 1 p.
- Erdine Resources Development Corp., 2009, Erdine concludes reverse takeover of Beta Mineral Inc.: Halifax, Nova Scotia, Canada, Erdine Resources Development Corp. press release, February 27, 3 p.
- Golden Gate Capital, 2008, Golden Gate Capital announces acquisition of U.S. Silica: San Francisco, CA, Golden Gate Capital press release, November 25, 2 p.
- Imerys SA, 2008a, Imerys NA Ceramics divests the Edgar, FL, production facility: Paris, France, Imerys SA press release, July 1, 1 p.
- Imerys SA, 2008b, Imerys pigments for paper to restructure middle Georgia kaolin operations: Paris, France, Imerys SA press release, August 1, 1 p.
- Imerys SA, 2009, 2008 results: Paris, France, Imerys SA press release, February 12, 15 p.
- Industrial Minerals, 2008a, Ashapura invests in Kerala kaolin: Industrial Minerals, no. 486, March, p. 12.
- Industrial Minerals, 2008b, Bentonite bound for success: Industrial Minerals, no. 490, July, p. 32–39.
- Industrial Minerals, 2008c, Continuing challenges for kaolin: Industrial Minerals, no. 491, August, p. 12.
- Industrial Minerals, 2008d, Europe's paper minerals pipeline opens: Industrial Minerals, no. 495, December, p. 24.
- Industrial Minerals, 2008e, Imerys idles Dry Branch calcined kaolin: Industrial Minerals, no. 489, June, p. 9.
- Industrial Minerals, 2008f, Kaolin cut-backs in the Americas: Industrial Minerals, no. 495, December, p. 11.
- Industrial Minerals, 2008g, Laviosa establishes Turkish bentonite arm: Industrial Minerals, no. 490, July, p. 10.
- Industrial Minerals, 2008h, Prices: Industrial Minerals, no. 495, December, p. 88.
- Industrial Minerals, 2008i, S&B moving forward: Industrial Minerals, no. 486, March, p. 60.
- Industrial Minerals, 2008j, Sud-Chemie eyes Italian bentonite market: Industrial Minerals, no. 492, September, p. 11.
- Industrial Minerals, 2008k, Whitemud metakaolin plant on stream: Industrial Minerals, no. 493, October, p. 12.
- Industrial Minerals, 2009, Harbinger sells US Silica Co.: Industrial Minerals, no. 496, January, p. 10.
- Jorgenson, J.D., 2009, Iron ore in January 2009: U.S. Geological Survey Mineral Industry Surveys, June, 7 p.
- KaMin LLC, 2008a, IMin purchases kaolin business from J.M. Huber Corporation: Macon, GA, KaMin press release, April 1, 1 p.
- KaMin LLC, 2008b, KaMin to restructure kaolin operation in Georgia: Macon, GA, KaMin press release, October 29, 1 p.
- Kaolin AD, 2008, Kaolin AD shall operate under the influence of the financial world crisis: Senovo, Bulgaria, Kaolin AD press release, May 12, p. 1. (Accessed December 11, 2008, at <http://www.kaolin.bg/en/n/32-kaolin-ad-shall-operate-under-the-influence-of-the-financial-world-crisis.html>.)
- Kilgore, Austin, 2010, Subprime problems persist, as Alt-A, Option ARM crisis brews: HousingWire, January 11. (Accessed May 7, 2010, at <http://www.housingwire.com/2010/01/11/subprime-problems-persist-as-alt-a-option-arm-crisis-brews/>.)
- McDonald, Joe, 2009, Volcker—U.S. growth possible this year: Manufacturing Net, June 12, 1 p. (Accessed June 15, 2009, at <http://www.manufacturing.net/article.aspx?id=203078>.)
- Pulp and Paper Network, LLC, 2009a, North American P&W shipments fell 8.2% last year: Pulp and Paper Network, LLC, February 10, 1 p. (Accessed February 26, 2009, at <http://www.pulpandpaper.net/NetLetter/ThreeG/02262009.asp>.)
- Pulp and Paper Network, LLC, 2009b, Paper and board output by Cepi members countries falls by around 4%: Pulp and Paper Network, LLC, February 25, 2 p. (Accessed February 26, 2009, at <http://www.pulpandpaper.net/NetLetter/ThreeG/02262009.asp>.)
- Rooney, Ben, 2009, Bernanke sees 'signs' decline is easing: CNNMoney.com, April 14, 1 p. (Accessed June 11, 2009, at <http://money.cnn.com/2009/04/14/news/economy/Bernanke/index.htm>.)
- Turkmenistan.ru, 2008, Kaolin plant inaugurated in Kjebel village in western Turkmenistan: Turkmenistan.ru, October 25, 1 p. (Accessed October, 27, 2008, at http://www.turkmenistan.ru/?page_id=3&lang_id=en&elem_id=13845&type=event&sort=date_desc.)
- U.S. Census Bureau, 2009a, Annual value of construction put in place: U.S. Census Bureau, February 2. (Accessed April 1, 2009, at <http://www.census.gov/const/C30/total.pdf>.)
- U.S. Census Bureau, 2009b, Clay construction products—Summary 2008: U.S. Census Bureau MQ327D(08)–4, March, 6 tables.
- U.S. Census Bureau, 2009c, Paint and allied products—2008: U.S. Census Bureau MQ325F(08)–1, July, 4 tables.
- U.S. Census Bureau, 2009d, Privately owned housing units started: U.S. Census Bureau. (Accessed May 18, 2008, at <http://www.census.gov/const/C30/total.pdf>.)
- U.S. Census Bureau, 2009e, Refractories—2008: U.S. Census Bureau MA327C(08)–1, May, 4 tables.
- U.S. Department of Agriculture, 2008, USDA Rural Development announces a \$10,000,000.00 guaranteed business & industry loan: U.S. Department of Agriculture news release, July 29, 1 p.
- U.S. International Trade Commission, [undated], International trade database: U.S. International Trade Commission. (Accessed April 20, 2009, at http://dataweb.usitc.gov/scripts/user_set.asp.)
- Wan, K.W., 2008, Bentonite bound for success: Industrial Minerals, no. 490, July, p. 32–39.
- Whitemud Resources Inc., 2008, Whitemud Resources reports operations update and 2008 first quarter financial results: Calgary, Saskatchewan, Canada, Whitemud Resources Inc. press release, December 16, 3 p.
- ZEOX Corp., 2008, ZEOX increases its stake to 59% in ZEOX Performance Materials, LLC: Vancouver, British Columbia, Canada, ZEOX Corp. press release, June 27, 1 p.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Clays. Ch. in Mineral Commodity Summaries, annual.
Clays. Ch. in United States Mineral Resources, Professional
Paper 820, 1973.

Other

China Clay Producers Association.
Clays. Ch. in Mineral Facts and Problems, U.S. Bureau of
Mines Bulletin 675, 1985.

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

(Thousand metric tons and thousand dollars)

	2004	2005	2006	2007	2008
<u>Domestic clays sold or used by producers:</u>					
Quantity	41,200	41,200	41,200	36,700 ^r	33,200
Value	1,680,000	1,590,000	1,770,000	1,750,000 ^r	1,670,000
<u>Exports:</u>					
Quantity	5,630	5,620	5,980	5,650	4,790
Value	936,000	929,000	1,000,000	928,000	978,000
<u>Imports for consumption:</u>					
Quantity	251	301	346	231	239
Value	61,700	59,400	79,200	73,900	119,000

^rRevised.

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, BY STATE^{1,2}

(Thousand metric tons and thousand dollars)

State	2007		2008	
	Quantity	Value	Quantity	Value
Alabama	2,240	42,300	1,970	34,400
Arkansas	1,120	4,520 ^r	796	10,700
California	578 ^r	6,480 ^r	618	6,930
Colorado	174	1,100	143	684
Florida	24	2,770	21	2,520
Georgia	8,670	1,000,000	7,920	936,000
Indiana	624	8,980 ^r	667	8,080
Iowa	331	2,630	269	1,140
Kansas	563	3,830	548	2,840
Kentucky	598	3,720	419	8,170
Louisiana	552	13,800	509	12,900
Maryland	173	W ^r	W	W
Michigan	533 ^r	2,250 ^r	365	1,730
Mississippi	575	7,580 ^r	869	6,030
Missouri	426	2,880 ^r	496	3,470
New Jersey	65	W	--	--
New York	699	28,500	745	28,200
North Carolina	1,740	20,300 ^r	1,270	12,900
Ohio	1,190	16,500	983	15,900
Oklahoma	1,050	5,170 ^r	756	3,900
Pennsylvania	683	4,890 ^r	640	4,840
South Carolina	1,160	21,600 ^r	690	13,500
South Dakota	151	W	155	W
Tennessee	876	32,000	723	27,000
Texas	2,020	16,300 ^r	2,140	25,700
Utah	531	10,400	479	10,200
Virginia	725	7,840 ^r	766	8,540
Wyoming	4,310	227,000	4,550	214,000
Other ³	2,970 ^r	255,000 ^r	3,640	264,000
Total	36,700 ^r	1,750,000 ^r	33,200	1,640,000

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

¹Excludes Puerto Rico.

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

³Includes all other producer States, concealed data within States, and data represented by symbol W.

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

(Thousand metric tons and thousand dollars)

	2007		2008	
	Quantity	Value	Quantity	Value
Type:				
Airfloat	780	34,800	690	31,000
Water-slurried	122	6,100	103	4,920
Unprocessed	169	8,100	174	8,380
Total	1,070	49,000	967	44,300
Use:				
Fillers, extenders, binders ²	47	NA	39	NA
Floor and wall tile	402	NA	340	NA
Miscellaneous ceramics ³	95	NA	92	NA
Pottery	6	NA	12	NA
Sanitaryware	253	NA	202	NA
Miscellaneous ⁴	21	NA	28	NA
Exports ⁵	247	NA	255	NA
Total	1,070	49,000	967	44,300

NA Not available.

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

²Includes animal feed; asphalt emulsions (2008); rubber; and other fillers, extenders, and binders.

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

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

⁵Includes ceramics and glass and floor and wall tile.

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

(Thousand metric tons and thousand dollars)

	2007		2008	
	Quantity	Value	Quantity	Value
Type:				
Nonswelling	219	11,100	172	10,400
Swelling	4,600	241,000	4,860	237,000
Total	4,820	252,000	5,030	247,000
Use:				
Domestic:				
Pet waste absorbents	1,030	NA	1,000 ^e	NA
Adhesives	8	NA	27	NA
Animal feed	121	NA	95	NA
Drilling mud	912	NA	954	NA
Filler and extender applications ²	83	NA	84	NA
Foundry sand	562	NA	590 ^e	NA
Pelletizing (iron ore) ³	677	NA	717 ^e	NA
Waterproofing and sealing	139	NA	168	NA
Miscellaneous civil engineering	301	NA	340 ^e	NA
Miscellaneous ⁴	128	NA	158	NA
Total	3,960	NA	4,130^e	NA
Exports:				
Drilling mud	204	NA	223 ^e	NA
Foundry sand	246	NA	259	NA
Other ⁵	404	NA	411	NA
Total	854	NA	894^e	NA
Grand total	4,820	252,000	5,030	247,000

^eEstimated. 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 fillers and extenders applications, paint, paper coating, paper filling, pesticides and related products, pharmaceuticals, and plastics.

³Excludes shipments to Canada. Total sales in North America were 747,000 metric tons (t) in 2007 and 611,000 t in 2008.

⁴Includes ceramics, chemical manufacturing, clarifying and decolorizing, heavy-clay products, oil and grease absorbents, refractories, and other unknown uses.

⁵Includes absorbents, fillers and extenders, 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^{1,2}

(Thousand metric tons and thousand dollars)

	2007		2008	
	Quantity	Value	Quantity	Value
State:				
Alabama	2,240	42,300 ^r	1,970	34,400
Arkansas	1,120	4,520 ^r	796	10,700
California	549	3,390 ^r	469	3,570
Georgia	1,350	8,110	952	6,020
Indiana	624	8,980 ^r	667	8,080
Kansas	563	3,830	548	2,840
Kentucky	598	3,720	419	8,170
Louisiana	552	13,800	509	12,900
Mississippi	508	2,980 ^r	433	2,340
Missouri	426	2,880 ^r	496	3,470
New York	699	28,500	745	28,200
North Carolina	1,720	19,500 ^r	1,260	12,900
Ohio	1,190	16,500	983	15,900
Oklahoma	1,050	5,170 ^r	756	3,900
Pennsylvania	683	4,890 ^r	640	4,840
South Carolina	826	3,990 ^r	461	2,130
Texas	1,950	12,600 ^r	2,070	13,700
Utah	531	10,400	479	10,200
Virginia	725	7,840 ^r	766	8,540
Other ³	2,660	12,700 ^r	2,050	9,140
Total	20,600	216,000	17,500	202,000
Use:				
Floor and wall tile ⁴	224	NA	241	NA
Heavy-clay products:				
Brick, extruded	10,300	NA	8,020	NA
Brick, other	1,470	NA	795	NA
Other ⁵	274	NA	266	NA
Lightweight aggregate:				
Concrete block	2,150	NA	1,890	NA
Highway surfacing	326	NA	341	NA
Structural concrete	759	NA	897	NA
Miscellaneous	689	NA	810	NA
Portland and other cements	2,950	NA	2,720	NA
Refractories ⁶	739	NA	596	NA
Miscellaneous ⁷	693	NA	894	NA
Total	20,600	216,000	17,500	202,000

^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 ceramic tile, quarry tile, and miscellaneous floor and wall tiles.

⁵Includes drain tile, flower pots, flue linings, sewer pipe, structural tile, and miscellaneous clay products.

⁶Includes firebrick, blocks and shapes, mortar and cement, grogs and calcines, and miscellaneous refractories.

⁷Includes exports; miscellaneous civil engineering and sealings; miscellaneous fillers, extenders, and binders; pottery, roofing granules; and other unknown uses.

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

(Thousand metric tons and thousand dollars)

	2007		2008	
	Quantity	Value	Quantity	Value
Production	565	23,800	447	17,700
Use:				
Heavy-clay products and lightweight aggregates ²	325	NA	232	NA
Refractories:				
Firebrick, block, shapes	--	NA	--	NA
Grog and calcines	W	NA	W	NA
Other refractories ³	W	NA	W	NA
Miscellaneous ⁴	240	NA	215	NA
Total	565	23,800	447	17,700

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

-- Zero.

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 other 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)

	2007		2008	
	Quantity	Value	Quantity	Value
Type:				
Attapulgite ²	245	36,500	W	W
Montmorillonite	2,360 ^r	211,000 ^r	2,350	231,000
Total	2,600 ^r	247,000 ^r	2,350	231,000
Use:				
Absorbents:				
Oil and grease absorbent	366 ^r	NA	338	NA
Pet waste absorbent	1,340 ^r	NA	1,180	NA
Animal feed	44 ^r	NA	42	NA
Fertilizers	(3)	NA	(3)	NA
Fillers, extenders, binders ⁴	233	NA	119	NA
Filtering, clarifying, and decolorizing animal, mineral, and vegetable oils and greases	73	NA	92	NA
Miscellaneous ⁵	522 ^r	NA	568	NA
Exports ⁶	22	NA	19	NA
Total	2,600 ^r	247,000 ^r	2,350	231,000

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

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

²Primarily gellant-grade fuller's earth. More information can be found in the "Fuller's Earth" portion of the production section of this report.

³Withheld to avoid disclosing company proprietary data; included in "Miscellaneous."

⁴Includes asphalt emulsions; medical, pharmaceuticals and cosmetics; paints; pesticides and related products; and unknown uses.

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

⁶Includes oil and grease absorbents (2007), pet waste absorbents (2007), drilling mud, paint (2008), and other unknown uses.

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

(Thousand metric tons and thousand dollars)

	2007		2008	
	Quantity	Value	Quantity	Value
State:				
Georgia	6,570	924,000	6,290	872,000
South Carolina	297	17,600	199	11,300
Other ²	244	17,300	257	16,800
Total	7,110	959,000	6,740	900,000
Type:				
Airfloat	1,180	85,600	1,130	79,700
Calcined: ³	1,390	280,000	1,390	260,000
Delaminated	1,140	150,000	1,070	144,000
Unprocessed	135	1,970	78	1,530
Water washed	3,260	442,000	3,080	414,000
Total	7,110	959,000	6,740	900,000

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

²Includes Alabama, Arkansas, 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)

Kind	2007		2008	
	Quantity	Value	Quantity	Value
Type:				
Airfloat	948	67,200	859	63,600
Calcined ²	1,290	267,000	1,360	251,000
Delaminated	1,140	150,000	1,070	144,000
Water washed	3,190	440,000	3,000	413,000
Total	6,570	924,000	6,290	872,000
Use:				
Domestic:				
Ceramics and glass:				
Catalysts (oil-refining)	W	NA	W	NA
Fiberglass	324	NA	251	NA
Roofing granules	35	NA	31	NA
Other ³	340	NA	371	NA
Fillers, extenders, binders:				
Adhesives	43	NA	33	NA
Paint	301	NA	237	NA
Paper coating	2,310	NA	1,880	NA
Paper filling	329	NA	250	NA
Plastic	78	NA	81	NA
Rubber	157	NA	124	NA
Other ⁴	41	NA	28	NA
Heavy-clay products ⁵	(6)	NA	(6)	NA
Refractories ⁷	(6)	NA	(6)	NA
Undistributed ⁸	685	NA	931	NA
Total	4,640	NA	4,220	NA
Exports:				
Paint	69	NA	70	NA
Paper coating ⁹	1,640	NA	1,760	NA
Paper filling ⁹	122	NA	110	NA
Rubber	19	NA	46	NA
Undistributed ¹⁰	75	NA	87	NA
Total	1,930	NA	2,070	NA
Grand total	6,570	924,000	6,290	872,000

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 pigment- and refractory-grade calcined kaolin.

³Includes electrical porcelain, fine china/dinnerware, pottery, miscellaneous ceramics, and sanitaryware.

⁴Includes animal feed; asphalt tile (2008); fertilizers; medical, pharmaceuticals and cosmetics; pesticides and related products (2008); and miscellaneous fillers, extenders, and binders.

⁵Includes brick (common and face), portland cement, and miscellaneous clay 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 absorbents, chemical manufacturing, floor and wall tiles, heavy-clay products, refractories (2008), waterproofing seals, and other unknown uses.

⁹Some export sales may be included under domestic sales.

¹⁰Includes miscellaneous ceramics and miscellaneous fillers, extenders, and other unknown uses.

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

(Thousand metric tons and thousand dollars)

	2007		2008	
	Quantity	Value	Quantity	Value
Production ²	297	17,600	199	11,300
Use:				
Ceramics ³	87	NA	79	NA
Rubber	76	NA	45	NA
Other uses ⁴	134	NA	75	NA
Exports ⁵	W	NA	W	NA
Total	297	17,600	199	11,300

NA Not available. W Withheld to avoid disclosing company proprietary data, included in "Other uses."

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, paper coating, plastics, and refractories.

⁵Includes fillers, extenders, and binders.

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

(Thousand metric tons)

Use	2007	2008
Domestic:		
Ceramics:		
Catalyst (oil and gas refining)	243	295
Electrical porcelain	W	W
Fine china and dinnerware	13	12
Floor and wall tile	70	106
Pottery	4	4
Roofing granules	39	31
Sanitaryware	30	25
Miscellaneous	122	109
Chemical manufacture	W	W
Fiberglass, mineral wool	337	262
Fillers, extenders, binders:		
Adhesive	53	35
Fertilizer	W	W
Medical, pharmaceutical, cosmetic	W	W
Paint	321	255
Paper coating	2,310	1,890
Paper filling	329	250
Pesticide	--	W
Plastic	89	88
Rubber	233	169
Miscellaneous	43	26
Heavy-clay products:		
Brick, common and face	114	52
Portland cement	90	64
Refractories ²	502	804
Miscellaneous applications	182	200
Total	5,130	4,640
Exports: ³		
Ceramics	W	W
Paint	85	83
Paper coating	1,640	1,760
Paper filling	122	110
Rubber	42	52
Miscellaneous	90	91
Total	1,980	2,090
Grand total	7,110	6,740

W Withheld to avoid disclosing company proprietary data; included in "Miscellaneous." -- Zero.

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

²Includes firebrick (blocks and shapes), grogs and calcines, and miscellaneous refractories.

³Withheld to avoid disclosing company proprietary data; included in "Exports: 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
2007:					
Alabama	599	42	72	713	27,300
Arkansas	408	--	--	408	2,250
Indiana	88	38	113	239	6,580
Kansas	--	--	57	57	498
Kentucky	127	54	--	181	1,200
Louisiana	289	72	120	481	13,300
Missouri	--	--	127	127	1,110
Nebraska	--	--	1	1	3
New York	225	260	--	485	25,400
North Carolina	--	--	8	8	65
Ohio	109	64	100	272	11,200
Oklahoma	36	5	--	41	1,190
Texas	38	142	256	435	3,600
Utah	127	80	156	363	7,600
Virginia	108	2	(3)	115	3,510
Total	2,150	759	689	3,930	105,000
2008:					
Alabama	593	42	71	705	21,000
Arkansas	169	56	--	225	8,690
Indiana	57	41	18	116	3,190
Kansas	--	--	55	55	480
Kentucky	66	72	--	138	6,400
Louisiana	192	77	185	454	12,500
Missouri	--	--	133	133	1,160
Nebraska	--	--	(3)	(3)	2
New York	259	305	--	564	24,900
North Carolina	--	--	6	6	48
Ohio	98	54	93	245	10,300
Oklahoma	28	4	--	32	952
Texas	206	165	359	730	5,200
Utah	127	80	200	407	9,270
Virginia	91	1	31	124	2,750
Total	1,890	897	1,150	3,930	107,000

-- Zero.

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

²Includes highway surfacing.

³Less than ½ unit.

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	2007		2008	
	Quantity	Value ^e	Quantity	Value ^e
Alabama	1,320	11,900 ^f	782	9,260
Arkansas	380	1,320 ^f	257	1,100
California	211	959 ^f	164	978
Colorado	154	992	108	467
Georgia	1,260	7,690 ^f	884	5,650
Kentucky ³	409	2,350	273	1,620
Maryland	W	W	W	W
Mississippi	508	2,980 ^f	433	2,340
North Carolina	1,650	18,700 ^f	1,250	12,800
Ohio	495	3,110 ^f	379	3,450
Oklahoma	601	2,710 ^f	541	2,460
Pennsylvania	603	3,630 ^f	555	3,450
South Carolina	619	2,810 ^f	453	2,100
Tennessee	199	1,360	155	1,090
Texas	814	4,860 ^f	604	4,080
Virginia	561	2,860 ^f	502	2,670
Other ⁴	1,980	42,900 ^f	1,480	8,660
Total	11,800	81,200 ^f	8,820	62,200

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

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 and data represented by symbol W. Excludes Alaska, Nevada, New Hampshire, Rhode Island, Vermont, and Wisconsin.

TABLE 14
U.S. EXPORTS OF CLAYS, BY TYPE^{1,2}

(Thousand metric tons and thousand dollars)

Material	2007		2008		Principal destinations in 2008
	Quantity	Value	Quantity	Value	
Ball clay	83	5,610	65	4,580	Mexico, 48%; Venezuela, 10%; Costa Rica, 6%.
Bentonite	1,430	158,000	1,090	161,000	Canada, 35%; Japan, 17%; Netherlands, 16%.
Fire clay	425	47,700	393	49,600	Mexico, 46%; Luxembourg, 30%; Japan, 16%.
Fuller's earth	134	37,700	127	44,100	Japan, 31%; Italy, 6%; Netherlands, 4%.
Kaolin	3,300	615,000	2,960	606,000	Japan, 21%; Canada, 15%; Finland, 10%; Mexico, 9%.
Clays, n.e.c.	279	63,600	153	112,000	Canada, 53%; Mexico, 9%; Japan, 6%.
Total	5,650	928,000	4,790	978,000	

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

²The Harmonized Tariff Schedule of the United States (HTS) codes for ball clay, fuller's earth, and clays, n.e.c. changed January 2007. Lower reported exports of ball clay and clays, n.e.c. in 2007 perhaps is do to accounting problems under the new HTS codes rather than an actual decrease in export tonnages.

Source: U.S. Census Bureau.

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

(Thousand metric tons and thousand dollars)

Material	2007		2008		Principal sources in 2008
	Quantity	Value	Quantity	Value	
China clay or kaolin	194	48,500	194	46,100	Brazil, 93%; United Kingdom, 4%.
Fire clay	2	584	1	94	China, 79%; United Kingdom, 17%.
Decolorizing earths and fuller's earth	--	--	1	100	United Kingdom, 58%; Japan, 22%; China, 20%.
Bentonite	11	2,390	7	3,100	Mexico, 47%; Greece, 21%; Canada, 8%; China, 8%.
Common blue clay and other ball clay	--	--	2	358	Canada, 60%; United Kingdom, 33%.
Other clay	--	--	4	3,230	Canada, 57%; Mexico, 18%; Germany, 15%.
Chamotte or Dina's Earth	--	--	1	42,400	Czech Republic, 92%; Poland, 8%.
Artificially activated clay and activated earth	23	22,400	29	23,400	Mexico, 75%; Germany, 14%.
Total	231	73,900	239	119,000	

-- Zero.

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

Source: U.S. Census Bureau.

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

(Metric tons)

Country ³	2004	2005	2006	2007	2008 ^e
Algeria ⁴	30,319	29,029	27,110	32,600	30,595 ⁵
Argentina	163,028	247,101	246,165 ^r	250,260 ^r	250,000
Armenia	561	732	720	1,129	1,100
Australia ^{c,4}	265,000	223,000	220,000	255,000	250,000
Azerbaijan	40,000 ^e	40,000 ^e	40,644	50,459	5,000
Bolivia	548	590	-- ^{r,e}	-- ^{r,e}	--
Bosnia and Herzegovina	24,353	24,882	24,645 ^r	32,912 ^r	32,000
Brazil, beneficiated	227,126	221,300	235,481	21,451 ^r	31,557 ⁵
Bulgaria	225,000	181,000	134,000 ^r	99,000 ^r	100,000
Burma	815 ^r	602 ^r	904 ^{r,6}	900 ^r	900
Chile	101	--	--	533	-- ⁵
Commonwealth of Independent States ^{c,7}	750,000	750,000	750,000	750,000	750,000
Croatia	16,000	17,391	16,410	19,578	19,500
Cyprus	155,717 ⁵	150,000	150,000	150,000	150,000
Czech Republic	224,000 ^r	216,000 ^r	267,000 ^r	335,000 ^r	174,000
Egypt ^e	30,000 ^r	30,000 ^r	30,000 ^r	30,000 ^r	30,000
Georgia ^e	1,800	7,876	4,487	5,000	5,000
Germany	404,549	352,374	363,998	384,709 ^r	385,000
Greece ^e	950,000	950,000	950,000	950,000	950,000
Guatemala	81,688	135,451	20,034	51,960 ^r	50,000
Hungary	6,449	9,000 ^r	6,600	5,400	5,400 ⁵
Indonesia ^e	5,000	5,000	5,500	5,500 ^r	6,000
Iran ⁷	193,046	261,888	260,000 ^e	250,000	240,000
Italy ^e	475,000 ^e	446,000 ^e	470,000	599,775	599,000 ⁵
Japan	455,282	421,629	425,000 ^r	430,000 ^r	430,000
Kenya ^e	50	50 ^r	50 ^r	60	60
Macedonia ^e	25,000 ^e	25,767	32,507 ^r	35,234 ^r	22,890 ⁵
Mexico	564,015	425,630	435,273	613,895 ^r	374,933 ^{p,5}
Morocco	85,400	85,400 ^e	80,400 ^e	81,000	80,000
Mozambique	3,336	17,318	3,515	3,600 ^e	3,600
New Zealand, processed ^e	10,050	7,590	3,028	6,154 ^r	753 ⁵
Pakistan	6,316	15,671	23,773 ^r	24,000 ^r	25,000
Peru	18,471	18,500	19,000 ^r	21,451	31,557 ⁵
Philippines	3,560	1,000	1,000 ^e	1,148 ^r	1,100
Poland ⁸	66,143	86,331	93,880	105,943	121,031 ⁵
Romania	22,337	20,226	21,165	16,911 ^r	16,600
Serbia	75 ⁹	75 ⁹	75	75	75
Slovakia	69,252	75,752	93,373	121,347	95,056 ⁵
South Africa ¹⁰	55,859	139,833	32,878	45,778	44,067 ^{p,5}
Spain	156,760	105,000 ^e	154,746 ^r	155,000 ^r	150,000
Turkey	850,000	925,000	950,000	930,000	900,000
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	4,550,000	4,710,000	4,940,000	4,820,000	5,030,000 ⁵
Zimbabwe ¹⁰	500	500	500	100	100
Total	11,600,000 ^r	11,700,000 ^r	11,900,000 ^r	12,000,000 ^r	11,700,000

^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 September 21, 2009.

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

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

⁴Includes bentonitic clays.

⁵Reported figure.

⁶Year beginning March 21 of that stated.

⁷Information is inadequate to formulate reliable estimates for individual countries, except Armenia, Georgia, Turkmenistan, and Ukraine.

⁸Montmorillite type bleaching clay.

⁹Montenegro and Serbia formally declared independence in June 2006 from each other and dissolved their union.

¹⁰May include other clays.

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

(Metric tons)

Country ³	2004	2005	2006	2007	2008 ^e
Algeria	2,284	831	--	--	--
Australia, attapulgite ^e	10,000	9,800	10,000	10,000	10,000
Guatemala	9	--	19	109 ^r	100
Italy ^e	3,000	3,000	3,000	3,000	3,000
Mexico	129,502	107,265	102,400	34,175 ^r	66,123 ^{p,4}
Morocco, smectite ^e	15,000	15,000	15,000	15,000	15,000
Pakistan	13,986	17,001	18,000 ^e	19,000 ^e	20,000
Senegal, attapulgite	200,000 ^e	127,000	140,000	150,000 ^{r,e}	167,000 ⁴
South Africa, attapulgite	20,419	33,682	49,225	68,377	69,876 ⁴
Spain: ^e					
Attapulgite	20,796 ⁴	20,000	20,000	20,000	20,000
Sepiolite	851,647 ⁴	800,000 ^r	800,000 ^r	800,000 ^r	800,000
United Kingdom ^{e,5}	140,000	115,000	--	--	--
United States ^{6,7}	3,260,000	2,730,000	2,540,000	2,600,000 ^r	2,350,000 ⁴
Total	4,670,000	3,980,000 ^r	3,700,000 ^r	3,720,000 ^r	3,520,000

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

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 September 21, 2009.

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.

⁷Excludes attapulgite.

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

(Metric tons)

Country ³	2004	2005	2006	2007	2008 ^c
Algeria	24,299	34,386	32,523	106,567	50,788 ⁴
Argentina	39,072	54,903	49,619	69,354 ^r	60,000
Australia, includes ball clay ^e	285,000	230,000	250,000	250,000	230,000
Austria, marketable	104,986 ^r	55,508 ^r	51,900 ^r	56,690 ^r	55,000
Bangladesh ^{e,5}	8,300	8,400	8,500	8,600	8,600
Belgium ^e	300,000	300,000	300,000	300,000	300,000
Bosnia and Herzegovina, crude	46,000	45,000	42,422	20,767 ^r	21,000
Brazil, beneficiated	2,381,000	2,410,000	2,455,000	2,527,000 ^r	2,500,000
Bulgaria	1,291,000	1,380,000	1,658,000	1,631,000	1,600,000
Chile	7,133	15,183	44,642	87,901	63,526 ⁴
Czech Republic	3,862,000	3,882,000	3,768,000	3,604,000 ^r	3,833,000 ⁴
Denmark, sales ^e	2,500	2,500	2,500	2,500	2,500
Ecuador	5,646	25,078	11,504	18,618	12,000
Egypt	295,430 ^r	415,400 ^r	416,000 ^{r,e}	416,000 ^{r,e}	416,000
Eritrea	101	100	100	100	100
Ethiopia	4,251	3,726	1,641	4,000 ^r	4,000
France, marketable ^e	323,000	316,000	300,000	307,253 ⁴	300,000
Germany	3,751,874	3,767,662	3,815,173	3,842,514 ^r	3,800,000
Greece ^e	60,000	60,000	60,000	60,000	60,000
Guatemala	--	4,107	4,395	5,871 ^r	5,500
Hungary, processed	7,530	7,000	7,000	3,000	3,000
India: ^e					
Processed	180,000	190,000	200,000	200,000	210,000
Salable crude	550,000	560,000	560,000	570,000	570,000
Indonesia ^e	15,000	15,000	15,000	15,000	15,000
Iran	531,109	311,501	310,000 ^e	350,000 ^e	320,000
Italy, kaolinitic earth	567,873	506,597	469,702	584,121	580,000
Japan	11,553	10,500	10,500 ^r	11,000 ^r	11,000
Jordan	216,566	168,264	112,787	101,000 ^r	181,000 ⁴
Kenya	760	780	810 ^r	910 ^r	940
Korea, Republic of	2,773,220	2,767,091	2,399,458	2,630,356	954,584 ⁴
Kyrgyzstan ^e	400,000	400,000	400,000	400,000	400,000
Madagascar ^e	-- ^r	-- ^r	-- ^r	-- ^r	--
Malaysia	326,928	494,511	341,223	587,508 ^r	400,000
Mexico	654,711	877,147	961,800	86,784 ^r	85,091 ^{p,4}
New Zealand	15,500	15,750	14,864	14,130 ^r	12,761 ⁴
Nigeria ^e	58,000	93,000	100,000	100,000	100,000
Pakistan	25,204	37,732	38,000 ^e	39,000	40,000
Paraguay ^e	66,600	66,600	66,000	66,000	66,000
Peru	2,720	2,700	5,750 ^r	7,532	13,215 ⁴
Poland, washed	191,312	159,207	199,755	210,373	221,275 ⁴
Portugal ^e	152,077	164,072 ^r	167,792 ^r	165,000 ^{r,e}	165,000
Romania	22,337	20,266	11,063	7,576 ^r	4,000
Russia, concentrate ^e	45,000	45,000	45,000	45,000	45,000
Saudi Arabia	-- ^e	1,500	4,000	4,400	4,400 ⁴
Serbia: ^e					
Crude	95,000 ⁶	95,000 ⁶	110,000	110,000	110,000
Washed	16,000 ⁶	16,000 ⁶	18,000	10,000	10,000

See footnotes at end of table.

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

(Metric tons)

Country ³	2004	2005	2006	2007	2008 ^c
Slovakia	46,000 ^r	31,000 ^r	58,000 ^r	46,000 ^r	45,000
South Africa	81,901	59,356	51,602	50,839 ^r	39,505 ^{p, 4}
Spain, marketable, crude and washed ⁷	437,990	450,000	464,049 ^r	465,000 ^{r, e}	450,000
Sri Lanka	9,200 ^e	9,400 ^e	9,500	9,500	9,700
Thailand, beneficiated	200,761	156,853	157,900	200,000	162,215 ⁴
Turkey ^c	536,008 ⁴	580,000	650,000	580,000	620,000
Uganda ^c	537 ⁴	31,000	30,000	30,000	30,000
Ukraine	1,468,000	1,566,000	1,777,000	2,386,000	2,400,000
United Kingdom, sales ⁸	1,995,000	1,911,000	1,800,000	1,800,000 ^e	1,800,000
United States ⁹	7,760,000	7,800,000	7,470,000	7,110,000	6,740,000 ⁴
Uzbekistan ^e	5,500,000	5,500,000	5,500,000	5,500,000	5,500,000
Venezuela ^c	10,000	10,000	10,000	10,000	10,000
Vietnam ^c	650,000	650,000	650,000	650,000	650,000
Zambia ^c	200	200	200	200	200
Total	38,400,000 ^r	38,800,000 ^r	38,500,000 ^r	38,500,000 ^r	36,300,000

^cEstimated. ^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 September 21, 2009.

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.

⁶Montenegro and Serbia formally declared independence in June 2006 from each other and dissolved their union.

⁷Includes crude and washed kaolin and refractory clays not further described.

⁸Dry weight.

⁹Kaolin sold or used by producers.