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Planning And Standards  
Research Triangle Park, NC 27711

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Air

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***Economic Impact Analysis of  
the Clay Ceramics  
Manufacturing NESHAP: Final Rule***



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***U.S. Environmental Protection Agency  
Office of Air Quality Planning and Standards  
Innovative Strategies and Economics Group, MD-C339-01  
Research Triangle Park, NC 27711***

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## Acronyms

CAA	Clean Air Act
DIFF	Dry Injection Fabric Filter
EIA	Economic Impact Analysis
EPA	United States Environmental Protection Agency
HAPs	Hazardous Air Pollutants
HCl	Hydrogen Chloride (also known as Hydrochloric Acid)
HF	Hydrogen Fluoride
ISEG	Innovative Strategies and Economics Group
MACT	Maximum Achievable Control Technology
NESHAP	National Emission Standards for Hazardous Air Pollutants
NAICS	North American Industrial Classification Code
OAQPS	Office of Air Quality, Planning, and Standards
RFA	Regulatory Flexibility Act
SBREFA	Small Business Regulatory Enforcement Fairness Act
SIC	Standard Industrial Classification
VOPS	Value of Product Shipments
VOS	Value of Shipments

## **ECONOMIC IMPACT ANALYSIS: CLAY CERAMICS MANUFACTURING**

### **1 INTRODUCTION**

Pursuant to Section 112 of the Clean Air Act, the U.S. Environmental Protection Agency (EPA or the Agency) is developing National Emissions Standards for Hazardous Air Pollutants (NESHAP) to address the emissions released from major sources in the clay ceramics manufacturing source category. The clay ceramics industry manufactures such products as dinnerware, kitchenware, pottery, sanitaryware, and ceramic floor and wall tile. EPA has defined the clay ceramics manufacturing source category to include only those facilities that produce pressed floor tile, pressed wall tile, other pressed tile, and sanitaryware because no major sources were identified in the other segments of the clay ceramics manufacturing industry. Ceramic tile and sanitaryware are used as inputs to the production of buildings, structures, and homes. The NESHAP which this economic impact analysis (EIA) addresses is scheduled to be proposed in mid-2001. The Innovative Strategies and Economics Group (ISEG) of the Office of Air Quality Planning and Standards (OAQPS) has developed this analysis in support of the evaluation of impacts associated with the clay ceramics manufacturing NESHAP.

#### **1.1 Scope and Purpose**

This report evaluates the economic impacts of pollution control requirements on ceramic floor and wall tile and sanitaryware manufacturing operations. The Clean Air Act (CAA) was designed to protect and enhance the quality of the nation's air resources and Section 112 of the CAA establishes the authority to control hazardous air pollutant (HAP) emissions. To reduce emissions of HAPs, the Agency establishes maximum achievable control technology (MACT) standards. The term "MACT floor" refers to the minimum control technology on which MACT standards can be based. The MACT floor is set by the average emissions limitation achieved by the best performing 12 percent of sources in a category or subcategory when that category or subcategory contains at least 30 sources. For this NESHAP, the MACT floors for existing kilns at major sources in the clay ceramics source category require no control of HAP emissions; however new kilns at major sources in this source category are required to meet a MACT floor that entails some level of control. Since the proposed rule requires no control of existing sources, no costs will be incurred by existing sources.

#### **1.2 Organization of the Report**

The report is organized as follows: Section 2 provides a profile of the industry which includes a description of the producers and consumers of clay ceramic products. This section also presents available market data and trends in the industry, including domestic production, foreign trade, and apparent U.S. consumption. Special attention is given to the ceramic tile and sanitaryware manufacturing segments of the industry, since the facilities that produce these products are included in the clay ceramics manufacturing source category as defined by EPA. Section 3 describes the facility-level costs new sources will face to comply with this NESHAP and Section 4 provides facility-, market-, and society-level impacts of complying with this rule. Small business considerations are made in Section 5 as required by the Regulatory Flexibility Act (RFA) which was modified by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

## **2 INDUSTRY PROFILE**

Though the clay ceramics manufacturing source category only includes facilities that produce ceramic tile and sanitaryware, this industry profile provides an overall description of the clay ceramics manufacturing industry. In some sections, however, the report will focus on ceramic tile and sanitaryware since producers of these products are included in the clay ceramics manufacturing source category. The industry profile is organized as follows: Section 2.1 describes the processes and costs of producing clay ceramic products, as well as the types of emissions released during production. Section 2.2 explains the various uses, consumers, and substitute products available for ceramic products. Section 2.3 provides a summary profile of the clay ceramics source category, including a description of the ceramic tile and sanitaryware manufacturing facilities and the companies that own them.

Clay ceramics are heat- and corrosion-resistant products made by shaping and heating clay minerals. Some ceramic products include pottery, dinnerware, kitchenware, sanitaryware, bathroom accessories, and floor and wall tile. Kitchenware and dinnerware are used for food service, storage, and preparation, while bathroom accessories, sanitaryware, and ceramic tile are used in the construction of homes and buildings. Pottery often serves a decorative purpose, but is sometimes used for food preparation and presentation.

Clay ceramics manufacturing falls under the following North American Industrial Classification System (NAICS) codes:

- **NAICS 327122** - Ceramic Wall and Floor Tile Manufacturing;
- **NAICS 327111** - Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories Manufacturing; and
- **NAICS 327112** - Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing.

These correspond to the following Standard Industrial Classification (SIC) codes:

- **SIC 3253** - Ceramic Wall and Floor Tile;
- **SIC 3261** - Vitreous China Plumbing Fixtures and China and Earthenware Fittings and Bathroom Accessories;
- **SIC 3262** - Vitreous China Table and Kitchen Articles;
- **SIC 3263** - Fine Earthenware (Whiteware) Table and Kitchen Articles; and
- **SIC 3269** - Pottery Products, not elsewhere classified (n.e.c.).

Production of the various traditional ceramic products follows a similar process. During this production process, HAPs are released. The primary HAPs emitted are hydrogen fluoride (HF) and hydrogen chloride (HCl) and the primary sources of these emissions are the kilns used to fire the ceramic products.

### **2.1 Production Overview**

This section provides a general description of the clay ceramics manufacturing process. Section 2.1.1 provides an overview of the production process, while Section 2.1.2 briefly describes the emissions released as clay ceramic products are produced. Section 2.1.3 addresses the costs of producing ceramic products and last, Section 2.1.4 discusses the values of the types of clay minerals used in the production of clay ceramics.

#### **2.1.1 General Process Description**

The general process steps used in the production of ceramics include raw material processing, mixing, forming, shape drying, glazing, firing, and finishing. A generic process flow diagram is shown in Figure 2-1 following Section 2.1.1. Information in this section was taken from EPA's Emission

Factor Documentation on Ceramic Products Manufacturing (1996). Raw material processing typically includes crushing, grinding, screening, drying, and granulation or powder formation. Some ceramic manufacturers perform some or all of these operations onsite, but many purchase processed raw materials that require little, if any, additional processing. After initial processing, the raw materials are mixed and formed. In some ceramic mixes, binders and other additives are used to form a temporary bond to maintain the shape of the ceramic until it can be fired. Other additives also may be included in the mix to impart specific properties to the finished product. In the forming step, the mixture is molded or shaped. The ceramic mix can be formed by a variety of processes, the most common of which are pressing and slip casting. After forming, the ceramic may be “green machined” to eliminate rough surfaces and edges or to modify the shape. The next step is shape drying, which can be performed in continuous or periodic dryers. Ceramic glazes can be applied before firing or between firing stages, depending on the type of product. Firing may be performed in one or more stages. The following paragraphs describe each of the principle processing steps used in the production of ceramics: raw material processing, mixing, forming, shape drying, glazing, firing, and finishing.

#### *2.1.1.1 Raw Material Processing*

The raw materials used in the manufacture of ceramics range from unprocessed clays and other minerals mined from natural deposits to high purity powders prepared by chemical synthesis. Naturally-occurring raw materials used to manufacture ceramics include a variety of clays (including ball clay, kaolin, fire clay, and common clay), feldspar, talc, silica, and nepheline syenite. Silica can be in the form of silica sand, quartz, or flint.

Many raw materials require some degree of beneficiation prior to use in ceramic production. The basic beneficiation processes include crushing, grinding, and sizing or classification. Facilities that form ceramic bodies by pressing, often granulate raw materials and raw material mixes to produce a free-flowing powder. In addition, some facilities dry raw materials onsite. Primary crushing is used to reduce the size of coarse materials, such as clays, down to approximately 1 to 5 centimeters (cm) (0.5 to 2 inches [in.]). The most common types of crushers used are jaw crushers, cone crushers, gyratory crushers, and roll crushers. Secondary crushing or grinding reduces particle size down to approximately 1 millimeter (mm) (0.04 in.) in diameter. Fine grinding or milling reduces the particle size down to as low as 1.0 micrometer ( $\mu\text{m}$ ) ( $4 \times 10^{-5}$  in.) in diameter. Ball mills are the most commonly used piece of equipment for milling. Hammer mills, vibratory mills, attrition mills, and fluid energy mills also are used. Crushing and grinding typically are dry processes, but some facilities use wet ball mills to grind and mix raw materials in one step.

Sizing and classification separate the raw material into size ranges. Sizing is most often accomplished using one or more vibrating screens in series. Screens can have one or more decks, with each successive deck fitted with an increasingly smaller mesh. A single-deck screen can produce two size fractions, the oversize (that material that does not pass through the screen) and the undersize (the material that passes through the screen). To achieve more than two size ranges, multi-deck screens are used. Often, the grinding and screening steps are designed as a closed-circuit system in which the grinder discharge is conveyed to screens, oversize material exiting the screen is conveyed back to the grinder, and undersize material is conveyed to the next step in the process or to storage. Air classification also is used in the ceramics industry to separate materials by size.

Some raw materials, particularly those that are stored outside, must be dried before being processed for ceramics manufacturing. Drying helps prevent caking during storage, prepares the material for dry mixing, and produces a consistent moisture content among the raw materials. Rotary dryers are most commonly used for drying ceramic raw materials. Vibrating grate dryers and fluidized bed dryers also are used. Raw material dryer operating temperatures generally range from 50° to 120°C (120° to 250°F).

#### *2.1.1.2 Mixing*

The purpose of mixing is to combine the constituents of a ceramic mix to produce a more chemically and physically uniform material for forming. The type of mixer used typically is a function of the forming method that follows mixing. Facilities that form products by slip-casting typically use blungers or wet mixers. Dry mixing is used when the ceramic is to be dry-pressed or formed by some other dry forming process.

Binders and other additives may also be added in the mixer. Binders are used to form temporary bonds between raw material grains to help maintain the shape of the ceramic until it can be fired. Organic binders are typically burned off during firing; inorganic binders become part of the ceramic matrix during firing. Binders also can serve as lubricants and can impart other properties to the final product. Some examples of binders used in the production of ceramics are clays, silicates, and phosphates. Additives generally are used to facilitate processing or impart specific properties to the final product. For example, clays and other materials can be used as fluxing agents that allow the ceramic product to be fired at lower temperatures. In slurry processing, deflocculants, surfactants, and antifoaming agents may be added prior to slip-casting to improve processing. Deflocculants and surfactants are used as dispersion aids.

#### *2.1.1.3 Forming*

In the forming step, the ceramic mix is consolidated and molded to produce a cohesive body of the desired shape and size. Forming methods can be classified as either dry forming, plastic molding, or wet forming. Dry forming consists of the simultaneous compacting and shaping of dry ceramic powders in a rigid die or flexible mold. The most commonly used dry forming method is pressing, which is used for forming relatively simple shapes. Ceramic tile typically are formed by dry pressing. Prior to pressing, many facilities granulate the ceramic mix to form a free-flowing powder, thereby improving handling and compaction. The most commonly used method of granulation is spray-drying. In this step, the ceramic mix is combined with water to form a slurry. The slurry is injected into a drying chamber with hot gases. As the hot gases contact the slurry, a powder is formed and collected in a cyclone or fabric filter. Spray dryers generally are gas-fired and operate at temperatures of 70° to 570°C (160° to 1050°F).

For more complex shapes, isostatic pressing and vibratory compaction can be used. In isostatic pressing, the ceramic mix is placed inside a flexible mold, which is then deaired, sealed, and placed in a pressurized chamber. Vibratory compaction is used for producing irregular shapes from ungranulated powders.

Plastic molding is accomplished by jiggering, or injection molding. Jiggering is used to form circular or axially symmetrical shapes by shaping a plastic material on a spinning platform. Jiggering is widely used in the production of dinnerware. In injection molding, a ceramic mixture, which typically is heated, is injected into a die. This method generally is used for making small, complex shapes.

Wet forming methods involve the use of a ceramic slurry. The most commonly used wet forming method is slip casting. Other wet forming methods include gelcasting and tape casting. In slip casting, a ceramic slurry with a moisture content of 20 to 35 percent is poured into a porous mold. Capillary suction of the mold draws the liquid from the mold, thereby consolidating the cast ceramic material. After a fixed time, the excess slurry is drained, and the cast shape is dried. Slip casting is widely used in the manufacture of sinks and other sanitaryware and structural ceramics with complex shapes.

#### *2.1.1.4 Shape Drying*

The next step is shape drying, which can be performed in continuous or periodic dryers. Generally, the type of dryer is dictated by the type of kiln used to fire the ceramic ware; a facility that uses continuous kilns will also use continuous dryers. Drying reduces the free moisture content of the ceramic shape to prevent differential shrinkage, distortion, cracking, and spalling when the shape is fired in the kiln. Drying also reduces the energy requirements for firing and can serve the purpose of driving



off organic additives. The most commonly used method of drying ceramics is by convection, in which heated air is circulated around the ceramics. Facilities that use tunnel kilns often use the waste heat from the cooling zone of the kiln to heat the dryer. Natural gas and electricity also are used to provide drying heat. In addition, some facilities use steam-heated dryers, and some dryers are fired with propane.

#### *2.1.1.5 Glazing*

Glazes resemble glass in structure and texture. The purpose of glazing is to provide a smooth, shiny surface that seals the ceramic body. Not all ceramics are glazed. Those that are glazed can be glazed prior to firing, or can be glazed after firing, followed by refiring to set the glaze. Many facilities prepare glazes onsite by grinding and mixing a combination of raw materials; other facilities purchase glazes that require no additional processing. In most cases, the primary materials in the glaze mix are the same materials that form the ceramic body. Metal oxides, such as chromium oxide, cobalt oxide, and manganese oxide often are used to color glazes. Glazes generally are applied by spraying, but dipping or flooding also are used for glaze application. Depending on their constituents, glazes mature at temperatures of 600° to 1500°C (1110° to 2730°F).

#### *2.1.1.6 Firing*

Firing serves three primary functions: to substantially reduce the number of pores in the ceramic; to increase the density of the ceramic; and to bond together the individual material grains into a strong, hard mass (ceramic bond). If firing results in the formation of a significant amount of glass, the process is referred to as vitrification. If no glass forming or melting occurs, the process is referred to as sintering. Firing cycles generally consist of three phases: gradual heating of the ceramic body to the soak temperature, which typically is approximately two-thirds of the melting point of the material at ambient pressure; a soak period of constant, peak temperature (soak temperature), where the bond between the material grains is formed; and a gradual cooling down of the fired ceramic. Maximum kiln temperatures typically range from about 900° to 1330°C (1650° to 2430°F).

As is the case for drying, firing can be performed as a continuous or batch process. Tunnel kilns and roller hearth kilns (roller kilns) are used for continuous firing. Tunnel kilns consist of a long refractory-lined tunnel through which the green ceramics move, typically stacked on rail cars. Tunnel kilns generally have separate zones for preheating or drying, firing, and cooling. Roller kilns are low-profile kilns that are similar to tunnel kilns except that the green ceramics travel through the kiln in a single layer on rollers. The primary advantages of tunnel kilns and roller kilns are lower energy consumption and the ease with which the ceramics can be transported through the firing process when compared to periodic kilns. Roller kilns have the additional advantage of shorter firing times than are required when tunnel kilns are used. The main disadvantages of tunnel and roller kilns are the high capital cost and inflexibility to changes in operating conditions. Most tunnel and roller kilns are fired with natural gas. Electricity and propane also are used to heat some tunnel kilns.

Batch firing kilns are referred to by several terms, which generally relate to the mechanism by which the kiln opens or by the method used to move the ceramic ware into or out of the kiln. Bell kilns and shuttle kilns are designed with a removable superstructure that is tilted or raised using hydraulic struts to allow entrance and egress. In elevator kilns, the kiln structure is suspended. The base or floor of the kiln is raised into position during firing and lowered to allow the ceramic shapes to be loaded or removed. In this memorandum, all batch firing kilns are referred to generically as periodic kilns.

The main advantage of periodic kilns is that they can readily accommodate changes in firing temperature profile and cycle time to match the requirements of a wide variety of ceramic products. The primary disadvantage of periodic kilns is higher energy costs per ton when compared to tunnel kiln and roller kiln costs per ton. Most periodic kilns are fired with natural gas. Some periodic kilns also are heated with electricity or propane. Periodic kiln operating temperatures range from 950° to 1370°C (1750° to 2500°F). Firing cycle times range from less than 1 hour to 48 hours.

### *2.1.1.7 Finishing*

Following firing, some ceramic products undergo one or more finishing steps to enhance their characteristics or to meet dimensional tolerances. Finishing can include grinding, polishing, sand blasting, drilling, sawing, and lathing. Most grinding and sawing processes use water sprays or baths to minimize particulate matter emissions.

### *2.1.2 Emissions from Clay Ceramics Manufacturing Facilities*

Production of clay ceramic products requires a number of steps that result in the emissions of pollutants. These pollutants include particulate matter (PM), nitrogen oxides (NO<sub>x</sub>), sulfur oxides (SO<sub>x</sub>), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), volatile organic compounds (VOCs), and hazardous air pollutants including HCl and HF. The handling and transfer operations, as well as the sizing and classifying of clay minerals result in PM emissions. Fuel combustion at the kilns and at some of the dryers results in emissions of SO<sub>x</sub>, NO<sub>x</sub>, CO, and CO<sub>2</sub>, however the SO<sub>x</sub> emissions also are a function of the sulfur content in the raw materials used to manufacture ceramics. Emissions of HF and HCl are a result of the release of fluoride and chloride compounds that are present in ceramic raw materials. The final processing of ceramics also results in emissions. Polishing and final grinding lead to PM emissions while surface coating and chemical treatment of the ceramics results in VOCs.

### *2.1.3 Costs of Production*

This section discusses the costs of producing clay ceramic products. There are several types of production costs such as:

- **capital expenditures**, including the costs of equipment and its installation;
- **energy costs**, which are the costs of electricity and fuels used in the production of clay ceramic products;
- **labor costs**, including the costs associated with wages and benefits; and
- **the cost of materials**, which are the costs of tangible inputs such as clay minerals, parts, and additives.

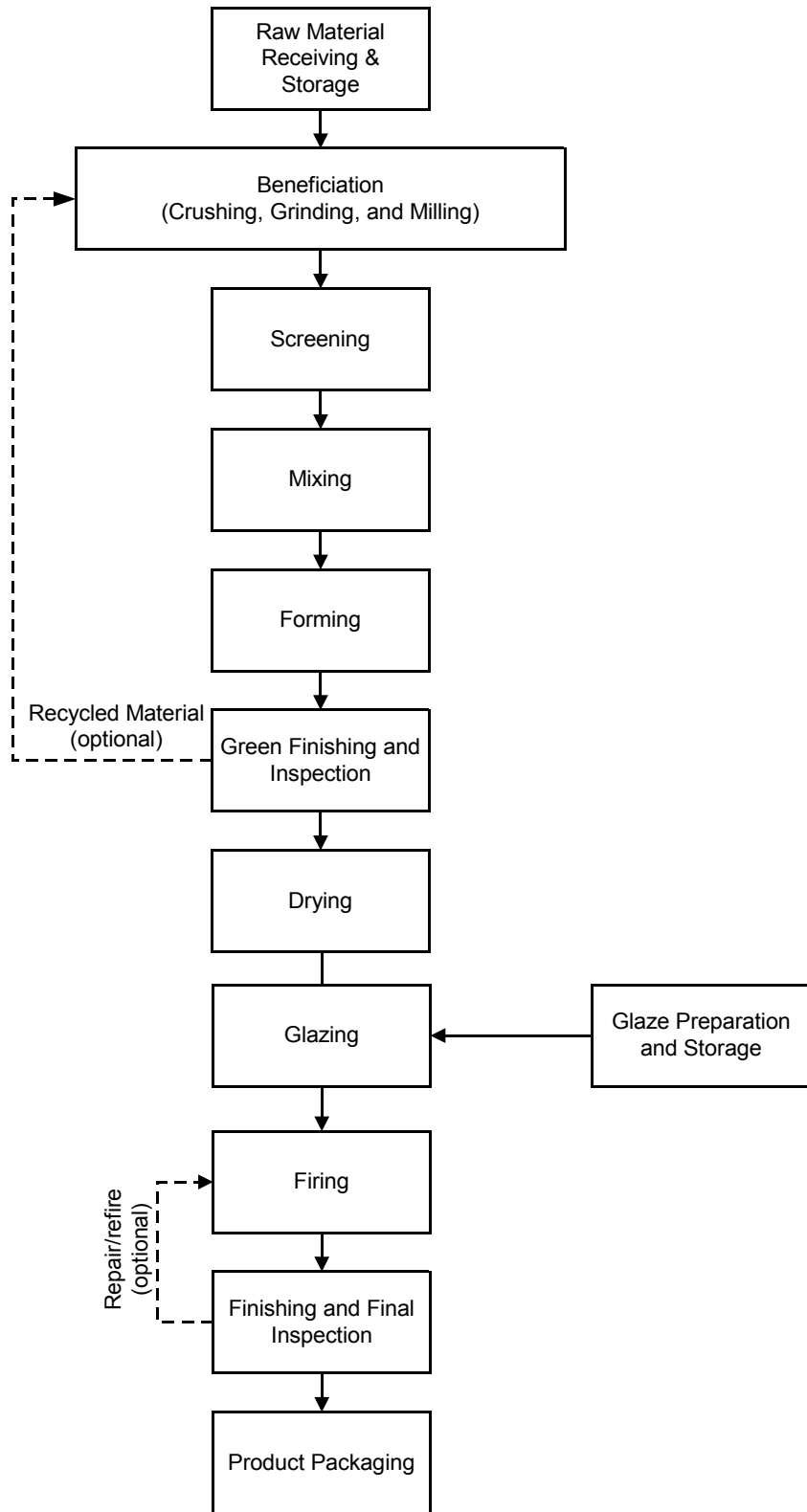


Figure 2-1. Ceramics Process Flow Diagram

Tables 2-1, 2-2, and 2-3 show the historical production cost data for the ceramic floor and wall tile industry (NAICS 327122; SIC 3253), the plumbing fixture and ceramic bathroom accessories industry (NAICS 327111; SIC 3261), and the vitreous china, kitchenware, and other pottery products industry (NAICS 327112; SICs 3262, 3263, and 3269). Data presented in these tables have been gathered from the U.S. Census Bureau.

**Table 2-1. Production Costs for the Ceramic Floor and Wall Tile Industry (NAICS 327122; SIC 3253) (\$10<sup>6</sup>)**

Year	Labor Costs	Material Costs	Energy Costs	Capital Expenditures <sup>a</sup>
1992	\$196.9	\$222.1	\$39.2	\$48.9
1993	\$206.3	\$213.7	\$47.2	\$68.0
1994	\$220.1	\$251.5	\$42.5	\$73.1
1995	\$233.9	\$290.5	\$43.9	\$61.5
1996	\$240.9	\$291.4	\$45.5	\$45.6
1997	\$236.1	\$290.9	\$48.6	\$79.6
1998	\$205.3	\$263.2	\$38.0	NA
Average	\$219.9	\$260.5	\$43.6	\$62.8
Average Share of Value of Shipments				
1992-1998	25%	30%	5%	7%

Notes: <sup>a</sup> Average for Capital Expenditures excludes figure for 1998 since it is unavailable.  
Sources: U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series*, "Ceramic Wall and Floor Tile Manufacturing." U.S. Government Printing Office.  
U.S. Department of Commerce, Bureau of the Census. *1998 Annual Survey of Manufactures, M98(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.  
U.S. Department of Commerce, Bureau of the Census. *1996 Annual Survey of Manufactures, M96(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.  
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U.S. Department of Commerce, Bureau of the Census. *1993 Annual Survey of Manufactures, M93(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.

**Table 2-2. Production Costs for the Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories Industry (NAICS 327111; SIC 3261) (\$10<sup>6</sup>)**

Year	Labor Costs	Material Costs	Energy Costs	Capital Expenditures <sup>a</sup>
1992	\$216.8	\$205.9	\$30.5	\$14.3
1993	\$240.4	\$242.7	\$35.8	\$12.8
1994	\$251.9	\$248.9	\$35.4	\$25.3
1995	\$262.5	\$234.9	\$39.6	\$23.3
1996	\$261.5	\$246.0	\$39.2	\$11.7

1997	\$285.2	\$253.4	\$34.5	\$14.9
1988	\$306.1	\$283.5	\$39.6	NA
Average	\$260.6	\$245.0	\$36.4	\$17.1
Average Share of Value of Shipments				
1992-1998	27%	25%	4%	2%

Notes: <sup>a</sup> Average for Capital Expenditures excludes figure for 1998 since it is unavailable.  
Sources: U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series*, "Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories Manufacturing." U.S. Government Printing Office.  
U.S. Department of Commerce, Bureau of the Census. *1998 Annual Survey of Manufactures, M98(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.  
U.S. Department of Commerce, Bureau of the Census. *1996 Annual Survey of Manufactures, M96(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.  
U.S. Department of Commerce, Bureau of the Census. *1994 Annual Survey of Manufactures, M94(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.  
U.S. Department of Commerce, Bureau of the Census. *1993 Annual Survey of Manufactures, M93(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.

**Table 2-3. Production Costs for the Vitreous China, Fine Earthenware, and Other Pottery Products Industry (NAICS 327112; SICs 3262, 3263, and 3269 ) (\$10<sup>6</sup>)**

Year	Labor Costs	Material Costs	Energy Costs <sup>a</sup>	Capital Expenditures <sup>b</sup>
1992	\$366.9	\$263.2	\$39.9	\$39.2
1993	\$369.2	\$266.1	\$41.5	\$56.9
1994	\$390.8	\$262.7	\$39.2	\$32.7
1995	\$382.8	\$267.3	\$39.0	\$35.6
1996	\$405.5	\$300.7	\$40.5	NA
1997	\$443.6	\$447.8	\$42.8	\$65.5
1998	\$510.1	\$438.9	\$45.8	NA
Average	\$408.8	\$321.0	\$41.2	\$46.0
Average Share of Value of Shipments				
1992-1998	33%	25%	3%	4%

Notes: <sup>a</sup> NAICS code 327112 corresponds to SIC codes 3262, 3263, 3269, and 3299 (Companies in SIC 3299 are not affected by this NESHAP and are not discussed in this report). Costs in this table were generated by summing the costs incurred by industries classified by SIC codes 3262, 3263, and 3269 except for 1997 and 1998 energy costs, which are given on the basis of NAICS code. Thus the 1997 and 1998 energy cost figures includes the energy cost figures for SIC 3299.  
<sup>b</sup> Average for Capital Expenditures excludes figure for 1996 and 1998 due to their unavailability.  
Sources: U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series*, "Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing." U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. *1998 Annual Survey of Manufactures*, M98(AS)-1 Statistics for Industry Groups and Industries. U.S. Government Printing Office.  
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 U.S. Department of Commerce, Bureau of the Census. *1993 Annual Survey of Manufactures*, M93(AS)-1 Statistics for Industry Groups and Industries. U.S. Government Printing Office.

Similar trends can be seen in the production costs across these three NAICS codes. Labor costs and the costs of materials account for larger shares of the value of shipments (VOS) relative to energy costs and capital expenditures. Both labor costs and the costs of materials are each well over 20 percent of the value of shipments. Energy costs and capital expenditures are each closer to 5 percent across all three NAICS codes. For the ceramic floor and wall tile industry (NAICS 327122), material costs are, on average, approximately equal to 30 percent of VOS, with labor costs following close behind at 25 percent. For the other two industries, labor costs make up the largest share of VOS, followed by the costs of materials. The 1998 VOS for the ceramic floor and wall tile industry is \$816.9 million. The 1998 VOS for the plumbing fixtures and bathroom accessories industry is almost \$1.2 billion, and the 1998 VOS for the vitreous china, kitchenware, and other pottery products industry is close to \$1.7 billion. Based on these figures, the ceramic floor and wall tile industry is the smallest of the three while the vitreous china, kitchenware, and other pottery products industry is the largest.

#### **2.1.4 Value of Clay Minerals**

All types of clays are used to produce ceramic products. However, the most common types include ball clay, common clay and shale, and kaolin. In 1997, 38 percent of all ceramic products were made using ball clay, 31 percent were made with common clay and shale, and 26 percent consisted of kaolin as the main clay mineral input (Virta, 1999). Though these three types of clay are commonly used in ceramics manufacturing, they generally are not interchangeable as inputs in the various ceramic products produced by the industry. Floor and wall tile are produced mainly with common clay and shale, while kaolin dominates the fine china, kitchenware, and dinnerware markets. Ball clay is the predominant clay type used to produce sanitaryware and pottery.

Table 2-4 shows the difference in values of ball clay, common clay and shale, and kaolin. The most expensive clay mineral is kaolin at an average price of \$114.42, followed far behind by ball clay and common clay and shale, with average prices of \$44.63 and \$5.64, respectively. Over the 1993 to 1997 time period, the price of common clay and shale and ball clay both increased. The price of common clay and shale grew 12 percent over this time period, reaching a peak price of \$6.08 in 1997. Ball clay also increased in value, with a price in 1997 that was 9 percent higher than in 1993 (\$46.25 per metric ton). Contrary to the behavior of the values of common clay and shale and ball clay, kaolin sharply dropped in

**Table 2-4. Price Value of Clay Minerals Used in Clay Ceramics Production: 1993 - 1997 (\$/metric ton)**

<b>Clay Minerals</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>Avg.</b>
Ball Clay	\$42.26	\$44.02	\$45.82	\$44.81	\$46.25	\$44.63
Common Clay & Shale	\$5.42	\$5.31	\$5.90	\$5.50	\$6.08	\$5.64
Kaolin	\$108.38	\$116.31	\$117.09	\$119.83	\$110.52	\$114.42

Sources: Virta, Robert. 1999. "Clays," In: *Minerals Yearbook, Metals and Minerals 1997: Volume 1*. U.S. Geological Survey. U.S. Government Printing Office.  
 Virta, Robert. 1998. "Clays," In: *Minerals Yearbook, Metals and Minerals 1996: Volume 1*. U.S. Geological Survey. U.S. Government Printing Office.  
 Virta, Robert. 1997. "Clays," In: *Minerals Yearbook, Metals and Minerals 1995: Volume 1*. U.S. Geological Survey. U.S. Government Printing Office.  
 Virta, Robert. 1996. "Clays," In: *Minerals Yearbook, Metals and Minerals 1994: Volume 1*. U.S. Geological Survey. U.S. Government Printing Office.

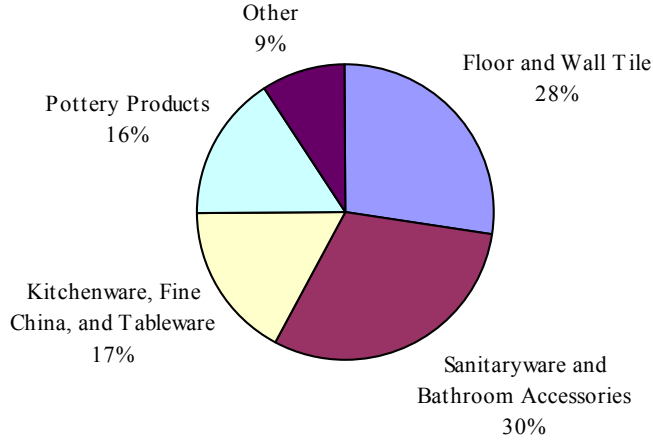
value in 1997. The value of kaolin steadily increased until it reached a peak of \$119.83 in 1996, but in 1997 the price fell to \$110.52.

## **2.2 Uses, Consumers, and Substitutes**

Clay minerals are the main input used to produce ceramic products. These products include floor and wall tile, fine china and kitchenware, pottery products, and bathroom accessories and sanitaryware. Some of these products are final goods, such as dinnerware, kitchenware, pottery, and fine china, that are purchased and used by the same consumer. Other products, such as sanitaryware and ceramic floor and wall tile, may be purchased by contractors and construction companies and used as inputs to build different types of structures, including homes, buildings, and office facilities. The following section describes the uses, consumers, and substitutes of ceramic products. In Section 2.2.1, the various uses for ceramic products are described. Section 2.2.2 identifies the intermediate and final consumers of ceramic products. Last, the different products that can act as substitutes for ceramic products are described in Section 2.2.3.

### **2.2.1 Uses of Ceramic Products**

The various types of ceramic products can be categorized based on their end use. Kitchenware, dinnerware, fine china, and some forms of pottery are products used for food preparation, storage, and service. Kitchenware includes containers, canisters, and other kitchen "hardware" used for food storage and preparation, while dinnerware refers to the plates, bowls, cups, saucers, and other ceramic dishes used for food service. Fine china is a more expensive form of dinnerware. Ceramic floor and wall tile, bathroom accessories (i.e., fixtures, towel racks, and soap dishes), and sanitaryware (i.e., toilets and sinks) are used in the construction of homes, buildings, and structures, however these product types have very different functions. Floor and wall tile serve a decorative purpose and are used to add character to homes and buildings. Sanitaryware and bathroom accessories are products installed in bathrooms and are primarily used for cleansing. In the case of sinks, they also are installed in kitchens.



**Product Shipments = \$3.24 billion**

**Figure 2-2. Distribution of Clay Ceramic Products by End Use: 1997**

Sources: U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census. Manufacturing Industry Series*, "Ceramic Wall and Floor Tile." U.S. Government Printing Office.  
 U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census. Manufacturing Industry Series*, "Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories Manufacturing." U.S. Government Printing Office.  
 U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census. Manufacturing Industry Series*, "Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing." U.S. Government Printing Office.

There is a common characteristic across the various ceramic products, even though they have differing functions. All are durable, heat resistant, waterproof, and most importantly, resistant to germs and contamination. These features are particularly important for products that come into contact with food and those that are used for washing and cleaning. Recently, there has been rising concern about salmonella, e. coli, and other forms of bacteria that may be present in uncooked poultry and meat. Since kitchenware and dinnerware are used to prepare and serve food, it is important they do not become permanently contaminated. Glazed ceramic products such as kitchenware and dinnerware can be thoroughly cleaned using hot water and soap without affecting the integrity of the product. It also is important for sinks and toilets to possess the above mentioned characteristics since these products come into contact with a number of germs. These products are used for washing, and it is imperative that they are water resistant.

Census data provide the 1997 values of select clay ceramic products produced by NAICS' 327111, 327112, and 327122. As Figure 2-2 shows, the value of sanitaryware and bathroom accessories represents 30 percent (\$982.7 million) of the total value of product shipments for selected output produced by the clay ceramics manufacturing industry (\$3.24 billion). Ceramic floor and wall tile also



represents a relatively large share (28 percent) of the value of product shipments at \$890.9 million. The value of kitchenware, fine china, and tableware products used for serving and cooking food is equal to \$542.6 million, or 17 percent of the total value of product shipments while the value of pottery products is equal to \$521 million (16 percent). The other end products, which include technical ceramics, unglazed earthenware, and other ceramic products not elsewhere specified account for the remaining 9 percent of the overall value of product shipments.

### **2.2.2 Consumers of Clay Ceramic Products**

Some ceramic products are purchased directly by the final consumer. These products include kitchenware, fine china, and pottery. Consumers generally purchase pottery for decorative purposes, although some types of pottery are also used for food preparation and presentation. Kitchenware and fine china also are purchased by consumers to facilitate food preparation and consumption. Fine china is more expensive than dinnerware and typically is used for special meals, while standard dinnerware is designed for daily dining.

Other ceramic products, such as sanitaryware, bathroom accessories, and floor and wall tile are purchased by construction companies to be used as inputs to the production of homes, buildings, and office facilities. Once these structures are built, consumers then purchase these structures from the construction companies. However, if consumers build homes or make improvements to existing structures themselves, they may directly purchase and install sanitaryware, bathroom accessories, and ceramic tiles.

Though ceramic floor and wall tile, sanitaryware, bathroom accessories, pottery, dinnerware, and kitchenware are all made using clay minerals, there are noticeable price differences across these products. For example, ceramic tiles tend to be relatively inexpensive while china and fancy dinnerware tend to cost more. These differences in price are based on a number of factors including the operating cost of capital, the level of skill and amount of labor used in production, and the cost of inputs used to produce the various ceramic products such as the type of clay minerals, additives, and decorative coatings.

### **2.2.3 Substitutes for Clay Ceramic Products**

Clay is just one of many materials that can be used to produce kitchenware, dinnerware, sanitaryware, bathroom accessories, and home decorations. Kitchen storage containers, dishes, and other miscellaneous kitchenware are available in glass, metal, and plastic. Plastic is a relatively inexpensive material used to manufacture different quality grades of kitchenware and dinnerware. Plastic plates, bowls, and cups can be made of relatively sturdy plastic for repeated use or they can be made with lower quality plastic so they can be disposed of after one time usage. Consumers often purchase plastic dinnerware because of its convenience. In addition to plastic, inexpensive paper or Styrofoam dinnerware also is available.

Bathroom accessories such as soap dishes, towel racks, toothbrush holders, and faucet fixtures come in an array of materials, including plastic, brushed or polished metal, and glass. Consumers usually base their choice of bathroom accessories on their specific tastes and the type of look they want

to create as they decorate the bathroom. Generally plastic accessories are relatively inexpensive, though when higher quality plastics are used, producers can charge prices in the same range as those for bathroom accessories made from glass, ceramics, or metal.

Clay is the most common material used for the manufacture of sanitaryware, but sinks and toilets can also be made out of stainless or enameled steel, fiberglass, or enameled cast iron. These materials all possess similar characteristics to ceramic sanitaryware, but to differing degrees. For example, steel may be less subject to cracking than ceramic material, however it is not as heat resistant. Another material used to produce sanitaryware is marble, which is one of the most expensive materials available for sanitaryware production.

## **2.3 Industry Organization**

This report addresses the economic impacts of pollution control requirements on facilities included in the clay ceramics manufacturing source category. Though existing sources at facilities in this source category face no compliance costs to meet the MACT floor, facilities will be required to control their releases of HAPs from new kilns. For this reason, it is important to understand the existing organization of the clay ceramics industry at both the facility-level and the company-level. This section of the EIA will focus specifically on the sanitaryware and bathroom accessories producers and the ceramic floor and wall tile producers since these are the facilities that are included in the clay ceramics manufacturing source category. Section 2.3.1 first provides an overview of the market structure of the clay ceramics manufacturing industry. Section 2.3.2 characterizes the manufacturing facilities in the source category, while the parent companies of these facilities are described in 2.3.3. Last, Section 2.3.4 provides data on domestic production, foreign trade, and apparent consumption of clay ceramic products.

### **2.3.1 Market Structure**

Market structure is of interest because it determines the behavior of producers and consumers in the industry. In perfectly competitive industries, no producer or consumer is able to influence the price of the product sold. In addition, producers are unable to affect the price of inputs purchased for use in production. This condition is most likely to hold if the industry has a large number of buyers and sellers, the products sold and inputs used in production are homogeneous, and entry and exit of firms is unrestricted. Entry and exit of firms are unrestricted for most industries, except in cases where the government regulates who is able to produce output, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market. In industries that are not perfectly competitive, producer and/or consumer behavior can have an effect on price.

Concentration ratios (CRs) and the Herfindahl-Hirschman index (HHI) can provide some insight into the competitiveness of an industry. The U.S. Census Bureau reports these ratios and indices for the four-digit SIC code level for 1992, the most recent year available. Table 2-5 provides the four- and eight-firm concentration ratios (CR4 and CR8, respectively) and the Herfindahl-Hirschman index for all of the SIC codes that characterize the clay ceramics industry. Particular attention should be given to the measures for SIC 3253, the ceramic floor and wall tile industry, and SIC 3261, the vitreous china

plumbing fixtures and bathroom accessories industry, since facilities operated by companies in these industries are included in the clay ceramics manufacturing source category addressed by this NESHAP.

The CR4 is lowest for SIC 3269 (pottery products, not elsewhere specified [n.e.c.]) at 25 percent and highest for SIC 3262 (vitreous china table and kitchen articles) and SIC 3263 (fine earthenware table and kitchen articles) at 81 percent and 85 percent, respectively. The lowest CR8 measure is again for SIC 3269, but is highest for SIC 3261 (vitreous china plumbing fixtures and china and earthenware fittings and bathroom accessories). A general examination of the table shows that the CRs for SIC 3269 are relatively small and those for SICs 3262 and 3263 are relatively large. The ratios for SIC 3253 are smaller than those for SIC 3261.

The criteria for evaluating the HHIs are based on the 1992 Department of Justice’s Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less concentrated industries are more likely to be price takers, while those in more concentrated industries have more ability to influence market prices. Based on these criteria, SIC 3253 is moderately competitive and SICs 3261 and 3262 are highly concentrated. A low

**Table 2-5. Market Concentration Measures for the Clay Ceramics Manufacturing Industry SIC Codes: 1992**

SIC Code	Value of Shipments (\$10 <sup>6</sup> )	CR4	CR8	HHI
3253	\$731.3	59%	75%	1217
3261	\$902.1	71%	94%	1923
3262	\$315.6	81%	92%	2470
3263	\$45.2	85%	92%	NA
3269	\$669.4	25%	35%	273

Notes: CR4 and CR8 are the concentration ratios of the top 4 and 8 firms in the industry (by sales), respectively. HHI refers to the Herfindahl-Hirschman Index, which is the sum of the squared market shares of each company in a given industry.

Source: U.S. Department of Commerce, Bureau of the Census. 2000. *1992 Concentration Ratios in Manufacturing*. <<http://www.census.gov/epcd/www/concentration.html>>.

HHI is calculated for SIC 3269, indicating it is highly competitive and no HHI is available for SIC 3263.

### 2.3.2 Manufacturing Facilities

As of 1997, there were 58 facilities in the clay ceramics manufacturing source category. Of these 58 facilities, 32 manufacture floor and wall tile while the remaining 26 manufacture sanitaryware.

Regardless of what type of product the facility produces, it can be classified as either one of two types of facilities: non-integrated producers and integrated producers. Non-integrated producers purchase clay mineral inputs to use in production and they focus on the manufacture of final goods, in this case ceramic tile or sanitaryware. Integrated producers are vertically integrated, which means they mine their own clay mineral inputs to use in the production of their final products.

The size of facilities depends on whether they are non-integrated or integrated producers. Plants that perform their own mining operations tend to be larger in size than those that purchase their own inputs from a minerals processing plant. Even if facilities are non-integrated producers, it is likely that they are located near sources of clay minerals so that the transportation costs of this essential input remains low. Thus, the locations of the 58 facilities are determined by the location of clay mineral deposits. These facilities are located across 22 states with the highest concentrations in Texas with 22 facilities, Ohio with 7 facilities, and Pennsylvania with 5 facilities.

### **2.3.3 Firm Characteristics**

The Agency identified 28 ultimate parent companies that owned and operated the 58 potentially affected facilities within this source category in the year 1997. Sales and employment data were obtained for these owning entities from either their survey response or one of the following secondary sources:

- Dun & Bradstreet Market Identifiers (Dun & Bradstreet, 1999)
- Moody's Corporate Profiles (Moody's Investors Service, 1999)
- Standard & Poor's Register-Corporate (Standard & Poor's Corp., 1998)
- Ward's Business Directory (Gale Group, 1997)

Appendix A provides a listing of these 29 companies identified by the Agency as owning the potentially affected clay ceramics manufacturing facilities.

Annual sales and employment data were available for 27 of the 28 companies (97 percent). The average (median) sales of companies with companies reporting data were \$507.6 million (\$24.1 million). This includes revenues from operations other than tile and sanitaryware production. The average (median) employment for these companies was 4,852 (550) workers. As of 1997, the four largest companies based on annual sales are:

- American Standard Companies, Inc. - \$6.7 billion with 57,000 employees;
- Premark International, Inc. - \$2.4 billion with 17,200 employees;
- U.S. Industries, Inc. - \$2.3 billion with 23,000 employees; and
- Kohler Co., Inc. - \$1.1 billion with 18,000 employees.

The average (median) company sales and employment were also calculated for the companies that own sanitaryware manufacturing facilities and those that own ceramic floor and wall tile manufacturing facilities. As Table 4-6 shows, companies that own and operate sanitaryware manufacturing facilities are much larger, based both on annual sales and employment figures. The average sales of companies that own sanitaryware facilities is almost ten times larger than the sales of those owning floor and wall tile facilities. The difference in the average number of employees is on the same scale. An examination of the median values of sales and employment confirm that companies that produce sanitaryware are much larger than those that produce tile, though median values are an order of

magnitude smaller than the mean values of sales and employment.

Another way these companies can be grouped is into small and large categories using Small Business Administration general size standard definitions for NAICS codes. These definitions are based on either annual sales or employment of owning entities. Responses by the facilities in the clay ceramics manufacturing source category indicate that there are four different NAICS codes represented with a small business definition range from 500 to 750 employees. Based on the SBA definitions, the Agency identified 13 companies owning facilities that produce sanitaryware or ceramic floor and wall tile as small (46.4 percent) and 15 as large (53.6 percent). One company for which no annual sales or employment data were available was assumed to be small. Section 4 further details the small business analysis conducted to determine if small businesses might potentially be impacted by this rule.

**Table 2-6. Average and Median Company Sales and Employment Based on Manufacturing Facility Ownership (\$10<sup>6</sup>): 1997**

Facility Type	Company Sales		Company Employment	
	Average	Median	Average	Median
Sanitaryware	\$1,230.6	\$140.0	11,805	1,500
Floor and Wall Tile	\$164.3	\$7.8	1,559	110

#### **2.3.4 Market Data and Trends**

This section focuses on historical market data for the ceramic floor and wall tile industry (SIC 3253) and the vitreous china plumbing fixtures segment of the vitreous china plumbing fixtures and bathroom accessories industry (SIC 3261). Detailed market data for SIC 3261 in its entirety and the remaining SIC codes were unavailable. Tale 2-7 presents the quantity of shipments, foreign trade, and apparent consumption for the ceramic floor and wall tile industry and Table 2-8 presents the values of shipments, trade, and apparent consumption for vitreous china plumbing fixtures.

**Table 2-7. Historical Data for the Ceramic Wall and Floor Tile Industry (SIC 3253) (10<sup>6</sup> square feet): 1995-1999**

Year	Quantity of Shipments	Exports <sup>a</sup>	Imports	Apparent Consumption <sup>b</sup>
1995	580.8	0	774.3	1,355.1
1996	575.8	0	883.7	1,459.5
1997	626.7	42.4	1,022.5	1,606.8
1998	621.0	41.6	1,232.5	1,441.9
1999	624.8	30.7	1,493.5	2,087.1
Average Annual Growth Rates				
1995-1999	1.9%	-14.0%	17.9%	14.0%

Notes: <sup>a</sup> Exports for 1995 and 1996 were reported as 'Not applicable' by the Census Bureau. It is therefore assumed that exports of ceramic floor and wall tile were equal to zero for these years.

<sup>b</sup> Value of apparent consumption is derived by subtracting exports from manufacturers' shipments plus value of imports.

Sources: U.S. Department of Commerce, Bureau of the Census. 2000. *Current Industrial Reports for Clay Construction Products - Summary 1999*. MQ32D(99)-5. U.S. Government Printing Office.  
 U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997*. MQ32D(97)-5. U.S. Government Printing Office.  
 U.S. Department of Commerce, Bureau of the Census. 1997. *Current Industrial Reports for Clay Construction Products - Summary 1995*. MQ32D(95)-5. U.S. Government Printing Office.

As Table 2-7 shows, both production and apparent consumption of ceramic floor and wall tile have increased since the mid 1990s. This is evident from an examination of the average annual growth rates. Production quantities of ceramic tile oscillated slightly year to year by increasing one year and then decreasing the next. However, in 1997 production increased by almost 9 percent. Apparent consumption also increased each year, with an average annual growth rate of 14 percent. The U.S. exports relatively small amounts of ceramic tile, and U.S. imports have exceeded the amount of tile produced domestically each year since 1995. In addition, the amount of ceramic tile that is imported has increased over the 1995 to 1999 time period. The average annual growth rate of ceramic tile imports is almost 18 percent.

The historical data presented in Table 2-8 captures the value of production, trade, and apparent consumption of vitreous china plumbing fixtures, which includes drinking fountains, lavatories, bathtubs, flush tanks, and sinks. Examination of the data show positive average annual growth of the values of production, imports, and consumption over the 1995 to 1999 time period. Exports of sanitaryware from the U.S. showed a net decrease through the mid to late 1990s. A closer look at Table 2-8 shows that the values of shipments, trade, and apparent consumption were all relatively high, but that they all decreased in 1996. Production values, imports, and consumption all steadily rose from this point on. Export values, however, increased by almost 17 percent in 1997, but then steadily declined in each subsequent year.

**Table 2-8. Historical Data for Vitreous China Plumbing Fixtures (\$10<sup>6</sup>): 1995 - 1999**

Year	Value of Shipments	Value of Exports	Value of Imports	Value of Apparent Consumption <sup>a</sup>
1995	\$891.9	\$61.1	\$71.2	\$901.2
1996	\$859.7	\$58.5	\$64.8	\$866.0
1997	\$876.8	\$68.4	\$50.5	\$858.9
1998	\$883.7	\$65.7	\$68.0	\$886.1
1999	\$932.2	\$57.5	\$101.6	\$976.3
Average Annual Growth Rates				
1995-1999	1.2%	-0.9%	13.3%	2.1%

Notes: <sup>a</sup> Value of apparent consumption is derived by subtracting exports from manufacturers' shipments plus value of imports.

Sources: U.S. Department of Commerce, Bureau of the Census. 2000. *Current Industrial Reports for Plumbing Fixtures - Summary 1999*. MQ332E(99)-5. U.S. Government Printing Office.  
U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Plumbing Fixtures - Summary 1997*. MQ34E(97)-5. U.S. Government Printing Office

The small quantities of ceramic tile exports and the negative average annual growth of the exports of vitreous china plumbing fixtures show that the U.S. is not a large exporter of ceramic products. In addition, the U.S. does not import a large amount of plumbing fixtures relative to its production of these products, though plumbing fixture imports values do exceed their export values. The U.S. does, however, import a relatively large amount of ceramic tile.

### 3 ENGINEERING COST ANALYSIS

Production of ceramic tile and sanitaryware results in emissions of HAPs from the kilns used in the production process. For this NESHAP, the MACT floor faced by existing major sources (in this case, kilns) in the clay ceramics manufacturing source category requires no control of their HAP emissions. New sources will, however, be subject to emissions standards developed under the authority of Section 112 of the CAA. Facilities with new kilns will be required to control their HAP emissions through the installation and operation of dry injection fabric filters (DIFFs), dry lime scrubber/fabric filters (DLSs), wet scrubbers (WSs), or equivalent control. This section describes the development of compliance cost estimates for projected new clay ceramics manufacturing sources associated with this NESHAP. Section 3.1 discusses the types of new kilns that are projected for this source category and Section 3.2 describes the estimated costs of controlling the HAP emissions from these new kilns.

#### 3.1 Projected New Kilns

The Agency projects one new kiln to begin operation in the clay ceramics manufacturing source category during the five year period following the promulgation of this NESHAP (by the end of the year 2007). The projected kiln is a 4 tph tunnel kiln projected to be used for sanitaryware production.

#### 3.2 Costs of Control

This section provides the estimated costs of installing and operating DIFFs on 4 tph tunnel kilns. The cost of DIFFs varies based on the size and the type of kiln upon which it will be installed. Table 3-1 summarizes the total and annualized capital costs, operating and maintenance expenses, and total annual costs for DIFF by kiln type, based on the Agency’s projection of the one kiln that will begin operation during the five year period subsequent to the promulgation of this NESHAP. Though all new sources in the clay ceramics manufacturing source category will be subject to the NESHAP and may choose to operate DIFFs to control their HAP emissions, Table 3-1 focuses on the installation of DIFFs on the specific kiln projected to begin operation in this source category.

**Table 3-1. New Source Compliance Costs of the Clay Ceramics Manufacturing NESHAP (\$10<sup>3</sup>)**

<b>Model Kiln</b>	<b>Total Capital</b>	<b>Annualized Capital<sup>a</sup></b>	<b>Annual O&amp;M</b>	<b>Annual MRR</b>	<b>Total Annualized<sup>b</sup> Cost</b>
Tunnel (4 tph) Sanitaryware	\$750	\$107	\$217	\$12.6	\$340

Notes: <sup>a</sup> Total capital costs are annualized over 10 years at 7 percent.

<sup>b</sup> Sum of annual capital, annual O&M, and annual MRR costs; rounded to the nearest 10<sup>th</sup> digit.

Source: U.S. Environmental Protection Agency. November 21, 2002. “Economic Inputs - Brick and Structural Clay Products Manufacturing and Clay Ceramics Manufacturing NESHAP”; Memorandum from Brian Shrager, Midwest Research Institute, to Mary Johnson, EPA, Emissions Standards Division.

#### **4 ECONOMIC IMPACT ANALYSIS**

In the economic impact analysis, the Agency typically examines how facilities will directly (through the imposition of compliance costs) or indirectly (through a change in market prices) affect the entire U.S. industry. Generally speaking, the implementation of a proposed rule will increase the costs of production at affected plants. These costs will vary across facilities depending on their physical characteristics, baseline controls, and the regulatory standards that are set. The response by producers to these additional costs determine the economic impacts of the regulation. Specifically, the cost of the regulation may induce some owners to change their current operating rates or to close their operations. These choices, affect, and in turn are affected by, the market prices for the products manufactured by the affected facilities.

For this regulation, the MACT floor faced by existing kilns at ceramic tile and sanitaryware facilities is a control technology that already exists at all major sources and some minor costs will be incurred by existing sources to document compliance with the standard. The total compliance costs for existing sources are approximately \$9,500, which represents a negligible impact on the industry (i.e., 0.001 percent of total industry revenues). With the negligible impact on industry revenues, it is unlikely prices will rise in the industry. Therefore, affected producers are expected to absorb the compliance costs as a component of their production costs. The change in production costs, however, is expected to be minimal. The new kiln that is added to the clay ceramics manufacturing source category is required to control their emissions of HAPs. The Agency has projected the addition of one kilns to the ceramic source category within the five years following promulgation as mentioned in Section 3. Section 4.1 of this report will describe the anticipated the industry impacts due to the addition of the new kiln while



Section 4.2 will demonstrate the impacts at the source level.

#### 4.1 Industry-level Impacts

To examine the projected impact of compliance costs associated with the new source on the ceramic tile and sanitaryware industries, a screening analysis is conducted to compare the annual industry compliance costs to the future industry value of shipments (VOS) for each of these clay ceramics industries. The analysis takes place using year 2007 projections of VOS because the new kiln is expected to be in operation within the five year period following the promulgation of this regulation. A ratio of industry compliance costs to the value of shipments provides an indication of the share that costs represent of the total value of output produced. To project the VOS in the year 2007, the average annual growth rate of the VOS for each industry was applied to the latest VOS estimate available to estimate the value of shipments for the year 2007.<sup>1</sup>

As Table 4-1 shows, the total annual compliance costs of the new sanitaryware kiln are equal to \$340,000 and the projected year 2007 VOS for this industry is close to \$1.84 billion. The share of compliance costs to VOS for the sanitaryware industry is also less than 0.01 percent. These ratios provide evidence showing that at the industry level, the total annual compliance costs associated with this rule are not expected to lead to a price increase for sanitaryware products.

**Table 4-1. Cost-to-Sales Ratios Vitreous China Plumbing Fixtures and Bathroom Accessories Industry (NAICS 327111; SIC 3261)**

Industry	Total Annual Costs (\$10 <sup>3</sup> )	2007 Projected VOS (\$10 <sup>3</sup> )	Cost-to-Sales Ratio
Sanitaryware	\$340	\$1,844,000	0.01 %

#### 4.2 Source-level Impacts

Though no change in either ceramic tile or sanitaryware market prices are expected to occur from this rule affecting new clay ceramics manufacturing kilns, it may be the case that this regulation

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<sup>1</sup> For the ceramic floor and wall tile industry, the average annual growth rate of VOS over the 1992 to 1998 time period was 2.3 percent (calculated using VOS data from U.S Bureau of the Census, *Annual Survey of Manufactures*). This growth rate was then applied to the 1999 VOS of \$843.03 million (1999 VOS retrieved from U.S Bureau of the Census, 2000, *Current Industrial Reports for Clay Construction Products - Summary 1999*). For the sanitaryware industry, the average annual growth rate of VOS for the same time period was higher at 4.9 percent (also calculated using VOS data from U.S. Bureau of the Census, *Annual Survey of Manufactures*). This was applied to the 1998 VOS of \$1,199.10 million (1998 VOS retrieved from U.S. Bureau of the Census, *Annual Survey of Manufactures*, 2000).

may delay the introduction of these projected kilns into their respective industries. To examine this potential impact of the proposed MACT standard, a ratio of kiln compliance costs to projected kiln sales can be estimated. If the costs of controlling the kiln represent a significant share of the revenues generated from the sale of products produced using the affected kiln, a facility may choose to delay the operation of these new sources. The total compliance costs for existing sources are approximately \$9,500, which represents a negligible impact on the industry (i.e., 0.001 percent of total industry revenues).

## **5 SMALL BUSINESS ANALYSIS**

The Regulatory Flexibility Act (RFA) of 1980 requires that special consideration be given to small entities affected by federal regulation. The RFA was amended in 1996 by the Small Business Regulatory Enforcement Fairness Act (SBREFA) to strengthen the RFA's analytical and procedural requirements. Prior to enactment of SBREFA, EPA exceeded the requirements of the RFA by requiring the preparation of a regulatory flexibility analysis for every rule that would have any impact, no matter how minor, on any number, no matter how small, of small entities. Under SBREFA, however, the Agency decided to implement the RFA as written and that a regulatory flexibility analysis will be required only for rules that will have a *significant* impact on a *substantial* number of small entities.

A small business analysis is conducted to determine if a regulatory action will potentially affect the economic welfare of owners of the potentially affected facilities. The ownership of these facilities ultimately falls on private individuals who may be owner/operators that directly conduct the business of the firm (i.e., "mom and pop shops" or partnerships) or, more commonly, investors or stockholders that employ others to conduct the business of the firm on their behalf (i.e., privately-held or publicly-traded corporations). The individuals or agents that manage these facilities have the capacity to conduct business transactions and make business decisions that affect the facility. The legal and financial responsibility for compliance with a regulatory action ultimately rests with these agents; however, the owners must bear the financial consequences of the decisions. Environmental regulations like this rule potentially affect all businesses, large and small, but small businesses may have special problems in complying with such regulations.

Generally, the small business analysis identifies the businesses that will be affected by this proposed rule and provides an analysis to assist in determining whether this rule is likely to impose a significant impact on a substantial number of the small businesses within this industry. Once these businesses are identified, a "sales test" is conducted which computes the annualized compliance costs as a share of sales for each company. Since facilities in the clay ceramics manufacturing source category face a MACT floor that requires no control of existing sources, companies owning these facilities face no compliance costs. In other words, for all of the companies that own facilities included in the clay ceramics manufacturing source category, all have compliance costs that are zero percent of their sales. This rule is therefore not expected to have a significant impact on a substantial number of small businesses.

Existing sources do not face negligible costs of control under this rule, but a new source will be required to control releases of HAPs. Even though new sources in the clay ceramics manufacturing

source category will face positive costs of complying with this NESHAP, impacts at the source are not expected to be substantial. Since source-level impacts are expected to be small, company-level impacts are anticipated to be even less significant. According to a report in Floor Covering Weekly (2000), the profitability margin of U.S. clay ceramic plants in 1998 was good, ranked at almost 39 percent. The 1998 profit margin is up from just over 31 percent in 1992. This increasing profit margin provides some indication that the costs of complying with the regulation for new sources, at least for those involved in the manufacture of floor and wall tile, will not significantly impact small businesses.

## 6 REFERENCES

- Dun and Bradstreet. 1999. Dun and Bradstreet Market Identifiers Electronic Database.
- Goddin, Lesley. 2000. "Ceramic Tile: State of the Industry," *Floor Covering Weekly*. <<http://www.floorcoveringweekly.com/story/story039902a.asp>>
- Gale Group. 1997. Ward's Business Directory.
- Moody's Investors Service. 1999. Moody's Corporate Profiles Database.
- Standard and Poor's Corporation. 1999. Standard and Poor's Register - Corporate Electronic Database.
- Donio, Paul J. "Tile With Style: A Guide to a Simple Yet Beautiful Remodeling Material," *Today's Homeowner*. <<http://www.todayshomeowner.com/interior/19970930.feature.html>> retrieved from Internet, 2000.
- U.S. Department of Commerce, Bureau of the Census. 2000. *1998 Annual Survey of Manufactures, M98(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 1998. *1996 Annual Survey of Manufactures, M96(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 1996. *1994 Annual Survey of Manufactures, M94(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 1995. *1993 Annual Survey of Manufactures, M93(AS)-1 Statistics for Industry Groups and Industries*. U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 2000. *1992 Concentration Ratios in Manufacturing*. U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 2000. *Current Industrial Reports for Clay Construction Products - Summary 1999, MQ32D(99)-5*.
- U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997, MQ32D(97)-5*.
- U.S. Department of Commerce, Bureau of the Census. 2000. *Current Industrial Reports for Plumbing Fixtures - Summary 1999, MQ332E(99)-5*.
- U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Plumbing Fixtures - Summary 1997, MQ32D(97)-5*.
- U.S. Department of Commerce, Bureau of the Census. 1997. *Current Industrial Reports for Plumbing Fixtures - Summary 1995, MQ32D(95)-5*.
- U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series, "Ceramic Wall and Floor Tile Manufacturing."* U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series, "Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing."* U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series, "Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories Manufacturing."* U.S. Government Printing Office.

- U.S. Department of Commerce, Bureau of the Census. 2000. *Current Industrial Reports - Survey of Plant Capacity*, 1998. U.S. Government Printing Office.
- U.S. Environmental Protection Agency. 1996. *Emission Factor Documentation for AP-42, Section 11.7*, "Ceramic Products Manufacturing."
- U.S. Environmental Protection Agency. 1999. Memorandum from Dottie Schmitt and Richard Marinshaw, Midwest Research Institute to Susan Zapata, Emissions Standards Division, Office of Air Quality Planning and Standards, "Preliminary Industry Characterization Data Inputs for ISEG, Clay Ceramics Manufacturing Facilities," September 17.
- U.S. Environmental Protection Agency. 2002. Memorandum from Brian Shrager, Midwest Research Institute to Mary Johnson, Emissions Standards Division, Office of Air Quality Planning and Standards, "Economics Inputs - Brick and Structural Clay Products Manufacturing and Clay Ceramics Manufacturing NESHAP," June 11.
- U.S. Environmental Protection Agency. 2001. Memorandum from Brian Shrager, Midwest Research Institute to Mary Johnson, Emissions Standards Division, Office of Air Quality Planning and Standards, "Costs for PM CEMS for Kilns - Brick and Structural Clay Products and Clay Ceramics Manufacturing NESHAP." July 6.
- U.S. Small Business Administration. 2001. Small Business Size Standards Matched to North American Industry Classification System (NAICS) Codes.  
<<http://www.sba.gov/size/Table-of-SS-based-on-NAICS.PDF>>
- U.S. Small Business Administration. 2001. Small Business Size Standards Matched to Standard Industrial Classification (SIC) Codes.  
<<http://www.sba.gov/regulations/siccodes/siccodes.pdf>>
- Virta, Robert. 1999. Clays, In: *Minerals Yearbook, Metals and Minerals 1997: Volume 1*. U.S. Geological Survey. U.S. Government Printing Office.
- Virta, Robert. 1998. Clays, In: *Minerals Yearbook, Metals and Minerals 1996: Volume 1*. U.S. Geological Survey. U.S. Government Printing Office.
- Virta, Robert. 1997. Clays, In: *Minerals Yearbook, Metals and Minerals 1995: Volume 1*. U.S. Geological Survey. U.S. Government Printing Office.
- Virta, Robert. 1996. Clays, In: *Minerals Yearbook, Metals and Minerals 1994: Volume 1*. U.S. Geological Survey. U.S. Government Printing Office.

**APPENDIX A: SUMMARY DATA FOR CLAY CERAMIC  
MANUFACTURING COMPANIES**

**Table A-1. Summary Data for Companies Operating Facilities in the Clay Ceramic Manufacturing Source Category: 1997/8**

Company Name	Number of Facilities	Number of Employees	Annual Sales (\$10 <sup>6</sup> )	Small Business
American Marazzi Tile, Inc.	2	NR	NR	N
American Standard Companies, Inc.	3	NR	NR	N
Briggs Industries, Inc. <sup>a</sup>	4	NR	NR	N
Clarke Ceramic Corp.	1	NR	NR	Y
CR/PL L.L.C. <sup>b</sup>	6	NR	NR	N
Curran Group, Inc. <sup>c</sup>	2	NR	NR	N
Dti Investors, L.L.C.	8	NR	NR	N
EPRO, Inc.	1	NR	NR	Y
Falcon Building Products, Inc. <sup>d</sup>	3	NR	NR	N
Gerber Plumbing Fixtures Corp. <sup>e</sup>	3	NR	NR	N
Hans Sumpf Co., Inc.	1	NR	NR	Y
Homexx International Corp.	1	NR	NR	Y
Huntington/Pacific Ceramics, Inc.	2	NR	NR	Y
Interceramic, Inc.	1	NR	NR	N
Kepcor, Inc.	1	NR	NR	Y
Kohler Co, Inc.	3	NR	NR	N
KPT, Inc.	1	NR	NR	Y
Laufen Ceramics, Inc.	2	NR	NR	N
Lone Star Ceramics Manufacturing Co., Inc.	1	NR	NR	Y
M.E. Tile Co.	1	NR	NR	Y
Peerless Pottery, Inc.	1	NR	NR	Y
Premark International, Inc. <sup>f</sup>	3	NR	NR	N
Quarry Tile Co., Inc.	1	NR	NR	Y
Summitville Tiles, Inc.	1	NR	NR	N
Tilecera, Inc.	1	NR	NR	N
U.S. Industries, Inc. <sup>g</sup>	2	NR	NR	N
Westminster Ceramics, Inc.	1	NR	NR	Y
Winburn Tile Manufacturing Co., Inc.	1	NR	NR	Y
<b>Totals</b>	<b>58</b>	<b>135,810</b>	<b>\$14,195.48</b>	<b>13</b>

Note: NR means Not Reported. Employment and sales data were used in the economic impact analysis but are taken from Dun & Bradstreet which are considered proprietary and are therefore not included in this table.

<sup>a</sup> Briggs Industries, Inc. owns CISA Industries

<sup>b</sup> CR/PL L.L.C. owns Universal Rundle Corp. and Crane Plumbing

<sup>c</sup> Curran Group, Inc. owns Crossville Ceramics

<sup>d</sup> Falcon Building Products, Inc. owns Mansfield Plumbing Products, Inc.

<sup>e</sup> Gerber Plumbing Fixtures Corp. owns Woodbridge Sanitary Pottery Corp.

<sup>f</sup> Premark International, Inc. owns Florida Tile Industries.

<sup>g</sup> U.S. Industries, Inc. owns Zurn Industries, Inc.