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Source Category Survey: Ceramic Clay Industry

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Office of Air, Noise, and Radiation
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1. SUMMARY

This document is a Source Category Survey Report for the ceramic clay industry. The purpose of this study is to determine the need for New Source Performance Standards for the ceramic clay industry in accordance with Section 111 of the Clean Air Act.

1.1 INDUSTRY DESCRIPTION

The ceramic clay industry can be separated into six segments, each of which manufactures a finished clay product from pre-processed raw materials: ceramic wall and floor tile, vitreous china plumbing fixtures, vitreous china table and kitchen articles, fine earthenware (whiteware) table and kitchen articles, porcelain electrical supplies, and pottery products.

There are approximately 346 plants in these six industry segments which are distributed across 40 states and Puerto Rico. Ohio and California together contain approximately 104 of these plants. In 1977 the value of shipments from the ceramic clay industry reached nearly 1.4 billion dollars. The porcelain electrical supplies and vitreous china plumbing fixtures industries accounted for 51 percent of this value.

The products from the ceramic clay industry are primarily used in the housing and electrical industries and in dining establishments and homes. The various segments of the ceramic clay industry studied in this report have real annual growth projections ranging from -0.5 to -1.0 percent over the next five years. These negative growth trends are reportedly a result of the projected decline of house construction and the impact of imports on the U.S. ceramics market.

1.2 PROCESSES

The ceramic clay industry, as defined for this study, begins with the receipt of pre-prepared clays, additives, and glazes. The clays and additives are mixed, molded into greenware, and fired in kilns to form a ceramic product. Pre-prepared glazes and pigments are mixed on site to yield specific qualities, and are applied to the products by either spray, dipping, or brush. The glazes are then baked onto the finished ceramic product in a final kiln. After cooling, the products are packaged and shipped.

1.3 EMISSION SOURCES

The principle point emission sources in the ceramic clay industry are the storage silos, kilns, and glaze spray booths. The sources of fugitive emissions from this industry are listed below:

materials transfer points
mixing and blending operations
storage bins
materials conveying operations
friction and isostatic presses
spray booths for applying glaze
product drying and cooling operations

Emissions from the storage silos and glaze spray booths consist mainly of particulates. The emission of hydrocarbons from the spray booths has been a concern in the past, however these have been eliminated by the substitution of water based glazes for previously used solvent based glazes. Uncontrolled particulate emissions from storage silos and spray booths would average 1.3 lbs/ton of product (0.65 kg/Mg). However, the ceramic clay industry routinely controls these emissions to 0.016 lbs/ton (0.008 kg/Mg) of product and 0.013 lbs/ton of product (0.007 kg/Mg), respectively.

Emissions from the kilns consist mainly of particulates. Particulate emissions rates from kilns average approximately 1.6 lbs/ton of product (0.8 kg/Mg). Because the kiln emissions values are low, emission control equipment is not used. Two states, Texas and Ohio, have even exempted plants from obtaining permits to operate the kilns.

Because the kilns use either natural gas or electricity for heat and have combustion temperatures typically less than 2250^{o}F (1232^{o}C), and combustion is well controlled, combustion pollutants such as SO_2, NO_x, CO, and hydrocarbons are not present in significant quantities. The combined emission rate of these pollutants for the average kiln is well under 30 tons per year. One noncriteria pollutant, hydrogen fluoride (HF), can be emitted from the kilns. The emission of HF results from the application and firing of a glaze containing calcium fluoride or from the use of feldspars containing fluoride. These practices, however, are declining and emissions of HF are not considered significant.

Fugitive emissions in the ceramic clay industry consist primarily of particulates. Uncontrolled fugitive particulate emissions in the ceramic clay industry total 36.3 lbs/ton of product (18.2 kg/Mg). Although some of the reported data are relatively high, uncontrolled fugitive emissions total less than 42 tons per year for the average plant. The ceramic clay industry, however, uses collection systems and fabric filters to reduce these emissions to 1.06 lbs/ton of product (0.66 kg/Mg) or 1.2 tons per year for the average size plant.

1.4 NATIONAL EMISSIONS

The total controlled national particulate emissions from the ceramic clay industry are estimated to be 872 tons per year. This does not include emissions from the porcelain electrical supplies industry, but does include emissions from 285 other plants. These controlled emissions average 3.1 tons per year per plant. Average uncontrolled particulate emissions from each plant are only 46 tons per year.

1.5 AVAILABLE CONTROL TECHNOLOGY

The Mine Safety Health Act of 1977 requires flint suppliers to ship by bulk or covered hopper cars. In order to unload the materials, plants in the ceramic clay industry have installed pneumatic unloading and conveying systems. Four of the five plants visited had pneumatic systems and the other plant receives materials in bags. An integal part of this system is a fabric filter on top of each storage silo to remove suspended raw materials from the conveying air.

The fabric filters currently in use achieve an average emission reduction of 98.7 percent. The particulate emissions from these sources are approximately 0.016 lbs/ton of product (0.008 kg/Mg).

Spray booths consist of an open faced chamber into which the glaze is sprayed. This chamber is then exhausted to the atmosphere through a collection device. Emissions from glaze spray booths are usually controlled with liquid cyclones or a baffle system. These remove the particulates (liquid droplets) from the air stream and discharge them in a liquid or slurry. Units in use have a reported removal efficiency of 98 percent.

Fugitive emissions from storage bins, dry pressing operations, transferring and conveying of materials, and mixing operations occur within the plant and are currently controlled by drawing them into an area exhaust system and discharging through a fabric filter with a reported efficiency of 97 to 99+ percent. All the plants visited had fugitive emission control devices.

1.6 "BEST" CONTROL SYSTEM

The "best" system of emission control for the ceramic clay industry includes a pneumatic unloading and conveying system serviced by fabric filters with an efficiency of about 99 percent. A wet cyclone would be employed to reduce emissions from spray booths. The collection efficiency of this device would also be approximately 99 percent. Fugitive emissions would be controlled by drawing them into an area exhaust system and venting through a fabric filter with a collection efficiency of 98 percent. All the plants contacted in the ceramic clay industry currently employ all or some of the control devices discussed above.

1.7 STATE REGULATIONS

The most common state regulations applicable to the ceramic clay industry are process weight particulate regulations, opacity regulations, and combustion regulations. The kilns operate primarily on natural gas and particulate emissions are insignificant. The kilns meet the combustion regulations in all the states examined. A typical process weight regulation limits particulate emissions to 2.0 lbs/hr (0.9 kg/hr). Available data indicates the storage silos, kilns, and spray booths presently used meet the process weight particulate emissions regulations in all states studied without applying control equipment. The states universally applied an opacity regulation limiting visible emissions to less than 20 percent opacity. Fugitive emissions as well as point source emissions are regulated by the opacity regulation. However, correlations between opacity and particulate emission rate from the ceramic clay industry are not available.

1.8 TEST METHODS

EPA reference test methods have been established for the sampling and analysis of the considered pollutants. These include EPA Methods 1 through 5 which measure particulate emissions, Methods 12a and 13b, which measure HF emissions, and Method 25 which measures organic emissions.

1.9 RESULTS AND RECOMMENDATIONS

Total uncontrolled particulate emissions from the greatest emission sources are 40.5 lbs/ton of product (20.3 kg/Mg). For a plant of average size (producing 2270 tons per year or 2059 Mg/yr) this amounts to 46 tons per year (42 Mg/yr). With the level of control currently used by the ceramic clay industry, these emissions are reduced to 3.1 tons per year (2.8 Mg/yr). The largest plant produces 30,000 tons per year (27,215 Mg/yr) and would emit only 41 tons of particulates per year (37 Mg/yr) as currently controlled.

Real growth projections for the ceramic clay industry show a decline in production. The emission data available have shown the potential and actual emissions from the ceramic clay industry to be relatively small.

Based on these findings it is concluded that there would be no significant air quality improvement from the promulgation of New Source Performance Standards for the ceramic clay industry. Therefore, it is recommended that no New Source Performance Standards be developed at this time.

2. INTRODUCTION

The purpose of this study is to assess the need for a New Source Performance Standard (NSPS) to regulate the emissions of air pollutants from the ceramic clay industry. The six industries included are classified under the Standard Industrial Classification (SIC) system as: 3253, Ceramic Wall and Floor Tile; 3261, Vitreous China Plumbing Fixtures and China and Earthenware Fittings and Bathroom Accessories; 3262, Vitreous China Table and Kitchen Articles; 3263, Fine Earthenware (Whiteware) Table and Kitchen Articles; 3264, Porcelain Electrical Supplies; and 3269, Pottery Products Not Elsewhere Classified. Industry segments specifically excluded are brick and structural clay products, and clay refractories which are currently being investigated in other EPA studies.

Processes and operations covered in this study are unloading and conveying of processed clay, mixing and blending of raw materials, forming the product, glazing the ware, ware and glaze drying, firing of the article, and cooling. Materials handling processes at the mine site are not included in this study. These processes and operations include mixing, washing and grinding, cleaning, screening, drying, conveying and transporting to the plant. These processes are expected to be covered in a separate NSPS study.

The authority for conducting this study comes from the Clean Air Act (CAA), as amended in 1977. Section 111 of the Act stipulates that EPA publish a list of categories of stationary sources which cause or contribute to air pollution that may be anticipated to endanger public health and welfare. The Act also requires EPA to promulgate New Source Performance Standards (NSPS) for sources within these categories. This source category survey was performed to determine if development of an NSPS for the ceramic clay industry was justified and to identify what processes and pollutants, if any, should be subject to regulation.

Part of the objective of the Source Category Survey of the ceramic clay industry is to determine if the nation would potentially realize a significant net benefit from an NSPS for this industry. The study involves determining if technology better than that currently being applied exists and whether a significant number of new sources would be affected by the NSPS. Since an NSPS would affect only new or modified plants, growth in the industry is an important consideration. If it is determined that an NSPS would be beneficial, then this report would provide guidance for development of an NSPS.

The scope of this study includes 1) an examination of the processes, pollutants, and control equipment used in the industry; 2) an assessment of the size, distribution, and growth of the industry; 3) the identification of "best" available control technology; and 4) an examination of the federal, state, and local regulations pertaining to the industry. This information was gathered by: 1) literature search of various journals and technical publications, including EPA documents; 2) telephone and personal contacts with industry trade associations, industry personnel, and Federal, State, and local officials familiar with the industry; and 3) visits to operating ceramic clay plants.

This report presents the results of the study to assess the need for development of an NSPS for the ceramic clay industry. It also includes recommendations based upon these results.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 GROWTH OF INDUSTRY

The growth of the ceramic clay industry has been projected to be negative at -0.5 to -1.0 percent annually over the next five years. No sector of the industry is projected to have growth. Imports have had a significant impact on the industry and their increasing share of the American consumer market is projected to continue. In general, industry officials do not foresee any new plant construction or expansions in the next five years within the wall and floor tile industry as well as the remaining industry sectors. There exists unutilized production capacity in the industry because of past cutbacks in production. It is expected then that no plants will be built in the next five years.

3.2 EMISSION SOURCES

3.2.1 Particulate Process Emission Sources

The sources of particulate emissions in the industry are the storage silos, kilns and glaze spray booths. The average uncontrolled emission factors for these processes and operations are estimated to be 1.27 lbs/ton (0.64 kg/Mg), 1.6 lbs/ton (0.8 kg/Mg), and 1.3 lbs/ton (0.65 kg/Mg) produced, respectively.

3.2.2 Fugitive Emission Sources

Fugitive emission sources in the industry include transporting and conveying of materials, mixing, blending, dry forming, and drying and cooling of the ware. Fugitive particulate emissions are estimated to be 36.3 lbs/ton (18.2 kg/Mg) of product.

3.2.3 Other Emissions

The gaseous and particulate emissions from the burning of fuel are small in this industry because natural gas is the principle if not the only fuel used, combustion temperatures are typically less than 2250°F (1232°C), and combustion is well controlled. The quality of the ware is an important consideration in the type of fuel used and fuels that burn less cleanly are not desirable according to industry personnel.

Fluoride emissions are not considered to be significant in the industry. There was no data obtained indicating fluoride is present in emissions from ceramic clay kilns.

3.3 NATIONAL EMISSIONS

The net uncontrolled particulate emissions from the ceramic clay industry including fugitive emissions are estimated to be 13,100 tons per year (1.19×10^7 kg/yr). Of this figure, 11,700 tons per year (1.06×10^7 kg/yr) comes from fugitive emission sources. The industry currently reduces these emissions to 870 tons per year (7.89×10^5 kg/yr) of which 340 tons per year (3.08×10^5 kg/yr) are from fugitive sources.

The typical state regulation would limit net national emissions from the point sources to approximately 19,300 tons/year (1.75×10^7 kg/yr). This allowable point source emission level is 6200 tons/year (5.62×10^6 kg/yr) greater than the uncontrolled emission level. Some state regulations also require fugitive emission sources to apply limited controls. No degree of control or levels for fugitive emissions were stipulated by the state regulations.

3.4 AVAILABILITY OF CONTROL TECHNOLOGY

Fabric filters are currently being used to control particulate emissions both from fugitive sources and point sources. Pneumatic systems are used for transporting and conveying raw material, and fabric filters are used to remove suspended materials from the air streams. Vacuum systems with lines running to areas of fugitive emission sources are also used to collect and convey fugitive emissions to fabric filters. The filters reduce emissions by approximately 97 to 99+ percent. The average discharge from the fabric filter for the industry is estimated to be 0.016 lbs/ton of product (0.008 kg/Mg).

Liquid cyclones or baffles are being used on the glaze spray booths. The system collects the aerosol and removes the droplets from the gas stream. These units reduce emissions by approximately 99 percent. The average discharge for the industry from these units is estimated to be 0.013 lbs/ton of product (0.0065 kg/Mg).

These operations currently have uncontrolled emission levels less than the allowable rate of the most stringent state regulations. Industry personnel have said that controls are used to ensure the quality of the product and to maintain a clean working environment for the safety and welfare of the workers. The dust or spray generated would foul the product and equipment if not removed.

3.5 STATE REGULATIONS

All the state regulatory agencies contacted (14) have said that they do not consider this industry to be a significant source of emissions. As a result, little monitoring or testing has been done. The test results available tend to corroborate their position. Additional support comes from Texas and Ohio agencies, which have exempted these sources from permit requirements because they consider the emissions insignificant. In general, states do have particulate regulations on opacity, fugitive emissions, and particulate emission from combustion and process sources. Few state regulations on combustion particulates apply to the industry because of the predominant use of natural gas as a fuel which is often exempted from combustion regulations. The most stringent process weight regulation generally would limit emissions to 2.0 lbs/hr (0.9 kg/hr). The greatest point source in the industry, the kiln, would have uncontrolled emissions of 0.4 lbs/hr (.18 kg/hr), well below the most stringent state regulation. The industry would meet the most stringent state emission regulation without using control equipment.

No visible emissions were observed during plant visits and therefore it is believed the industry in general would meet opacity regulations. Fugitive emission sources are contained within the plant and are controlled. Emissions from fugitive sources meet typical state regulations.

3.6 TEST METHODS

There are EPA test methods applicable to the ceramic clay industry. These include EPA Methods 1 through 5 for particulates, Method 13a and

13b for HF emissions, and Method 25 for organic emissions. None of the data obtained during this study resulted from the use of these methods because most states do not require the ceramic industry to monitor or test sources of emissions.

3.7 RECOMMENDATIONS

It is recommended that no New Source Performance Standards be developed for the ceramic clay industry. National uncontrolled emissions from the industry are less than the allowable emissions from typical state emission regulations. The industry is also expected to have negative growth from -0.5 to -1.0 percent annually. There exists unutilized production capacity in the industry and therefore construction of new plants is unlikely. Emissions from the industry are controlled to maintain product quality and clean working conditions. No other controls than those already described have been demonstrated in the industry. It is estimated that promulgation of New Source Performance Standards for the ceramic clay industry would result in no emission reduction benefit.

4. DESCRIPTION OF INDUSTRY

The ceramic clay industry as defined for this study consists of 6 Standard Industrial Classification (SIC) code numbers: 3253, 3261, 3262, 3263, 3264, and 3269. Manufacturers classified under these codes start with prepared clays and materials, and produce a finished clay product. A description of each industrial grouping, by SIC code, is presented below[1]:

- 3253 Ceramic Wall and Floor Tile
- 3261 Vitreous China Plumbing Fixtures, China and Earthenware Fittings and Bathroom Accessories
- 3262 Vitreous China Table and Kitchen Articles - (for use in households and in hotels, restaurants, and other commercial institutions for preparing, serving, or storing food or drink).
- 3263 Fine Earthenware (Whiteware) Table and Kitchen Articles - (semivitreous types of earthenware table and kitchen articles for preparing, serving, or storing food or drink).
- 3264 Porcelain Electrical Supplies - (electrical insulators, molded porcelain parts for electrical supplies)
- 3269 Pottery Products, Not Elsewhere Classified - (firing and decorating white china and earthenware for the trade and manufacturing art and ornamental pottery, industrial and laboratory pottery, stoneware and coarse earthenware table and kitchen articles, unglazed red earthenware florists' articles, and other pottery products, not elsewhere classified).

4.1 SOURCE CATEGORY PROFILE

This section provides information about the distribution, employment, density, and capacity of plants in the subgroupings of the ceramic clay industry. Statistics on employment, and distribution of plants were obtained from the Department of Commerce and the Department of Labor publications. Other data and information about these industries were supplied by trade organizations and individuals with a specific knowledge of the industry.

Table 4-1 presents a summary, by number of employees, of the size of the plants in each applicable SIC code. Table 4-2 provides a breakdown by geographical regions of the number of plants in each SIC code and also gives the percentage of the industry that these plants represent.

4.1.1 Ceramic Wall and Floor Tile

In 1972 there were 83 facilities in the United States which produced ceramic floor and/or wall tile. Fifty-six facilities employed 20 or more employees. The total industry employed 8300 people and produced 308.7 million square feet of tile.[4] In 1977 there were 82 facilities operating in the industry with 50 facilities employing 20 or more employees. The total industry employed 7800 people and produced 283.7 million square feet of tile.[4]

Production in 1978 totaled 283 million square feet of tile, valued at 252 million dollars.[6] According to figures available in 1979 there were 64 plants operating in the industry and all employed 20 or more people.[5]

Ceramic wall and floor tile plants are concentrated in the Mid-Atlantic, East North Central, and West South Central geographical regions, as shown in Table 4-2.

4.1.2 Vitreous China Plumbing Fixtures

In 1972, 59 facilities were reported producing vitreous china plumbing fixtures. The industry employed 9600 people and produced 20,322.6 thousand pieces.[7] In 1977 there were a reported 70 facilities in operation, employing 9200 people and produced 20,176.1 thousand pieces.[7]

TABLE 4-1. 1979 EMPLOYMENT DISTRIBUTION OF PLANTS BY SIC CODES 3253, 3261, 3262, 3263, 3264 and 3269[2]

Number of Employees	Number of Plants in Employment Range by SIC Code					
	3253	3261	3262	3263	3264	3269
	Wall and Floor Tile	Plumbing Fixtures	China Table and Kitchen Ware	Fine Earthen and Kitchen Ware	Porcelain Electrical Supplies	Other Pottery Products
20-49	23	5	2	4	N/A	60
50-99	6	5	3	1	N/A	49
100-249	26	18	6	3	N/A	22
250-499	6	14	5	3	N/A	6
500-999	2	5	1	4	N/A	2
1000-2499	1	0	3	0	N/A	0
TOTAL	64	47	20	15	61	139

N/A = Not Available.

TABLE 4-2. 1979 GEOGRAPHICAL DISTRIBUTION OF PLANTS IN THE CERAMIC CLAY INDUSTRY[3]

Geographical Division	Total Number of Plants[a]	SIC 3253		SIC 3261		SIC 3262		SIC 3263		SIC 3264		SIC 3269	
		# Plants	% of Industry	# Plants	% of Industry	# Plants	% of Industry	# Plants	% of Industry	# Plants	% of Industry	# Plants	% of Industry
New England (ME,NH,VT,MA,RI,CT)	11	0	0	2	2.88	2	1.87	0	0	N/A	N/A	7	2.55
Middle Atlantic (NY,NJ,PA)	57	10	27.31	11	19.75	7	48.57	3	14.32	N/A	N/A	26	17.16
East North Central (OH,IN,IL,MI,WI)	83	14	20.5	18	39.15	5	13.01	7	59.01	N/A	N/A	39	35.87
West North Central (MN,IA,MO,ND,SD,NE,KS)	9	0	0	1	1.04	0	0	0	0	N/A	N/A	8	3.78
South Atlantic (DE,MD,DC,VA,WV,NC,SC,GA,FL)	21	9	9.36	3	9.8	1	24.31	2	10.5	N/A	N/A	6	2.51
East South Central (KY,TN,AL,MS)	21	8	14.1	3	5.84	2	5.83	0	0	N/A	N/A	8	5.05
West South Central (AR,LA,OK,TX)	26	13	20.96	5	15.02	1	2.71	0	0	N/A	N/A	7	4.44
Mountain (MT,ID,WY,CO,NM,AZ,UT,NV)	6	1	0.26	0	0	0	0	0	0	N/A	N/A	5	1.87
Pacific (WA,OR,CA,AK,HI)	51	9	7.51	4	6.53	2	3.59	3	16.17	N/A	N/A	33	26.93
TOTAL	285	64	100	47	100.01	20	99.89	15	100	61		139	100.16

NA = Not available

[a]Does not include Porcelain Electrical Supplies Industry (SIC 3264).

The value of shipments in 1978 was approximately 407 million dollars, a sales increase of 17 percent over 1977 values. However, this statistic does not take into account the effect of inflation.[8]

Data available in 1979 indicate 47 facilities were in production. The data also indicates 68 percent of all plants in this industry employ between 100 and 500 people. No plant employs more than 1000 people.[7]

The highest density of facilities producing vitreous plumbing fixtures occurs in the Mid-Atlantic and East North Central states as shown in Table 4-2.

4.1.3 Vitreous China Food Utensils

There were 34 plants reported producing vitreous china food utensils in 1972 with 20 plants employing 20 or more people.[9] There were 5900 people employed and 10.6 million dozen pieces were produced. There were 30 plants reported in this classification in 1977. Fourteen plants employed 20 or more people.[9] There were 7100 people employed and 10.9 million dozen pieces were produced. The value of shipments in 1977 totaled about 138 million dollars.[9] In 1979 there were 20 plants in this classification. Data available in 1979 reveals that 100 percent of all facilities in this industry employ 20 or more people. Three plants employ between 1000 and 2500 people.[10]

Sixty percent of the plants in this industry are located in the Mid-Atlantic and East North Central states, as shown in Table 4-2.

4.1.4 Fine Earthenware Food Utensils

In 1972, 18 plants were reported producing fine earthenware food utensils.[11] Fifteen plants employed 20 or more people. Employment totaled 6800 people and 13.7 million dozen pieces were produced. In 1977, 24 plants were reported in production with 18 plants employing 20 or more people.[11] Employment totaled 5200 people and 13.0 million dozen pieces were produced.[12] The value of shipments in 1977 were reported at 91 million dollars.[11,12]

Fifteen plants were in production 1979. Data available in 1979 indicates that the existing plants are fairly evenly distributed among the employment ranges, as shown in Table 4-1. There are, however, no plants employing more than 1000 people.[12]

Nearly 50 percent of the facilities in this industry are located in the East North Central states.

4.1.5 Porcelain Electrical Supplies

There were a reported 83 plants producing porcelain electrical supplies in 1972.[13] Sixty-four plants employed 20 or more people. There were 13,400 people employed and 91.8 million pieces were produced.[13] In 1977, the same number of plants (83) were reported in production but with only 53 plants employing 20 or more people.[13] There were 10,700 people employed and 76.3 million pieces were produced. The value of shipments amounted to 338 million dollars in 1977.[13] The 1979 data reports 61 plants in production.[14] There are no other current data available concerning this segment of the ceramic industry.

4.1.6 Pottery Products, Not Elsewhere Classified

In 1972, there were a reported 426 plants producing pottery products with 95 plants employing 20 or more people.[15] Employment was 9100 people. In 1977, a total of 730 plants were reported in this classification, with 115 plants employing 20 or more people.[15] Employment was 10,200[17] and the value of product shipments was 229 million dollars in 1977.[15] All of these plants employ 20 or more people. Seventy-eight percent of these plants employ less than 100 people. No plant employs more than 1000 people.[16]

The highest densities of plants in this industry occur in the Mid-Atlantic, East North Central, and Pacific states.

4.2 PRODUCTION TRENDS

This section presents recent production trends and discusses the factors that have influenced the growth and development of this industry. Future growth trends in these industries will also be examined.

4.2.1 Ceramic Wall and Floor Tile

Production reached a peak of nearly 308 million square feet in 1972 and 1973, but dropped to 273 million square feet in 1974. Production has been fluctuating since then.[17] Domestic production of ceramic wall and floor tile in 1978 totaled 283 million square feet, an increase of 6.8 percent from 1977 production. Furthermore, the production in this industry sector has increased nearly 16 percent in the first half of 1979.[18]

The domestic industry, however, does not have an exclusive market in the United States. In 1978, imports of ceramic floor and wall tile accounted for 47 percent of the total United States consumption of this product. This is an increase in the share of the domestic United States market from the 30 percent share it had in 1967.[19]

The ceramic tile industry in America has been attempting to reduce costs and modernize in order to become more competitive with the less expensive imports. There has been a shift towards larger, more efficient plants with many of the small producers either going out of business, consolidating, or merging with other corporations. Industry pressure to maintain tariff rates and other import deterrants have been partially successful in providing a stable United States market share for the domestic producers.

The ceramic wall and floor tile industry relies heavily upon the construction market. As a result, its growth is related directly to the housing industry and construction starts. The year 1978 was a boom year in housing and it is expected that housing starts will decline over the next five years.[20] The real growth rate of the domestic ceramic floor and wall tile industry is estimated, by the U.S. Department of Commerce, to be a -0.8 percent annually for the next five years.[20]

4.2.2 Vitreous Plumbing Fixtures

Domestic production of vitreous plumbing fixtures was valued at 407 million dollars in 1978, up 58.6 million dollars from 1977 values.[21] This increase in product value is a result, in part, of inflation. In 1977 it was estimated that the vitreous plumbing industry would be producing near its maximum capacity of 18,000,000 units.[22]

The sanitaryware industry is no longer monopolized by the vitreous plumbing fixtures industry. Plastics have made vast progress in this area and are very competitive with the vitreous plumbing fixtures. No quantifiable data is currently available on how much impact plastics have made. The industry is also tied to the housing industry in much the same way as the ceramic wall and floor tile industry. As a result of competition from plastics and the decline of the housing market, the real growth for the vitreous plumbing fixtures industry is projected to be a -0.8 percent annually for the next five years.[23]

4.2.3 Vitreous China Food Utensils

Product shipments in the vitreous china food utensil industry were valued at approximately 138 million dollars in 1977.[24] This industry depends mainly upon hotels, restaurants and home markets. According to one industry official "The trend towards finger foods, such as hamburgers and fried chicken, does little to enhance the hotel china business".[25] Personal expenditures or consumer spending, the major influence in the china food utensils industry, is expected to decrease over the next five years. Therefore, the real growth rate for the vitreous china food utensil industry is estimated to be -0.5 percent annually for the next five years.[26]

4.2.4 Fine Earthenware Food Utensils

In 1977 product shipments from facilities in this classification were valued at about 91 million dollars.[27] The fine earthenware food utensil industry is influenced by many of the same factors influencing the vitreous china food utensil industry. Especially important is the amount of personal expenditures. The real growth rate projection for this industry is -1.0 percent annually for the next five years.[28]

4.2.5 Porcelain Electrical Supplies

The value of shipments from plants producing porcelain electrical supplies in 1977 was 338 million dollars.[29] This industry is related to housing and construction starts in the same way as are the ceramic wall and floor tile and vitreous plumbing fixtures industries. Because of this, the real growth forecast is the same as for those two industries; -0.8 percent annually for the next five years.[30]

4.2.6 Pottery Products, Not Elsewhere Classified

The shipments of products from this industry were valued at 229 million dollars in 1977.[31] The production and sale of pottery products are also related to the amount of personal expenditures. Because of this relation the real growth projection is -1.0 percent annually for the next five years.[32]

4.2.7 Net Trends

The 5 year real growth rate projections for segments of the ceramic clay industry range from -0.5 percent to -1.0 percent annually,[33] and therefore no new plants are expected to be built in the next five years. A common influence for all of these growth projections is the state of the national economy. It is anticipated that the ceramic clay industry will experience fluctuations in production due to competition from foreign producers and other domestic products.

4.3 PROCESS DESCRIPTION

The processes used in the manufacture of the various ceramic clay products covered in this study are very similar and therefore a singular description will be given. The processes vary slightly in accordance with the type of product manufactured. The variation is in the body material mixture and the type of forming. Although the quantity of emissions may vary, the type of emissions are generally not affected by the product being manufactured.

As illustrated in Figure 4-1, the processes can be divided conveniently into three operations; body preparation, firing and glazing. Glazing and firing follow body preparation but glazing can occur before or after firing.

4.3.1 Body Preparation

Body preparation consists of all process steps prior to firing or glazing. Body preparation therefore includes the mixing of the raw materials, in the proper proportions, to form the body material. It also includes the forming of the greenware, or clay body, by a wet or dry process.

Raw materials for the ceramic clay industry include processed and prepared materials and raw ores. If raw ore is received it is crushed, ground, screened and cleaned to prepare it for use. Prepared materials are received in either railroad hopper cars or bags and sometimes in bulk trucks. The hoppers are unloaded pneumatically into silos. Bags are unloaded by hand or front-end loaders. The prepared materials are stored in silos or enclosed bins. The raw materials, consisting of clays (china clay, ball clay, kaolin, etc.), fluxes (feldspars, talc, soda ash, etc.), silicas (flints, quartz, etc.) and other minor ingredients

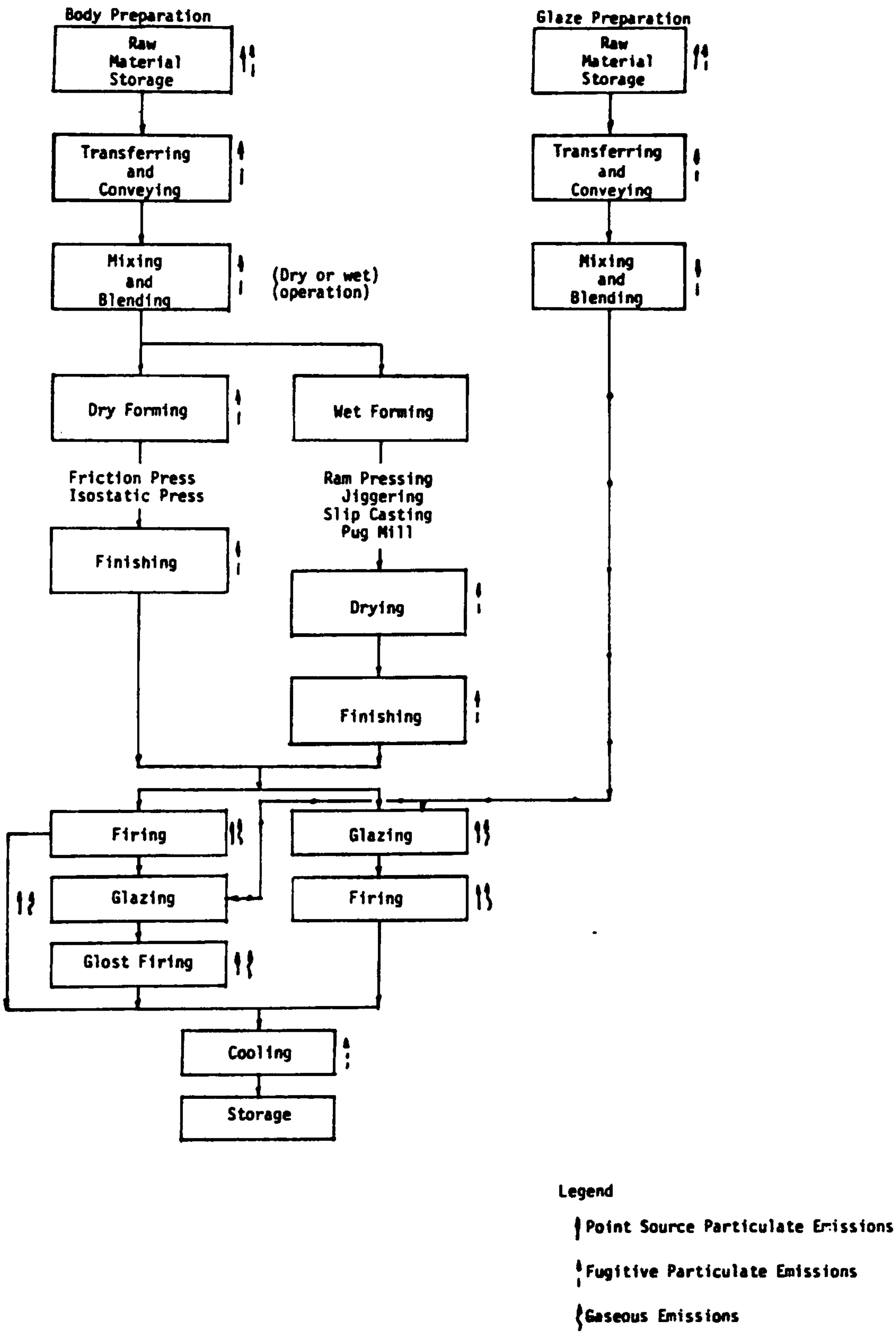

Figure 4-1. General Process Flow Diagram

are blended to form the body material. The clays constitute the main body. Fluxes are added to lower the required firing temperature and to promote vitrification. Vitrification is the formation of glass by partial melting during firing. Silicas are added for strength. They undergo structural changes upon firing to bond the clay particles into a strong, rigid mass.

Uncontrolled fugitive emissions from the unloading and storage of materials average approximately 35 lbs per ton (18 kg/Mg) of product manufactured according to AP-42 factors.[34] Controls such as enclosing the unloading area and conveying equipment can reduce these emissions to approximately 8 lbs/ton of product (4 kg/Mg). Fabric or bag filters installed on storage silos reduce emissions from 1.27 lbs/ton (0.6 kg/Mg) on the upstream side of the device to less than 0.02 lbs/ton (0.01 kg/Mg) on the downstream side.

The raw materials are then batched and mixed to form the body material. Water is usually added during mixing. However in the manufacture of wall and floor tile and electrical supplies these are mixed dry if dry forming is used. Uncontrolled fugitive emissions for dry mixing and conveying average approximately 18 lbs/ton (9 kg/Mg). With control devices such as fabric filters these emissions can be reduced to approximately 1 lb/ton (0.5 kg/Mg).

Wet forming processes, such as ram pressing, jiggering, slipcasting, etc., form a moist greenware product. Dry forming using friction presses or isostatic presses form tile or electrical products. Wet forming does not produce any emissions. Dry forming is reported to produce fugitive emissions averaging 19 lbs/ton (10 kg/Mg). These emissions can be collected by a vacuum system and ducted to a fabric filter to reduce these emissions to approximately 0.5 lbs/ton (0.25 kg/Mg).

The greenware formed by wet forming is allowed to partially dry before glazing or firing takes place. Very little if any emissions occur during the drying process. Typically the drying is done in open areas at room temperature. Tiles and electrical products formed by dry processes are "vacuumed" and fettled. They are then glazed if necessary and fired.

4.3.2 Firing

The green body is placed on kiln cars. The cars are then loaded into the kiln (typically a tunnel kiln fired with natural gas). As the body temperature is raised, carbonaceous matter is burned out, chemical water is excluded, and carbonates and sulfates begin to decompose. On further heating, some of the minerals break down into new forms, and the fluxes react with the decomposing minerals to form liquid silicates or glasses. More glass forms as the temperature is raised and begins to pull the unmelted grains together causing shrinkage and an increase in bulk density. When the proper degree of maturity is reached or the proper amount of porosity is achieved the body is cooled. Upon cooling the liquid glass becomes rigid thus forming a strong bond between the remaining crystalline grains. Depending upon the degree of porosity remaining in the body, it is classified as unvitrified (clay pots, etc.), semivitrified (stoneware, dinnerware, etc.) or vitrified (white-ware, etc.).

Firing can be accomplished in one or two stages. Typically the body is first fired at a low temperature (bisque fired) which removes the volatile organics and allows part or all of the shrinking to occur. Glaze is then applied to the body which is fired (glost firing) to maturity at a temperature between 2100 to 2300°F (1149 to 1260°C). However, low cost items can be one-fired. In this process the green body is glazed and then fired to maturity at a temperature of approximately 2220°F (1215°C). In fine china, the body is first fired to maturity at a temperature usually between 2100 -2200°F (1149 to 1204°C), then glazed. The glazed body is again fired at a low temperature, usually 1300 - 1350°F (704 to 732°C), to set the glaze.

The kilns are typically fired using natural gas. The quality of the fuel is important in order that the product not be adversely affected. Natural gas is a clean burning fuel generating low levels of particulate emissions. Source testing of kiln exhausts report uncontrolled emission of 1.6 lbs particulates/ton (0.8 kg/Mg) of product with no significant gaseous emissions.

4.3.3 Glazing

The proportions of raw materials used to form the glaze are very similar to body composition except the silica oxide is in higher concentration. The composition includes a frit (which imparts the color of the glaze, its opacity and other characteristics), clay and other minor ingredients. The frit material usually comes preground in 50 lb bags. There are a number of types of frits commercially available. The clays are generally received in bulk by rail car and truck. The materials are batched and mixed with water usually in a ball mill. The glaze is then stored ready for use. Fugitive emissions similar to those discussed for the bulk material handling operations occur in the glaze material conveying and transferring phases of this operation.

The glaze is applied to the body either by hand dipping or spraying. Hand dipping generates no emissions. Spray emissions are usually controlled by a spray booth equipped with a baffle or water curtain control device. The booths are usually small enclosures of approximately 8 cubic feet. The uncontrolled emissions from spray operations have been reported as averaging 1.3 lbs/ton (0.7 kg/Mg) of particulate while controlled emissions are 0.013 lbs/ton (0.007 kg/Mg). No significant gaseous emissions have been reported. Fluoride and lead have virtually been eliminated from the glazes because of health related problems and regulations. No VOC emissions are present since water based glazes have replaced the organic solvent based glazes.

Some finishing of the product may be required. Finishing might require grinding, polishing, etc. As a result of quality control, finishing is seldom necessary and is not considered a significant source of emissions. Some grinding is done on electrical porcelain to form the finished product but this is usually done with the addition of water, therefore the emissions are not considered significant.

The product once fired to maturity is cooled to room temperature, stored and shipped. No significant emissions occur during these operations.

4.4 REFERENCES

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5. AIR EMISSIONS DEVELOPED IN SOURCE CATEGORY

Section 5.1 identifies the types and quantities of emissions from individual emissions sources in the ceramic clay industry. Emissions from a typical uncontrolled plant and from a plant controlled to meet a typical State Implementation Plan are estimated in this section. An estimate of the total national emissions from the ceramic clay industry is presented in Section 5.2.

The information presented in this chapter is based on source test data. There is a scarcity of source test data for this industry. State regulatory agencies generally believe that the ceramic clay industry is not a source of significant emissions and therefore have not required extensive source testing. The availability of emissions data is discussed in more detail in Chapter 7. Emission factors from EPA Document AP-42, Compilation of Air Pollutant Emission Factors, are included for comparison with the reported test data.

5.1 PLANT AND PROCESS EMISSIONS

The major point sources of emissions from a ceramic clay plant are the storage silos, the kilns, and the spray booths. Sources of fugitive emissions include the following:

Materials transfer points
Mixing and blending operations
Storage bins
Materials conveying operations
Friction and isostatic presses
Spray booths for applying glaze
Product drying and cooling operations.

Any new plant that has an on-site clay crushing or grinding operations in addition to the above operations, may have these sources regulated by a New Source Performance Standard for non-metallic minerals presently being developed. About 28 percent of the ceramic wall and floor tile industry could be regulated under this standard.

5.1.1 Point Source Emissions

Point sources are sources which emit pollutants to the atmosphere via a stack or vent. Storage silos, kilns, and spray booths are the primary point sources in the ceramic clay industry.

5.1.2 Storage Silos. Emissions from storage silos consist mainly of particulates. Most silos are loaded by a pneumatic conveying system. These pneumatic conveying systems are an indirect result of the Mine Safety and Health Act of 1977, and also serve to reduce labor costs. The Mine Safety and Health Act of 1977 requires flint suppliers to ship by hopper cars which require pneumatic unloading. All plants which have a pneumatic conveying system have installed fabric filters to clean the conveying air before it is discharged to the atmosphere. Since the pneumatic conveyors transport the materials in an air stream, the plants would lose most of the raw materials if the bag filters were not used.

One source test is available and reports uncontrolled particulate emissions as 1.27 lbs/ton product (0.64 kg/Mg), and controlled emissions as 0.016 lbs/ton product (0.008 kg/Mg).[1] However, this source test was not conducted with a method approved by the EPA. It was a measurement of particulates collected in on-line filters located upstream and downstream of the fabric filter and the results may not be reliable.

The fabric filters are considered an integral part of the process equipment because without it there would be a great loss of valuable raw material. It is possible that fabric filters would not be considered as an air pollution control device. If not considered as a control device, the discharge from the fabric filter would be the source of uncontrolled emissions with emissions of 0.016 lbs/ton (0.008 kg/Mg) of product.

5.1.1.2 Kilns. All kilns in this source category are fired with natural gas. Many kilns have a standby fuel of #2 fuel oil or propane, but these are rarely used. Because they use natural gas for firing and because operating temperatures are low and combustion is well controlled, the emissions from kilns are relatively free from combustion pollutants such as NO_x, SO_2, HC, or CO. Particulate emissions from the clay body may occur during the drying and firing in the kiln. One noncriteria pollutant which may be emitted is hydrogen fluoride. One to two producers contacted add calcium fluoride to their glaze composition, and when the glazed body is fired some of the fluoride will be volatized. Little is known about the evolution of fluoride from the kilns. The addition of calcium fluoride to the glazes is not a widespread practice.

Table 5-1 presents the source test data which is available on kilns. This table also presents emission factors from AP-42 for brick kilns. Uncontrolled particulate emissions ranged from 0 to 2.5 lbs/ton (1.25 kg/Mg) of product, and averaged 1.6 lbs/ton (0.8 kg/Mg). The reported values of 2.5 and 0 lbs/ton of product seem high and low, respectively. Because the amount of emissions being measured is very low, measurement errors are more common. As a comparison, AP-42 reports a particulate emission factor of 0.04 lbs/ton (0.02 kg/Mg) for brick kilns. Brick clay is not as refined as the clay body material used in this industry, nor is the brick glazed. Therefore, emissions from ceramic kilns would be expected to be lower than from brick kilns. No plant contacted reported any direct control devices on the kiln exhaust. Some plants use the exhaust from the kiln for drying followed by a particulate control device. Only one plant contacted reported such a system.

5.1.1.3 Spray Booths. Emissions from spray booths consist mainly of particulates resulting from glaze overspray. Emissions of hydrocarbons were a concern in the past because of the use of organic solvents in the glazes. However, the telephone survey and plant visits revealed that glazes are now prepared with water as a base, thus organic emissions have been eliminated. None of the plants contacted used organic solvents in preparing glazes. No source test data is available on the extent of hydrocarbon emissions from current operations.

TABLE 5-1. SUMMARY OF SOURCE TEST DATA ON EMISSIONS FROM GAS FIRED KILNS[2,3,4]

	Uncontrolled Emission Factors					Controlled Emission Factors
	Particulates	SO_x	NO_x	HC	CO	Particulates
	lbs/ton (kg/Mg)	lbs/ton (kg/Mg)	lbs/ton (kg/Mg)	lbs/ton (kg/Mg)	lbs/ton (kg/Mg)	lbs/ton (kg/Mg)
Plant E	0.4 (0.2)	0.7 (0.35)	N/A	N/A	N/A	N/A
Plant F	N/A	N/A	N/A	N/A	N/A	0.13 (0.065)
Plant G	2.5 (1.25)	N/A	N/A	N/A	N/A	N/A
	2.5 (1.25)	N/A	N/A	N/A	N/A	N/A
	2.5 (1.25)	N/A	N/A	N/A	N/A	N/A
Plant H	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	N/A
AP-42	0.04 (0.02)	N	0.15 (0.075)	0.02 (0.01)	0.04 (0.02)	N/A

N/A = Not Available
N = Negligible

There is one source test on emissions from spray booths. It was provided by industry but it was not done by an EPA test method. Uncontrolled particulate emissions were reported to be 0.015 lbs/ton product (0.0075 kg/Mg), while controlled emissions were 0.0003 lbs/ton product (0.00015 kg/Mg).[5] The data which was gathered from the NEDS report and the various state agencies indicate that no spray booth has controlled particulate emissions greater than 5 TPY. This data includes emissions for 80 spray booths.

Tennessee currently uses a particulate emission factor of 0.025 lbs/ton (0.0125 kg/Mg) for controlled emissions from spray booths. An average collection efficiency of 98 percent was used to determine a factor for uncontrolled emissions.

5.1.2 Fugitive Emissions

Fugitive emissions are emissions resulting from attrition losses during materials handling. Fugitive emissions can also result from leaks or openings in process equipment. Although test data are available for some of the fugitive sources listed above, emissions from these sources are usually difficult to measure. Test data reported for these sources are presented in Table 5-1 and 5-2.

5.1.2.1 Materials Transfer Points. Fugitive emissions from materials transfer points result from the charging of raw materials from a conveyor to some piece of process equipment. Mixer and blender charging operations account for most of the emissions from this source. Because the Mine Safety and Health Act of 1977 requires flint suppiers to ship by bulk or covered railroad hopper cars, many plants in the ceramic clay industry have installed pneumatic conveying systems. Of the plants which provided process data, 52 percent had pneumatic systems. All plants contacted had dust collection systems on transfer points. These systems have virtually eliminated the emissions from this source. There are no test data available to quantify emissions from material transfer points.

5.1.2.2 Mixing and Blending Operations. Mixing and blending operations are used to produce a uniform body composition. Although water is usually added in this process, some particulate emissions may

TABLE 5-2. SUMMARY OF SOURCE TEST DATA ON PARTICULATE EMISSIONS FROM MIXERS[6,7,8]

	Uncontrolled emissions		Controlled emissions	
	lbs/ton prod.	kg/Mg prod.	lbs/ton prod.	kg/Mg prod.
Plant A	0.13	0.065	N/A	N/A
Plant B	5.5	2.75	0.11	0.055
	46.6	23.3	0.93	0.465
	75.0	37.5	1.50	0.75
Plant C	0.83	0.42	0.019	0.01

N/A = Not Available

occur. Table 5-2 summarizes the source test data on mixers. Using weighted values, the average value of uncontrolled particulate emissions is 17.3 lbs/ton (9 kg/Mg) of product, while controlled emissions average 0.52 lbs/ton (0.26 kg/Mg). During the plant visits no visible emissions from this source were observed. Because plant observations revealed no visible emissions, and because nothing is known about the test methods employed, some of the emissions values reported in Table 5-2 may not be representative.

5.1.2.3 Storage Bins. Particulate emissions from storage bins occur only when the storage bins are exposed to drafts or during the transfer of materials. All storage bins observed during plant visits had coverings, and no visible emissions were apparent from this source. No test data are available on this fugitive emission source.

5.1.2.4 Materials Conveying. Particulate emissions from the conveying of materials originate from open conveyors. Fifty-two percent of the plants contacted in the ceramic clay industry have installed pneumatic conveying systems and have eliminated this source of fugitive emissions. There is one emission test available for this source, however, the test method used is not an EPA approved test method. Particulate emissions were measured with a filter device. Uncontrolled particulate emissions were reported as 0.27 lbs/ton product (0.14 kg/Mg) while controlled emissions were only 0.0061 lbs/ton (0.003 kg/Mg).[9]

5.1.2.5 Friction and Isostatic Presses. Friction pressing is used in the wall and floor tile industry to form dry clay into tiles. Isostatic pressing is used to form some electric insulators from dry clay. These processes result in fugitive emissions because they use dry clay (maximum of 6.5 percent moisture) from which particulates become airborne. Table 5-3 summarizes the source test data on friction presses. Uncontrolled particulate emissions ranged from 0.66 to 52 lbs/ton (0.33 to 26 kg/Mg) of product, however controlled emissions ranged from only 0.04 to 1.04 lbs/ton (0.02 to .52 kg/Mg) product. Again, no visible emissions were observed during plant visits. Test methods are not reported, therefore some of the emissions values may not be representative.

TABLE 5-3. SUMMARY OF SOURCE TEST DATA ON PARTICULATE EMISSIONS FROM PRESSES[10,11,12]

	Uncontrolled emissions		Controlled emissions	
	lbs/ton prod.	kg/Mg prod.	lbs/ton prod.	kg/Mg prod.
Plant B	52	26	1.04	0.52
Plant C	4.4	2.2	0.04	0.02
Plant D	0.66	0.33	N/A	N/A

5.1.2.6 Spray Booths. Although spray booths are considered point sources, the possibility of fugitive emissions also exists. The spray booths are box shapes varying in size and shape but generally with an open face on one side and an exhaust on the backside. The article is placed or conveyed inside the booth and either hand sprayed or automatically sprayed with glaze. If the spray booth is not operating properly, some particulates may escape. All of the plants visited had either baffles or water curtain type devices on the spray collected from the booths. During the plant visits no emissions were observed from this source. No source test data are available on this fugitive emissions source.

5.1.3 Emissions From a Typical Plant

This section discusses the emissions, both uncontrolled and controlled, from a typical plant in the ceramic clay industry. The average production rate for plants in this industry is 2270 tons of product per year (2059 Mg/yr). The greatest emission sources in a typical plant are the storage silos, kilns, spray booths, mixers, and presses.

Table 5-4 summarizes the emission factors that were estimated using the available data. Emission factors are presented for uncontrolled and controlled emissions and for emissions from a typical plant controlled to meet typical SIP control levels.

Uncontrolled particulate emissions from the greatest sources in a typical ceramic clay plant total 40.5 lbs/ton (20.25 kg/Mg) of product. The total uncontrolled emissions from a typical ceramic clay plant would be about 46 tons per year (42 Mg/yr).

All plants contacted in the ceramic clay industry reduce emissions beyond that level required by the typical SIP plan. Under current controls, the greatest sources in a ceramic clay plant emit only 2.7 lbs/ton (1.35 kg/Mg) of product. According to industry personnel emissions are reduced for material recovery, product quality, and to maintain a clean working environment. Annual total emissions from the greatest sources in a typical plant are only 3.1 tons per year (2.8 Mg/yr).

TABLE 5-4. PARTICULATE EMISSION FACTORS FOR A TYPICAL CERAMIC CLAY INDUSTRY PLANT

Emissions Source	Uncontrolled Emissions lbs/ton	Uncontrolled Emissions kg/Mg	Controlled Emissions lbs/ton	Controlled Emissions kg/Mg	Typical SIP Control Level[b] lbs/ton	Typical SIP Control Level[b] kg/Mg
Storage silos	1.27	0.64	0.016	0.008	7.35	3.68
Gas Fired Kiln	1.6	0.8	1.6[a]	0.8[a]	7.35	3.68
Spray Booth	1.3	0.65	0.013	0.0065	7.35	3.68
Mixers	17.3	8.7	0.52	0.26	17.3[c]	8.7
Presses	19	9.5	0.54	0.27	19[c]	9.5
TOTAL	40.5	20.3	2.69	1.35	59.8	29.9

[a]There is no control equipment on the gas fired kiln.

[b]Based on average allowable process emissions rates from Table 8-2.

[c]Fugitive emissions are not typically regulated except by "reasonable precaution" to prevent their emissions. Emissions were considered as fugitive.

5.2 TOTAL NATIONAL EMISSIONS FROM THE CERAMIC CLAY INDUSTRY

This section presents an estimate of the total national emissions from the ceramic clay industry. The method used to calculate these emissions is also presented.

Total national particulate emissions from the non-electrical portion of the ceramic clay industry are estimated to be 872 tons per year (791 Mg/yr). National emission from the porcelain electrical supplies are not estimated because national production figures were not available. The break down by industry segment of this national emission rate is presented in Table 5-5. As shown in Section 5.1 no other pollutants are emitted in significant quantities. Particulate emissions from the porcelain electrical supplies industry are not included in this estimate because of a lack of data. This estimate does however, include the particulate emissions from the other five industrial classifications. Nationwide emissions were estimated using the following procedure:

1. Each plant within each SIC that had available emissions data was located within the EIS plant list[18] to find its corresponding percentage of national market.

2. Each plant's emission data within a SIC were added together to arrive at a total emission level for that SIC.

3. Each plant's corresponding percentage of national market was then added.

4. The total emissions were then divided by the corresponding sum of percentage of national market to arrive at a national emissions level for each SIC.

5. The emission levels for each SIC were then added to arrive at a total national emission level.

The best available emission data represents source test data if it was available but in some cases emission factors had to be used.

5.3 SUMMARY

Emissions from the ceramic clay industry consist mainly of particulates. Point sources identified in the ceramic clay industry are the storage silos, kilns, and spray booths. The greatest sources of fugitive

TABLE 5-5. NATIONAL EMISSION RATE BY SIC CODE[13,14,15,16,17]

SIC Code	National Emission Rate
SIC 3253 Ceramic Wall and Floor Tile	32.7 TPY
SIC 3261 Vitreous China Plumbing Fixtures	226.0 TPY
SIC 3262 Vitreous China Table and Kitchen Articles	70.0 TPY
SIC 3263 Fine Earthenware Table and Kitchen Articles	22.3 TPY
SIC 3264 Porcelain Electrical Supplies	ND
SIC 3269 Pottery Products, Not Elsewhere Classified	521.0 TPY
TOTAL	872.0 TPY

ND - Not Determinable

emissions are the mixers and presses. Uncontrolled particulate emissions from these sources total 40.5 lb/ton (20.25 kg/Mg) of product. The ceramic clay industry currently reduces these emission to 2.7 lbs/ton (1.35 kg/Mg).

Total national particulate emissions from the non-electrical portion of the source category are 872 tons per year (791 Mg/yr). This represents the emissions from 285 plants in the ceramic clay industry. This results in an average emission of only 3.1 tons per year (2.8 Mg/yr) of particulates per plant.

Source test data is scarce in the industry, and the accuracy of the data is questionable. The amounts of particulates being measured are small and conducive to errors. Even though some of the data seem to show high values, the emissions from these plants are expected to be small. The average plant which produces 2270 tons of product per year (2059 Mg/yr) emits only 46 tons of particulates per year (42 Mg/yr) when uncontrolled. The largest plants (30,000 TPY) would emit 608 tons of particulates per year (552 Mg/yr) uncontrolled. However, with the control equipment currently in use in the ceramic clay industry, these 608 tons (552 Mg/yr) of emissions are reduced to 41 tons per year (37 Mg/yr).

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6. EMISSION CONTROL SYSTEMS

This section discusses the current types of air pollution control equipment used in the ceramic clay industry to control particulate emissions. No SO_2, NO_x, or other gaseous emission control systems are used in the industry because the emission levels are negligible.

Although the equipment discussed in this section is considered to be air pollution control equipment, industry personnel have indicated it was not for these reasons the equipment had been installed. Wet scrubbers and baffles were installed on glazing operations over 40 years ago to maintain a clean work environment, for product quality control, and to protect production equipment. Likewise, the fabric filters and vacuum systems used to collect and remove particulate matter from various processes were installed as an integral part of a conveying system which reduces labor costs and/or maintains a clean work environment for the worker and protects the quality of the product.

6.1 CURRENT CONTROL TECHNIQUES

Fabric filtration is the most commonly used technique to control particulate emission from ceramic clay manufacturing processes. Dust from materials handling, transferring, conveying, friction presses, mixers and blenders is collected via a vacuum system and routed to a fabric filter to reclaim or remove the particulates. Electrostatic Precipitators (ESP) have not been used in the industry and will not be discussed further in this study.

Wet cyclones and baffles are used on the glaze spray booth operations to recover or control the particulate emissions. These are liquid particles (aerosols) as compared to the mineral particles discussed above.

6.1.1 Fabric Filtration[1,2]

In fabric filtration, particulate matter is removed from the carrier gas stream by the impingement and adhesion of the particle onto the filter medium. As particles collect on the media, the deposits themselves act as filter media enhancing removal. When the deposits become so thick that the pressure necessary to force the gas through the filters becomes very high the filter is replaced or cleaned.

Fabric filters used in this industry have reported removal efficiencies of 97 to 99+ percent.

6.1.2 Wet Cyclones[3,4]

Wet cyclones mix water with the incoming particles to increase particle diameter and density. Therefore, as the particles enter the cyclone they undergo a greater drag and inertial force. The shape of the cyclone creates a vortex as the gas stream enters it. The larger particles and water droplets are forced to the outer walls where the particles are removed with the water. The cleaned gas stream is vented from the center of the vortex to the atmosphere. The units used in the industry have been reported to have a particulate removal efficiency of approximately 98 percent.

6.1.3 Baffles[5,6]

Baffle equipment operates similar to wet cyclones without the use of water. The inertial forces developed in the baffle arrangement cause the particulates to impinge on the baffles. The particles are removed from the baffles and recycled to various processes or are disposed. These units have a reported efficiency of approximately 98 percent as applied in the ceramic clay industry.

6.2 ALTERNATIVE CONTROL TECHNIQUES

Other than the application of higher efficiency fabric filters and wet scrubbers, there are no alternate control techniques demonstrated for the particulate emissions from this industry.

6.3 "BEST SYSTEMS" OF EMISSION REDUCTION

The best systems for control or reduction of emissions in the ceramic clay industry consists of the following: (1) an enclosed material storage and the use of covered unloading and conveying systems; (2) the use of hoods around material transfer points, dry presses, cooling and drying areas and other sources of particulate emissions to contain the emissions and the use of vacuum systems to collect and convey these emissions to fabric filters to remove the emissions from the air stream; and (3) the use of hoods around spray glazing operations to contain emissions and a vacuum system to convey the emissions to a wet scrubber to remove the emissions from the air stream. See Figure 6-1. All the plants contacted in the industry have controls on their spray glaze operations and 95 percent of the plants contacted have some form of dust collection system.

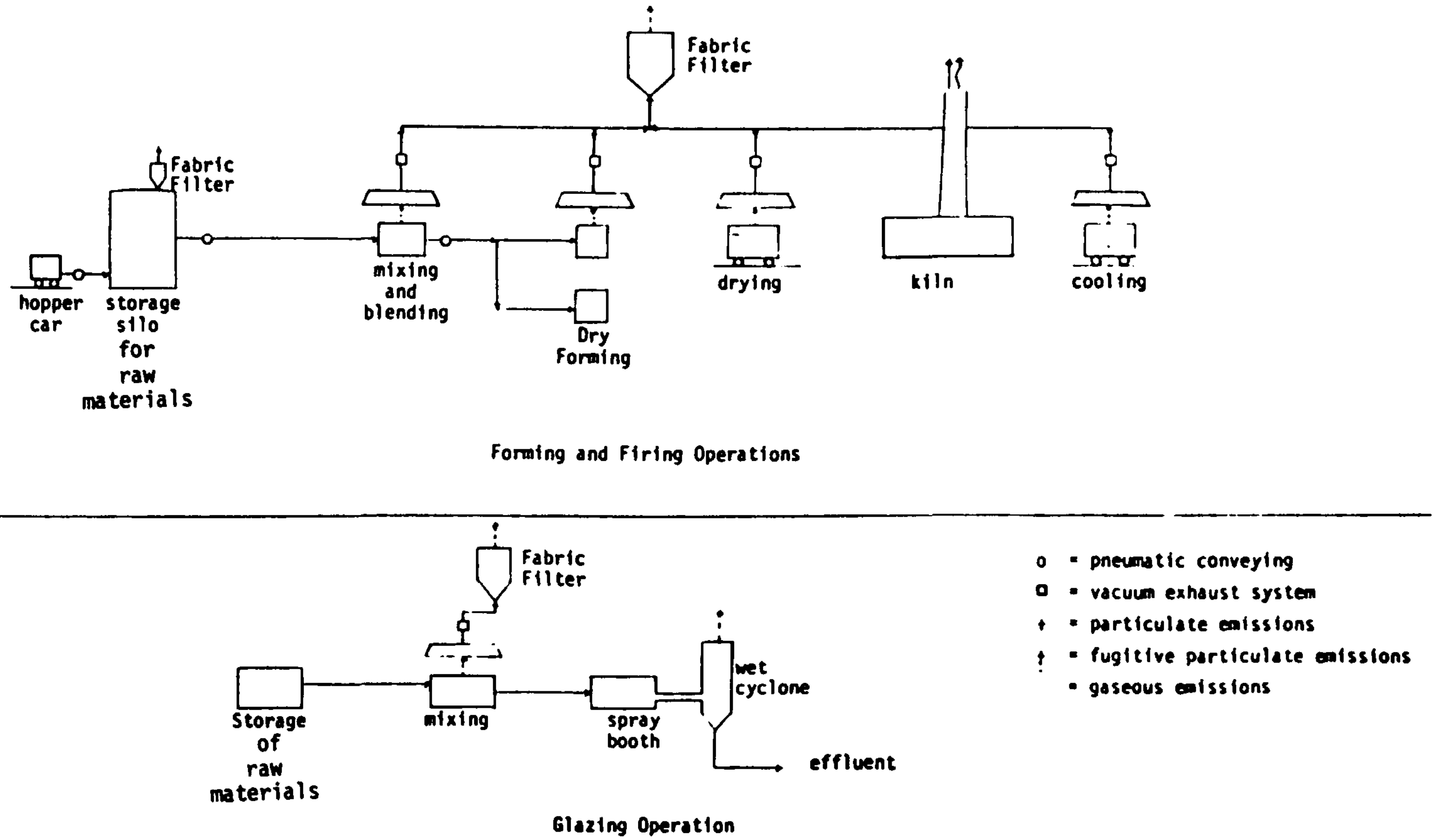

Figure 6-1. "Best" System for Emission Reduction

6.4 REFERENCES

1. Stern, Arthur C., Wohlers, Henry C, Beubel, Richard W., Loury, William P. Fundamentals of Air Pollution, Academic Press, New York 1973, Pg. 406 to 416.

2. Lund, Herbert L., Industrial Pollution Control Handbook, McGraw-Hill Book Company, New York, 1971, Pg. 23-9 to 23-28.

3. Reference 1.

4. Reference 2.

5. Reference 1.

6. Reference 2.

7. EMISSION DATA

Section 7.1 discusses the availability and nature of emission data for the ceramic clay industry. Section 7.2 lists the sample collection and analysis methods available for determining the emissions of particulates, hydrocarbons and fluorides from various processes in the ceramic clay industry.

7.1 AVAILABILITY OF DATA

7.1.1 Summary of Available Test Data

Although a large quantity of data were gathered during this study, very little of the data were source test data. Information from the National Emission Data System (NEDS)[1] and the state agencies yielded source test data on 6 kilns, 4 mixing operations, and 1 friction press. The rest of the state and NEDS data were either conflicting with one another or concerning some process outside the scope of this report or were estimates of emissions. Although the Compliance Data System (CDS)[2] report was helpful in providing information on compliance, it did not provide any actual test data. Finally, the industrial contacts were an important, but limited, source of source test data for emissions from clay processing operations.

The reason for the lack of source test data is that many states do not consider any of the sources in the ceramic clay industry as being significant. Telephone contacts with state agencies concerning this matter have been documented in the project files. Texas and Ohio have exempted plants from requiring a permit to operate their kilns.

The following sections discuss the availability and quality of test data obtained from specific data sources. The emission test data obtained in this study have been presented in Chapter 5.

7.1.2 National Emission Data System (NEDS)

The National Emission Data System (NEDS) provides a nationwide compilation of data from emission sources in the ceramic clay industry. Useful information presented in NEDS includes controlled emissions rates, the test method used, the control equipment and their efficiencies, process descriptions, and stack parameters. Each state is responsible for submitting emission data to this system. However, the information in NEDS is not always the most current and was found to conflict with data from other sources.

The NEDS obtained for this study listed 77 different ceramic clay plants. However, source test results were reported for only 16 plants. Furthermore the data from only three of these plants were considered consistent with one another. The distribution of plant data among the six SIC codes is presented in Table 7-1. The emission data retrieved from NEDS is presented in Chapter 5.

7.1.3 Compliance Data System (CDS)

The CDS reports information on the compliance status of air pollution sources. This information is kept by the EPA, Office of Enforcement, and can be retrieved by SIC code number. The data provide the compliance status and a brief description of the point source. However, CDS does not report actual source test results or emission data. Because the Compliance Data System relies on information from the states, it may not contain the most recent data. The CDS data used in this study provided compliance data on 74 plants. No plants were reported in non-compliance.

7.1.4 State or Local Agencies

State and local air control agencies will have the most recent source test data outside of that data directly available from industry sources, or the NEDS system.

Other information, such as permit applications or recent emission problems with a plant, can usually be obtained from the agency air pollution control files. The data for a plant usually will include stack parameters, control equipment and their efficiencies, a process

TABLE 7-1. SUMMARY OF NEDS REPORT

SIC Classification	Number of plants in NEDS	Number of plants with source test data
Ceramic Wall and floor tile (3253)	24	5
Vitreous plumbing fixtures (3261)	10	0
Vitreous china food utensils (3262)	3	2
Fine earthenware food utensils (3263)	1	0
Porcelain electrical supplies (3264)	18	5
Pottery products, not elsewhere classified (3269)	21	4
TOTAL	77	16

description, compliance status, controlled and uncontrolled emissions, test or calculation methods used, and whether emission data is from a source test or otherwise.

Data for this study were gathered from six states - New York, Pennsylvania, Ohio, Kentucky, Texas and California. The distribution of plants in these states and the availability of test data from the state agencies is presented in Table 7-2.

7.1.5 Industrial Contacts

Industry contacts were used to fill gaps left by the other data sources. This was the best source for up-to-date and specific source test data.

The major producers in each industrial classification were contacted by phone and by letter to obtain general process information. The distribution, by industry classification, of plants contacted for this study is presented in Table 7-3. From the list of plants contacted plants were chosen for on-site visits to obtain specific process and air pollution control data. Those plants visited were felt to be representative of the ceramic clay industry and to incorporate the best control technology.

7.2 SAMPLE COLLECTION AND ANALYSIS

The EPA has established reference test methods for sampling and analytical methods to determine particulate, hydrocarbon, and hydrogen fluoride emissions. A complete description and presentation of each method can be found in 40 CFR Part 60. Following are the recommended methods for sampling and analysis of emissions from the ceramic clay industry.

TABLE 7-2. SUMMARY OF STATE DATA RECEIVED

SIC Classification	Number of plants in these states	Number of plants in these states with source test data
Ceramic wall and floor tile (3253)	15	4
Vitreous plumbing fixtures (3261)	9	0
Vitreous china food utensils (3262)	1	1
Fine earthenware food utensils (3263)	0	0
Porcelain electrical supplies (3264)	7	0
Pottery products, not elsewhere classified (3269)	19	0
TOTAL	51	5

TABLE 7-3. SUMMARY OF INDUSTRIAL CONTACTS

Industry Segment	Number of plants Contacted	Percentage of industry segment
Ceramic wall and floor tile (3253)	8	35.58
Vitreous plumbing fixtures (3261)	9	35.87
Vitreous china food utensils (3262)	9	82.97
Fine earthenware food utensils (3263)	3	31.31
Porcelain electrical supplies (3264)	5	ND
Pottery products, not elsewhere classified (3269)	14	27.74
TOTAL	48	ND

ND - Not Determinable - national production figures are not available.

Method 1: Sample and Velocity Traverses for Stationary Sources

Method 2: Determination of Stack Gas Velocity and Volumetric Flowrate

Method 3: Gas Analysis for CO_2, O_2, Excess Air, and Dry Molecular Weight

Method 5: Determination of Particulate Emissions from Stationary Sources

Method 13a: Determination of Total Fluoride Emissions from Stationary Sources - SPADNS Zirconium Lake Method

This method determines the fluoride concentration by measuring the absorbance of the sample with a spectrophotometer. Once the absorbance is determined the fluoride concentration can be found on a calibration curve.

Method 13b: Determine of Total Fluoride Emissions from Stationary Sources - Specific Ion Electrode Method

This method determines the fluoride concentration by measuring the intensity of the electric field between a reference electrode and a fluoride sensing electrode when immersed in the sample. This electric intensity can be used to find the fluoride concentration on a calibration curve.

Method 25: Determination of Total Gaseous Non-Methane Organic Emissions as Carbon.

7.3 REFERENCES

1. National Emissions Data System. October 15, 1979.

2. Compliance Data System Computer Printout. November 20, 1979.

8. STATE EMISSION REGULATIONS

State regulations applicable to the ceramic clay industry are summarized below for nine states. These regulations apply to approximately 70 percent of the ceramic clay industry as defined in this study. To illustrate values obtained under the various state regulations an example plant will be defined with a capacity of 0.4 tons/hr (0.36 Mg/hr), a kiln burning 5 MBtu/hr of natural gas operating 24 hrs/day, 7 day/wk, 52 wk/yr and having a stack 29 feet (8.8 m) high, a diameter of 2.0 ft (0.6 m) with a gas flow of 7600 acfm (215 m^3/min) and an exit temperature of 300^oF (149^oC).

This is 65 percent larger than the typical plant discussed in Chapter 5. This plant was chosen because it is one of the plants in the ceramic clay industry with complete data on its equipment and fuel consumption. Emission rates from this plant, both uncontrolled and controlled, will be compared to the allowable emissions rate under the most stringent state regulation. Emissions rates from this plant are based upon the emission factors from Table 5-4.

Since natural gas is the primary fuel for plants in the industry and alternative fuels are not desirable, only natural gas firing will be considered.

8.1 PARTICULATE EMISSION REGULATIONS

Table 8-1 summarizes the particulate emission regulations of the nine selected states. Table 8-2 summarizes the allowable emission rate by state regulations based upon the example plant described above.

Table 8-1 contains four types of particulate emission regulations: opacity, fugitive, combustion, and process. Opacity or "Visible Emissions" regulations regulate the opacity or degree of visibility of emissions in units of percent opacity or the Ringelman scale. "Fugitive emissions"

TABLE 8-1. SUMMARY OF SELECTED STATE PARTICULATE EMISSION REGULATIONS

State	Visible Emissions (Opacity)	Fugitive Emissions	Particulates From Combustion	Particulates From Process
Georgia	Emissions are to be less than 20% Opacity.	Persons shall take all reasonable precautions to prevent fugitive dust including installation and use of hoods, fans, and fabric filters; covering of open bodied material when storing or conveying.	For Fuel Burning Equipment with less than 10 million BTU heat input per hour E = 0.5. For equipment with greater than 10 and less than 250 million BTU heat input per hour $E = 0.5 (10/R)^{0.5}$. For equipment greater than 250 million Btu heat input per hour A = 0.10 lbs/million Btu input.	Allowable rates of emission for new equipment is $E = 4.1 P^{0.67}$ for P up to and including 30 tons/hr and $E = 55 P^{0.11} - 40$ for P greater than 30 tons/hr. For Koalin and Fuller's Earth Processes $E = 3.59 P^{0.62}$ for $P \leq 30$ tons/hr and $E = 17.31 P^{0.16}$ for $P > 30$ tons/hr.
California (South Coast Air Quality Management District)	Emissions are to be less than 20% Opacity.	NA	For total combustion contaminants the allowable emissions rate is .1 grains per cubic foot of gas calculated at 12 percent CO_2 (Particulates are not regulated separately)	Allowable emission rates approximately given by Table.
Ohio	No discharge from any single source of emission shall be equal to or darker than No. 1 Ringelmann chart or 20% Opacity.	Persons shall take reasonable precautions to prevent such emissions including: application of water chemicals etc; use of hoods, fans and control equipment; covering of materials when stored or in motion.	For fuel burning equipment no particulate emission shall exceed those in Figure 1. (For $1 \leq R \leq 10$, Allowable emissions are 0.4 lbs/million Btu heat input.)	Allowable rates of emissions are $E = 4.10 P^{0.67}$ for $P \leq 30$ and $E = 55.0 P^{0.11} - 40$ for $P > 30$.

NA = Not available.

TABLE 8-1. (continued)

State	Visible Emissions (Opacity)	Fugitive Emissions	Particulates From Combustion	Particulates From Process
Pennsylvania	No person shall emit visible emissions equal to or greater than 20% opacity.	Any person shall take reasonable precautions to prevent emissions including adding water or chemicals on material stockpiles.	No person shall discharge emissions from combustion in excess of 0.4 lbs/million Btu heat input when $2.5 \leq R \leq 50$ million Btus/hr or $A = 3.6\ R^{-0.56}$ when $50 < R \leq 600$.	No person shall emit particulate matter from any process effluent gas exceeding 0.04 grains per dry standard cubic foot when volume < 150,000 dscf.
New Jersey	No person shall emit from stack or chimney emissions greater than 20% Opacity, excluding water vapor.	None	No person shall discharge emissions from combustion in excess of the allowable set forth in the table. (For heat input of 1 million Btu/hr E = 0.6, for heat input of 10 million Btu/hr E = 6.0 Btu/hr.)	No person shall discharge emissions from any source through stack or chimney in excess of the allowable set forth in the table. (For potential emission rate from source of 50 lbs/hr E = 00.5 (99% eff.), for 100 lbs/hr E = 1.0; For source gas of 3000 scfm or less, E = 0.5 for 6000 scfm E = 6.0: Largest of the two is to be used.
New York	No person shall allow emissions having an average opacity of 20% or greater.	None	Does not apply.	No person shall discharge emissions from any source in excess of the allowable as determined by $E = 0.024\ P^{0.67}$ for P up to 100,000 lb/hr.
Tennessee	No person shall cause or allow the discharge of emissions from any source greater than No. 1 Ringelmann or 20% Opacity.	No person shall cause of allow emissions without taking reasonable precautions including use of water or chemicals or hoods, fans and fabric filters.	The maximum allowable particulate emissions for new fuel burning equipment shall be determined as: $A = 0.6$ for $R \leq 10$ $A = 0.6\ (10/R)^{0.5566}$ for $10 < R < 250$ $A = 0.1$ for $R \geq 250$.	The allowable emission level from any new process shall be determined as $E = 3.59\ P^{0.62}$ for $P \leq 30$ $E = 17.31\ P^{0.16}$ for $P > 30$.

TABLE 8-1. (continued)

State	Visible Emissions (Opacity)	Fugitive Emissions	Particulates From Combustion	Particulates From Process
West Virginia	No person shall cause or allow emissions of smoke from any fuel burning unit darker than No. 1 Ringelmann or equivalent opacity.	No person shall cause or allow any source to operate that is not equipped with a fugitive matter control system.	No person shall cause or allow the discharge of emissions from fuel burning units to exceed the allowable as determined by: E = 0.09 R as long as no more than 600 lbs/hr total will be discharged from all gas fired units.	No person shall cause or allow the discharge of emissions from process to exceed the maximum allowable in the table. (For 5000 lbs/hr process weight E = 5, for 10,000 lb/hr E = 10 and for 20,000 lbs/hr E = 16.
Texas	No person shall cause or allow visible emissions from any stationary flue to exceed 20% opacity over a 5-minute period.	No person shall cause or allow any material to be handled or conveyed without taking precaution to prevent fugitive emissions including the use of water or chemicals or hoods, fans and filters	No person shall cause or allow emissions to exceed the allowable as determined by $E = 0.048\ q^{0.62}$ where q is gas flow in acfm.	No person shall cause or allow emissions to exceed the allowable as determined by $E = 3.12\ P^{0.985}$ for $P \leq 20$ $E = 25.4\ P^{0.287}$ for $P > 20$.

Legend

C = Allowable emissions in gr/dscf.

A = Allowable emissions in lbs/million Btu.

E = Allowable Emission Rate (lbs/hr).

P = Process Weight (tons/hr).

R = heat input (million Btu/hr).

Q = gas flow rate in dscfm.

TABLE 8-2. ALLOWABLE EMISSION RATES FROM THE NINE SELECTED STATES FOR THE EXAMPLE PLANT

State	Visible Emissions	Fugitive Emissions	Particulate from Combustion	Particulate from Process	NO_x	SO_x	CO	HC	Fluoride
Georgia	< 20% opacity	Control material unloading and loading and conveying operations.	0.5 lbs/hr	2.2 lbs/hr	8.4 lbs/hr	69.61 lbs/hr	–	–	–
California	< 20% opacity	Same	DNA	2.2 lbs/hr		NA	NA	NA	NA
Ohio	< 20% opacity	Same	2.0 lbs/hr	2.2 lbs/hr	–	–	–	–	–
Pennsylvania	< 20% opacity	Same	2.0 lbs/hr	2.6 lbs/hr	–	11.9 lbs/hr	–	–	–
New Jersey	< 20% opacity	–	3.0 lbs/hr	1.3 lbs/hr	–	47.7 lbs/hr	–	–	–
New York	< 20% opacity	–	DNA	2.1 lbs/hr	DNA	–	–	–	–
Tennessee	< 20% opacity	Same as Georgia	3.0 lbs/hr	2.0 lbs/hr	DNA	–	–	–	–
West Virginia	< 20% opacity	Must have control	0.45 lbs/hr	0.8 lbs/hr	–	–	–	–	–
Texas	< 20% opacity	Same as Georgia	12.2 lbs/hr	1.3 lbs/hr	–	–	–	–	17.7 lbs/hr

DNA = Does not apply.
NA=Not available.

are visible emissions other than water droplets coming from any source other than a stack, vent or exhaust. "Combustion Emissions" are those emissions coming from the burning of fuels, in this case natural gas. "Process Emissions" are those emissions from the stacks or vents of production processes other than those from the burning of fuel.

8.1.1 Opacity and Fugitive Emissions Regulations

All the states require visible emissions to be less than 20 percent opacity.

West Virginia has the most stringent regulations on fugitive emissions. West Virginia regulations require some form of control. Two other states, New Jersey and New York have no regulations on fugitive emissions. The remaining states require reasonable precaution to be taken to prevent fugitive emissions. Fugitive emission regulations would apply to material unloading and loading operations, mixing, blendings and conveying.

8.1.2 Process Emission Regulations

Table 8-2 illustrates the allowable process emission rate for the nine selected states. Values ranged between 2.6 to 0.8 lbs/hr (1.2 to 0.4 kg/hr) with an average of 1.7 lbs/hr (0.8 kg/hr).

The particulate emission regulations of West Virginia are the most stringent of the nine selected states; at a rate of 0.80 lbs/hr (0.4 kg/hr). The least stringent rate is Pennsylvania's 2.6 lbs/hr (1.2 kg/hr). These regulations would apply to particulate emissions from the storage silos, glaze spray booths and the non-combustion emission from the kilns.

8.1.3 Combustion Emission Regulations

The allowable combustion particulates emission rates for the nine states are illustrated in Table 8-2. Values range from 0.45 to 12.2 lbs/hr (0.2 to 5.5 kg/hr) with an average of 3.6 lbs/hr (1.6 kg/hr), excluding New York which exempts natural gas fired units. West Virginia and Georgia require the most stringent controls allowing 0.45 and 0.50 lbs/hr (0.2 kg/hr) respectively. Texas is the least stringent with a value of 12.2 lbs/hr (5.5 kg/hr) allowable. Since natural gas is used, particulate emissions are neglible and reported particulate emission from kilns are taken as being from the product rather than from the combustion of fuel.

Table 8-3 illustrates that the uncontrolled particulate emissions from the industry presently meet the most stringent allowable rates allowed by any of the nine selected states. Therefore, the industry would not be affected by these regulations. In addition, the industry further reduces these emissions as shown in Table 8.3. Industry personnel have said that reduction is necessary to maintain the quality of the product and to protect the workers' health.

8.2 GASEOUS EMISSION REGULATIONS

Table 8-4 summarizes the nine selected state regulations of gaseous emissions. Since natural gas is primarily used in the ceramic clay industry, emissions do not require the control or degree of control as would be required if less clean fuels were used. Many states exempt equipment burning natural gas or other gas fuels from regulations entirely. In addition, regulations generally apply to fuel-burning equipment with greater than 250 million Btu/hr heat input, well above any sources in this industry. States regulations with this stipulation were assumed not to apply to this industry. Georgia is the only state of the nine that has general regulations for the emission of NO_x. Georgia's regulations in general would allow less than 21 lbs/ton (11 kg/Mg) of NO_x emissions from any source. Georgia, Pennsylvania and New Jersey have regulations on SO_x emissions. Pennsylvania SO_x regulations are the most stringent. In general their regulations would allow less than 30 lbs/ton (15 kg/Mg) of SO_x emission from any source. None of the 9 state regulations reviewed have process regulations on carbon monoxide and hydrocarbons.

Several states have regulations on volatile organic compounds, but these would generally not apply to this industry because wide-spread use of water-based glazes.

Fluoride emissions have occurred in the ceramic clay industry and for this reason some investigation of fluoride emissions was made in this study. As Table 8-4 shows, Texas is the only state with regulations

TABLE 8-3. SUMMARY OF CONTROL REQUIRED BY THE NINE SELECTED STATE PARTICULATE REGULATIONS

Emission Source	Uncontrolled Emission Rate	Most Stringent SIP Control[a]	Current Control Level[c]
Storage Silos	1.27 lbs/ton (0.6 kg/Mg)	2 lbs/ton (1 kg/Mg)	0.016 lbs/ton (0.008 kg/Mg)
Gas Fired Kiln	1.6 lbs/ton (0.8 kg/Mg)	2 lbs/ton (1 kg/Mg)	1.6 lbs/ton (0.8 kg/Mg)
Spray Booths	1.3 lbs/ton (0.7 kg/Mg)	2 lbs/ton (1 kg/Mg)	0.013 lbs/ton (0.007 kg/Mg)
Fugitive	36.3 lbs/ton (18.1 kg/Mg)	NA[b]	1.06 lbs/ton (0.53 kg/Mg)

[a] Based on West Virginia Regulation for example plant of .4 tons/hr.

[b] West Virginia is only state that requires fugitive emission control but has no limits reported.

[c] In general, all plants in the industry currently have controls that reduce uncontrolled emissions to these levels.

TABLE 8-4. SUMMARY OF SELECTED STATE REGULATIONS ON GASEOUS EMISSIONS

State	NO_x	SO_x	CO	Hydrocarbons
Georgia	For Fuel Burning Equipment equal to or greater than 250 million Btu/hr heat input when firing gas 0.2 lbs of NO_x per million Btu of heat input. No person shall allow NO_x emissions except from fuel burning equipment equal to or exceeding: for $H < 300$; $N = 9300\ (H/300)^3$. A weighted average if more than one stack is located at a given site.	From any source of emission SO_2 shall not equal or exceed for $H < 90$, $S = 1.2\ FxH$; for $90 \leq H < 300$, $S = 4000\ F\ (H/300)^3$. New source regulations with heat input > 250 million Btu's/hr heat input apply only to liquid and solid fossil fuels.	None	None
California	NA	NA	NA	NA
Ohio	Does not apply.	None	None	None
Pennsylvania	None	No person shall emit SO_x from any source exceeding 500 ppm in effluent gas by volume.	None	None
New Jersey	None	No person shall discharge SO_2 emissions from stack or chimney exceeding 2000 ppm by volume, if total gas volume is greater than 3000 scfm, SO_2 discharge is greater than 50 lbs/hr and the maximum exceeds 100 lbs/hr.	None	None
New York	Does not apply.	None	None	None
Tennessee	Does not apply.	None	None	None
West Virginia	None	None	None	None
Texas	None	None	None	None

Legend

N = total NO_x (lbs/hr).

NA = Not available.

F = a constant (1 for non combustion sources, 2 for heat input ≤ 10,000 million Btu/hr, and 3 if > 10,000 million Btu/hr).

S = lbs/hr of SO_2 from stack.

H = stack height in feet.

on fluoride emissions. Fluoride is not a common emission from the ceramic clay industry. Some glazes have fluoride as a constituent but according to data received it is small quantities and poses no problem. In addition no plant contacted during this study used fluoride in their glazes. Using the example plant described above, Texas regulations would allow an emission rate of 17.7 lbs/hr (8.0 Kg/hr) of fluoride. A state agency emission data system reported the largest level of fluoride emissions for a plant in the industry. Although it is not source test data, but rather an AP-42 emission factor, it reports an emission rate of 1.2 lbs/hr (0.5 Kg/hr), or just greater than 5 tons per year (4.5 Mg/hr). No fluoride emission controls would be required for this emission source.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-450/3-80-017	2.	3. RECIPIENT'S ACCESSION NO.
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7. AUTHOR(S)		8. PERFORMING ORGANIZATION REPORT NO.
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		11. CONTRACT/GRANT NO. 68-02-3058
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15. SUPPLEMENTARY NOTES		

16. ABSTRACT

This report contains background information which was used for determining the need for new source performance standards (NSPS) for the ceramic clay industry in accordance with Section 111 of the Clean Air Act. Air pollution emissions and growth trends of the ceramic clay industry are examined. Manufacturing processes, control techniques, and state and local air pollution regulations are discussed.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Pollution Control Ceramic Clay Ceramics Manufacture New Source Performance Standards	Air Pollution Control	13B

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