Prevention of Significant Air Quality Deterioration Review

Preliminary Determination

December, 2011

Facility Name: PyraMax Ceramics, LLC – King's Mill Facility
City: Wrens
County: Jefferson
AIRS Number: 04-13-163-00035
Application Number: 20584
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Review Conducted by:
State of Georgia - Department of Natural Resources
Environmental Protection Division - Air Protection Branch
Stationary Source Permitting Program

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SUMMARY

The Environmental Protection Division (EPD) has reviewed Georgia Air Quality Application No. 20584 submitted by PyraMax Ceramics, LLC - King's Mill Facility for a permit to construct and operate a ceramic proppant manufacturing facility in Wrens, Jefferson County, Georgia. The products will be used in the oil and natural gas industry. The facility will have two parallel process/kiln lines. Each consists of material handling, milling, slurry preparing, spray drying/pelletizing, green pellet screening, calcining/sintering, finishing, and packaging and shipping operations. Supporting operations at the facility include boilers, emergency generators, R&D and QA/QC labs, fuel and chemical storage tanks.

The proposed facility will result in emissions of carbon monoxide (CO), fluorides (mostly hydrogen fluoride, i.e. HF), greenhouse gases (GHG), nitrogen oxides (NO_x), particulate matter (PM)/particulate matter of 10 micrometers or less (PM_{10})/particulate matter of 2.5 micrometers or less ($PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOC). These are pollutants regulated under the Clear Air Act (CAA). A Prevention of Significant Deterioration (PSD) analysis was performed for the facility for these pollutants to determine if any potential emissions of such pollutants were above the corresponding "major source" or "significance increase" threshold/rate under Federal "New Source Review"/"Prevention of Significant Deterioration" (NSR/PSD) rules. The annual potential emissions of CO, GHG and NO_x from the facility were above their corresponding "major source" thresholds/rates under NSR/PSD rules; while the emissions of PM_{10}, $PM_{2.5}$, SO_2 and VOC exceeded the corresponding "significant increase" thresholds under NSR/PSD rules. Consequently, these emissions are subject to Best Available Control Technology (BACT) Review/Determination under NSR/PSD rule.

This facility will also emit ammonia (NH_3), hydrogen fluoride (HF), methanol, chlorides (mostly hydrogen chloride, i.e., HCl) and methyl acetate. Ammonia and methyl acetate are not considered VOCs; and they are not listed "Hazardous Air Pollutants" (HAPs). Both are regulated under Georgia Rules for Air Quality Control 391-3-1-.02(2)(a)3(ii) which authorizes a program to determine if the ambient impact of the emissions of toxic air pollutant (TAP) involved is acceptable, as discussed in Section 7 of the Preliminary Determination. Section 112(g) of the 1990 Clean Air Act (CAA) is the leading rule that regulates the HCl, HF and methanol emissions via a case-by-case Maximum Achievable Control Technology (MACT) Determination included with this Preliminary Determination as Appendix A.

PyraMax Ceramics, LLC - King's Mill Facility is located in Jefferson County, which is classified as "attainment" or "unclassifiable" for SO_2, $PM_{2.5}$ and PM_{10}, NO_X, CO, and ozone (VOC).

The EPD review of the data submitted by PyraMax Ceramics, LLC – King's Mill Facility related to the proposed ceramic proppant manufacturing facility indicates that the project will be in compliance with all applicable state and federal air quality regulations.

It is the preliminary determination of the EPD that the proposal provides for the application of BACT for the control of CO, GHG, NO_x, PM, PM_{10}, VOC, and SO_2 emissions, as required by NSR/PSD regulation 40 CFR 52.21(j).

It has been determined through approved modeling techniques that the estimated emissions will not cause or contribute to a violation of any ambient air standard or allowable PSD increment in the area surrounding the facility or in Class I areas located within 300 km of the facility. It has further been determined that the proposal will not cause impairment of visibility or detrimental effects on soils or vegetation. Any air quality impacts produced by project-related growth should be inconsequential.

This Preliminary Determination concludes that an Air Quality Permit should be issued to PyraMax Ceramics, LLC - King's Mill Facility for the construction and operation of the ceramic proppant manufacturing facility. Various conditions have been incorporated into the proposed air quality permit to ensure and confirm compliance with all applicable air quality regulations. A copy of the draft permit amendment is included in Appendix B.

1.0 INTRODUCTION – FACILITY INFORMATION AND EMISSIONS DATA

On July 26, 2011, PyraMax Ceramics, LLC - King's Mill Facility (hereafter "PyraMax Ceramics") submitted an application (No. 20584) for an air quality permit to construct and operate a "green-field" ceramic proppant manufacturing facility. The facility is located on County Road 291, Wrens, Jefferson County, Georgia.

Table 1-1: Title V Major Source Status

Pollutant	Is the Pollutant Emitted?	If emitted, what is the facility's Title V status for the Pollutant?		
		Major Source Status	Major Source Requesting SM Status	Non-Major Source Status
PM	√	√		
PM_{10}	√	√		
$PM_{2.5}$	√	√		
SO_2	√	√		
VOC	√	√		
NO_x	√	√		
CO	√	√		
TRS	N/A			
H_2S	N/A			
Individual HAP	√	√		
Total HAPs	√	√		
GHG	√	√		

Based on the proposed project description and data provided in the permit application (Appendix C), the estimated potential emissions of regulated pollutants from the facility are listed in Table 1-2 below:

Table 1-2: Emissions Increases from the Project

Pollutant	Potential Emissions (tpy)	PSD Major Source Emission Threshold (tpy)	PSD Significant Emission Increase (tpy)	Subject to PSD Review
PM	157	250	25	Yes
PM_{10}	157[1]	250	15	Yes
$PM_{2.5}$	107	250	10	Yes
VOC	130	250	40	Yes
NO_X	351	250	40	Yes
CO	608	250	100	Yes
SO_2	103	250	40	Yes
TRS	N/A	250	10	N/A
Pb	<0.6	250	0.6	N/A
GHG	167,570 (as CO_2e)	100,000/250[2]	75,000[3]	Yes
Non-HF Fluorides	0.19	250	3	No
H_2S	N/A	250	10	N/A
Sulfuric Acidic Mist (SAM)	N/A	250	7	N/A

[1] All PM were assumed as PM_{10}.

[2] 100,000 tpy on a CO_2e basis and 250 tpy on a mass basis.

[3] CO_2e basis.

Based on the information presented in Table 1-2 above, PyraMax Ceramics' proposed facility, as specified per Georgia Air Quality Application No. 20584, is classified as a major source under NSR/PSD rules because of the annual potential emissions of CO, GHG and NO_x exceed the major sources threshold. Therefore, this project is required to undergo PSD review.

Through its new source review procedure, EPD has evaluated PyraMax Ceramics' proposal for compliance with State and Federal requirements. The findings of EPD have been assembled in this Preliminary Determination.

This facility will be a major source for HAPs, having emissions of more than 10 tons per year of a single HAP and 25 tons per year of a combination of HAPs. Therefore, it is subject to a case-by-case MACT evaluation because there is no NESHAP Part 63 MACT standard for the ceramic proppant manufacturing facilities. A "Notice of MACT" Approval is included with this Preliminary Determination as Appendix A.

2.0 PROCESS DESCRIPTION

PyraMax Ceramics submitted Georgia Air Quality Application No. 20584 proposing to construct and operate a ceramic proppant manufacturing facility in Wrens, Jefferson County, Georgia. The facility will consist of two identical process/kiln lines which can be operated independently. The manufacturing processes along the production/kiln lines are described below. For more details and process diagrams, please refer to Application No. 20584.

Raw Material Handling

The facility will receive locally mined raw clay as feedstock via trucks to a number of covered storage bays. Expected emissions from this operation are particulate matter as fugitive clay particles scattering from the working area. Such emissions are insignificant due to the high moisture content of the clay (approximately 20% by weight), and, to the use of appropriate control measures, including paving facility roads, timely cleaning of roads and working areas, enclosing clay handling and storage areas and restricting clay delivery trucks access to facility roads. There is also a plan to build a truck tire washing station.

Slurry Preparation

Front-end loaders will move the received clay from storage bays to a cage mill which breaks the clay into a fine powder. The fine clay powder is then moved by conveyor to a feeder which transfers the clay powder into a mixer. The mixer than converts the clay powder into a stable suspended mixture/slurry by mixing the clay with water and a small amount of a dispersant. The slurry is agitated and then pH balanced using aqueous ammonia, then stored in tanks. The slurry is then wet screened before addition of a binder agent. Expected emissions from slurry preparation include VOC (impurity in the additive) PM, PM_{10}, and $PM_{2.5}$. Particulate emissions will be negligible due to the high moisture content and moisture content of the material.

Pelletization/Spray Drying

Pelletization of the slurry feed from the storage tanks takes place in spray dryers/pelletizers. These units are heated by burning natural gas with propane as backup fuel. Green clay pellets form from spraying the slurry into the dryers/pelletizers, dry under the heat, then are coated by fresh incoming slurry, and dried again. The process continues until desired bead size is achieved. Each process/kiln line has one spray dryer/pelletizer heated to a desirable temperature by a direct-fired low NO_x natural gas burners with maximum heat input capacity of 75 MMBtu/hr.

Expected emissions from this process include PM, PM_{10}, and $PM_{2.5}$, combustion byproducts (CO, NO_x, SO_2, PM, PM_{10} and $PM_{2.5}$,, VOC and GHG/CO_2), and VOC when volatile organics in the additives are evaporated (mostly methanol and methyl acetate). All the emissions will be carried by exhaust gas through a baghouse for removal of PM, PM_{10}, and $PM_{2.5}$, and then discharged into the atmosphere via a stack. The emission of methanol is regulated via a case-by-case MACT Determination as presented in Appendix A. Methyl acetate is one of the exempt compounds by EPA and not considered as VOC. It is not a HAP compound either.

Green Pellet Screening

In this process two multiple-stack screens will separate green pellets conveyed from spray dryers/pelletizers according to their sizes. On-sized pellets are conveyed to calciners/kilns for further processing. Oversized pellets are diverted to a cage mill for size reduction and then re-fed to the pelletizer feed bin for reprocessing; while undersized pellets are sent directly beck to the pelletizer feed bin. Only PM, PM_{10} and $PM_{2.5}$ are emitted from this process, and controlled by baghouses and bin vent filters depending on the operation involved.

Calcining/Sintering

On-sized green pellets are conveyed to the calciner/kiln bins via conveyors and bucket elevators, and metered into the charging end of each counter flow dry-process rotary calciner/kiln where they are slowly heated, dried and then calcined/sintered, releasing moisture and other impurities in the process. The calciner/kiln rotates as heated by a low NO_x burner fired by natural gas with propane as backup fuel. The burner fires directly onto the kiln feed/green pellets streaming in so that hot exhaust gases travel counter flow to the incoming green proppant pellets/beads. The capacity of the kiln burner is 49.3 MMBtu/hr and can heat the calciner/kiln up to 3,000°F.

Each rotary kiln/calciner is closely followed by a separate rotary cooler which introduces cooling air in the discharge end of the cooler.

Expected emissions from the calciner/kiln include criteria pollutants (CO, NO_x, PM, PM_{10} and $PM_{2.5}$, SO_2 and VOC), greenhouse gas (GHG), and HAPs. Majority of the HAPs emissions are HCl and HF converted from chlorides and fluorides naturally existing in the clay at high temperature. Almost all the SO_2 emissions are from the conversion of elemental sulfur and sulfur compounds contained naturally in the clay, which could vary significantly among different mining sites or even geographical locations/formations with the same mining site. Part of the particulate matter emissions are from tumbling action of the clay pellets inside the calciner/kiln and the rest from fuel combustion. The other part are condensable particulate matter (CPM) formed by certain gaseous compounds in exhaust gas at the stack exits, including mainly acids and ammonia salts. Fuel combustion generates almost all the CO and NO_x emissions. The majority of the NO_x formation is due to thermal NOx generation. Due to the use of clean fuels, particulate matter, SO_2, and VOC emissions from fuel combustion are insignificant. VOC emissions from conversion of naturally occurring carbon compounds in kiln feedstock/green clay pellets are minimum because the clay pellets contain little such compounds. Kiln and cooler exhaust gas streams carrying these missions are routed to a "catalytic baghouse" for multi-pollutant control.

The "catalytic baghouse" itself utilizes, instead of fabric filter bags, an array of rigid porous ceramic tube filters to capture the particulate matter. In addition, nano catalysts are impregnated across the wall of the ceramic tube filters to facilitate the reduction of NO_x to nitrogen (N_2) in the presence of appropriate reducing agents such as ammonia, which is injected into the exhaust gas strategically upstream of the "catalytic baghouse". Consequently, the ceramic tube filters will function collectively as a "selective catalytic reactor" (SCR) to abate NO_x emissions. To reduce acid gas emissions, predominantly SO_2, HCl and HF, calcium or sodium based powdery alkaline sorbents such as sodium bicarbonate ($NaHCO_3$) are injected strategically into the kiln exhaust air upstream of the "catalytic baghouse" to neutralize the gaseous acids by forming sodium salts such as Na_2SO_4, NaCl and NaF. These fine solids are then captured along with other dust by the "catalytic baghouse"/ceramic tube filters downstream.

Finishing

The calcined/sintered ceramic proppants are conveyed from the kiln cooler to the final product screens. On-sized proppants are transferred to quality control bins and off-sized proppant recycled back to the kiln for further processing. On-size ceramic proppants are tested for quality and those passing the testing are sent to storage silos awaiting for shipping. Dust collection will occur at transfer points pneumatically and diverted to a common baghouse. Each storage silo and bin is equipped with a vent filter to control particulate matter emissions. Finished proppants are conveyed to a rail car loading spout and into railcars for delivery to customers. Dust generated during railcar loading are controlled via pneumatic collection at transfer points and then a common baghouse.

Supporting operations

The proposed ceramic proppant manufacturing plant will have the following supporting operations/equipment:

- On-site research and development and QA/QC labs;

- Two (2) natural gas-fired 9.8 MMBtu/hr boilers with propane backup;
- Three (3) 60,000 gallon propane storage tanks providing backup fuel for all natural gas-fired units;
- One (1) 14,250 gallon dispersant storage tank;
- Two (2) diesel engine powered emergency generator sets each consists of two (2) 500 kW diesel engines each drives one (1) generator;
- Two (2) 2,375 gallon storage tanks for the emergency engines;
- One (1) 7,000 gallon aboveground diesel fuel storage tank for site vehicles;
- One (1) 1,000 gallon aboveground diesel fuel storage tank for site vehicles; and
- Two (2) aqueous ammonia storage tanks for process pH control and control device operation.
- One storage silo for sorbent for control device operation.

Emission Control

The facility-wide potential emissions of criteria pollutants (CO, NO_x, PM, PM_{10} and $PM_{2.5}$, SO_2 and VOC) and GHG will exceed either the corresponding major source thresholds or significant increase levels under NSR/PSD regulations under CAA. As required by NSR/PSD regulations, BACT is required to control these emissions.

Because the facility-wide potential HAP emissions such as methanol, HF and HCl exceed the major source thresholds under Section 112 of CAA of 1990, Case-By-Cases MACT as determined per Section 112(g) of CAA is used to control the HAP emissions.

PyraMax Ceramics' permit application and supporting documentation are included in Appendix C of this Preliminary Determination and can be found online at www.georgiaair.org/airpermit.

3.0 REVIEW OF APPLICABLE RULES AND REGULATIONS

3.1 State Rules

Georgia Rule for Air Quality Control (Georgia Rules) 391-3-1-.03(1) requires that any person prior to beginning the construction or modification of any facility which may result in an increase in air pollution shall obtain a permit for the construction or modification of such facility from the Director upon a determination by the Director that the facility can reasonably be expected to comply with all the provisions of the Act and the rules and regulations promulgated thereunder. Georgia Rule 391-3-1-.03(8)(b) continues that no permit to construct a new stationary source or modify an existing stationary source shall be issued unless such proposed source meets all the requirements for review and for obtaining a permit prescribed in Title I, Part C of the Federal Act [i.e., Prevention of Significant Deterioration of Air Quality (PSD)], and Section 391-3-1-.02(7) of the Georgia Rules (i.e., PSD).

- Georgia Rule (b) [391-3-1-.02(2)(b) - *Visible Emissions* is a general rule limiting the opacity of stack visible emissions from a source to less than 40%. This regulation applies to any source with stack visible emissions but is not subject to other more restrictive source specific limit for the same visible emissions. The provisions of Georgia Rule (b) apply only to facilities or sources subject to some emission limitation under subsection 391-3-1-.02(2).

- Georgia Rule (p) [391-3-1-.02(2)(p) - *Particulate Emissions from Kaolin and Fuller's Earth Processes*], which uses process input rate based equations similar to the process weight rule to set PM emission limits, depending on if the sources were constructed or extensively modified before or after January 1, 1972. The applicable stack PM emission rate is determined using either one of four equations, depending on the process input rate and age of the equipment.

- Georgia Rule (g) [391-3-1-.02(2)(g) - *Sulfur Dioxide*] limits the sulfur content of liquid or solid fossil fuel(s) or wood residue burned by a new fuel-burning source constructed or extensively modified after January 1, 1972. The limitation is based on the type of the fossil fuel(s) (liquid, solid or wood residue) and the heat input rate of the source. Since none of the fuel burning sources at this facility has a heat input rate greater than 100 MM BTU/hr, the sulfur content of fuel(s) used for these sources shall not exceed 2.5% by weight. Firing these sources with only natural gas and propane, PyraMax Ceramics will comply with this limit because the sulfur content of commercial available natural gas and propane in Georgia is substantially below this limit.

- Georgia Rule (n) [391-3-1-.02(2)(n) - *Fugitive Dust*] commonly known as the fugitive dust rule, requires PyraMax Ceramics to take all reasonable precautions to prevent fugitive dust emissions from any operation, process, handling, transportation or storage facility prone to such emissions, and lists a number of such precautions. In addition, Georgia Rule (n) limits the opacity of such fugitive emissions to less than 20%.

- Georgia Rule (d) [391-3-1-.02(2)(d) – *Fuel Burning Equipment* limits the PM emissions (lbs/MMBtu) from each 9.8 MMBtu/hr natural gas-fired boiler according to boiler's heat input and construction date. In addition, Georgia Rule (d) limits the opacity of such PM emissions to less than 20% opacity except for one 6-minute per hour of not more than 27% opacity. Firing both boilers with only "clean fuels", i.e., natural gas and propane, PyraMax Ceramics will comply with these limits. Direct-heating fuel burning units such as spray dryers/pelletizers and calciners/kilns where fuel gas is in touch with materials being processed/heated are not subject to this rule.

Because the emission standards/limits under pertinent New Source Performance Standard (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP)/ MACT or PSD/NSR rules are more stringent than those in the aforementioned rules, these SIP rules are subsumed by the pertinent federal rules.

3.2 Federal Rule - PSD

The regulations for PSD in 40 CFR 52.21 require that any new major source or modification of an existing major source be reviewed to determine the potential emissions of all pollutants subject to regulations under the Clean Air Act. The PSD review requirements apply to any new or modified source which belongs to one of 28 specific source categories having potential emissions of 100 tons per year or more of any regulated pollutant, or to all other sources having potential emissions of 250 tons per year or more of any regulated pollutant. They also apply to any modification of a major stationary source which results in a significant net emission increase of any regulated pollutant.

Georgia has adopted a regulatory program for PSD permits, which the United States Environmental Protection Agency (EPA) has approved as part of Georgia's State Implementation Plan (SIP). This regulatory program is located in the Georgia Rules at 391-3-1-.02(7). This means that Georgia EPD issues PSD permits for new major sources pursuant to the requirements of Georgia's regulations. It also means that Georgia EPD considers, but is not legally bound to accept, EPA comments or guidance. A commonly used source of EPA guidance on PSD permitting is EPA's Draft October 1990 New Source Review Workshop Manual for Prevention of Significant Deterioration and Nonattainment Area Permitting (NSR Workshop Manual). The NSR Workshop Manual is a comprehensive guidance document on the entire PSD permitting process.

The PSD regulations require that any major stationary source or major modification subject to the regulations meet the following requirements:

- Application of BACT for each regulated pollutant that would be emitted in significant amounts;
- Analysis of the ambient air impact;
- Analysis of the impact on soils, vegetation, and visibility;
- Analysis of the impact on Class I areas; and
- Public notification of the proposed plant in a newspaper of general circulation

Definition of BACT

The PSD regulation requires that BACT be applied to all regulated air pollutants emitted in significant amounts. Section 169 of the Clean Air Act defines BACT as an emission limitation reflecting the maximum degree of reduction that the permitting authority (in this case, EPD), on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such a facility through application of production processes and available methods, systems, and techniques. In all cases BACT must establish emission limitations or specific design characteristics at least as stringent as applicable New Source Performance Standards (NSPS). In addition, if EPD determines that there is no economically reasonable or technologically feasible way to measure the emissions, and hence to impose and enforceable emissions standard, it may require the source to use a design, equipment, work practice or operations standard or combination thereof, to reduce emissions of the pollutant to the maximum extent practicable.

EPA's NSR Workshop Manual includes guidance on the 5-step top-down process for determining BACT. In general, Georgia EPD requires PSD permit applicants to use the top-down process in the BACT analysis, which EPA reviews. The five steps of a top-down BACT review procedure identified by EPA per BACT guidelines are listed below:

Step 1: Identification of all control technologies;
Step 2: Elimination of technically infeasible options;
Step 3: Ranking of remaining control technologies by control effectiveness;
Step 4: Evaluation of the most effective controls and documentation of results; and
Step 5: Selection of BACT.

The following is a discussion of the applicable federal rules and regulations pertaining to the equipment that is the subject of this preliminary determination, which is then followed by the top-down BACT analysis.

3.3 New Source Performance Standard (NSPS)

40 CFR Part 60, Subpart A - *General Provisions*, imposes generally applicable provisions for initial notifications, initial compliance testing, monitoring, and recordkeeping requirements for equipment at the facility subject to a specific NSPS standard, as indicated by the pertinent NSPS standard.

40 CFR Part 60, Subpart OOO – *Standards of Performance for Nonmetallic Mineral Processing Plants* applies to each of the conveyors, bins, bucket elevators, screens, crushers, and mills associated with each of the new ceramic proppant production lines. Subpart OOO establishes process/source specific PM, visible and fugitive emissions limits, and record keeping, testing, compliance demonstration and reporting requirements for each of the affected sources. Subpart OOO limits are summarized below:

a. No greater than 7% opacity for fugitive emissions (including those escaping capture systems) except for any crusher that does not use a capture system, which shall not exhibit fugitive emissions greater than 12% opacity.

b. No greater than 0.014 gr./dscf for stack PM emissions from capture systems feeding a dry control device except for individually enclosed storage bins.

c. For any transfer point on a conveyor belt or any other affected facility enclosed in a building, each enclosed affected facility shall comply with the emission limits in paragraphs (a) and (b) noted above, or the building shall comply with the following emission limits:

- Fugitive emissions from the building openings (except vents with mechanically induced air flow for exhausting PM emissions from the building) shall not exceed 7% opacity.
- PM emissions from any building vent with mechanically induced air flow for exhausting PM emissions shall exceed 0.014 gr./dscf).

40 CFR Part 60, Subpart UUU – *Standards of Performance for Calciners and Dryers in Mineral Industries* applies to each of the spray dryers/pelletizers and rotary kilns (also referred to as calciners on in the application). Subpart UUU establishes source specific PM and visible emissions limits, and record keeping, testing, compliance demonstration and reporting requirements for each of the affected sources. Subpart UUU limits are summarized below

a. Emissions of particulate matter from calciners and dryers installed in series shall not exceed 0.04 gr./dscf.

b. Emissions of particulate matter from dryers shall not exceed 0.025 gr./dscf

c. Visible emissions shall not exceed 10% percent opacity.

40 CFR Part 60, Subpart IIII - *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines* applies to each new 500 kW stationary emergency diesel generator which will commence construction after July 11, 2005. These diesel generators must meet the applicable Tier III emissions limits (as certified by EPA) for the same model year and capacity and burn fuel oil that meets the specifications under NSPS Subpart IIII. Subpart IIII also limits the maintenance check and readiness testing time for each emergency diesel generator to 100 hours per year.

For each established limit under the above NSPS standards, please refer to conditions in Section 3.0 of the proposed permit No. 3295-163-0035-P-01-0 which is included in Appendix B.

The two (2) new natural gas-fired boilers are rated less than 10 MMBtu/hr each, and therefore exempt from all requirements under 40 CFR 60, Subpart Dc - *Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units.*

3.4 National Emissions Standards For Hazardous Air Pollutants

40 CFR Part 63, Subpart A, *General Provisions*, imposes general requirements for initial notifications, initial compliance testing, monitoring, and recordkeeping. PyraMax Ceramics' two (2) new emergency stationary diesel generator sets (G1 and G2) with four (4) 500 kW diesel engine - generator combos are considered as "new stationary sources" by 40 CFR Part 63, Subpart ZZZZ - *National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines,* and subject to the MACT standard. As emergency stationary diesel generators rated greater 500 brake horsepower located at a major stationary source for HAPs emissions, these diesel generators are not subject to the requirements of Subpart ZZZZ. The Permittee is only required to submit an initial notification and a statement that the generators are for emergency use only. This permit establishes conditions to limit the use of the diesel generators to emergency situations only. Subpart ZZZZ also contains tables listing the applicable provisions of 40 CFR Part 63, Subpart A.

40 CFR Part 63 Subpart DDDDD – *National Emissions Standards for Hazardous Air Pollutants for Major Sources, Industrial, Commercial, and Institutional Boilers and Process Heaters* final rule was published in the Federal Register on March 21, 2011. This rule would be applicable to the facility's natural gas boilers. However, in May 2011 EPA announced a delay of the effective date for the Rule. Then, on June 24, 2011 EPA announced, as part of a filing with the U.S. Court of Appeals for the DC Circuit, that a new Rule would be proposed by the end of October 2011, and the rule would be finalized by the end of April 2012. On December 2, 2011 EPA issued a proposed reconsideration to the Boiler MACT rules.

Under the Rule published on March 21, 2011, the only significant requirement under the Rule for the applicant's proposed natural gas fired boilers would have been conducting a tune-up of the boiler or process heater biennially as specified in 40 CFR 63.7540. These requirements have stayed relatively consistent with the recent EPA proposal of December 2, 2011.

3.5 Section of 112(g)(2)(B) of the Clean Air Act (CAA) Amendment of 1990

PyraMax Ceramics will use an additive/chemical compound as disperser during the clay slurry preparation. This additive contains less than 1% by weight of methanol (an EPA listed HAP) as an impurity which will eventually evaporate into the air during spray drying of the clay slurry, resulting in approximately 48 tons per year of methanol emissions, which exceed the 10-ton per year major source threshold for single HAP emissions under 40 CFR Part 63 Subpart B. In addition, HF and HCl are emitted from calciners/kilns as naturally occurring fluorides and chlorides in clay which are converted into gaseous HF and HCl at high temperature. These HAP emissions combined will exceed the 25-ton per year major source threshold for combined HAP emissions under 40 CFR Part 63 Subpart B. Because there is no NESHAP Part 63 MACT standard for the ceramic proppant manufacturing facilities like

PyraMax Ceramics', these HAP emissions are subject to a Case-by-Case MACT Determination under 112(g) of CAA Amendment of 1990.

A "Notice of MACT" Approval per 112(g) of 1990 CAA for the HAP emissions from this facility is included with this Preliminary Determination as Appendix A.

3.6 State and Federal – Startup and Shutdown and Excess Emissions

Excess emission provisions for startup, shutdown, and malfunction are provided in Georgia Rule 391-3-1-.02(2)(a)7. Excess emissions from various process units along the proposed new ceramic proppant manufacturing lines, as listed in Section 3.1 of draft Air Quality Permit No. 3295-163-0035-P-01-0, would most likely result from a malfunction of the associated control equipment. The facility cannot anticipate or predict malfunctions. However, the facility is required to minimize emissions during periods of startup, shutdown, and malfunction.

3.7 Federal Rule – 40 CFR 64 – Compliance Assurance Monitoring

As a green-field source/site, PyraMax Ceramics, LLC – King's Mill Facility is required to prepare and submit monitoring plans for emission units/sources subject to the CAM requirements with the initial Title V operating permit application within 12 months of the startup of this new source. This SIP/PSD construction permit, as issued under the authority of Georgia Rules 391-3-1-.02(7), *"Prevention of Significant Deterioration of Air Quality"* and 391-3-1-.03(1), *"Construction (SIP) Permit"*, is not required to incorporate the applicable CAM requirements.

4.0 CONTROL TECHNOLOGY REVIEW

The proposed project will result in emissions that are significant enough to trigger PSD/BACT review for the following pollutants: CO, GHG, NO_x, PM, PM_{10}, $PM_{2.5}$, SO_2 and VOC. This section describes in details each piece of equipment with associated emissions, possible control technologies for the pollutants involved, and determines source and emission-specific BACT.

4.1 Fugitive Particulate Matter (PM) Emissions

Because the potential particulate matter (PM, PM10, PM2.5) emissions from PyraMax Ceramics has triggered PSD/BACT applicability, PSD rule requires addition of quantifiable fugitive emissions to PSD/BACT applicability analysis.

Operations/process units at this facility that generate fugitive particulate matter (PM, PM_{10} and $PM_{2.5}$) emissions include front-end loaders, truck and rail car loading and unloading, roads and unclosed storage buildings where use of designated dust capture systems is not feasible. Fugitive dust sources generally involve the re-entrainment of settled dust/clay particles by machine movement and material transportation. Wind-blown dust from the working area such as stockpiles and roads also contributes to the fugitive PM, PM10, and PM2.5 emissions.

The moisture content of the material processed can have a substantial effect on fugitive emissions. Surface wetness causes fine particles to agglomerate on or to adhere to the faces of larger particles, with a resulting dust suppression effect.

Raw clay becomes extremely slick when wet, making travel across wet surfaces dangerous. Enclosing every storage and/or loading and unloading operation could impede operation or become infeasible. For this reason, road and working area cleaning and scraping measures to minimize dust/fugitive emissions usually are options favored by the industry.

According to the application No. 20548, the fugitive PM, PM_{10} and $PM_{2.5}$ emissions are insignificant due to the high moisture content of the clay (approximately 20% by weight) and the following measures proposed as BACT for the fugitive PM emissions by PyraMax Ceramics:

- Paving facility roads with concrete or asphalt;
- Timely cleaning of roads and working areas;
- Enclosing clay handling and storage areas;
- Restricting clay delivery trucks access to facility roads; and
- Operating a truck tire washing station.

Most of the proposed measures have been determined previously by EPD as BACT for such fugitive PM, PM10, and PM2.5 emissions from similar facilities.

BACT Determination

Based on the nature of the sources, materials and equipment involved, EPD has determined that the fugitive PM, PM_{10} and $PM_{2.5}$ emission control measures proposed by PyraMax Ceramics constitute BACT. The corresponding emission limit for the BACT is 10% opacity for visible emissions from any fugitive PM emission sources, and no visible emissions from any enclosed process buildings and wet operations. Specific operating, monitoring, testing, record keeping, and reporting requirements, as applicable, are contained in this permit amendment to ensure the implementation of the BACT. Some of these requirements are adopted from NSPS Subpart OOO and Georgia Rule (n).

4.2 Particulate Matter Emissions from Materials Handling, Storage, Conveying, Spray Drying/Pelletizing, Screening, Calciner/Kiln, Packaging and Shipping

PM/PM_{10}/$PM_{2.5}$ are emitted from various materials handling and processing operations, include loading and unloading, conveying and storage, weighing, mixing, grinding/milling, spray drying/pelletizing, screening, calcining, packaging and shipping. These operations collectively form each ceramic proppant process/kiln line. Exhaust gas streams from the spray dryers/pelletizers and calciners/kilns contain PM/PM_{10}/$PM_{2.5}$ generated by the entrainment of the powdery materials, soot from fuel combustion, and to a lesser degree, salt particulates formed mainly via reaction between $SO_{2,}$ HCl, HF and sodium bicarbonate and ammonia in calciner/kiln exhaust gas streams. Excluding such soot and salts, most of the process PM/PM_{10}/$PM_{2.5}$ emissions are finely dispersed solids as either part of the raw materials, intermediate or final products. Some of them can be returned to the process once captured.

In addition to the filterable particulate matter emissions, condensable particulate matter emissions (CPM) can be significant part of the $PM_{2.5}$ emission, ranging from 10 to 50% depending on control measures, temperature, and other source-specific condition. CPM are formed when gaseous pollutants in flue gas condense to liquids or solids at stack exit(s), and remain stable in the atmosphere and could be collected on ambient samplers. For example, acids, certain ammonia salts such as $(NH_4)_2SO_4$ and NH_4Cl, certain organic materials (e.g., alkalis, PAHs, PCBs, PCDDs and acids), and metals (e.g., As, Se, Sb, Pb compounds)[1]. CPM emissions from PyraMax Ceramics' calciners/kilns are expected to be significant due mainly to the presence of acids and ammonia in exhaust gas streams[2]. On other hand, CPM emissions from other PM emission sources such as spray dryers/pelletizers, material handling and boilers were expected to be less significant due to the lack or low concentration of the CPM precursors[3].

Control of process particulate matter emissions is achieved by the collection of the particles/dust from the process exhaust/ventilation stack exhaust gas streams. Most clay processing plants use fabric baghouses for controlling the particulate matter emissions in stack/ventilation exhaust gas streams.

There are no particulate matter emissions from certain wet processes such as milling, slurry preparation, and wet screening operations and therefore no BACT analysis is required for such sources.

The applicant proposed a number of control options for the particulate matter (PM, PM_{10}, and/or $PM_{2.5}$) emissions. Georgia Air Quality Application No. 20485 dated July 21, 2011 provides a detailed discussion on the mechanisms, characteristics and technical feasibilities of the particulate matter (PM, PM_{10}, and $PM_{2.5}$) emission control technology options identified by PyraMax Ceramics. Please refer to Part 5.0 of Volume 1 of the application for details.

Georgia EPD's review results in the following observations provided in this document section. Table 4.2-1 ranks the control options identified according to their control efficiency.

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[1] Ron Myers, Measurement Policy Group, SPPD, OAQPS, EPA, *"Direct $PM_{2.5}$ Emissions Data, Testing, and Monitoring Issues",* http://www.epa.gov/ttnnaaqs/pm/presents/condensable_pm_issues-ron_myers.ppt

[2] Page 5-27, Georgia Air Quality Permit Application No. 20584, PyraMax Ceramics, LLC – King's Mill Facility, July 21, 201.1

[3] Page 5-39, Georgia Air Quality Permit Application No. 20584, PyraMax Ceramics, LLC – King's Mill Facility, July 21, 2011.

Table 4.2-1: Ranking of Technically Feasible PM Emission Controls from Materials Handling, Storage, Conveying, Milling, Calciner/Kiln, Packaging and Shipping Operations

Control Technology Ranking	Control Technology	Control Efficiency
1	• Ceramic Tube Filter Collectors • Fabric Filter Collectors(Baghouses) • Electrostatic Precipitators (ESPs)	>99%
2	Wet Scrubbing/Washing	<99%
3	Cyclone and Venturi Scrubbers	<90%

Fabric filter collectors (also known as baghouses) are one of the most efficient means to separate PM/PM_{10}/$PM_{2.5}$ from a gas stream. Baghouses are capable of maintaining mass collection efficiencies of greater than 99%. In baghouses, dust-laden gas streams from collecting or ventilation systems are passed through a felted or woven fabric, causing PM/PM_{10}/$PM_{2.5}$ in the gas streams to be collected/captured on the surface of the fabric by sieving and other capturing mechanisms including impaction, Brownian diffusion, and electrostatic attraction.

ESPs use an electrostatic field to charge particulate matter contained in the gas streams. The charged particulates then migrate to grounded collecting surfaces/plates due to electrostatic attraction. The collected particles are then dislodged by vibrating or rapping the collector surface, and subsequently collected in a hopper at the bottom of the ESP. ESPs are capable of very high collection efficiencies, even for very small particles.

Wet scrubbers remove PM/PM_{10}/$PM_{2.5}$ via mainly impact between the scrubbing solution and the PM-laden gas, and are less efficient than either baghouses or ESPs. Inertial separators (cyclonic and Venturi scrubbers) can have efficiencies around 90% within narrow particle size ranges. These devices have not been demonstrated as effective controls at similar clay processing plants. The control efficiency of a wet scrubber (spraying or packed bed) is higher than that of a cyclone, but not as high as that of a baghouse or ESP due mainly to short-circuiting. Wet scrubbing is known for creating wastewater and sludge disposal problems, straining water supply, and requiring substantial additional energy for pumping water and propelling cooled exhaust air stream out the stacks.

Ceramic tube filters are made of porous refractory ceramic materials and shaped like solid tubes. They offer high-temperature filtration capability, high collection efficiency, corrosion resistance, and durability. Consequently, Ceramic tube filters have found their application in high temperature processes subject to strict emissions limits such as metal smelting, chemicals production, glass manufacturing, and waste incineration[4].

In principle, the operation of ceramic tube filter systems is similar to fabric baghouses. The ceramic tube filter systems utilize arrays of porous ceramic tubes in replacement of woven fabric bags as filtering media to capture/collect PM/PM_{10}/$PM_{2.5}$. The gas to be cleaned is typically drawn into the ceramic filter system by an induced-draft fan such that the PM/PM_{10}/$PM_{2.5}$ being collected builds up on the outside of tube filter in the form of a cake. The cleaned gas passes through the wall of the tuber filter and into plenum, the cake being periodically removed from the tube filters by reverse-pulse compress air.

The ceramic tube filters are composed of fibrous ceramic materials, light weight, and ductile, and very efficient in capturing particulate matter emissions. Typically they can reduce particulate matter to levels less than 0.001 grains/dscf, which is superior to that achieved by typical baghouses (0.003 – 0.01 grains/dscf)[5]. The unique surface structure of these ceramic tube filters do better job than fabric filters to keep the collected particles on the surface as a dust layer/cake, resulting in good "caking" that enables particle penetration to remain low.

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[4] Andrew Starting & Gary Elliott, "Controlling Emissions With Ceramic Filters", *Chemical Engineering,* January 2009

[5] "Handbook: Control Technologies for Hazardous Air Pollutants", EPA/625/6-91/014, Page 3-14.

Georgia EPD is incorporating photographs and diagrams that are contained in Application No. 20854 and are copyrighted by TriMer. Figures 4.2-1and 4.2-2 are photographic images showing the front view and end of ceramic tube filters.. Figures 4.2-1 and 4.2-2 are taken directly from 0411 TriMer Bulletin-UltraCat Hot Gas Filtration Boiler MACT Solution) for illustrative purposes only.

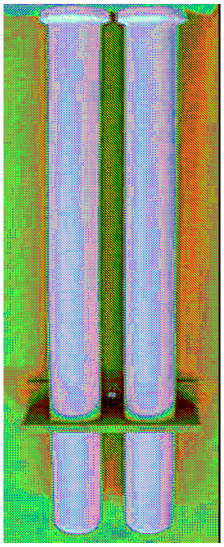


Figure 4.2-1: Front View Photo of UltraTemp and UltraCat Ceramic Filters

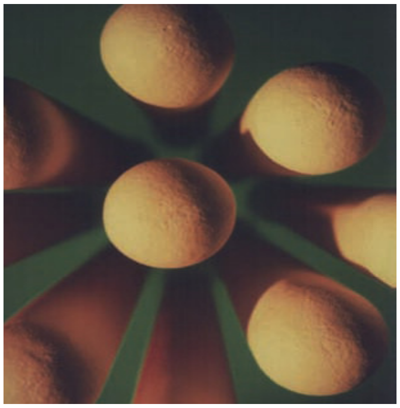
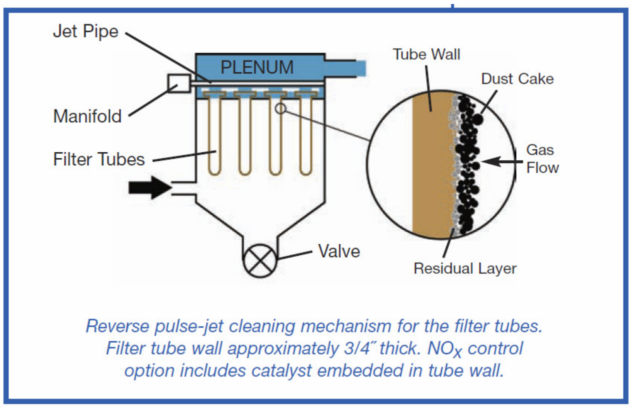


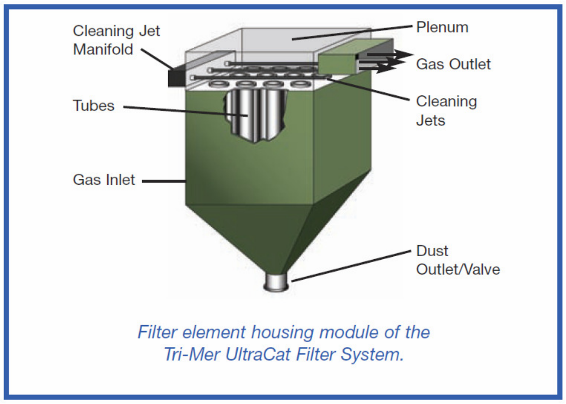
Figure 4.2.-2: End View Photo of UltraTemp and UltraCat Ceramic Filters

Ceramic tube filters are heat resistant by nature, and can be operated over a wide temperature range even at levels fabric filters cannot sustain. In addition, they are more durable than fabric filters, with average life span of 5 to 10 year on most of applications. The unique structure of the ceramic filters give them an exceptional ability to capture fine particulate at the surface, without blinding. This makes the filters easy to clean using standard pulse-jet techniques. Being fibrous, rather than granular, the filter elements are also lightweight, and have a low resistance to flow, which minimizes the number of elements required for a given application.[6] Figures 4.2-3 and 4.2-4 illustrate a ceramic tube filtration system in a baghouse configuration with a reverse pulse-jet cleaning action. The filters are back-flushed with compressed air. Figures 4.2-3 and 4.2-4 are taken directly from 0411 TriMer Bulletin-UltraCat Hot Gas Filtration Boiler MACT Solution) for illustrative purposes only.



Reverse pulse-jet cleaning mechanism for the filter tubes. Filter tube wall approximately 3/4″ thick. NO_X control option includes catalyst embedded in tube wall.

Figures 4.2-3: Illustration of a Cross Section of a Ceramic Filter Compartment



Filter element housing module of the Tri-Mer UltraCat Filter System.

Figures 4.2-4: Illustration of a 3D View of the Same Ceramic Filter Compartment Shown in Figure 4.2-3

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[6] Tri-Mer® Corporation, http://www.tri-mer.com/hot-gas-filtration.html

Figure 4.2-5 shows drawing of an assembled particulate matter (PM/PM_{10}/$PM_{2.5}$) control system/unit equipped with ceramic tube filters in a typical baghouse configuration. Figure 4.2-5 is taken directly from 0411 TriMer Bulletin-UltraCat Hot Gas Filtration Boiler MACT Solution) for illustrative purposes only. PyraMax Ceramics proposed in this application to use the same systems specifically for the control of particulate matter emissions from calciners/kilns; while regular fabric filter/baghouse systems were proposed for controlling PM/PM_{10}/$PM_{2.5}$ emissions from other sources. The main reason behind choosing the ceramic tube filters instead of traditional fabric filters to control the PM/PM_{10}/$PM_{2.5}$ emissions from calciners/kilns is that ceramic tube filters embedded with nano-catalysts for NO_x are available. At the presence of certain reduction agent such as ammonia and appropriate temperature, these micro catalysts will facilitate the conversion of NO_x back to nitrogen, thus reducing the NO_x emissions, much like a traditional selective catalytic reactor (SCR). Considering that both calciners/kilns are the major NO_x emission sources at this facility, and provide a desirable temperature range for the use of the system, PyraMax Ceramics proposed to equip each calciner/kiln with a nano-catalysts embedded ceramic tube filter system to take full advantage of the technology.

Baghouses (including those using tube ceramic filters) and ESPs are considered equivalent as the most efficient/top technology for controlling the PM emissions. Coupled with a properly designed and designated capture system(s), properly designed, maintained and operated baghouses or ESPs can readily reduce particulate matter emissions by more that 99%. A review of previous BACT determinations for similar sources and various permits issued to nonmetallic mineral processing plants indicated that baghouses are almost exclusively used at the facilities and considered as BACT for controlling process particulate matter emissions.

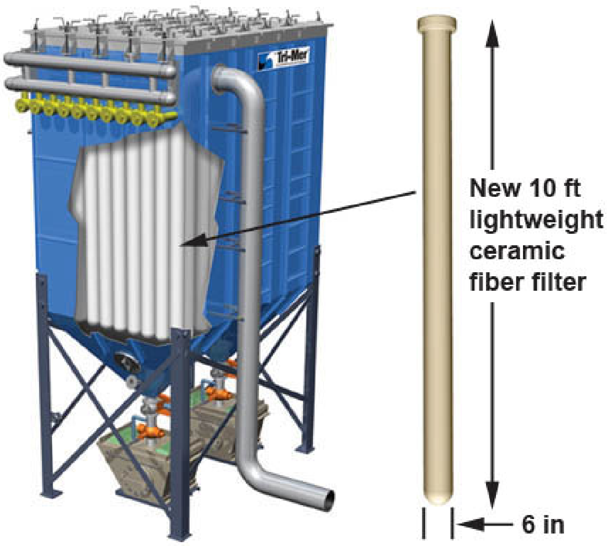

Figure 4.2-5: 3D Drawing of a PM Filter Assembly Equipped With Ceramic Filters in a Typical Baghouse Configuration ((Taken from Tri-Mer publication)

BACT Determination

PyraMax Ceramics proposed to use a number of fabric baghouses to control the PM/PM_{10}/$PM_{2.5}$ emissions from each ceramic proppant production line wherever feasible except calciners/kilns. A ceramic tube filter system(thereafter "catalytic baghouse") was proposed for the control of the particulate matter emissions from each calciner/kiln. Wherever possible, the collected fines will be returned to the production process.

Georgia EPD accepts the applicant's proposal for using ceramic filter/"catalytic baghouse" systems to control the calciner/kiln particulate matter emissions and using fabric baghouses wherever feasible to control particulate matter emissions from other sources constitutes BACT.

The BACT PM emission limits as proposed by PyraMax and accepted by EPD are:
Each Calciner/Kiln:

- 0.010 gr/dscf of filterable PM/PM_{10} (3-hour average)
- 6.98 lbs./hr of $PM_{2.5}$ (filterable and CPM) (3-hour average)
- 8.53 lbs./hr PM/PM_{10} (filterable and CPM) (3-hour averaging)
- 10% opacity (Georgia EPD has added this requirement as BACT), 6-minute averaging

Each Spray Dryer/Pelletizer:

- 0.010 gr/dscf of PM/PM_{10} (3-hour average). CPM emissions from this source are expected to be insignificant.
- 0.006 gr/dscf of $PM_{2.5}$ (3-hour average). CPM emissions from this source are expected to be insignificant.
- 10% opacity (6-minute average). Georgia EPD has added this requirement as BACT.

Other Point PM Sources with Baghouse Control:

- 0.005 gr/dscf of filterable PM/PM_{10}/$PM_{2.5}$). CPM emissions from these sources are expected to be insignificant.
- 7% opacity (6-minute average). Georgia EPD has added this requirement as BACT.

4.3 Particulate Matter Emissions from Boilers and Stationary Emergency Diesel Generators

Combustion units/sources with particulate matter (PM, PM_{10}, and $PM_{2.5}$) emissions include the two (2) 9.8 MMBtu/hr natural gas-fired boilers and two (2) stationary emergency diesel generator sets (i.e., two 500 kW diesel engines each powers a generator). Table 4.3.1 and 4.3.2 rank the emission control or abatement options identified for these sources according to their control efficiencies in accordance with the applicant's proposal.

Georgia Air Quality Application No. 20485 dated July 21, 2011 provides a discussion on the mechanisms, characteristics and technical feasibilities of the particulate matter emission control technology options identified for the sources. Please refer to Part 5.0 of Volume 1 of the application for details.

Table 4.3-1: Ranking of PM Control Technologies for Boilers

Control Technology Ranking	Control Technology	Control Efficiency
1	Fabric Filter Collectors(Baghouses), Electrostatic Precipitators (ESPs)	>99%
2	Wet Scrubber	<99%
3	Venturi Scrubber	<90%
4	Exclusive use of natural gas or propane as fuel	N/A

Table 4.3-2: Ranking of PM Control Technologies for Internal Combustion Engines

Control Technology Ranking	Control Technology	Control Efficiency
1	Fabric Filter Collectors Electrostatic Precipitators (ESPs)	>99%
2	Wet Scrubber	<99%
3	Exclusive use of diesel as fuel	N/A

Based on review of known existing commercial and institutional size boilers identified in the RACT/BACT/LEAR database, no baghouses, ESPs or wet scrubbers have ever been utilized for controlling particulate matter emissions from a natural gas-fired boiler of this size or with a similar magnitude of particulate matter emissions. At approximately 0.99 tons per year of uncontrolled particulate matter emissions (per Appendix C of Volume I of application), using any baghouse, ESP, wet scrubber or Venturi scrubber is economically infeasible as potential control technologies for the boilers.

The same situation applies also to the 500 kW stationary emergency diesel generator sets. Limited to 500 hours of operating time per year each and fueled only with extreme low sulfur diesel fuels as allowed by the NSPS Subpart IIII standards, identified add-on control options for particulate matter emissions is economically infeasible and may intervene the normal operation of the unit.

BACT Determination

PyraMax Ceramics proposed exclusively use of ultra sulfur diesel and operating 100 hour per year for each emergency diesel generator as BACT for the generators (pages 5-58 of Volume 1 of Application No. 20584), and exclusively combustion of natural gas or propane as BACT for the boilers (page 5-50 of Volume 1 of Application No. 20584).

Table 4.3-3: PyraMax Ceramics' Proposed PM BACT for Boilers & Diesel Generators

Process Description	BACT Requirement
Each Natural Gas Fired Boiler	Exclusive use of natural gas or propane as fuel
Each 500 kW Stationary Emergency Diesel Generator	Exclusive use of low sulfur diesel as fuel[1]; Limited to 100 hours annual operating time. PM emission limit of 0.20 g/kW-hr (0.15 g/HP-hr.)[2]

[1] 40 CFR Part 60, Subpart IIII fuel requirement.
[2] 40 CFR Part 60, Subpart IIII Emission limits and certified by EPA via manufacturer.

EPD has determined that PyraMax Ceramics' proposals listed in Table 4.3-3 are BACT except the 100-hour annual operating time limit. Both NSPS Subpart IIII and MACT Subpart ZZZZ limit the annual maintenance check and readiness testing time for each emergency diesel generator, but not the time for emergency power generation. However, Georgia Rule 391-3-1-.03(6)(b)11(v)(l) defines an emergency generators as "a generator whose function is to provide back-up power when electric power from the local utility is interrupted and which operates for less than 500 hours-per-year,……" in the area (Jefferson County) where PyraMax Ceramic's facility will be located. EPD has determined that the 500-hour annual operating time limit for each 500 kW diesel generator is part of the BACT.

As part of the BACT, each diesel generator must meet the applicable Tier III emissions limits (as certified by EPA) for the same model year and capacity and burn fuel oil that meets the specifications under NSPS Subpart IIII. This permit will establish corresponding operational, maintenance and recordkeeping requirements to ensure the compliance with the BACT. In addition, applicable requirements incorporated into this permit per NSPS Subpart IIII will also ensure the compliance with the fuel requirements and particulate matter emission limitations, as the emergency diesel generators/engines are certified under 40 CFR Part 89 to the applicable Tier III emission standards from new nonroad compression ignition engines, as required by 40 CFR Part 60, Subpart IIII. PyraMax is required to install, operate and maintain each diesel generator according to manufacturer's specifications and applicable NSPS Subpart IIII requirements. The Tier III nonroad compression ignition engine emission standards for PM are numerically equivalent or more stringent than NSPS Subpart IIII for the same model year and engine power.

4.4 CO Emissions from Fuel Combustion Sources

4.4.1 CO Emissions from Rotary Calciners/Kilns

Because the CO emissions from these sources have triggered PSD applicability, the CO emissions are evaluated for BACT.

Each of the calciners/kilns' CO emissions are generated by two independent sources:

- Incomplete fuel combustion in the calciners/kilns;
- Incomplete oxidation/combustion of carbonaceous materials in the feed/raw materials introduced to the calciners/kilns.

Condition leading to such incomplete combustions include insufficient oxygen/air, poor fuel/air mixing, low combustion temperature, insufficient combustion gas residence time, and load reduction. For this reason, the exhaust gas from each calciner/kiln is continually analyzed for oxygen (O_2) and CO via a computerized data acquisition and combustion/process control system.

The amount of CO generated depends on the operating conditions of the calciners/kilns and, more specifically, on the amount of excess oxygen/air available for the fuel combustion. CO levels also depend on the calciner/kiln design specifically the features for reducing NO_x.

In the calciner/kiln, organic materials naturally occurring in the kiln feed/clay are progressively heated and begin to thermally degrade. A significant fraction of such materials is oxidized to CO_2, with the rest as short-chain VOCs and CO. The amount of CO generated from such a pyrolitic process depends on the nature of the organics present in the feed materials. Light hydrocarbon species typically produce more VOC and less CO, and vice versa.

Review of literature, the BACT/LAER Clearinghouse, and permits issued to facilities with similar operations such as structural clay product manufacturing, ceramic product manufacturing and Portland cement manufacturing indicates that proper equipment design and process operation (i.e., good combustion techniques) represents BACT for CO emissions from rotary calciners/kilns. Properly controlled combustion in these calciners/kilns minimizes CO formation by ensuring that temperature profile and O_2 availability are adequate for complete combustion of fuel. Therefore, a properly designed and operated rotary ceramic calciner/kiln acts as a thermal oxidizer, capable of converting majority of the CO generated to CO_2.

In conclusion, a reduction in CO emissions can be achieved by the combination of following approaches:

- Using raw materials containing relatively low carbonaceous matter and hydrocarbons;
- Employing good combustion techniques at the calciner/kiln;
- Creating sufficient residence time from proper design of calciner/kiln size and duct lengths to complete fuel burnout.

In addition to proper equipment design, good combustion technique and raw material selection, add-on controls can achieve further reduction of CO emissions. Such controls would involve some type of thermal oxidation from CO to CO_2 in clean gas streams with minimal amounts of particulate matter. The oxidation technology options includes direct flame oxidation and energy-saving regenerative thermal oxidation (RTO) and catalytic oxidation. Thermal oxidation can also control VOC emissions via combustion and turn organic compounds/hydrocarbons into basically water and CO_2. Because of the presence of chlorides and sulfur which could foul the catalysts, and the relatively high post-control gas stream dust concentration which could mask catalyst surface and reduce the effectiveness and operational time of the catalysts, the catalytic oxidation is technically feasible but difficult for control of CO and VOC emissions from rotary ceramic calciners/kilns.

Georgia Air Quality Application No. 20485 dated July 21, 2011 provides a discussions on the mechanisms, characteristics and technical feasibilities of the CO emission control technology options identified for the sources. Please refer to Part 5.0 of Volume 1 of the application for details. The applicant's control technologies identified as technically feasible for CO emissions from PyraMax Ceramics' rotary calciners/kilns are ranked by control efficiency in Table 4.4.1-1 below:

Table 4.4.1-1: Ranking of Control Technologies for CO Emissions from Rotary Ceramic Calciner/Kiln

Control Technology Ranking	Control Technology	Control Efficiency[7]
1	Regenerative Thermal Oxidation	98%
2	Catalytic Oxidation	95%
3	Good Combustion Techniques	0-20%

Using RTO or catalytic oxidizers to reduce CO (and also VOC) emissions from ceramic calciner/kiln incurs high cost. The current cost of controlling CO with a RTO system is estimated at approximately $21,000 per ton of CO reduced[8], and $14,000 per ton of CO with a catalytic oxidizer[9].

BACT Determination

EPD has determined, based on the cost estimations, that neither RTO nor catalytic oxidizer discussed above is economically feasible as BACT for controlling the CO emissions from PyraMax Ceramics' calciners/kilns.

EPD has determined that PyraMax Ceramics' proposal of optimizing design, operation, and maintenance of the rotary calciner/kiln and associated combustion systems to minimize the CO emissions constitutes BACT. Georgia EPD does not support the applicant's CO BACT proposal of 51.36 lb/hr on a 3-hour average. Based on the emission testing results and operating data obtained from an existing similar facility in operation for several years[10], EPD has determined that the BACT limit for the CO emissions from each calciner/kiln is not to exceed 33.0 lbs/hr (3-hour average).

CO emissions could be effected to certain degree by possible variations in equipment, process parameters and control, clay carbon content, and NO_x emission reduction measures among similar facilities. To account for effects of these variations on the CO emissions, EPD has decided to set this CO BACT emission limit (in lbs. of CO/ton of kiln feed) 15% higher than that established by EPD for Carbo Ceramics – Toomsboro Plant.[11] The decision was based EPD's review of the six CO emission performance tests conducted on three existing ceramic proppant calciners/kilns similar to PyraMax Ceramics', and owned and operated by the Carbo Ceramics – Toomsboro Plant.

4.4.2 CO Emissions from Spray Dryers/Pelletizers

Because the temperature in PyraMax Ceramics' spray dryers/pelletizers are substantially lower than that in the calciners/kilns, and too low for the sizeable oxidation/combustion of carbonaceous materials in the clay slurry to occur, CO emissions from the spray dryers/pelletizers are almost exclusively from incomplete fuel combustion.

Georgia Air Quality Application No. 20485 dated July 21, 2011 provides a discussion on the mechanisms, characteristics and technical feasibilities of the CO emission control technology options identified for the sources. Please refer to Part 5.0 of Volume 1 of the application for details. Table 4.4.2-1 ranks the technically feasible control technologies for controlling CO emission from the spray dryers/pelletizers per the applicant (Chapter 5 of Volume I).

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[7] Per US EPA Air Pollution Control Cost Manual – 6th Edition

[8] Page 5-22, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics – King's Mill Facility.

[9] Page 5-23, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics – King's Mill Facility.

[10] Carbo Ceramics – Toomsboro Plant, Toomsboro, Georgia.

[11] Testing reports submitted by Georgia Air Quality Permit No. 3295-319-0029-V-02-1

Table 4.4.2-1: Ranking of Control Technologies for CO Emissions from Spray Dryers/Pelletizers

Control Technology Ranking	Control Technology	Control Efficiency[12]
1	Regenerative Thermal Oxidation	98%
2	Catalytic Oxidation	95%
3	Good Combustion Techniques	0-20%

Review of literature, the BACT/LAER Clearinghouse, and permits issued to facilities with similar operations such as structural clay product manufacturing, ceramic product manufacturing and cement manufacturing by other states indicates that proper equipment design and process operation (i.e., good combustion technology) represents BACT for CO emissions from dryers. Properly controlled combustion in the spray dryers/pelletizers minimizes CO formation by ensuring that temperature profiles and O_2 availability are adequate for complete combustion of fuel.

Add-on control systems identical to those discussed for the calciners/kilns can be used in the same way to further reduce the CO emission from PyraMax Ceramics' spray dryers/pelletizers, though literature research indicates that presently no such system has been used for such sources.

Similar to calciner/kiln, using RTO or catalytic oxidizer to reduce CO (and VOC) emissions from spray dryers/pelletizers incurs high cost. The current cost of controlling CO with a RTO system is estimated approximately at between $200,000 per ton of CO removed, and $145,000 per ton of CO removed with a catalytic oxidizer[13].

BACT Determination

EPD has determined, based on the cost estimations, that the RTO and the catalytic oxidizer are not economically feasible as BACT for controlling the CO emissions from PyraMax Ceramics' spray dryers.

EPD has determined that PyraMax Ceramics' proposal of optimizing design, operation, and maintenance of the spray dryers and associated combustion systems to minimize the emissions of CO constitutes BACT. The numeric BACT limit for the CO emissions from each spray dryer/pelletizer is 13.73 lbs./hr (3-hour average) as recommended by the applicant.

4.4.3 CO Emissions from Natural Gas-Fired Boilers

Incomplete fuel combustion is the sole source of the CO emissions from the two (2) 9.8 MMBtu/hr natural gas-fired boilers with propane as backup fuel. Therefore, boiler manufacturers have made efforts to optimize the design, operation and maintenance of their boilers including associated combustion control systems for allowing good combustion and thus minimizing the CO emissions. Such optimization process is often referred to as combustion controls, and based on maintaining continuous mixing of air and fuel in a proper proportion via appropriate turbulence, residence time, and combustion chamber temperature. In theory, excess air/oxygen and higher furnace temperature could minimize CO emissions, but such approach can often result in an increase in emissions of NO_x from the same process. Consequently, efforts have been made by boiler manufacturers to design their boiler's combustion systems (specifically the air/fuel mixing ratios and furnace temperatures) such that CO levels are reduced as much as possible without causing NO_x levels to increase significantly.

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[12] Per US EPA Air Pollution Control Cost Manual – 6th Edition

[13] Page 5-37, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics – King's Mill Facility.

These boilers will be purchased as a "packaged boiler" each integrated with all of its components - burner, controls and auxiliary equipment, designed as a single engineered package, and ready for on-site installation. Their performances including emission levels, are guaranteed by the manufacturer(s)

Add-on control systems identical to those discussed for the calciners/kilns and spray dryers/pelletizers could be used in a same way to further reduce the CO emission from these boilers, though literature research indicates that presently no such system has been used for natural gas-fired boilers at such capacity.

Georgia Air Quality Application No. 20485 dated July 21, 2011 provides a discussion on the mechanisms, characteristics and technical feasibilities of the CO emission control technology options identified for the sources. Please refer to Part 5.0 of Volume 1 of the application for details. Table 4.4.3-1 ranks the technically feasible control technologies for controlling CO emission from the boilers in term of control efficiency.

Table 4.4.3-1: Ranking of Technically Feasible Control Technologies for CO Emissions from Natural Gas-Fired Boiler

Control Technology Ranking	Control Technology	Control Efficiency[14]
1	Regenerative Thermal Oxidation	98%
2	Catalytic Oxidation	95%
3	Good Combustion Techniques	0-20%

Control cost of using RTO and catalytic oxidizers to reduce CO (and also VOC) emissions from the boilers is high, estimated at approximately $250,000 per ton and $144,000 per ton of CO removed by RTO and catalytic oxidizer respectively[15].

BACT Determination

EPD agrees with PyraMax Ceramics' conclusion that based on the cost estimations, neither the RTO nor the catalytic oxidizer as discussed above is economically feasible as BACT for controlling the CO emissions from the 9.8 MMBtu/hr natural gas-fired boilers. EPD agrees with the applicant that BACT for CO for these small boilers is good combustion practices coupled with the use of natural gas or propane as fuel.

4.4.4 CO Emissions from Stationary Emergency Diesel Generators/Engines

CO emissions from the stationary emergency diesel generator sets are the result of incomplete fuel combustion. Incomplete combustion of fuel reduces the fuel efficiency, increases operational cost and worsens the performance of the engines involved. For these reasons, engine/generator manufactures have made efforts to optimize the design, control and operation of the engines (referred as Good Combustion Techniques) to minimize the incomplete fuel combustion. To regulate CO emissions from diesel engines, EPA has promulgated NSPS Subpart IIII which limits the CO emissions from diesel based on the manufacturing data/model year and rated capacity of the engine involved.

Georgia Air Quality Application No. 20485 dated July 21, 2011 provides a discussion on the mechanisms, characteristics and technical feasibilities of the CO emission control technology options identified for the sources. Please refer to Part 5.0 of Volume 1 of the application for details. Technically feasible add-on/post combustion control technology is based on thermal

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[14] Per US EPA Air Pollution Control Cost Manual – 6th Edition

[15] Page 5-48, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics – King's Mill Facility.

oxidation/ combustion of CO in the exhaust gas into CO_2 and water, and embodied as Regenerative Thermal Oxidizer (RTO) and Catalytic Oxidizer.

EPA has determined in the development of NSPS Subpart IIII that add-on controls are economically infeasible for emergency internal combustion engines. The applicant proposed a CO BACT emission limit for the generators equal to that of the applicable NSPS IIII standard, or 3.5 g/kW-hr as found on Volume I application page 5-57.

BACT Determination
EPD has determined that, based on the cost estimations, the RTO and the catalytic oxidizer are not economically feasible as BACT for controlling the CO emissions from PyraMax Ceramics' stationary emergency diesel generators/engines.

EPD has determined that compliance with the applicable requirements under NSPS IIII and NESHAP ZZZZ is BACT for the CO emissions from PyraMax Ceramics' stationary emergency diesel generators/engines. Certified to be in compliance with the applicable Tier III nonroad compression ignition engine emission standards specified in 40 CFR Part 89, PyraMax Ceramics' 500 kW stationary emergency diesel generators will meet or exceed the BACT for CO for the same model year and engine power.

4.5 SO_2 Emissions from Fuel Combustion Sources

SO_2 emissions are generated when sulfur contained in the fuel and raw materials is oxidized in the air at high temperature. Two types of SO_2 emission sources exit at this facility:

- External combustion process units including the boilers (indirect heating process), spray dryers/pelletizers and calciners/kilns (direct heating process); and
- Internal combustion process units, i.e., diesel generators/engines.

For boilers and diesel generators, fuel sulfur is the only source of SO_2 emissions. Most likely it is also true for spray dryers/pelletizers because the working temperature of the units is not high enough for sizable oxidation of natural occurring sulfur contained in the clay into SO_2 (formation of small amounts of SO_2 still occurs at the vicinity of the burner flame zones). Since these boilers and spray dryers/pelletizers only burn natural gas and propane, and the diesel generators only use extreme low sulfur diesel fuels, SO_2 emissions from these units are insignificant.

Consequently, at this facility SO_2 emissions are generated primarily from the oxidation of the naturally occurring sulfur contained in clay at high temperature in the calciners/kilns. Based on the results of on-site testing at an existing facility producing the same product via similar process and equipment, SO_2 emission from these calciners/kilns account for approximately 97% of the facility-wide SO_2 emissions[16].

Georgia Air Quality Application No. 20485 dated July 21, 2011 provides a discussion on the mechanisms, characteristics and technical feasibilities of the SO_2 emission control technology options identified for the sources. Please refer to Part 5.0 of Volume 1 of the application for details. Technically feasible control technologies for the SO_2 emissions from this facility are ranked by control effectiveness in Table 4.5-1. Because all the technologies identified except the use of low sulfur fuels are post-combustion/add-on control devices designed to remove SO_2 from exhaust/flue gases, they are applicable to PyraMax Ceramics' all four types of combustion sources. A discussion of the applicable post-combustion/add-on control devices is provided in this section.

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[16] Table C-2, Georgia Air Quality Permit Application No. 20584, PyraMax Ceramics, LLC – King's Mill Facility, July 21, 201

Absorption/Wet Scrubbing can be an effective add-on control technology for SO_2 removal. Wet scrubbers use an aqueous alkaline solution to convert gaseous SO_2 in exhaust/flue gas into water soluble or insoluble sulfates via neutralization. The technology has been shown to provide SO_2 control in excess of 90% under optimal operating conditions. Wet Absorption control devices include packed towers, plate or tray columns, Venturi scrubbers, and spray chambers.

In all cases, fresh scrubbing solution is added continuously via pH and flow rate control to the scrubbing units to compensate for the quantity of the alkali reacted with SO_2 and the amount of solutions lost due to evaporation.

Wet scrubbing can also remove particulate matter, some VOC, and other acidic gases to various extent. Application of a wet scrubber requires passing the exhaust/flue gases through a primary particulate matter control, producing a calcium sulfate ($CaSO_4$) or a sodium sulfate (Na_2SO_4) as byproduct/sludge, depending on what alkali compound is used.

On the other hand, wet scrubbing has a number of downsides:

- Adverse environmental and economic impacts by generating solid waste requiring landfill disposal (if a usable sulfate byproduct cannot be recovered from the sludge), and treatment and disposal of liquid blowdown containing dissolved solids (various salts including mainly sulfates).
- Replenish large quantities of fresh water lost due to vaporization of the scrubbing solution has an impact on the water supply in the area.
- The static pressure drop through the wet scrubber and demister increases the electrical energy demand for the facility and has an adverse impact on energy usage at the site. In addition, the need to drive and to reheat stack gases for proper atmospheric dispersion and corrosion prevention has a significant energy impact.

Adsorption/Dry or Semi-Dry Scrubbing systems spray or inject dry or semi-dry powdery alkalis such as lime, calcium hydrate, limestone, or soda into ducts transferring SO_2-laden exhaust gases or into add-on control devices (dry scrubbers) where the flue gases pass. Similar to wet scrubbing, dry or semi-dry scrubbing remove SO_2 via neutralization which converts gaseous SO_2 into solid sulfates. A variety of dry absorbent injection scrubbing systems have been used on wet and dry cement kilns and brick kilns.

No adverse environmental or energy impacts are expected from the use of the dry absorption in general. Compared to wet scrubbing, dry or semi-dry scrubbing costs substantially less in terms of equipment, operation, maintenance, reagents/absorbents and disposal of solid scrubbing wastes.

"Catalytic Baghouse" System: Because as much as 97% of SO_2 emissions could be generated by the calciners/kilns where naturally occurring sulfur in clay is converted to SO_2 at high temperature, PyraMax Ceramics proposed to equip each calciner/kiln with one "catalytic baghouse" to control the SO_2 emissions. The mechanism and configuration of the "catalytic baghouse" system is similar to that of a typical dry scrubber consisting of a powdery alkaline absorbent injection unit followed by a fabric baghouse, except that the "catalytic baghouse" system uses a ceramic tube filter system instead of a fabric baghouse to capture particulate matters (unused absorbent powders and sulfates) generated during the process. Vendor documentation indicates this system could achieve a SO_2 control efficiency of 90 – 98%[17], which is substantially higher than that of a system using a traditional fabric baghouse. A tentative explanation of such high control efficiency is that ceramic filters can achieve better "caking" than

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[17] Georgia Air Quality Permit Application No. 20584, PyraMax Ceramics, LLC – King's Mill Facility, July 21, 201

traditional fabric baghouses, especially these designed for elevated temperature applications. Better "caking" could increase the contacting time/path length and surface between gaseous SO_2 molecules and powdery alkaline absorbents, and thus enhance the neutralization reaction/scrubbing, resulting in an increase in control efficiency.

The calciners/kilns at the same time are the sources of significant emissions of other acid gases, mainly HCl and HF resulted from conversion of naturally occurring chlorides and fluorides in clay at high temperature. Both compounds are EPA listed HAP. The "catalytic baghouse" can also reduce HCl and HF and other acid gases. This system has been determined by EPD as case-by-case MACT for control of HCl and HF. For detailed discussion, please refer to Appendix A.

Figure 4.5-1 is taken directly from 0411 TriMer Bulletin-UltraCat Hot Gas Filtration Boiler MACT Solution- (copyrighted bulletin by TriMer) for illustrative purposes only. Figure 4.5-1 illustrates a typical "catalytic baghouse"/ceramic tube filter system consisting of an absorbent injection unit, an aqueous ammonia injection unit, and a ceramic tube filter unit containing an array of ceramic tube filters. The ceramic tube filters are impregnated with nano particles of catalysts and function also as SCR for NO_x emission control.

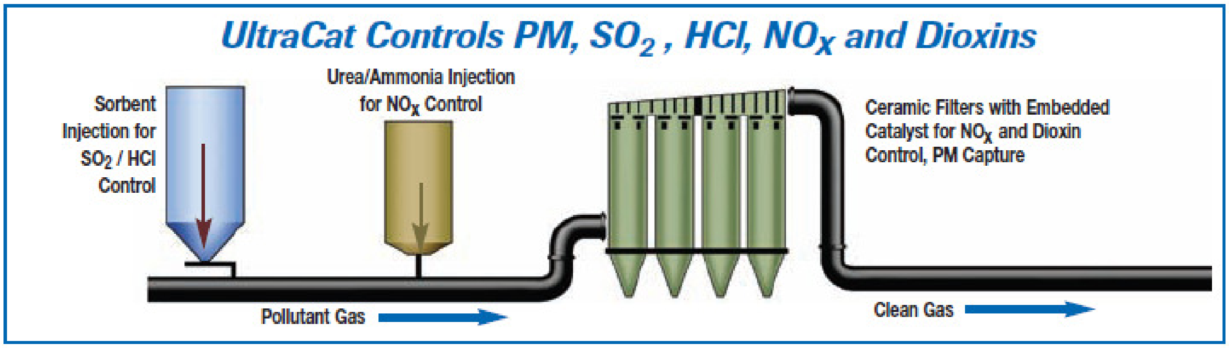

Figure 4.5-1: Illustration of a SO_2, HCl, HF, NO_x and PM Control System Using Ceramic Filters with Embedded Catalysts for NO_x Control[18]

Based on EPD's analysis, Table 4.5-1 ranks the SO_2 control technologies selected based on their control efficiency. Both wet scrubber and the "catalytic baghouse" system are at the top of top down list.

Table 4.5-1: Ranking of Technically Feasible Control Technologies for SO_2 Emissions

Emission Source	Ranking	Control Technology	Typical Control Efficiency
Calciners/Kilns; Spray Dryers/Pelletizers; Natural Gas-Fired Boilers; Emergency Diesel Generators	1	• Wet Scrubber; • "Catalytic Baghouse" System	90%
	2	Semi-Dry Scrubber (Spray Dryer Type)	80%
	3	Dry Scrubber (Injection System)	+50%
	4	Use of Only Natural Gas, Propane & Extreme Low Sulfur Fuel Oil As Fuels	N/A

BACT Determination

EPD has determined that the proposed "catalytic baghouse"/ceramic filter system, in combination of exclusive use of natural gas and propane, is BACT for SO_2 emissions from the ceramic proppant calciners/kilns at PyraMax Ceramics' facility. The applicant proposed an SO_2 BACT of

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[18] Tri-Mer Corporation, http://www.tri-mer.com/hot-gas-filtration.html

limit from the calciners/kilns of 11.64 lb/hr on a 3-hour average during EPA Method 6 or 6C testing, based on no less than 90% reduction of SO_2 on a 3-hour average during EPA Method 6 or 6C testing. Georgia EPD has determined that the BACT consists of 90% reduction of the SO_2 emissions (3-hour average during EPA Method 6 or 6C testing), and 11.64 lbs/hr of SO_2 which is calculated using daily analysis of clay sulfur content (24-hour average) and the control efficiency as established during the most recent EPD-approved performance test.

Based on the cost estimations provided with the application No. 20584, EPD has determined also that none of the add-on control technology discussed above is economically feasible as BACT for controlling SO_2 emissions from <u>other</u> combustion sources at this facility, including spray dryers/pelletizers, boilers, and diesel generators. The low loading rates/concentrations of SO_2 in the exhaust/flue gases from these sources diminish the amounts of SO_2 available for removal, causing the costs for removing each ton of SO_2 economically infeasible.

Instead, the following constitutes BACT for the SO_2 emissions from spray dryers/pelletizers, boilers, and diesel generators:

- Exclusive use of natural gas and propane as fuels for all the boilers and spray dryers/pelletizers.
- Exclusive use of ultra low sulfur diesel fuels as required by NSPS Subpart IIII for all the stationary emergency diesel generators/engines

To ensure the compliance with the BACT limits, conditions in this permit will establish relevant SO_2 emission limits and operating, monitoring, testing, record keeping, compliance demonstration and reporting requirements, including, but not limited to, production records, fuel usage and fuel certification records, and daily analysis of sulfur content in raw clay processed by each calciner/kiln. A mass balance based on the records of the results of daily raw clay sulfur content analysis and kiln input rate will be utilized to demonstrate compliance with the BACT mass discharging rate limit in pound per hour for each calciner/kiln.

4.6 NO_x Emissions from Fuel Combustion Sources

At this facility, NO_x is formed as a result of oxidation of nitrogen occurring at high temperature such as during fuel combustion in boilers, spray dryers/pelletizers, calciners/kilns and internal combustion engines. NO_x is produced mainly through two mechanisms during combustion:

- High temperature oxidation of fuel nitrogen into fuel NO_x; and
- Thermal formation of NO_x from nitrogen in combustion air.

Fuel NO_x is formed due to the oxidation of nitrogen or its compounds contained in fuel. The resulting NO_x emissions are primarily affected by the fuel nitrogen content and excess air/oxygen in the flame. In case of calciners/kilns, nitrogen compounds in the kiln feed, i.e., green ware pellets may also contribute to NO_x emissions but to much smaller extent.

In general, substituting a fuel with one that has a higher heating value will reduce NO_x emissions in part because fuel/heating efficiency is increased and less total fuel is consumed. Increasing fuel efficiency has the same result. Modern rotary calciners/kilns such as the ones at PyraMax Ceramics are optimized in both design and operation to maximize fuel efficiency.

In addition to maximized fuel efficiency due to optimized design and operation, for years boilers and internal combustion engines have also been designed to comply with the applicable NO_x emission standards in Federal regulations such as New Sources Performance Standards, e.g., 40 CFR Part 60, Subpart Dc for boilers and 40 CFR Part 60, Subpart IIII for internal combustion engines. Therefore, NO_x emissions from these sources are curtailed accordingly.

Thermal NO_x is the most significant NO_x formation mechanism in the calciner/kiln combustion because the process involves relatively high temperature (up to 3,000°F). The rate of thermal conversion from nitrogen (N_2) in the combustion air to NO_x is controlled by both excess O_2 in the flame and the temperature of the flame. In general, NO_x levels increase with the higher flame temperatures that are typical in the kiln burning zone. In addition, the burner design, as it affects flame shape, and the fuel to air ratio, can mitigate the formation of thermal NO_x. In most modern rotary calciners/kilns, including the ones proposed by PyraMax Ceramics, low-NO_x burners and Good Combustion Techniques consisting of appropriate equipment design and process control are commonly used to reduce the thermal NO_x emissions.

The NO_x formation mechanism of the spray dryers/pelletizers is similar to that of the calciners/kilns, except that the spray dryers work at much low temperature range than calciners/kilns. Consequently, spray dryer's high temperature zone where thermal NO_x can form is significantly smaller that of the calciners/kilns. Results of on-site testing at a similar facility indicated that the NO_x emissions from the spray dryers were less than 7% of that from the calciners/kilns[19].

Because of their relatively small capacity, small high temperature zone, and/or short operating time (500 hours per year for each emergency diesel generator), NO_x emissions from the two 9.8 MM BTU/hr natural gas boilers and all the emergency diesel generators are insignificant compared to these from kilns and spray dryers.

Technically feasible control technologies for the NO_x emissions from these sources are ranked by their control effectiveness in Table 4.6-1 as taken from the application.

Table 4.6-1: Ranking of Technically Feasible Control Technologies for NO_x Emissions

Emission Source	Ranking	Control Technology	Control Efficiency
Calciner/Kiln	1	"Catalytic Baghouse" System	<95%
	2	• Selective Catalytic Reduction (SCR) • Selective Non Catalytic Reduction (SNCR)	70-90%
	3	Low NO_x Combustion Technology	N/A

Available add-on control technologies for NO_x include selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR).

Selective Non-Catalytic Reduction (SNCR) involves injecting an ammonia or urea-containing solution into exhaust/flue gas streams to reduce NO_x. The solution may be supplied in the form of anhydrous ammonia, aqueous ammonia, or urea. The injection point shall have the optimum temperature range of 800° to 1,090°C. Residence time, turbulence, oxygen content, and a number of other factors specific to the given gas stream are also important for the success of SNCR.

Unreacted ammonia emitted as gas in the plume will react with SO_2 or HCl in the condensed water vapor plume forming a highly visible plume under certain weather conditions.

Any reduction in initial concentration of NO_x prior to introduction of the flue gas to the SNCR will result in a minimization of reagent used by the SNCR to reduce the NO_x. This results in cost savings and makes the SNCR a more effective means of reducing NOx emissions. Low NO_x

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[19] Tables 5.2.1-3, Georgia Air Quality Permit Application No. 18293 revised on February 9, 2009, Carbo Ceramics – Toomsboro Plant.

burners can also be used in conjunction with SNCR to help reducing the NO_x subsequently reduced by SNCR.

It is worth noting that ammonia in the gas stream competes with CO for available hydroxyl radicals, resulting in increases in CO emissions. Therefore, in addition to the "ammonia slip" and ammonium sulfate submicron aerosol emissions, SNCR's effect on CO emissions should also be taken into consideration during the establishment of the extent of using SNCR to reduce NO_x, i.e., the level of NH_3/NO_x ratio. These considerations should balance CO, NO_x, NH_3 and SO_2 emissions on a case-by-case basis, and establish relevant emission standards accordingly.

Selective Catalytic Reduction (SCR) uses an ammonia or urea-containing solution/reagent in the presence of a catalyst to reduce NO_x at a relatively lower temperature and enhanced speed than SNCR. The catalyst is typically vanadium pentoxide, zeolite, or titanium dioxide. The SCR process has been proven to reduce NO_x emissions from combustion sources such as incinerators and boilers used in electric power generation plants.

In summary, the control efficiency of both SNCR and SCR are comparable, and ranked at the top among all the NO_x control technologies discussed above. The control efficiencies of the rest of the technologies vary based on such factors as equipment design, raw materials, fuels, combustion and operating parameters, and are difficult to be placed.

"Catalytic Baghouse" System: PyraMax proposed in this application to use the "catalytic baghouse" system to control the NO_x emissions from the calciners/kilns at this facility. This system functions as a SCR to reduce the NO_x emissions, but instead of over a designated catalyst bed/vessel, the reaction occurs mainly inside the ceramic tube filters' wall which are embedded with nano-catalysts. Figures 4.6-1 and 4.6-2 are taken directly from 0411 TriMer Bulletin-UltraCat Hot Gas Filtration Boiler MACT Solution- (copyrighted bulletin by TriMer) for illustrative purposes only. Figure 4.6-1 illustrates portion of the cross section of the ceramic filter tube wall embedded with the nano-catalysts. Figure 4.6-2 shows a micrograph of the nano-catalysts embedded on the ceramic fibers which compose the ceramic tube filters.

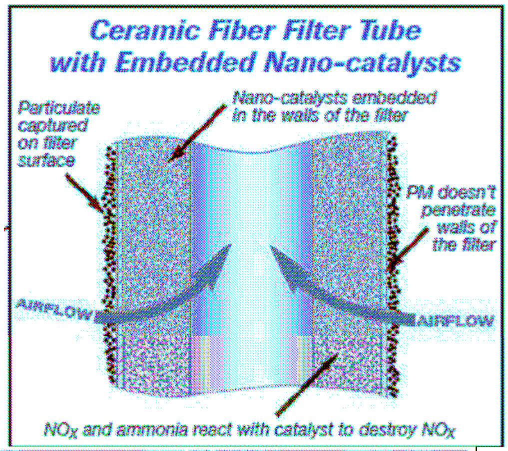

Figure 4.6-1: Illustration of Ceramic Filter Cross Section with Embedded Nano-Catalysts

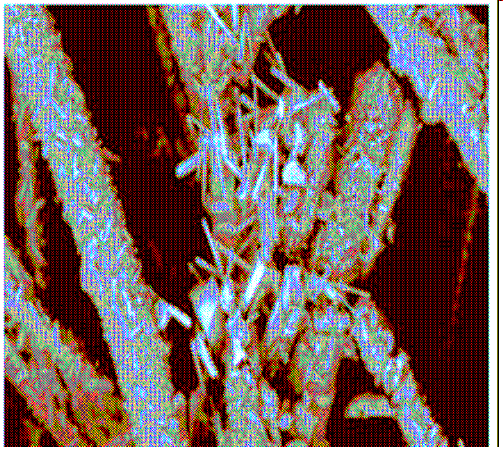

Figure 4.6-2: Micrograph of Nano-catalysts Embedded on Ceramic Fibers Composing the Wall of the Ceramic Filters

According to the manufacturer[20], the NO_x control efficiency of the "catalytic baghouse" system is higher than a typical SCR or SNCR while the system costs less and works from a substantial lower temperature. Temperature of normal operating range for such system is approximately 350°F to 700°F. Similar to a SCR, an ammonia or urea-containing solution is injected upstream of the ceramic tube filters and then reacts with NO_x at the surface of the embedded catalysts to form nitrogen gas and water vapor, which exiting from the inside of the ceramic filter tubes and then discharging from the system into the atmosphere. The proprietary nano catalysts are resistant to sulfur poisoning and are protected from particulate contamination or fouling because they are embedded inside the filter walls, i.e., located at "clean side" of the "baghouse"/filter.

The fine sizes of the embedded nano-catalysts increase the surface area for reaction to take place and, at the same time, may reduce the energy barrier for the reaction to occur. Both would be expected to lower the minimum reaction temperature, accelerate the reaction, and make the reaction more complete. Consequently, the "catalytic baghouse" system could achieve a NO_x control efficiency higher than that of a typical SCR, up to 95% removal[21].

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[20] Tri-Mer

[21] Tri- Mer

Low NOx Combustion Technology: Low NO_x burners are designed in such as way that they can produce optimized or modified combustion conditions/characteristics in order minimize the formation of thermal NO_x. They offer precise mixing of fuel and air to keep the flame temperature low and to dissipate heat quickly through the use of low excess air, off stoichiometric combustion and combustion gas recirculation[22]. Depending on specific application, a low NO_x burner could accomplish any combination of the three features. All the dry sprayers/pelletizers and calciners/kilns at PyraMax Ceramics' facility will be equipped with low NO_x burners.

Application No. 20584 dated July 21, 2011 also has further discussions on the mechanisms, characteristics and feasibilities of all the NO_x emission control technology options identified. Please refer to Section 5.0 of Volume 1 of the application for details.

BACT Determination

EPD has determined that the "catalytic baghouse" system plus low NO_x burner and Good Combustion Technology, as proposed by PyraMax Ceramics, are BACT for NO_x emissions from the ceramic calciners/kilns, with a removal efficiency of no less than 80% by weight.

Based on the cost estimations provided with the application No. 20584, EPD has decided also that none of the add-on control technology discussed above except the low NO_x burner is economically feasible as BACT for controlling the NO_x emissions from other combustion sources at this facility.

Instead, the following constitutes BACT for the NO_x emissions from these sources:

- Using Good Combustion Techniques to control the NO_x emissions from each spray dryer/pelletizer to no more than 2.25 lbs/hr (3-hour average);
- Using low NO_x burner to limit NO_x emissions from each boiler to no more than 12 ppmv@3% O_2 on dry standard conditions, which are employed by manufacturer(s). This BACT limits was established by EPD for this type of boilers in a similar facility.[23]
- Certifying that the emergency diesel generators are in compliance with the applicable Tier III NO_x emission standard for nonroad compression ignition engines, which are equivalent or more stringent than the 40 CFR Part 60, Subpart IIII NO_x standard for the same engines.

To ensure the compliance with the BACT limits, conditions in this permit will establish the relevant NO_x emission limits, and operating, work practice, maintenance, monitoring, testing, record keeping, compliance demonstration and reporting requirements for the NO_x BACT. For each calciner/kiln, annual NO_x performance testing is required. In addition, the NO_x emissions from each calciner/kiln will be monitored routinely using a portable NO_x analyzer.

4.7 VOC Emissions from Fuel Combustion Sources

Because the potential VOC emissions from the proposed facility exceed the 40-tons per year significant increase level under NSR/PSD rules, the VOC emissions are evaluated for BACT. At this facility, only fuel combustion sources have VOC emissions, including spray dryers/pelletizers, calciners/kilns, boilers and diesel generators. These VOC emission sources are subject to BACT review.

For boilers and diesel generators, VOC emissions are the results of incomplete fuel combustion. Fuel combustion contributes small portion of VOC emissions from spray dryers/pelletizers and calciners/kilns. Most of the VOC emissions from the spray dryers/pelletizers result from

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[22] www.charmeck.org/mecklenburg/.../NOxReductionhandoutFINAL.pdf

[23] Georgia Air Quality Permit No. 3241-153-0003-V-05-0, CEMEX Southeast, LLC

evaporation of the organic compounds or impurities (mostly methanol) contained in a dispersant added to clay slurry being dried/baked inside the spray dryer/pelletizer. In addition to the VOC emissions from fuel combustion, oxidation of carbonaceous materials in the feed stock/green clay pellets introduced to the calciners/kilns also generate VOC emissions. The amount of VOC generated from such pyrolitic process depends on the nature of the organics present in the feed materials. Light hydrocarbon species typically produce more VOCs and less CO and vice versa. Among theses sources, spray dryers/pelletizers generate most of the VOC emissions due to the vaporization of methanol contained in dispersant, which account for approximately 95% of the facility-wide VOC emissions[24].

According to EPA, there are no known cases of similar spray dryers using any add-on VOC HAPs control in clay and ceramic products manufacturing industries[25]. An information search also confirms that there are no known cases of add-on VOC control being utilized for similar ceramic calciners/kilns.

The applicant proposed in Chapter 5.14 of Volume I, the potential control technologies that include regenerative thermal oxidizer (RTO), oxidation catalyst, and good combustion techniques. Georgia EPD adds the following potential VOC control technologies: Quencher/scrubber system (Direct Contact Condensation), carbon adsorption, biofiltration, and pollution prevention & substitute materials, as listed in Table 4.7-1:

Table 4.7-1: Evaluated Control Options for the VOC Emissions from Spray Dryers/Pelletizers

Control Option No.	Control Technology
1	Quencher/Scrubber System (Direct Contact Condensation)
2	Carbon Adsorption
3	Regenerative Thermal Oxidation (RTO)
4	Catalytic Oxidation
5	Biofiltration
6	Pollution Prevention & Substitute Material

Quencher/Scrubber System (Direct Contact Condensation) can, in theory, reduce the methanol emissions from PyraMax Ceramics' spray dryers/pelletizers by chilling the exhaust gas streams from these sources. As the temperature of the exhaust gas streams is lowered, a portion of the methanol in the exhaust gas streams could be condensed and thus removed (direct contact condensation). Nevertheless, the methanol concentration in each of the exhaust gas streams from the spray dryers/pelletizers is approximately 12.4 ppm by volume, which is substantially below the low boundary of the concentration range (1,000 ppm by volume) for VOC condensation control technology to be effective[26]. In addition to the low concentration, the spray dryers/pelletizers' exhaust gas streams are rich in water vapor. Condensation of large quantity of water would make the operation of the condensation system even less cost-effective and practical. Based on these findings, condensation is deemed technically infeasible and not considered further for this BACT analysis.

The control/removal efficiencies of the rest evaluated control options for the VOC emissions from PyraMax Ceramic's spray dryers/pelletizers are listed below:

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[24] Table C-2, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics – Kiln's Mill Facility.

[25] Per a 2007 telephone conversion with Mr. Jeff Telander, Project Lead of 40 CFR Part 63, Subpart JJJJJ (NESHAP MACT standard for Brick & Structural Clay Products Manufacturing) and Subpart KKKKK (NESHAP MACT standard for Clay Ceramics Manufacturing), 919-541-5427, telander.jeff@epa.gov.

[26] EPA, *Survey of Control Technologies for Low Concentration Organic Vapor Streams*, EPA-456/R-95-003, May 1995.

Table 4.7-2: Evaluated Applicable Control Options for VOC Emissions from PyraMax Ceramics' Spray Dryers/Pelletizers

Control Option No.	Control Technology	Control Efficiency
2	Carbon Adsorption	98%
3	Regenerative Thermal Oxidation	98%
4	Catalytic Oxidation	95%
5	Biofiltration	90%
6	Pollution Prevention & Substitute Material	N/A

Adsorption is a surface phenomenon where VOC compounds are selectively adsorbed on the surface of such materials (adsorbents) as activated carbon, silica gel or alumina. Activated carbon in various granular shapes/sizes is the most widely used adsorbent. Carbon adsorption technology has been used by various industries for controlling VOC emissions from a variety of sources/processes, especially for recovering VOC compounds from VOC-rich gas exhaust/ventilation gas streams. For detailed discussion, please refer to Appendix A: *112(g) of CAA Case-By-Case Maximum Achievable Control Technology Determination*.

A regenerative thermal oxidizer (RTO) can readily oxidize/burn the VOC in the spray dryers/pelletizers' exhaust gas streams into CO_2 and water vapor when designed, maintained and operated properly. The advantage of an RTO over a direct flame thermal oxidizer is its increased thermal efficiency via effective heat recovery. The control efficiency of an RTO, when properly maintained and operated, can be as high as 99%[27]. Although the use of an RTO has been determined to be technically feasible in theory, no RTOs have been employed to control the VOC emissions in sources similar to PyraMax Ceramics' spray dryers/pelletizers.

A catalytic oxidizer destroys the VOC emissions in exhaust gas streams via oxidation just like an RTO. The catalysts serve to reduce the activation energy required for the complete oxidation of the VOC compounds involved, thus enable the oxidation or burn-off of the VOC compounds to take place at a relatively low temperature, which reduce the energy demand thus the cost of the control. The control efficiency of catalytic oxidizers can reach 95% when they are properly maintained and operated[28]. Although they are technically feasible in theory, no catalytic oxidizers have been found to control VOC emissions in a process unit/source similar to PyraMax Ceramics' spray dryers/pelletizers.

Biofiltration uses microbes to consume pollutants from a contaminated air stream. In suitable environment, microbes can easily decompose organic compounds, or VOCs, into CO_2, water and biomass via metabolism. Depending on the nature of the pollutants and suitability of the working environment, the efficiency of the system could reach 90%. For detailed discussion, please refer to Appendix A: *112(g) of CAA Case-By-Case Maximum Achievable Control Technology Determination.*

The dispersant used by PyraMax Ceramics in slurry preparation contains up to 1% by weight of methanol as impurity. Continuous use of an additive with the minimum amount of the methanol is the primary mechanism available for minimizing the methanol emissions. Efforts to find a supplier which could provide the same chemical with less methanol as impurity were not successful because industry grades of this chemicals from different suppliers contain almost the same amount of methanol as impurity. Agent grades of the same chemicals contain much less impurities including methanol, but are far too expensive to be used in large scale commercial production.

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[27] Page 4-2, EPA, *Handbook: Control Technologies for Hazardous Air Pollutants*, EPA/625/6-91/014, June 1991.

[28] Page 4-12, EPA, *Handbook: Control Technologies for Hazardous Air Pollutants*, EPA/625/6-91/014, June 1991.

Review of literature, BACT/LAER Clearinghouse and PSD permits issued to similar facilities in the U.S. indicates that no add-on control devices have been used as BACT for VOC emissions from spray dryers/pelletizers.

Due to the relatively low VOC loading rate/concentration (which diminishes the amount of VOC to be captured or destroyed and the capture or control efficiency), and the large exhaust gas flow from the spray dryers/pelletizer (Exhaust gas flow rate generally dictates the size of the control system and thus the cost of the system), all the add-on control systems discussed above incur high control costs, as shown in Table 4.7-3.

Table 4.7-3: Cost Impact of the Evaluated Applicable Control Options for VOC Emissions from PyraMax Ceramics' Spray Dryers/Pelletizers

Control Option No.	Control Technology	Cost Effectiveness[1] ($/ton methanol & methyl acetate reduced)
2	Carbon Adsorption	$15, 750
3	Regenerative Thermal Oxidation (RTO)	$60,000
4	Catalytic Oxidation	$19,308
5	Biotrickling Filter	$74, 350
6	Pollution Prevention & Substitute Material	N/A

[1] Control costs for option 3 and 4 were obtained from PyraMax Ceramics' Application No. 20584 dated July 21, 2011. Control costs for carbon adsorption and biotrickling filer were derived from cost analysis data as provided by Georgia Air Quality Permit Application No. 18293 revised on February 9, 2009, submitted by Carbo Ceramics – Toomsboro Plant.

Georgia Air Quality Application No. 20485 dated July 21, 2011 has further discussions on the mechanisms, characteristics and technical feasibilities of the VOC emission control technology options identified for the sources. Please refer to Part 5.0 of Volume 1 of the application for details.

VOC BACT Determination

EPD has determined that, based on the cost estimation data in Table 4.7-3, none of the technically feasible add-on VOC emission control technologies identified is economically feasible as BACT for control of the VOC emissions from PyraMax Ceramics' spray dryers/pelletizers. Because the VOC emission levels from the rest of the sources are even lower than that of spray dryers/pelletizers due to an even lower concentration and/or larger exhaust gas flow in case of calciners/kilns and boilers, or due to limited operating hours in case of emergency diesel generators, costs for the same add-on VOC control systems for these sources should be even higher than those for the spray dryers/pelletizers. Therefore, the same add-on control systems are also economically infeasible as BACT for control of the VOC emissions from these sources.

EPD has determined that the following constitutes BACT for the VOC emissions from this facility:

- Use only natural gas and propane as fuel for boilers, spray dryers/pelletizers, and calciners/kilns;
- Use only diesel fuels which meets requirements/standards under 40 CFR Part 60, Subpart IIII for the emergency diesel generators;
- Purchase and operate emergency diesel generators which are certified by EPA to the applicable Federal Emission Standards according to 40 CFR Part 60, Subpart IIII or 4 grams per kW-hr.
- Limit the VOC emissions from each spray dryer/pelletizer to 11.78 lbs./hr (24-hour average).

- Limit the VOC emissions from each calciner/kiln to 0.54 lbs./hr (24-hour average).
- Limit the accumulated annual operating time for each stationary emergency diesel generator to no more than 500 hours.
- Install, operate, and maintain all the fuel combustion sources according to manufacturers' specifications and instructions or a plan prepared by the facility and approved by EPD and/or manufacturer(s) designed to minimize incomplete combustion of fuel.

To ensure the compliance with the BACT limits, conditions in this permit will establish the relevant VOC emissions limits, operational, work practice, maintenance, monitoring, testing, record keeping, compliance demonstration and reporting requirements for the VOC BACT.

4.8 GHG Emissions from Fuel Combustion Sources

Because the potential GHG emissions from PyraMax Ceramic's proposed facility exceed the major source threshold under NSR/PSD rules, the GHG emissions are evaluated for BACT. At this facility, only fuel combustion sources have GHG emissions, including spray dryers/pelletizers, calciners/kilns, boilers and emergency diesel generators. These GHG emissions sources are sub ject to BACT review.

The GHG emissions from these sources include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) due to fossil fuel combustion. Additional GHG emissions include:

- CO_2 formed during dry scrubbing of acid gases (SO_2, HCl, and HF) in calciner/kiln exhausts where powdery dry alkaline sorbents injected into exhaust gases react with the acid gases and releasing CO_2 as one of the products generated during the neutralization reaction.
- CO_2 formed during the oxidation/combustion of carbonaceous materials in the feed/raw materials introduced to the calciners/kilns at high temperature.

For all the GHG sources at PyraMax Ceramics' facility, CO_2 emissions produced by fossil fuel combustion account for most of the GHG emissions, and therefore are targeted in this GHG BACT analysis by Georgia EPD. The applicant also conducted a BACT analysis for methane and N_2O.

Up to date, potential CO_2 control strategies and technologies for all the fuel combustion sources at this facility include;

- Carbon capture and storage (CCS)
- Selection of the most efficient processing or combustion technology
- Selection of the lowest carbon fuel
- Installation of energy efficient options for the combustion sources

Carbon capture and storage (CCS) involves separation and capture of CO_2 from the flue gas involved pressurization of the captured CO_2, transportation of the pressurized CO_2 via pipeline, and finally injection and long-term geologic storage of the captured CO_2. In U.S., several technologies have demonstrated potential to separate and capture CO_2, with some of them remaining at the laboratory scale only, while others proven effective at the slip-stream or pilot-sale.

Selection of the most efficient process and/or combustion technology can also reduce CO_2 emissions. PyraMax Ceramics' rotary calciners/kilns will be dry-process units fed with dry kiln input materials/green pellets, and therefore more fuel/heat efficient than wet process kilns which require additional heat/fuel to drive off the moisture in the wet or semi-wet kiln input materials. Burning less fuel than wet-process kilns, dry-process calciners/kilns will emit less CO_2 than wet-process kilns when producing same quantity of products.

The emergency diesel generators/engines at PyraMax Ceramics' facility are certified for compliance with the applicable U.S. EPA Tier III standards, which means that their emissions are the lowest and fuel efficiency are the highest among those commercially available.

Low-carbon intensity fuel selection for GHG BACT analysis is the primary control option which can be considered a low CO_2-emitting process. Except the emergency diesel generators, all the combustion sources (boilers, spray dryers/pelletizers and kilns/calciners) at PyraMax Ceramics' facility will be fired with natural gas with propane as backup fuel during curtailment of the natural gas supply. Natural gas is the lowest GHG-emitting fuel on a direct carbon basis than all other fossil fuels.

Installation of energy efficient options for the combustion sources includes approaches such as using the most fuel efficient fuel combustion equipment or add-on combustion control system and recovering waste heat available for maximizing fuel efficiency.
Operating practices that increase energy efficiency can also improve the fuel efficiencies of the combustion sources at this facility, and in turn reduce the CO_2 emissions from fuel combustion. Such practices include good combustion technique and control, insulation, maintenance, and waste heat recovery. Both the spray dryers/pelletizers and kilns/calciners have computerized combustion control systems to maintain their fuel combustion processes at optimized conditions. This will maximize heat/fuel efficiency and minimize fuel consumption, in additional to providing proper process heating profiles. To maintain the combustion processes at optimized conditions, those computerized combustion control systems constantly monitor the temperature, the exhaust flow rate, and the exhaust CO and oxygen levels of the process units to evaluate the combustion process involved, and adjust accordingly mainly the fuel to air ratio if necessary.

Each of the 9.8 mmBTU/hr natural-gas fired boilers is purchased as a "packaged boiler". It is integrated with all of its components - burner, controls and auxiliary equipment, designed as a single engineered package, and ready for on-site installation. The boiler's performances such as fuel efficiency and emission levels are guaranteed by the manufacturer(s). The boiler manufacturer(s) has made efforts to optimize the design, operation and maintenance of the boiler including associated combustion control systems for such guaranteed performance.

Similar to the natural-gas fired boilers, each emergency diesel generator is purchased as a single piece of "ready to use" equipment that is integrated with all its components including combustion control components. The manufacturer has made efforts to optimize the design, operation and maintenance of the diesel generators to allow the generator to comply with all the applicable Federal fuel and emission standards. The generator's performances such as fuel efficiency and emission levels are guaranteed and certified by the manufacturer.

In addition to the approaches discussed above, proper insulation of heated process equipment and fuel burning units will reduce heat loss and increase heat efficiency, and therefore reduce fuel usage rate, which, in turn, will reduce GHG/CO_2 emissions. PyraMax Ceramics and the equipment manufacturers are expected to make efforts to ensure proper insulation of the process equipment, which would also enhance their bottom line by either reducing production cost or making the equipment more marketable.

Georgia Air Quality Application No. 20485 dated July 21, 2011 has extensive discussions on the mechanisms, characteristics and technical feasibilities of all the GHG emission control technology options identified for the sources involved. Please refer to Subparts 5.26 thru 5.36 of Volume 1 of the application for details.

GHG BACT Determination
EPD has determined that, based on U.S. EPA's GHG emissions control guidance documents and information data bases, none of the add-on tailpipe GHG emission control technology options identified is economically or technically feasible as BACT for control of the GHG emissions from PyraMax Ceramics' facility. The proposed GHG BACT for the GHG emissions from PyraMax Ceramic's facility are listed below:

- Use of low carbon-density fuel i.e., natural gas.

- Good Combustion Techniques such as equipment design, maintenance, and combustion process control including appropriate combustion temperature, air to fuel ratio, and air/fuel mixing that can reduce fuel usage by increasing combustion efficiency thus fuel efficiency.

- Good equipment thermal/heat insulation.

- Heat/thermal energy recovery when feasible.

- Install and operate dry-process rotary calciners/kilns for sintering the ceramic proppants.
- Install and operate emergency diesel generators which are certified by EPA for compliance with the application Tier III standards.

- Limit the CO_2e emissions from each spray dryer/pelletizer to 44,446 tons based on 12-month rolling total, as proposed by PyraMax Ceramics.

- Limit the CO_2e emissions from each calciner/kiln to 0.218 lbs./ton cooler product based on 12-month rolling average, as proposed by PyraMax Ceramics.

- Limit the CO_2e emissions from each 9.8 MM/Btu/hr natural gas fired boiler to 5,809 tons based on 12-month rolling total, as proposed by PyraMax Ceramics.

- Limit combined CO_{2e} emissions from all the diesel generators to 153 tons per year on a 12-month rolling basis, as proposed by PyraMax Ceramics.

4.9 Summary of Numeric BACT Limits

All the numeric BACT emission limits as determined by this Preliminary Determination are summarized in Table 4.9-1 below.

Table 4.9-1: Summary of Numeric BACT Limits

Operation	Emission[1]	Emission Limit	Compliance Method	Averaging Time
Each calciner/kiln	Filterable PM/PM_{10}	0.010 gr./dscf	Methods 5 (Method 201/ 201A)	3 hours
	PM/PM_{10} & CPM combined[1]	8.53 lbs./hr	Methods 5 & 202 (Method 201/201A and Method 202)	
	$PM_{2.5}$ & CPM combined	6.98 lbs./hr	Methods 5 & 202 (Method 201/201A and Method 202)	
Each spray dryer/pelletizer	PM/PM_{10}	0.010 gr./dscf	Method 5 (Method 201/201A)	3 hours
	$PM_{2.5}$	0.006 gr./dscf		
Each spray dryer/ pelletizer and calciner/kiln	Visible	10% opacity	COMS	6-minute average
Each of the emission units with baghouse control excluding spray	$PM/PM_{10}/PM_{2.5}$	0.005 gr./dscf	Methods 5 (Method 201 or 201A in conjunction with Method 202 if necessary)	3 hours

Operation	Emission[1]	Emission Limit	Compliance Method	Averaging Time
dryers/pelletizers and calciners/kilns	Visible	7% opacity	Method 9	6-minute average
All fugitive sources	Fugitive	10% opacity	Method 22 and/or Method 9	Per Method 22 or Method 9
Each calciner/kiln	SO_2	No less than 90% by weight overall control	Method 6 or 6C; Daily Analyzing of Clay Sulfur Content	3 hours;
		Not to exceed 11.64 lbs/hr.		Daily average
	NO_x	No less than 80% by weight overall control	Method 7 or 7E	3 hours
		Not to exceed 36.3 lbs/hr.		
	CO VOC	33.0 lbs/hr. 0.54 lbs/hr	Method 10 Mass Balance Calculation	3 hours Daily Average
	CO_2e	436.0 lbs/ton cooler product	Mss balance calculation based on Division-approved emission factors	12-month rolling
Each spray dryer/pelletizer	NO_x	Not to exceed 2.25 lbs/hr.	Method 7 or 7E	3 hours
	CO	Not to exceed 13.73 lbs/hr.	Method 10	3 hours
	VOC	Not to exceed 11.78 lbs/hr.	Mass balance calculation	Daily average
	CO_2e	44,446 tons	Mss balance calculation based on Division-approved emission factors	12-month rolling total
Each 9.8 MMBtu/hr natural gas fired boiler	NO_x	12 ppmv@ 3% O_2 at dry standard conditions	Manufacturer's written guarantee	N/A
	CO_2e	5,809 tons	Mss balance calculation based on EPD-approved emission factors	12-month rolling total
Two (2) Emergency Diesel Generator Sets Combined[2]	CO_2e	153 tons	Mss balance calculation based on Division-approved emission factors	12-month rolling total

[1] CPM: condensable particulate matter

[2] The Tier III NOx, CO, PM and VOC emission standards applicable to each 500 kW diesel generator have been determined as BACT for the same unit. Since each generator will be purchased as certified by U.S EPA to be in compliance with these standards, the BACT standards are not listed in this table. Please refer to Table 1 of 40 CFR 89.112 for details.

5.0 TESTING AND MONITORING REQUIREMENTS

Testing Requirements:

Depending on the regulatory status, PyraMax Ceramics' emission sources will be subject to testing requirements under federal rules including PSD/NSR/BACT, NSPS Subparts OOO and UUU, and 112(g) case-by-case MACT. These testing requirements are emission or source/process specific, and sometimes complementary to each other.

40 CFR Part 60, Subpart OOO: This NSPS standard requires initial performance tests on the process units/emission sources subject to the applicable PM and visible emissions limits under the Subpart. The tests shall demonstrate compliance with the applicable emission limits using Method 5, Method 9 and/or Method 22, depending on the nature of the source involved. PyraMax Ceramics' shall follow the applicable procedures specified in Subpart OOO to conduct the PM, visible and/or fugitive emission testing.

40 CFR Part 60, Subpart UUU: This NSPS standard requires initial performance tests on the spray dryers/pelletizers and calciners/kilns to demonstrate compliance with the applicable PM and visible emission limits using Method 5 and Method 9. PyraMax Ceramics shall follow the applicable procedures specified in Subpart UUU to conduct the PM and visible emission testing. PyraMax Ceramic is required to use COMS to monitor the visible emissions from the affected sources during the testing.

PSD/NSR/BACT: All the point and fugitive PM emission sources directly involving the clay processing not only have visible and/or particulate matter emission limits under either Subpart OOO or Subpart UUU, but also are subject to the visible and particulate matter emission limits under PSD/BACT rules. PyraMax Ceramics shall conduct Method 9, Method 22, Method 5, Method 202 and method 201/201A tests as appropriate on the sources to demonstrate initial compliance with the applicable BACT visible and particulate matter emission limits. The point sources may include, but not to be limited to, baghouse-controlled raw material handling operations, raw or finished product storage bins/silos, material conveying system transfer points, milling, screening, packaging systems, bulk loading or unloading systems, spray dryers/pelletizers and calciners/kilns.

PyraMax Ceramics shall, when required by EPD, conduct performance tests to determine the PM_{10} emissions from each stack/point source of particulate matter emissions. Compliance with the PM_{10} emission limits is important because the ambient impacts of the potential PM_{10} emissions from PyraMax Ceramics have been assessed via atmospheric dispersion modeling.

PyraMax Ceramics shall, when required either by this Permit or by EPD, conduct performance tests to determine the emissions of $PM_{2.5}$ including condensable PM (CPM) (condensable portion of $PM_{2.5}$ emissions from any stack/point sources). After the promulgation of $PM_{2.5}$ NAAQS, EPA initialized this testing requirement by stating under 40 CFR 50.1002(c) that *"After January 1, 2011, for purposes of establishing emission limits under 40 CFR 51.1009 and 51.1010, States must establish such limits taking into consideration of condensable fraction of direct $PM_{2.5}$ emissions*". Compliance with the $PM_{2.5}$ and CPM emission limits is important because the ambient impacts of the potential $PM_{2.5}$ emissions from PyraMax Ceramics' facility have been assessed via atmospheric dispersion modeling.

To ensure continuous compliance with the BACT particulate matter emissions limits, PyraMax Ceramics is required to conduct $PM/PM_{10}/PM_{2.5}$ and CPM emission performance tests on each calciner/kiln and spray dryer on each process/kiln line every 36 months after the completion of the initial performance tests.

When any source modifications or change in operation(s) that may adversely affect the PM/PM_{10}/$PM_{2.5}$, CPM emissions or visible emissions from any such source, PyraMax Ceramics shall conduct a performance test on the source using Method 5, Method 201/201A, Method 202, Method 9 or Method 22 as appropriate, and establish new operational parameter(s) that could affect the particulate matter emissions.

PyraMax Ceramics shall conduct initial performance tests for the CO, NO_x and SO_2 emissions from each rotary calciner/kiln to demonstrate compliance with the corresponding BACT emission limits. The same performance tests shall be repeated annually thereafter. In addition, the NO_x emissions from each calciner/kiln will be monitored using a portable NO_x analyzer following the methodology and protocol approved by EPD. During the performance testing, PyraMax Ceramics shall establish the NO_x and SO_2 emission rates, operating parameters, and control efficiency of each "catalytic baghouses" serving the calciner/kiln being tested. Please refer to Parts 4.0 and 5.0 of Georgia Air Quality Permit No. 3295-163-0035-P-01-0 for details of the testing requirements.

PyraMax Ceramics is required to conduct initial and annual HCl and HF emission performance tests on each calciner/kiln to demonstrate compliance with the case-by-case MACT emission limits. During the performance testing, PyraMax Ceramics shall establish the mission rates, operating parameters, and control efficiency of each "catalytic bughouses" serving the calciner/kiln being tested.

The SO_2 emissions from each calciner/kiln will be determined daily via analysis of the sulfur content of the raw clay processed by the calciner/kiln and mass balance calculation.

Appropriate operating parameters that may affect the emissions shall be determined during the tests and utilized/maintained once the results of the tests are approved by EPD. Such parameters include, but not to be limited to, kiln feed rate, exhaust flow rate, temperature profile and burner setting, baghouse pressure drop and inlet temperature, and ammonia and sodium bicarbonate injection rate and/or NH_3/NO_x and $NaHCO_3/NO_x$ molar ratio.

Monitoring Requirements:

PyraMax Ceramics' ceramic proppant manufacturing operations are subject to the monitoring requirements under PSD/BACT, NSPS (Subpart IIII, Subpart OOO and Subpart UUU), and applicable SIP regulations. These monitoring requirements are emission or source/process specific and, depending on the regulatory status of the source, may be complementary to each other.

Since both spray dryers/pelletizers and calciners/kilns are major sources of PM emissions which contribute to the visible emissions, Subpart UUU requires COMS to be used to monitor visible emissions.

PyraMax Ceramics estimated that the calciners/kilns emit majority of the SO_2 and NO_2 emissions (99% of SO_2 and 91% of NO_x) from the whole plant, meanwhile the emissions could fluctuate significantly, especially SO_2 due to the variation of clay sulfur content. The NO_x emissions from each calciner/kiln will be monitored routinely using a portable NO_x analyzer following the methodology and protocol approved by the Division and incorporated into the permit. The SO_2 emissions from each calciner/kiln will be monitored by daily analyzing of sulfur content of the clay processed.

PyraMax Ceramics is required to install devices to continuously monitor the inlet temperature of baghouses receiving hot gases and to record the time of each incident when the temperature

exceeds the filter bag design temperature. This requirement prevents the heat damage of the filter bags.
PyraMax Ceramics is required to install devices to continuously monitor the inlet temperature of each "catalytic baghouse" and to record the time of each incident when the temperature deviates outside the designated operating temperature range. This monitoring requirement ensures the proper function of the "catalytic baghouse" as SCR for control of NO_x emissions from the calciner/kiln.

PyraMax Ceramics is required to conduct daily visible emission check (VE) on all baghouses except those having COMS, and retain a record in a daily VE log suitable for inspection or submittal. The daily VE check log shall also include causes of any visible emission and corrective actions taken.

To ensure the proper function of the baghouses controlling particulate matter emission, PyraMax Ceramics is required to record the pressure drop at least on a weekly basis. In addition, a Prevention Maintenance Program (PPM) including scheduled equipment inspection requirements shall be developed for all the baghouses as supplement to the daily VE check.

PyraMax Ceramics is required to perform daily operation and maintenance inspections on the dust/fugitive emissions suppression and cleanup systems, and keep records of the inspection.

To ensure the performance of each "catalytic baghouse" which is also functioning as a SCR for NO_x control and as a dry scrubber for SO_2 control, PyraMax Ceramics shall monitor continuously the ammonia and sodium bicarbonate injection rate to the calciner/kiln exhausts upstream of each "catalytic baghouse". Because proper NH_3/NO_x and $NaHCO_3/NO_x$ molar ratios are crucial to each "catalytic baghouse" functioning as a SCR for NO_x control and a dry scrubber for SO_2 control, PyraMax Ceramics shall use the monitoring data to maintain the NH_3/NO_x and $NaHCO_3/NO_x$ molar ratios at the levels established during the most recent EPD-approved performance tests.

NSPS Subpart IIII and SIP rules require each stationary emergency diesel generator to be equipped with a non-resettable hour meter to track its operating time. The Permittee shall use the meter to record the time of operation and the nature of the operation. Compliance with the relevant annual operating time limits is a requirement by SIP rule for the generator to remain as an emergency generator and one of the presumptions used in the BACT determination for the generator.

Monitoring for compliance with the GHG BACT emission limits consist of mass balance calculations of the GHC emissions from boilers, sprays dryers/pelletizers and calciners/kilns based on EPD-approved emission factors and production records. Please refer to Part 6.0 of Georgia Air Quality Permit No. 3295-163-0035-P-01-0 for details.

CAM Applicability:

As a green-field source/site, PyraMax Ceramics, LLC – King's Mill Facility is required to prepare and submit monitoring plans for emission units/sources subject to the CAM requirements with the initial Title V operating permit application within 12 months of the startup of this new source. This SIP/PSD construction permit, as issued under the authority of Georgia Rules 391-3-1-.02(7), *"Prevention of Significant Deterioration of Air Quality"* and 391-3-1-.03(1), *"Construction (SIP) Permit"*, is not required to incorporate the applicable CAM requirements.

6.0 AMBIENT AIR QUALITY REVIEW

An air quality analysis is required to determine the ambient impacts associated with the construction and operation of the proposed modifications. The main purpose of the air quality analysis is to demonstrate that emissions emitted from the proposed modifications, in conjunction with other applicable emissions from existing sources (including secondary emissions from growth associated with the new project), will not cause or contribute to a violation of any applicable National Ambient Air Quality Standard (NAAQS) or PSD increment in a Class I or Class II area. NAAQS exist for NO_2, CO, $PM_{2.5}$, PM_{10}, SO_2, Ozone (O_3), and lead. PSD increments exist for SO_2, NO_2, and PM_{10}.

The proposed project at the PyraMax Ceramics, LLC – King's Mill Facility triggers PSD review for CO, NO_2, SO_2, PM_{10} and $PM_{2.5.}$ An air quality analysis was conducted to demonstrate the facility's compliance with the NAAQS and PSD Increment standards for CO, NO_2, SO_2, PM_{10} and $PM_{2.5}$. An additional analysis was conducted to demonstrate compliance with the Georgia air toxics program. This section of the application discusses the air quality analysis requirements, methodologies, and results. Supporting documentation may be found in the Air Quality Dispersion Report of the application and in the additional information packages.

Modeling Requirements

The air quality modeling analysis was conducted in accordance with Appendix W of Title 40 of the Code of Federal Regulations (CFR) §51, *Guideline on Air Quality Models*, and Georgia EPD's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Revised).*

The proposed project will cause net emission increases of for CO, NO_2, SO_2, PM_{10} and $PM_{2.5}$ that are greater than the applicable PSD Significant Emission Rates. Therefore, air dispersion modeling analyses are required to demonstrate compliance with the NAAQS and PSD Increment

Significance Analysis: Ambient Monitoring Requirements and Source Inventories

Initially, a Significance Analysis is conducted to determine if the CO, NO_2, SO_2, PM_{10} and $PM_{2.5}$ emissions increases at the PyraMax Ceramics, LLC – King's Mill Facility would significantly impact the area surrounding the facility. Maximum ground-level concentrations are compared to the pollutant-specific U.S. EPA-established Significant Impact Level (SIL). The SIL for the pollutants of concern are summarized in Table 6-1.

If a significant impact (i.e., an ambient impact above the SIL) does not result, no further modeling analyses would be conducted for that pollutant for NAAQS or PSD Increment. If a significant impact does result, further refined modeling would be completed to demonstrate that the proposed project would not cause or contribute to a violation of the NAAQS or consume more than the available Class II Increment.

Under current U.S. EPA policies, the maximum impacts due to the emissions increases from a project are also assessed against monitoring *de minimis* levels to determine whether pre-construction monitoring should be considered. These monitoring *de minimis* levels are also listed in Table 6-1. If either the predicted modeled impact from an emission increase or the existing ambient concentration is less than the monitoring *de minimis* concentration, the permitting agency has the discretionary authority to exempt an applicant from pre-construction ambient monitoring. This evaluation is required for CO, NO_2, SO_2, PM_{10} and $PM_{2.5.}$

If any off-site pollutant impacts calculated in the Significance Analysis exceed the SIL, a Significant Impact Area (SIA) would be determined. The SIA encompasses a circle centered on the facility with a radius extending out to (1) the farthest location where the emissions increase of a pollutant from the project causes a significant ambient impact, or (2) a distance of 50 km, whichever is less. All sources within a distance of 50 km of the edge of a SIA are assumed to potentially contribute to ground-level concentrations within the SIA and would be evaluated for possible inclusion in the NAAQS and PSD Increment analyses.

Table 6-1: Summary of Modeling Significance Levels

Pollutant	Averaging Period	PSD Significant Impact Level (ug/m^3)	PSD Monitoring Deminimis Concentration (ug/m^3)
PM_{10}	Annual	1	--
	24-Hour	5	10
$PM_{2.5}$	Annual	0.3	--
	24-Hour	1.2	--
SO_2	Annual	1	--
	24-Hour	5	13
	3-Hour	25	--
	1-hour (interim)	7.8	--
NO_x	Annual	1	14
	1-hour (interim)	7.5	--
CO	8-Hour	500	575
	1-Hour	2000	--

NAAQS Analysis

The primary NAAQS are the maximum concentration ceilings, measured in terms of total concentration of pollutant in the atmosphere, which define the "levels of air quality which the U.S. EPA judges are necessary, with an adequate margin of safety, to protect the public health." Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The primary and secondary NAAQS are listed in Table 6-2 below.

Table 6-2: Summary of National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS	
		Primary / Secondary (ug/m^3)	Primary / Secondary (ppm)
PM_{10}	Annual	*Revoked 12/17/06	*Revoked 12/17/06
	24-Hour	150 / 150	--
$PM_{2.5}$	Annual	15 / 15	--
	24-Hour	35 / 35	--
SO_2	Annual	80 / None	0.03 / None
	24-Hour	365 / None	0.14 / None
	3-Hour	None/1300	None / 0.5
	1-hour	196/196	0.075 / 0.075
NO_X	Annual	100 / 100	0.053 / 0.053
	1-hour	188/188	--/--
CO	8-Hour	10,000 / None	9 / None
	1-Hour	40,000 / None	35 / None

If the maximum pollutant impact calculated in the Significance Analysis exceeds the SIL at an off-property receptor, a NAAQS analysis is required. The NAAQS analysis would include the potential emissions from all emission units at the PyraMax Ceramics, except for units that are generally exempt from permitting requirements and are normally operated only in emergency situations. The emissions modeled for this analysis would reflect the results of the BACT analysis for the modified emission unit. Facility emissions would then be combined with the allowable emissions of sources included in the regional source inventory. The resulting impacts, added to appropriate background concentrations, would be assessed against the applicable NAAQS to demonstrate compliance. For an annual average NAAQS analysis, the highest modeled concentration among five consecutive years of meteorological data would be assessed, while the highest second-high impact would be assessed for the short-term averaging periods.

PSD Increment Analysis

The PSD Increments were established to "prevent deterioration" of air quality in certain areas of the country where air quality was better than the NAAQS. To achieve this goal, U.S. EPA established PSD Increments for certain pollutants. The sum of the PSD Increment concentration and a baseline concentration defines a "reduced" ambient standard, either lower than or equal to the NAAQS that must be met in an attainment area. Significant deterioration is said to have occurred if the change in emissions occurring since the baseline date results in an off-property impact greater than the PSD Increment (i.e., the increased emissions "consume" more that the available PSD Increment).

U.S. EPA has established PSD Increments for NO_X, SO_2, and PM_{10}; no increments have been established for CO or $PM_{2.5}$ (however, $PM_{2.5}$ increments are expected to be added soon). The PSD Increments are further broken into Class I, II, and III Increments. PyraMax Ceramics is located in a Class II area. The PSD Increments are listed in Table 6-3.

Table 6-3: Summary of PSD Increments

Pollutant	Averaging Period	PSD Increment	
		Class I (ug/m^3)	Class II (ug/m^3)
PM_{10}	Annual	4	17
	24-Hour	8	30
SO_2	Annual	2	20
	24-Hour	5	91
	3-Hour	25	512
NO_X	Annual	2.5	25

To demonstrate compliance with the PSD Increments, the increment-affecting emissions (i.e., all emissions increases or decreases after the appropriate baseline date) from the facility and those sources in the regional inventory would be modeled to demonstrate compliance with the PSD Class II increment for any pollutant greater than the SIL in the Significance Analysis. For an annual average analysis, the highest incremental impact will be used. For a short-term average analysis, the highest second-high impact will be used.

The determination of whether an emissions change at a given source consumes or expands increment is based on the source classification (major or minor) and the time the change occurs in relation to baseline dates. The major source baseline date for NO_X is February 8, 1988, and the major source baseline for SO_2 and PM_{10} is January 6, 1975. Emission changes at major sources that occur after the major source baseline dates affect Increment. In contrast, emission changes at minor sources only affect Increment after the minor source baseline date, which is set at the time when the first PSD application is completed in a given area, usually arranged on a county-by-county basis. For Jefferson County, the minor source baseline dates have been set for PM_{10} as July 26, 2011 and for NO_2 as October 20, 2002.

Modeling Methodology

Details on the dispersion model, including meteorological data, source data, and receptors can be found in EPD's PSD Dispersion Modeling and Air Toxics Assessment Review in Appendix C of this Preliminary Determination and in Volume 2 of the permit application.

Modeling Results

Table 6-4 show that the proposed project will not cause ambient impacts of CO and SO_2 above the appropriate SIL, therefore, no further PSD analyses were conducted for CO or SO_2.

However, ambient impacts above the SILs were predicted for NO_2 for annual and 1-Hour averaging periods, and PM_{10} and $PM_{2.5}$ for annual and 24-hour periods, requiring NAAQS and Increment analyses be performed for NO_2, PM_{10} and $PM_{2.5}$.

Table 6-4: Class II Significance Analysis Results – Project Impacts vs. Class II SILs

Pollutant	Averaging Period	Model Met Data Period [yymmddhh]	UTM East Zone 17 (m)	UTM North Zone 17 (m)	Maximum Impact* (ug/m^3)	SIL (ug/m^3)	Significant?
NO_2	Annual	2010	372600.90	3671102.20	1.2	1	**Yes**
	1-Hour$^+$	5-yr average	372082.00	3670709.50	43.4	7.5	**Yes**
PM_{10}	Annual	2010	372680.50	3671041.60	1.24	1	**Yes**
	24-Hour	07022024	372687.60	3671376.00	9.39	5	**Yes**
$PM_{2.5}$	Annual$^\#$	5-yr average	372680.50	3671041.50	0.63	0.3	**Yes**
	24-Hour$^\#$	5-yr average	372687.60	3671276.00	4.25	1.2	**Yes**
SO_2	Annual	2010	372922.60	3670694.40	0.26	1	No
	24-Hour	08082224	373287.60	3670476.00	2.57	5	No
	3-Hour	08122415	372487.60	3671576.00	6.43	25	No
	1-Hour+	5-yr average	373287.60	3671776.00	7.13	7.8	No
CO	8-Hour	08082216	373287.60	3670476.00	28.3	500	No
	1-Hour	10080708	373287.60	3671776.00	54.2	2000	No

* Highest concentration over all averaging periods, except 1-hour SO_2, NO_2, and annual and 24-hour $PM_{2.5}$

$^+$ Highest of the average highest 1-hour concentration across all receptors over 5-years

$^\#$ Highest of the average individual year's highest annual and 24-hour concentration across all receptors over 5-year modeling

Preconstruction Monitoring Evaluation- Monitoring *De Minimis Concentration*

The applicant compared the maximum–modeled concentrations with the monitoring *De Minimis* concentrations to determine whether the proposed facility is required to conduct preconstruction monitoring. Table 6-5 shows that concentrations of CO, NO_2, PM_{10}, and SO_2 are below their respective *de minimis* levels, which exempts those contaminants from preconstruction monitoring requirements. However, the modeled concentration of $PM_{2.5}$ is greater than the *De Minimis* level and therefore preconstruction monitoring would be required. In lieu of such monitoring effort, Georgia EPD existing ambient air data from a representative regional monitoring station can be used. Such state (site ID 132450091) is located on Bungalow Road, Augusta, Richmond County, GA, approximately 44 km northeast of the proposed facility. Being operated by Georgia EPD, the data from that monitoring station can be considered as contemporaneous and fulfilling all QA/QC requirements. Georgia EPD also considered this data to be conservatively representative of $PM_{2.5}$ concentrations in the vicinity of the Jefferson County project site, due to the monitor's proximity to the significantly more populated Augusta area.

Table 6-5: Project Pollutants Monitoring De Minimis Impacts

Criteria Pollutant	Averaging Period	*De Minimis* Concentration (μg/m^3)	Maximum Projected Concentration* (μg/m^3)	Receptor UTM East Zone 17 (m)	Receptor UTM West Zone 17 (m)	Model Met Data Period [yymmddhh]	Exceeds *De Minimis*?
CO	8-hour	575	28.3	373287.60	3670476.00	08082216	No
NO_2	Annual	14	1.2	372600.90	3671102.20	2010	No
SO_2	24-hour	13	2.57	373287.60	3670476.00	08082224	No
PM10	24-hour	10	9.39	372687.60	3671376.00	07022024	No
PM2.5	24-hour	4	4.25	372687.60	3671276.00	5-yr avg	Yes

*Highest concentration over all averaging periods, except 24-hour PM2.5, the highest concentration averaged over 5-year modeling individual year's 24-hour H1Hs at the entire receptor grids.

Preconstruction Monitoring Evaluation- Ozone Impact Analysis

Since no significant air quality concentration has been established for ozone impact analysis, PSD permit applicants with a proposed net emission increase of 100 tons/year or more of VOC or NOx are required to conduct an ambient air impact analysis that includes pre-application monitoring data to determine the current state of the ambient air conditions for this pollutant.

The proposed PyraMax-Kings Mill facility is expected to emit 351 tpy NOx and 130 tpy VOC. There are no existing ozone monitors in Jefferson County. The applicant presented the 3-year rolling average ozone concentrations at the three monitors closest to the proposed site, compared the population density, industrial and mobile NOx emissions between the Jefferson County, and Richmond, Columbia, and Bibb counties. It is found that the Columbia County ozone monitor at Riverside Park, Evans, is considered to be conservatively representative of the air quality at the project site. Since this area is in attainment with the 8-hour ozone standard (75 ppb), PyraMax would also be in attainment for ozone. The site (ID: 130730001) is about 50 km away from the facility (which allows transport time for the photochemical formation of ozone from its precursors emitted by the project), and the latest three-year design value (2008-2010 average of 4th highest annual values) is 69 ppbv.

Regional Source Inventories

The project significance modeling above shows three criteria pollutants – PM10, PM2.5, and NO_2 exceeded their applicable SILS with the significant impact distances of 1.2 km for PM10, 2.2km for PM2.5, 0.63 km for annual NO_2, and 8.7 km for 1-hour NO_2. Therefore, refined modeling analysis is required to assess their compliance with the NAAQS standard and allowable PSD increment.

To develop the PM10/PM2.5 and the annual NO_2 inventories, the applicant evaluated all major and minor sources within "significant impact distances" (or SIDs) plus 50km (total screening area) for possible inclusion in the refined NAAQS and PSD increment analysis. Note that the PM2.5 inventory sources were conservatively assumed to be the same as those of PM10 due to the lack of quality PM2.5 emission data. The Minor Source Baseline Data for NO_2 in Jefferson County of 1/10/2002 was also used to determine if a particular NOx source had to be included in the NO_2 Increment Inventory. The Minor Source Baseline Data was set for PM10 in this county upon the PyraMax application having been deemed complete (7/26/11). The PM2.5 Minor Source Baseline Data of 10/20/11 was preceded by the completeness determination for this application, so no PM2.5 Increment assessment was conducted. The 20D methodology was applied to screen out those facilities no large enough – in terms of emission rates – to be included in the modeling analysis, with the exception of those facilities located within the significant impact area (SIA) that were all included regardless of their size. The regional sources located within close proximity to each other (2 km) were clustered together and their total emissions were used to apply the 20D methodology. The Ambient Ratio Method Tier 2 value of 0.8 was applied to all NOx emissions.

Due to the large significant impact area of the 1-hour NO_2 (8.7km), Georgia EPD recommended the applicant assess the total screening area as the maximum 1-hour wind-transport distance from the project site-the pollutant travels at the maximum hourly wind speed of 11.28 m/s in the 2006-2010 Augusta/Daniel Field meteorological data. This resulted in a relatively small screening distance of about 41km. Similar cluster method and 20D methodology were applied to determine the sources included in the refined analysis. No sources were deleted within the area of receptors with significant project concentrations.

The applicant did not develop a separate emission inventory for the evaluation of PSD increment, but used the annual NO_2 and 24-hour PM10 regional inventory for the NAAQS analysis for conservatism. No 1-hour NO_2 increment limit exists, and no PM2.5 increment analysis is necessary for this application, as Georgia EPD has not incorporated the PM2.5 Increment, SILs, and SMC Rule into Rule 391-3-1 yet, and since the application was deemed complete prior to the PM2.5 trigger date (10/20/11). The only Increment-consuming sources which did not screen out were those of the PyraMax project itself. The regional source inventory used in the analysis is included in the permit application (Volume II).

NAAQS Analysis

In the NAAQS analysis, impacts within the facility's SIA due to the potential emissions from all sources at the facility and those sources included in the regional inventory were calculated. Since the modeled ambient air concentrations only reflect impacts from industrial sources, a "background" concentration was added to the modeled concentrations prior to assessing compliance with the NAAQS.

The results of the NAAQS analysis are shown in Table 6-6. For the short-term averaging periods, the impacts are the highest second-high impacts. For the annual averaging period, the impacts are the highest impact. When the total impact at all significant receptors within the SIA are below the corresponding NAAQS, compliance is demonstrated.

Table 6-6: NAAQS Analysis Results

Pollutant	Averaging Period	Year	UTM East (km)	UTM North (m)	Predicted Conc* (ug/m^3)	Background (ug/m^3)	Total Impact** (ug/m^3)	NAAQS (ug/m^3)	Exceed NAAQS?
NO$_2$	1-Hour	5-yr average	376650.00	3675300.00	152.0+	35.8	187.8	188	No
	Annual	2010	372600.90	3671102.20	3.35	5.2	8.55	100	No
PM$_{10}$	24-hour	08102224	371687.60	3670576.00	7.78	38	45.8	150	No
PM$_{2.5}$	Annual	5-yr average	372680.50	3671041.60	0.84	12.7	13.54	15	No
	24-hour	5-yr average	371787.60	3670576.00	4.64	25.3	29.4	35	No

* Highest concentration for annual averaging periods, highest sixth high concentration for the PM10 24-hour period, and the highest of the average 1st-highest concentration across all receptors over the five modeling years for PM2.5 annual and 24-hour period.

** Total impact is the sum of the predicted concentration plus the background concentration.

[+] 1-hour impact shown is the highest compliance concentration at a significant receptor location, calculated as the average 8th-highest daily maximum 1-hour concentration across all receptors over the five modeling years

As indicated in Table 6-6 above, all the total modeled impacts at all significant receptors within the SIA are below the corresponding NAAQS.

Class II Increment Analysis

The modeled impacts from the NAAQS run were evaluated to determine whether compliance with the Increment was demonstrated. The results are presented in Table 6-7.

Table 6-7: Increment Analysis Results

Pollutant	Averaging Period	Year	UTM East (m)	UTM North (m)	Maximum Increment Consumed* (ug/m^3)	Allowable Increment (ug/m^3)	Exceed Increment?
NO$_2$	Annual	2010	372600.90	3671102.20	3.35	25	No
PM$_{10}$	Annual	2010	372680.50	3671041.60	1.39	17	No
	24-Hour	08102224	371687.60	3670576.00	7.78	30	No

* Highest concentration for annual averaging periods, and highest second high concentration for the short-term periods.

Class I Significant Impact and AQRV Analysis

Eight Class I areas exist within a 300km range from PyraMax – Kings Mill facility, these are: Cape Romain Wilderness Area, SC; Okefenokee National Wildlife Refuges, GA; Wolf Island Wildlife Refuges, GA; Shining Rock Wilderness Area, NC; Cohutta Wilderness, GA; Joyce Kilmer-Slick Rock Wilderness, NC/TN; Linville Gorge Wilderness, NC; and Great Smoky Mountains National Park, NC/TN. Among these, Wolf Island Wildlife Refuges is the closest, located approximately 222km southeast from the proposed facility.

To determine whether the proposed project is subject to the Class I modeling analysis, a Q/D screening analysis was performed, where Q is the sum of all visibility-affecting pollutants in tons per year emitted from the proposed facility, calculated on a worse-case 24-hour period basis (FLAG 2010 Approach), and D is the distance in kilometers, from the proposed facility to the corresponding Class I area boundary. The sum of the pollutants – NOx, PM10 and SO2 from the proposed PyraMax project is 610 tpy. The distance to the nearest Class I area (Wolf Island Wildlife Refuges, GA) is 222 km from the PyraMax-Kings Mill facility. This yields a Q/D ratio of 2.74, well below the value of 10 currently used by the Federal Land Management (FLM) to screen a proposed project. The FLM typically does not require Air Quality Related Values (AQRV) assessments in nearby Class I areas (those within 300km of the project site) if the Q/D ratio is less than 10.

PyraMax provided the three FLM agencies (the Fish and Wildlife Service, the Forest Service, and the National Park Service) the qualitative Q/D evaluation of its impact on Class I areas within 300km distance from the facility, and requested their opinions on the findings of no adverse impacts to any AQRVs at the near-by Class I areas. The response from the FLM of the Great Smoky Mountains National Park agreed the applicant's finding of no potential adverse impacts. No other comments or guidance has been received from the FLMs.

PyraMax conducted a Class I area significant impact analysis (also referred to as a Class I PSD increment analysis) to conservatively assess the maximum concentration of PM10, NO2, and SO2 emitted from the proposed project without building downwash at a distance of 50km from the project site since all Class I areas are located further than 50km. Table 6-8 shows that the modeled maximum impacts of any criteria pollutant were below their respective Class I area "significant impact levels" (SILs). For this reason, a refined Class I Increment assessment was not required.

Table 6-8: Project Impacts vs. Class I Significance Levels

Criteria Pollutant	Averaging Period	Significance Level (mg/m3)	Max Projected Conc* (mg/m^3)	Receptor UTM East Zone 17 (m)	Receptor UTM West Zone 17 (m)	Model Met Data Period [yymmddhh]	Exceeds SIL?
PM_{10}	Annual	0.20	0.013	419675.90	3654521.60	2010	No
	24-Hour	0.32	0.180	334097.80	3702939.40	07062724	No
NO_2	Annual	0.10	0.018	419384.60	3653699.00	2010	No
SO_2	Annual	0.08	0.006	419384.60	3653699.00	2010	No
	24-Hour	0.20	0.104	368912.20	3620921.80	09112324	No
	3-Hour	1.00	0.308	350481.40	3625860.30	09010312	No

7.0 ADDITIONAL IMPACT ANALYSES

PSD requires an analysis of impairment to visibility, soils, and vegetation that will occur as a result of a modification to the facility and an analysis of the air quality impact projected for the area as a result of the general commercial, residential, and other growth associated with the proposed project.

Soils and Vegetation

To address the potential soil and vegetation impacts, the applicant adopted the NAAQS results of the NOx at 1-hour and annual period because EPA recently proposed to use the secondary NAAQS standards for such analysis. Note that CO and SO_2 were not significant (the maximum modeling concentration due to the proposed project were less than their respective SILs). Table 7-1 shows the total potential impact of NO_2 is less than its screening threshold levels.

Table 7-1: CLASS I AREA Vegetative Impact Results (AERMOD with downwash)

Pollutant	Averaging Period	All Source Impact *	Background Concentration	Total Potential Impact*	Screening Level$^+$	Exceed Screening Level?
		(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	
NO_2^+	1-hour	152.0	35.8	187.8	188	No
	Annual	3.35	5.2	8.55	100	No
CO	No impact area defined					
SO_2	No impact area defined					

* NAAQS results including both project and offsite inventories. Total impact is the sum of the predicted concentration plus the background concentration.

$^+$ Screening levels for NOx are the existing secondary annual and proposed secondary 1-hour NAAQS standards.

Regarding to the Class II visibility analysis, the maximum $PM_{2.5}$, PM_{10} and NO_x significant impact distances are 2.2 km, 1.2 km, and 8.7 km, respectively. There are no potentially sensitive receptors (such as, scenic vistas, airports) within the 8.7 km SIA. For this reason, it was not necessary to conduct an analysis of visible plume impacts.

Growth

The purpose of a growth analysis is to predict how much new growth is likely to occur as a result of the project and the resulting air quality impacts from this growth. No adverse impacts on growth are anticipated from the project since any workforce growth and residential and commercial growth that would be associated with the proposed project (expected to be minimal) would not cause a quantifiable impact on the air quality of the area surrounding the facility.

Georgia Toxic Air Pollutant Modeling Analysis

Georgia EPD regulates the emissions of toxic air pollutant (TAP) emissions through a program covered by the provisions of *Georgia Rules for Air Quality Control*, 391-3-1-.02(2)(a)3.(ii). A TAP is defined as any substance that may have an adverse effect on public health, excluding any specific substance that is covered by a State or Federal ambient air quality standard. Procedures governing the Georgia EPD's review of TAP emissions as part of air permit reviews are contained in the agency's "*Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Revised).*"

Selection of Toxic Air Pollutants for Modeling

For projects with quantifiable increases in TAP emissions, an air dispersion modeling analysis is generally performed to demonstrate that off-property impacts are less than the established Acceptable Ambient Concentration (AAC) values. The TAP evaluated are restricted to those that may increase due to the proposed project. Thus, the TAP analysis would generally be an assessment of off-property impacts due to facility-wide emissions of any TAP emitted by a facility. To conduct a facility-wide TAP impact evaluation for any pollutant that could conceivably be emitted by the facility is impractical. A literature review would suggest that at least one molecule of hundreds of organic and inorganic chemical compounds could be emitted from the various combustion units. This is understandable given the nature of the fuels (natural gas, propane and diesel fuel oil) fed to the combustion sources, and the fact that there are complex chemical reactions and combustion of fuel taking place in some. The vast majority of compounds potentially emitted however are emitted in only trace amounts that are not reasonably quantifiable.

TAP emissions as by-products of fuel combustion in various fuel burning sources (boilers, spray dryers/pelletizers, calciners/kilns and emergency diesel generators) were estimated using applicable AP 42 emission factors and/or manufacturer's data. Emission of other TAP were estimated based usage rates of the chemicals containing the TAP compounds and available site-testing data from similar sources. Please refer to Appendix C of Volume 1 and Section 6 and Appendix F of Volume 2 of the Georgia Air Quality Permit Application No. 20584 for details.

For each TAP identified for further analysis, both the short-term and long-term AAC were calculated following the procedures given in Georgia EPD's *Guideline*. Figure 8-3 of Georgia EPD's *Guideline* contains a flow chart of the process for determining long-term and short-term ambient thresholds. PyraMax Ceramics referenced the resources previously detailed to determine the long-term (i.e., annual average) and short-term AAC (i.e., 24-hour or 15-minute). The AACs were verified by the EPD.

Determination of Toxic Air Pollutant Impact

The Georgia EPD *Guideline* recommends a tiered approach to model TAP impacts, beginning with screening analyses using SCREEN3, followed by refined modeling, if necessary, with ISCST3 or AERMOD. For the refined modeling completed, the infrastructure setup for the SIA analyses was relied upon with appropriate sources added for the TAP modeling. Note that per the Georgia EPD's *Guideline*, downwash was not considered in the TAP assessment.

Initial Screening Analysis Technique

Generally, an initial screening analysis is performed in which the total TAP emission rate is modeled from the stack with the lowest effective release height to obtain the maximum ground level concentration (MGLC). Note the MGLC could occur within the facility boundary for this evaluation method. The individual MGLC is obtained and compared to the smallest AAC. Due to the likelihood that this screening would result in the need for further analysis for most TAP, the analyses were initiated with the secondary screening technique.

The proposed facility emits significant amounts of the following six air toxic pollutants (TAPs): HF, HCl, Ammonia, Hexane, Methanol, and Methyl Acetate. The annual, 24-hour and 15-minute AACs of the above six TAPs were reviewed based on U.S. EPA IRIS reference concentration (RfC), and OSHA Permissible Exposure (PEL), etc, according to the Georgia Air Toxics Guideline. The modeled maximum ground-level concentrations (MGLCs) were calculated using the AERMOD dispersion model (version 11103) for 1 hour, 24 hours, and annual averaging periods. Table 7-2 summarizes the AAC levels and MGLCs of the TAPs at the above three averaging periods. Note that the maximum 15-min impact is based on the maximum 1-hour modeled impact multiplied by a factor of 1.32. As shown in the Table 7-2, the modeled MGLCs for all TAPs evaluated by the applicant are well below their respective AAC levels. Therefore, the applicant meets the applicable Georgia Air Toxics Guideline.

Table 7-2. MODELED MGLCS AND THE RESPECTIVE AACS

Pollutant	CAS	Averaging period	MGLC ($\mu g/m^3$)	AAC ($\mu g/m^3$)	Averaging period	MGLC ($\mu g/m^3$)	AAC ($\mu g/m^3$)
HF	7664-390-3	24-hour	0.23	5.84	15-min	1.08	245
HCL	7647-01-0	Annual	0.01	20	15-min	0.70	700
Hexane	110-54-3	Annual	0.02	700	15-min	1.57	17600
NH3	7664-41-7	Annual	3.48	100	15-min	128	2450
Methanol	67-56-1	24-hour	181	619	15-min	3273	32750
Methyl Acetate	110-54-3	24-hour	11.3	476	15-min	4893	75750

8.0 EXPLANATION OF DRAFT PERMIT CONDITIONS

The permit requirements for this proposed facility are included in draft Georgia Air Quality Permit No. 3295-163-0035-P-01-0.

Section 1.0: Facility Requirements Pertaining to the Entire Facility

PyraMax Ceramics, LLC – King's Mill Facility is a green-field major source under NSR/PSD for emissions of criteria pollutants and under 40 CFR Part 63 Subpart B for HAP emissions. The facility will produce ceramic proppants via two identical process/kiln lines which can be operated independently. Production at the facility consists mainly of material handling, milling, clay slurry preparation, pelletizing/spray drying, green pellet screening, calcining/sintering, finishing and supporting operations such as boilers, emergency diesel generators, storage tanks for fuel and chemicals. Detailed process description is contained in the permit referred above.

This draft permit applies BACT for emissions of CO, GHG, NO_x, $PM/PM_{10}/PM_{2.5,}$, SO_2 and VOC from various sources of such emissions. In addition, the permit establishes a case-by-case MACT for HAP emissions from the spray dryers/pelletizers and calciners/kilns, as determined per Section 112(g) of CAA Amendment of 1990 because: (1) This facility is a major HAP emission source due to methanol emissions from the spray dryers/pelletizers and combined HAPs (mostly methanol, HCl and HF) emissions from the entire facility: and (2) There is no NESHAP Part 63 MACT standard for ceramic pellet/proppant manufacturing industry.

Section 2.0: Requirements Pertaining to the Entire Facility

Conditions 2.1.1 through 2.1.6 are standard SIP facility-wide general requirement permit conditions for good work practice to minimize emissions, prevention of emission dilution, application submittal, record keeping, condition governances, permit amendment, and facility ownership change.

Condition 2.1.7 requires the Permittee to apply a Title V operation permit within 12 calendar months after commencing operation of this facility. Conditions 2.1.8 explains the circumstances for permit expiration and permit extension under NSR/PSD rule.

In case any standard(s) or requirement(s) in this permit is revised by Federal or State authority, Condition 2.1.9 requires the Permittee to comply with the revised standard(s) or requirement(s).

The ambient impacts of the criteria pollutants emitted from this modification have been assessed using atmospheric dispersion models and determined to be acceptable under pertinent NSR/PSD rules. During the modeling, "model receptors" inside the area bounded by "boundary receptors" were removed from modeling. Upon the request from the Divisions' air impact modeling program, Condition 2.2.1 establishes the require measures restricting public access to the property "non-ambient" air.

Section 3.0: Requirements for Emission Units

To facilitate quick and easy cross references, Table 3.1 lists all the process units/emission sources and associated air pollution control devices, and identifies applicable regulations and permit conditions incorporating the corresponding emission limits and other requirements. The BACT annual operating time limit in Condition 3.2.1 allows each 500 kW diesel generator to remain an emergency generating unit under SIP rules, thus exempt from PSD ambient impact analysis/modeling.

General BACT Requirements: Condition 3.3.1 requires the Permittee to comply with all applicable general provision provisions of the New Source Performance Standards (NSPS) as found in 40 CFR 60 Subpart A. NSPS standards usually specify the applicable general provision involved.

The operating and maintenance requirements in Conditions 3.3.4 and 3.3.5 aim to minimize the PM emissions from sources involved.

Conditions 3.3.1, 3.3.2, 3.3.4, and 3.3.5 impose general BACT requirements for the project..

NSPS Requirements:
Condition 3.3.6 imposes the requirements of Subpart A of Part 60.

Condition 3.3.7 incorporates the applicable PM and visible emission limits under NSPS Subpart OOO as amended by EPA on April 28, 2009. These emission limits apply to affected facilities constructed, modified and reconstructed on or after April 22, 2008. The condition also list process units/equipment subject to the emission limits.

Condition 3.3.8 incorporates the applicable PM and visible emission limits under NSPS Subpart UUU. These emission limits apply to spray dryers/pelletizers and calciners/kiln at this facility.

Conditions 3.3.9 through 3.3.11 imposes the requirements of Subpart IIII of Part 60 on the emergency generators.

Conditions 3.3.10 and 3.3.11 incorporate the applicable emission, operating, maintenance, and installation standards and requirements for each emergency stationary diesel generator under 40 CFR Part 60, Subpart IIII. The generator's manufacturer is required to certify with EPA that the unit is in compliance with applicable emission limits under Subpart IIII before marketing the diesel generator/engine. The same standards and requirements also are deemed as BACT for all the emergency stationary diesel generators. PyraMax Ceramics shall purchase diesel generators certified by EPA for compliance with all the applicable NSPS emission standards.

Specific BACT Requirements for this Project:
Condition 3.3.12 specifies the numerical BACT limit, compliance method, and averaging time for emissions of PM, PM10, PM2.5 from each calciner/kiln, spray dryer/pelletizer, each emission unit with baghouse control; visible emissions from each spray dryer/pelletizer and calciner/kiln, each emission unit with baghouse control, and all fugitive sources; SO2 emissions from each calciner/spray dryer; NOx emissions from each calciner/kiln, spray dryer/pelletizer, and boiler; CO emissions from each calciner/kiln; spray dryer/pelletizer; and VOC emissions from each spray dryer/pelletizer.

To ensure performance of the "catalytic baghouses" functioning as SCR for controlling NO_x emissions from calciners/kilns, Conditions 3.3.13 and 3.3.14 establish the temperature range and ammonia usage rate for normal operation of the "catalytic baghouses". The working temperature range in Condition 3.2.4 prevents the SCR temperature from dropping below that established during the most recent EPD-approved performance test so that the NO_x control efficiency could be maintain no less than the BACT level. The up limit of the SCR working temperature range, as specified by the manufacture, would presumably prevent the nano catalysts embedded in ceramic filters from heat damage. Condition 3.2.5 ensures the maintenance of the proper molar ratio between ammonia and NO_x, and prevents control efficiency from falling below the BACT level due to ammonia under-dosage, or ammonia slip due to ammonia over-dosage.

To maintain the SO_2 control efficiency of each "catalytic baghouse" at the BACT level, Condition 3.3.15 requires PyraMax Ceramics to maintain the injection rate of sodium bicarbonate to the "catalytic baghouses" at a level that would allow the molar ratio between sodium bicarbonate and SO_2 to remain at or greater than the level established during the most recent EPD-approved performance test.
Condition 3.3.16 incorporates the fuel standards under NSPS Subpart IIII which are applicable to each of the 500 kW stationary emergency diesel generators as BACT for SO2 emissions.

3.3.17 specifies the annual operating limit for each stationary emergency diesel generator.

NESHAP and Case-By-Case MACT Conditions:
Conditions 3.3.17 and 3.3.19 establish the case-by-case MACT emission standards under Section 112(g) of CAA Amendment of 1990 for methanol emissions from the spray dryers/pelletizers, and for HCl and HF from calciners/kilns. No add-on control is the case-by-case MACT for the methanol emissions. Dry scrubbing via the "catalytic baghouses" is deemed case-by-case MACT for the HCl and HF from calciners/kilns.

Because the facility is a major source for HAP emission, Condition 3.3.18 incorporates the applicable operating requirements/limitations for all the stationary emergency diesel generators subject to 40 CFR Part 63, Subpart ZZZZ, i.e., the NESHAP MACT standard for stationary reciprocating internal combustion engines. Condition 3.2.11 incorporates an applicable notification requirement for these stationary emergency diesel generators subject to 40 CFR Part 63, Subpart ZZZZ.

To allow each of the stationary diesel generators in the generator sets to retain the status of an emergency unit under SIP regulation, Condition 3.2.1 limits the accumulated annual operating time for each generator/engine to no more than 500 hours per year. As emergency units, these diesel generators are exempted from PSD ambient impact/analysis/modeling.

On December 2, 2011, U.S. EPA proposed an amended NESHAP/MACT standard, 40 CFR Part 63, Subpart DDDDD, *"National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters"*. Once finalized, the Rule would require mainly PyraMax Ceramics to tune-up each 9.8 MMBtu/hr natural gas -fired boilers biennially to optimize and maintain the boiler performance, and record the CO and oxygen levels before and after the tune-up. These proposed MACT requirements in the Rule that are applicable to the boilers would be considered as case-by-case MACT for PyraMax Ceramic's Boilers. Condition 3.3.20 establishes the case-by-case MACT requirements for the 9.8 MM/Btu/hr natural gas fired boilers. Once the Subpart DDDDD is promulgated, the finalized applicable requirements will be incorporated into this permit via a permit amendment.

Equipment SIP Rule Standards
Condition 3.4 1 incorporate measures for minimizing fugitive emissions under Georgia Rule (n). The Permittee shall make efforts to implement the measures which are considered feasible.

Condition 3.4.2 is a Vault Condition developed by the Division and applicable to the 9.8 MMBtu/hr natural gas-fired boilers. This condition incorporates applicable PM and visible emission limits under Georgia Rule (d) for the boilers. Burning only clean fuel including natural gas and propane and therefore having negligible PM emissions, the boilers are expected to comply with these limits.

Section 4.0: Requirements for Testing

Condition 4.1.1 lists applicable methods for performance testing and monitoring of the emissions from this facility. Conditions 4.1.2 through 4.1.5 contain standard general requirements with regard to the continuous monitoring system(s) to be used during the testing, the production rate during the testing, the notification of the testing, and the reporting of the testing results.

Condition 4.2.1 incorporates initial performance testing requirements applicable to sources subject to NSPS Subpart UUU, i.e., all the spray dryers/pelletizers and calciners/kilns at this facility.

Conditions 4.2.2 through 4.2.4 incorporate applicable testing and reporting requirements for the PM, visible and fugitive emissions from the sources subject to 40 CFR Part 60, Subpart OOO. Condition 4.2.2 allows the duration of the Method 9 testing to be reduced to 30 minutes when testing reveals that the source meets certain conditions. Condition 4.2.3 allows an alternative testing procedure when the fugitive emissions from two or more sources continuously interfere with each other and use of Method 5I instead of Method 5.

Conditions 4.2.5 and 4.2.6 require initial performance testing for all the sources with BACT and/or MACT emission standards. No such testing is required when a testing pursuant to NSPS Subpart UUU or Subpart OOO has already been conducted on the same sources for same emissions and under the same operating conditions. PyraMax Ceramics shall record all operating parameters, production information and other parameters affecting the emissions and/or required in the emission calculations, such as ammonia and sodium bicarbonate injection rates, and "catalytic baghouse" inlet temperature. To reduce redundant testing, Condition 4.2.6 allows the Permittee to use appropriate results from NSPS performance testing to demonstrate initial compliance with the applicable BACT emission limits for the same affected sources, provided that the testing condition and methodology used in the NSPS testing meet the requirements of this condition. In lieu of the testing required by this condition, the appropriate BACT performance testing results may be used to demonstrate initial compliance with the PM and visible emission limits for the same affected sources subject to NSPS Subpart UUU or OOO, provided that the testing condition and methodology meet the requirements of the relevant NSPS standards. This will reduce redundant testing.

Condition 4.2.7 requires annual testing of HCl and HF emissions from calciners/kilns to ensure compliance with the case-by case MACT limitations.

Condition 4.2.8 requires annual testing of CO emissions from calciners/kilns to ensure compliance with the BACT limit.

Condition 4.2.9 requires the Permittee to repeat testing every 36 months for specified particulate matter emissions from the spray dryer/pelletizers and calciners/kilns after the initial performance test..

Condition 4.2.10 requires the Permittee to conduct annual testing for NO_x and SO_2 emissions from each calciner/kiln to ensure compliance with the BACT limits.

Condition 4.2.11 requires the Permittee to records critical operating parameters of each "catalytic baghouse" when it functions as a SCR for NO_x emission control and as a dry scrubber for acid gas control.

Condition 4.2.12 requires the Permittee to determine the NO_x and acid gas control efficiencies achieved during the testing for each "catalytic baghouse" when it functions as a SCR for NO_x emission control and as a dry scrubber for acid gas control. The resulted control efficiencies shall be equal to or greater than the corresponding BACT levels. To maintain the control efficiencies achieved during the testing, the Permittee shall maintain the NH_3/NO_x and $NaHCO_3/SO_2$ molar ratios established in the testing for future operation, provided that the testing is approved by the Division.

Section 5.0: Requirements for Monitoring

Condition 5.1.1 contains general requirements for the operation of continuous monitoring system. The COMS monitoring requirements in Condition 5.2.1 is incorporated from NSPS Subpart UUU, and will ensure spray dryers/pelletizers and calciners/kilns, i.e., the two main PM emission sources at the facility, to comply with the pertinent PM and visible emissions limits.

To prevent thermal damage to the fabric filtration bags, Condition 5.2.2 requires continuous monitoring of inlet temperature or surrogate temperature for baghouses working at elevated temperature.

Conditions 5.2.3 and 5.2.5 establish daily visible emission (VE) check requirements for point/stack sources with visible emissions and for sources with fugitive emissions. The daily VE check is a common requirements for mineral processing industries such as cement plants, kaolin clay plants and other ceramic proppant manufacturing facilities. Representing a BACT requirement, Condition 5.2.5 is more stringent that the similar VE daily check condition in SIP standard condition vault.

To ensure proper function of the baghouses and thus minimize emissions, Condition 5.2.4 requires the Permittee to perform routine operation and maintenance check according a Preventive Maintenance Program approved by EPD.

To ensure compliance with the fugitive emission limits, and minimize the fugitive emissions, Conditions 5.2.5 establishes the monitoring requirements for fugitive emission control measures employed at the facility.

Condition 5.2.6 establishes the monitoring requirements under NSPS Subpart IIII for using a non-resettable hour meter to track the number of hours operated for each of the stationary emergency diesel generators during any type of operation. This condition allows the diesel generators to remain as emergency units and therefore are exempt from certain regulations.

Condition 5.2.7 requires quarterly Method 22 visible emission inspections on affected facilities that use baghouse to control PM emissions. This is a new monitoring requirement under 40 CFR Part 60, Subpart OOO as amended on April 28, 2009. When the quarterly 30-minute visible emissions inspection has been conducted on any affected baghouse during the day, no daily VE check on the same baghouse is necessary for that day.

Condition 5.2.8 establishes detailed procedures for routine monitoring of the NO_x emissions from each calciner/kiln using a portable NO_x analyzer. The NO_x emission data from the monitoring will be used to determine the ammonia injection rates to the "catalytic baghouses" until the next monitoring.

The flow monitor specified in Condition 5.2.9 would provide instant exhaust flow rate data required in the NO_x emission determination specified in Condition 5.2.8.

Condition 5.2.10 requires the Permittee to monitor and record specified operating parameters and production data to ensure and demonstrate emission compliance.

Section 6.0: Other Specific Requirements

Conditions 6.1.1 through 6.1.6 contain respectively general requirements for the record keeping type and duration,, reporting of deviations, excess emissions, exceedances, or excursions, quarterly report, sampling records, and record keeping of measurements for monitoring systems (monitoring, calibration, adjustment and maintenance) and performance testing.

Condition 6.1.7 incorporates the applicable reporting requirements for excess emissions, exceedances, excursions or additional information to be included in the PSD/BACT quarterly reports required by Condition 6.1.4. To reduce ammonia slip due to over-dosage, this condition requires the report of each instance that the recorded ammonia injection rate deviate more than 5% above the "current injection rate (W_{NH3})" as determined per Condition 6.2.16.

Condition 6.2.1 incorporates the applicable notification requirements under NSPS Subpart OOO. These requirement establish time frames for milestones such as record keeping, reporting, performance testing, maintenance and emission/compliance calculation.

Condition 6.2.2 ensures the compliance with the fugitive emission limits and minimization of such emissions. Conditions 6.2.3 through 6.2.5 establish the record keeping, emission calculation/compliance demonstration and reporting requirements for compliance with the case-by-case MACT emission limits.

Condition 6.2.6 establishes the applicable the record keeping, emission calculation/compliance demonstration and reporting requirements for compliance with the BACT VOC emission limit

Condition 6.2.7 incorporate the requirements for submitting testing results a specified by NSPS Subpart OOO. Condition 6.2.8 specifies how to submit the written notification of the actual date of initial startup of each affected facility/source in case of phased construction or modification.

Conditions 6.2.9 through 6.2.13 establish the applicable record keeping, compliance demonstration, notification and reporting requirement necessary for demonstrating compliance with the operating and fuel usage limitations under NSPS Subpart IIII for the emergency diesel generators.

Conditions 6.2.14, 6.2.15 and 6.2.16 establish detailed requirements and procedures showing how to determine daily SO_2 emission rate and the "current injection rate" for sodium bicarbonate and ammonia. The "current injection rate" could maintain respectively the $NaHCO_3/SO_2$ and NH_3/NO_x molar ratio thus the SO_2 and NO_x control efficiency at the level established during the most recent Division-approved performance test(s).

Conditions 6.2.17 and 6.2.18 establish the record keeping, emission calculation/compliance demonstration and reporting requirements for compliance with the case-by-case MACT emission limits for emissions of HCl and HF. Condition 6.2.19 ensures the reduction of fugitive emissions and compliance with the BACT requirements by requiring relevant operating records.

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APPENDIX A -112(g) of CAA Case-By-Case Maximum Achievable Control Technology Determination, PyraMax Ceramics, LLC – King's Mill Facility

112(g) of CAA Case-By-Case Maximum Achievable Control Technology (MACT)
Determination Review of PyraMax Ceramics, LLC – King's Mill Facility
Construction and Operation of a New Ceramic Proppant Manufacturing Facility
Located in Wrens, Georgia (Jefferson County)

NOTICE OF MACT APPROVAL

Air Quality Permit Application No. 20584
Dated July 21, 2011

Reviewing Authority

State of Georgia
Department of Natural Resources
Environmental Protection Division
Air Protection Branch
Stationary Source Permitting Program (SSPP)

Prepared By:

Wei-Wei Qiu – Environmental Engineer, Mineral Unit

James Capp – Chief, Air Protection Branch
Eric Cornwell – Program Manager, Stationary Source Permitting Program
Hamid Yavari – Mineral Unit Manager, Stationary Source Permitting Program

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1.0 EXECUTIVE SUMMARY

PyraMax Ceramics, LLC – King's Mill Facility (hereafter "PyraMax Ceramics") submitted Air Quality Application No. 20584 proposing to construct and operate a ceramic proppant manufacturing facility located on County Road 291, Wrens, Jefferson County, Georgia. Jefferson County is classified as "attainment" or "unclassifiable" for all criteria pollutants.

The facility will consist of two identical process/kiln lines which can be operated independently. Each process/kiln line consists of mainly the following operations. For more facility details and process diagrams, please refer to Application No. 20584.

- **Materials Handling:** Materials handling operations include unloading, loading, distribution, storage, and packaging. Expected emissions from this operation are PM, PM_{10} and $PM_{2.5}$. Baghouses, bin filters and other measures as appropriate will be employed wherever feasible to control the emissions.

- **Slurry Preparation**: A mixer transfers milled fine clay powder into a stable suspended mixture/slurry by mixing the clay with water and a dispersant. The slurry is agitated and then pH balanced using aqueous ammonia, then stored in tanks. The slurry is then wet screened before addition of a binder agent. Air pollutant emissions from this process is negligible due to wet process.

- **Spray Drying/Pelletizing:** The slurry is fed into directly heated/fired spray dryers/pelletizers when flue is in touch with slurry. Green clay pellets form in the unit, dry under the heat, then are coated by fresh incoming slurry, and dry again, until desired bead size is achieved. Expected emissions from this process include process particulate matters and combustion byproducts (CO, NO_x, SO_2, particulate matters, VOC and GHG), and VOC when volatile organics in the additives are evaporated (mostly methanol). Methanol is an EPA- listed HAP compound. A baghouse will be used for removal of the particulate matter.

- **Green Pellet Screening**: Green pellets are separated by multiple-stack screens according to their sizes. On-sized pellets are conveyed to calciners/kilns for further processing. Oversized pellets are diverted to a cage mill for size reduction and then re-fed to the pelletizer feed bin, while undersized pellets are sent directly beck to the pelletizer feed bin. Only particulate matters are emitted from this process, and controlled by baghouses and/or bin vent filters.

- **Calcining**: On-sized green pellets are metered into the charging end of each counter flow dry-process rotary calciner/kiln where they are slowly heated, dried and then calcined/sintered, releasing moisture and other impurities in the process. Each rotary kiln/calciner is closely followed by a separate rotary cooler which introduces cooling air in the discharge end of the cooler. Expected emissions from calcining include CO, NO_x, PM, PM_{10}, $PM_{2.5}$, SO_2 and VOC), green house gas (GHG), and HAPs (HCl and HF). Kiln and cooler exhaust gas streams carrying these missions are routed to a "catalytic baghouse" for multi-pollutant control (particulate matters, acid gases and NO_x).

- **Finishing:** The calcined/sintered ceramic proppants are conveyed to final product screens. On-sized proppants are transferred to quality control bins and off-sized ones recycled back to the kiln for further processing. On-size ceramic proppants are tested for quality and those passing the testing are sent to storage silos awaiting for shipping. Each silo or bin is equipped with a vent filter to control PM, PM_{10}, $PM_{2.5}$ emissions. Finished pellets/proppants are conveyed to a rail car loading spout and into railcars for delivery to customers. Dust generated during railcar loading is controlled via pneumatic collection at transfer points and then a common baghouse.

- **Supporting:** Supporting operations include emergency diesel generators, fuel and chemical storage tanks, and two 9.8 MMbtu/hr natural gas-fired boilers.

PyraMax Ceramics will use an additive/chemical compound as disperser during the slurry preparation. This disperser contains less than 1% by weight of methanol (EPA listed HAP) as an impurity which evaporates into the atmosphere during spray drying/palletizing of the slurry. The facility has the potential to emit more than 10 tons per year of methanol and more than 25 tons per year of all HAPs combined, including mostly methanol (48.0 tpy), HCl (5.89 tpy) and HF (9.04 tpy). Because the emissions of methanol exceed major source thresholds of 10 tons per year for a single HAP, and the emissions of methanol, HCl and HF combined exceed the major source threshold of 25 tons per year for combined HAPs under 40 CFR Part 63 Subpart B, and there is no NESHAP Part 63 MACT standard for the ceramic proppant manufacturing industry, the HAPs emissions from PyraMax Ceramics are subject to a Case-by-Case MACT determination under 112(g) of CAA Amendment of 1990.

The Section 112(g)(2)(B) trigger date for Georgia is June 29, 1998. Constructed after this date and having no 40 CFR Part 63 NESHAP standard, PyraMax Ceramics is a "newly constructed major source" pursuant to Section 112(g) of the CAA Amendments of 1990, and is subject to a case-by-case MACT determination. The requirements for such case-by-case control technology reviews are codified in 40 CFR Part 63, Subpart B and are adopted by reference, with a few revisions and clarifications, into the Georgia Rules for Air Quality Control.

To satisfy the 112(g) case-by-case MACT requirements (40 CFR 63.40 through 63.44, *Control Technology Requirements in Accordance with Section 112(g)(2)(B) of the 1990 Clean Air Act Amendments*), PyraMax Ceramics submitted with the application No. 20584 a proposed case-by-case MACT determination specifying control technology intending to meet the MACT emission limitations. PyraMax Ceramics' analysis of similar facilities indicates that the case-by-case MACT should be the limitation of the potential methanol emissions to the levels as dictated by the potential usage rate of the methanol-containing additive without add-on control. PyraMax Ceramics has requested that HF and HCl emissions be limited for each process line. The Division has conducted case-by-case MACT determination for the sources subject to the 112(g) case-by-case MACT determination. Numerical MACT emission rate limits have been established for the HCl and HF emissions from each calciner/kiln plus initial and annual testing for compliance assurance.

2.0 APPLICATION INFORMATION

2.1 Application Content

The permit application No. 20584 includes the following information:

(1) SIP Air Quality Permit Application forms for the new/green-field emission sources;

(2) Description of the processes/operations alone each process/kiln line;

(3) Emissions inventory/calculation sheets indicating the potential emissions from the facility;

(4) Proposed BACT for CO, GHG, NO_x, PM, PM_{10}, $PM_{2.5}$, SO_2 and VOC emissions from the facility;

(5) Proposed 112(g) of CAA case-by-case MACT for methanol, hydrogen fluoride (HF) and hydrogen chloride (HCl) emissions from the facility;

(6) Analyses of air quality/ambient impact modeling for CO, NO_x, $PM/PM_{10}/PM_{2.5}$, and SO_2 emissions from the facility per PSD/NSR requirements; and

(7) Ambient impact assessments/modeling for emissions of air toxic pollutants emissions from the facility per SIP rule requirements.

2.2 Applicant Information

(1) Facility Owner:

PyraMax Ceramics, LLC.
County Road 291
Wrens, Georgia 30833

(2) Facility Information:

PyraMax Ceramics, LLC. – King's Mill facility
County Road 291
Wrens, Georgia 30833 (Jefferson County)

2.3 Authorized Representative

Don A. Anschutz
Vice President of Manufacturing
17515 Spring Cypress Road, Suite C#253
Cypress, Taxes 77429

2.4 Application Submittals

July 26, 2011:	Date of initial application received and assigned as Application No. 20584
October 24, 2011	Submitted additional information regarding to the case-by-case MACT determination

3.0 BACKGROUND

3.1 Facility Location

PyraMax Ceramics will be located on County Road 291, Wrens, Jefferson County, Georgia. Jefferson County is classified as "attainment" or "unclassifiable" for all criteria pollutants.

3.2 Permit Status of Facility Operations

PyraMax Ceramics submitted the application No. 20584 applying for a SIP Air Quality Permit for the construction and operation of the proposed green-field ceramic proppant manufacturing facility.

3.3 Project Schedule

Construction of PyraMax Ceramics' new ceramic proppant manufacturing facility is expected to begin in June of 2012. The application No. 20584 does not indicate when regular production operations will commence.

3.4 Proposed Operation

PyraMax Ceramics' proposed ceramic proppant manufacturing facility is a greenfield/new source. It will consist of two identical ceramic proppant process/kiln lines which can be operated independently. Operations along each process/kiln line consists of mainly material handling and storage, milling, slurry preparing, screening, spray drying/pelletizing, calcining and packaging and shipping operations. Each process line is supported by a 9.8 MMBtu/hr natural gas-fired boiler and two (2) 500 kW stationary emergency diesel generators. Both lines will also have separate and/or shared fuel and chemical storage facilities.

4.0 EMISSION RATES AND CHANGES

The methodologies used to quantify emissions from the emission units at PyraMax Ceramics' new ceramic proppant manufacturing facility are summarized in the application No. 20584 dated July 21, 2011. The emission rates are estimated either based on available source specific testing data, AP 42 emission factors, proposed BACT limits or requirements, or mass balance based on production records.

4.1 Case-by-Case MACT Applicability Under Section 112(g) of the CAA Amendment of 1990

Under the Clean Air Act (CAA) Amendments of 1990, EPA is required to regulate large or "major" industrial facilities that emit one or more of listed hazardous air pollutants (HAPs). HAPs are those pollutants that are known or suspected of causing cancer or other serious health effects, such as developmental effects or birth defects. On July 16, 1992, EPA published a list of industrial source categories that emit one or more of these hazardous air pollutants. EPA is required to develop standards for listed industrial categories of "major" sources (those that have the potential to emit 10 tons/year (TPY) or more of a listed pollutant or 25 TPY or more of a combination of pollutants) that will require the application of stringent controls, known as maximum achievable control technology (MACT).

The Section 112(g) provision is designed to ensure that emissions of toxic air pollutants do not increase if a facility is constructed or reconstructed before EPA issues a MACT for that particular category of sources or facilities. A newly constructed or reconstructed major source of HAP without a promulgated Part 63 NESHAP MACT standard will be subject to the requirements of 40 CFR 63.40 through 63.44, including a case-by-case MACT determination as described by the Section 112(g) of the 1990 Clean Air Act Amendments.

PyraMax Ceramics' new facility is considered "construction of a major source" as defined by 40 CFR 63.41 because it has the potential to emit more than 10 tons per year of any individual HAP or 25 tons per year of any combination of HAPs. Constructed after the Section 112(g)(2)(B) trigger date for Georgia of June 29, 1998 and having no promulgated 40 CFR Part 63 NESHAP MACT standard, the new ceramic proppant manufacturing facility is considered a newly constructed major source under Section 112(g) of CAA Amendment of 1990 and is subject to a case-by-case MACT determination.

Newly constructed major sources subject to Section 112(g) of CAA Amendment of 1990 would be subject to stringent air pollution control requirements, referred to as "new source MACT." Under the Clean Air Act, new source MACT control is required to be no less stringent than "the best controlled similar source". At least two questions should be answered to determine if an emission unit is similar: (1) Do the two emission units have similar emission types, and (2) Can the emission units be controlled with the same type of control technology. If the two emission units do have similar emission types and are controllable to approximately the same extent with the same control technologies, then the two emission units can be considered similar for the purposes of a case-by-case MACT determination……".[1]

4.2 HAP Emissions Profile

All fuel combustion processes at PyraMax Ceramics emit gaseous and solid HAP compounds as combustion by-products. The amount of the HAP emissions depends mainly on the type and quantity of the fuel. Therefore, each boiler, spray dryer/pelletizer, calciner/kiln and emergency diesel generator at PyraMax Ceramics' facility is a source of HAP emissions. In addition, HAP compounds are released from raw materials via evaporation, i.e., the methanol emissions from spray dryers/pelletizers, and via chemical reactions at high temperature, i.e., chlorides and fluorides emissions from calciners/kilns.

Page 3 of Form 1.00 in the application No. 20584 dated July 21, 2011 estimates the facility-wide total potential HAP emissions to be 70.55 TPY, including 48.0 TPY of methanol from spray drying/palletizing, 5.89 TPY of HCl and 9.04 TPY of HF from calcining, and 2.11 TPY of Hexane as by-product of fuel combustion. The rest of HAP emissions consist of trace amounts of various inorganic and organic compounds and elements as byproducts from fuel combustion, and insignificant in comparison with the methanol, HCl and HF emissions [2].

5.0 112(G) OF CAA CASE-BY CASE MACT ANALYSIS

A 112(g) case-by-case MACT determination is required for this facility. MACT emission limitation for new sources is defined as:

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[1] US EPA, *Guidelines for MACT Determinations under Section 112(j) Requirements*, EPA 453/R-02-001, February 2002; http://epa.gov/ttn/atw/112j/guidance.pdf.

[2] Table C-3, Attachment C, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics, LLC. – King's Mill Facility.

> "…the emission limitation which is not less stringent that the emission limitation achieved in practice by the best controlled similar source, and which reflects the maximum degree of deduction in emissions that the permitting authority, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, determines is achievable by the constructed or reconstructed major source."
> [40 CFR 63.41]

The requirements of the determination are set forth in 40 CFR 63.40 through 63.44.

5.1 MACT Technical Approach

Because EPA could not immediately issue MACT standards for all industries (and there was a potential for significant new sources of toxic air emissions to remain uncontrolled), Section 112(g) of the Clean Air Act acts as a "gap-filler" requiring MACT-level control of air toxics when a new major source of HAP is constructed or reconstructed. The facility provides basic information about the source and its potential emissions through its air quality permit application. The application also specifies the emission controls that will ensure that new source MACT will be met. The Division reviews and approves (or disapproves) the application, and provides an opportunity for public comment on the determination.

The principles of an 112(g) case-by-case MACT determination are outlined in 40 CFR 63.43(d)(1) through (4) as follows:

"……

(d) *Principles of MACT Determinations.* The following general principles shall govern preparation by the owner or operator of each permit application or other application requiring a case-by-case MACT determination concerning construction or reconstruction of a major source, and all subsequent review of and actions taken concerning such an application by the permitting authority:

(1) The MACT emission limitation or MACT requirements recommended by the applicant and approved by the permitting authority shall not be less stringent than the emission control which is achieved in practice by the best controlled similar source, as determined by the permitting authority.

(2) Based upon available information, as defined in this subpart, the MACT emission limitation and control technology (including any requirements under paragraph (d)(3) of this section) recommended by the applicant and approved by the permitting authority shall achieve the maximum degree of reduction in emissions of HAP which can be achieved by utilizing those control technologies that can be identified from the available information, taking into consideration the costs of achieving such emission reduction and any non-air quality health and environmental impacts and energy requirements associated with the emission reduction.

(3) The applicant may recommend a specific design, equipment, work practice, or operational standard, or a combination thereof, and the permitting authority may approve such a standard if the permitting authority specifically determines that it is not feasible to prescribe or enforce an emission limitation under the criteria set forth in section 112(h)(2) of the Act.

(4) If the Administrator has either proposed a relevant emission standard pursuant to section 112(d) or section 112(h) of the Act or adopted a presumptive MACT determination for the source category which includes the constructed or reconstructed major source, then the MACT requirements applied to the constructed or reconstructed major source shall have considered those MACT emission limitations and requirements of the proposed standard or presumptive MACT determination.

……".

In February 2002, EPA issued *"Guidelines for MACT Determination under Section 112(j) Requirements"*[3] for a major HAP source in a source category for which EPA missed the deadline for promulgating a MACT Standard. These guidelines offer a suggested step-by-step process for making a MACT determination consistent with the above principles. The process is summarized as followings:

Tier I: Making a MACT floor finding

Step 1 - Identify all the MACT affected emission unit(s). These emission points will be grouped into emission units (MACT emission units) subject to a MACT determination. When no relevant emission standard has been proposed, the MACT emission unit will be determined on a case-by-case basis.

Step 2 - Make a MACT floor finding. Using the available information provided by the EPA, other permitting authorities, and/or the permit applications, a level of HAP emission control that is equal to the MACT floor for each type of emission unit undergoing review should be calculated. Section 112(d) of CAA 1990 Amendment instructs the EPA to set emission standards for new sources based on the emissions control achieved in practice by the best controlled similar source and to set emission standards for existing sources based on an average emission limitation achieved by the best performing 12% of existing sources or best performing five sources in the source category or subcategory for categories with fewer than 30 sources. The word "average" can have several different meanings, including arithmetic mean, median, and mode.

It is not necessary for the MACT floor to be determined based on emissions information from every existing source in the source category or subcategory if such information is not available. The permitting authority, however, should check with EPA Regional Offices and EPA Headquarters for any available information that could be used in determining the MACT floor. If a MACT floor is determined, it is only necessary to complete Tier I and Tier III of the MACT analysis. If, under Tier I, the MACT floor cannot be determined or is equal to "no control", Tier II of the analysis should be completed before moving on to Tier III.

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[3] EPA, *Guidelines for MACT Determinations under Section 112(j) Requirements*, EPA 453/R-02-001, February 2002; http://epa.gov/ttn/atw/112j/guidance.pdf.

Tier II: Considering all control technologies

Step 1 – Identify all commercially available and demonstrated control technologies that are reasonably applicable to such source. Available control technologies include but are not limited to: reducing the volume of, or eliminating emissions of pollutants through process changes, substitution of materials or other techniques; enclosing systems or processes to eliminate emissions; collecting, capturing, or treating pollutants when released from a process, stack, storage, or fugitive emission point; using design, equipment, work practices, or operational standards (including requirements for operator training or certification); or, a combination of any of these methods. Each control technology should be evaluated to consider the costs, non-air quality health and environmental impacts, and energy requirements associated with using each control technology.

Step 2- Eliminate technically infeasible control technologies. A technology is generally considered technically infeasible if there are structural, design, physical or operational constraints that prevent the application of the control technology to the emission unit. A technology may also be eliminated if the permitting authority deems it unreasonable. A technology is considered unreasonable if the operational reliability and performance have not been demonstrated by approved methods under conditions representative of those applicable to the source for which MACT is being determined.

Step 3- Determine efficiency of applicable control technologies via a detailed analysis of all of the available reasonably applicable control technologies. The efficiency of each control technology in reducing overall HAP emissions should be determined. Generally, MACT has been selected based on an overall reduction of all HAP emissions.

Tier III - Identifying MACT

Step 1 - Identify the maximum emission reduction control technology. When a MACT floor finding is made, the permitting authority will need to use available information to identify the control technology(s) that reduce HAP emissions from the MACT emission units to the maximum extent considering the factors in Section 112(d)(2) of the Act and to a level that is at least equal to or greater than the MACT floor.
As in Tier II, the permitting authority should conduct an analysis to eliminate any technically infeasible control technologies, to determine the efficiency of applicable control technologies and at the same time take into consideration "the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements" [section112(d)(2)].

Step 2 - Conduct an impacts analysis. The control technology that achieves the maximum degree of HAP emission reductions with consideration to costs, non-air quality health and environmental impacts, and energy requirements is MACT. The Act does not provide direction on the significance of one consideration to another. The EPA believes that it is inappropriate to provide specific guidance for determining the amount of consideration that should be given to any

> one factor. Such decisions will need to be made based on the information available at the time of the MACT determination.
>
> **Step 3** -- Establish the MACT emission limitation. The MACT emission limitation established by the permitting authority is based on the degree of emission reduction that can be obtained by the affected source if MACT is applied and is properly operated and maintained.

However, the Guideline also states that "This process is presented here as suggested guidance in determining MACT. Permitting authorities are free to use the process with which they are most familiar to determine MACT"[4].

5.2 Potential Control Options Review

HAP emissions sources/process units at PyraMax Ceramics include natural gas-fired spray dryers/pelletizers, natural gas-fired rotary ceramic calciners/kilns, natural gas-fired boilers, and stationary emergency diesel generators. They are grouped into the following source categories:

- Industrial Boilers: 9.8 MMBtu/hr natural gas-fired boiler Nos. 1 and 2.
- Reciprocating Internal Combustion Engines & Stationary Internal Combustion Engines: stationary emergency diesel generator sets Nos. 1 and 2, each consisting two (2) 500 kW diesel engines – generator combos.
- Calciners/Kilns Nos. 1 and 2.
- Spray Dryers/Pelletizers Nos. 1 and 2.

The first two sources categories are listed in EPA's Source Category List under 112(c) of CAA Amendment of 1990, as revised on June 30, 2005.[5] But neither spray dryers/pelletizers nor calciners/kilns are listed as a source category in the List. Both are direct heating process units where flue gases are in touch with materials being heated/processed. Spray dryers/pelletizers remove physically-bound water and volatile organic substances from clay slurry via evaporation in hot air, and thus emit most if not all the methanol discussed previously. Calciners/kilns further drive off residue physically-bound water and volatile organic substances from semi-dried slurry/kiln feed/green pellets and then remove chemically-bond water from the kiln feed/clay to produce ceramic proppants via sintering at a much high temperature. Because of the high temperature (>3,000°F), calciners/kilns can readily oxidize/burn most of the organic and inorganic compounds contained in the calciner/kiln feed, and turn them into water, CO_2 and other oxidizes including CO, NO_x, and SO_2. With regard to the HAP emissions, the calciners/kilns release chlorides and fluorides contained in the clay into the air mainly in forms of acidic gases (HCl and HF), plus less amounts of solid chlorides and fluorides which are also EPA listed HAPs. Because the significant differences in the process and emission nature and characteristics between the spray dryers/pelletizers and the calciners/kilns at PyraMax Ceramics facility, they are considered as two source categories with regard to this 112(g) case-by-case MACT determination.

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[4] Page 3-5, *"Guidelines for MACT Determinations under Section 112(j) Requirements"*, EPA 453/R-02-001, February 2002; http://epa.gov/ttn/atw/112j/guidance.pdf.

[5] *Federal Register*, Volume 70, No. 125, June 30/Notices; http://www.epa.gov/fedrgstr/EPA-AIR/2005/June/Day-30/a12942.htm

All the stationary emergency diesel generators at PyraMax Ceramics are subject to the promulgated NESHAP/MACT standard, 40 CFR Part 63, Subpart ZZZZ - *National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines [RICE].* They are not subject to this case-by-case MACT determination.

The 9.8 MMBtu/hr natural gas -fired boilers are subject to amended NESHAP/MACT standard, 40 CFR Part 63, Subpart DDDDD, *"National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters".* The rule was finalized in March 2011, but the effective date is currently stayed and amendments to the rule have recently been proposed. This rule will apply to the boiler.

No currently promulgated NESHAP MACT Standards under 40 CFR Part 63 has been identified to be applicable to the rest of the HAP emissions source categories (spray dryers/pelletizers, boilers and calciners/kilns). Therefore, theses sources are the subjects of this case-by-case MACT determination per 40 CFR 63.40 through 63.44.

5.3 Technical Feasibility Review

A control method or technology is considered available if it can be obtained through commercial channels or applied within the common sense meaning of the term. An available control technology is applicable if it can reasonably be installed and operated. A technology that is both available and applicable is technically feasible. EPA has identified the potential control options in the proposed MACT standard as being available and applicable.

5.4 Case-by-Case MACT Determination for Spray Dryer/Pelletizer

Tier I: Making a MACT floor finding

Step 1: Identify the Case-by-Case MACT – Affected Emission Unit

The clay slurry injected into each of the spray dryers/pelletizers contains an additive with less than 1% by weight of methanol, which is assumed to be driven off in the spray dryers/pelletizers since the operating temperature of these sources is above the boiling point for methanol. The methanol content is an impurity in the additive. The potential methanol emission rate is estimated at 5.48 lbs/hr or 24 TPY for each spray dryer/pelletizer[6]. Both spray dryers/pelletizers are considered as "new sources" under Section 112(g) of CAA Amendment of 1990.

Step 2: Make a MACT Floor Finding

According to Section 112(d) of the CAA Amendment of 1990, the MACT floor for a new source is the level of HAP emission control achieved in practice by the best controlled similar source. EPA's RBLC database indicates that no source similar to PyraMax Ceramics' spray dryers/Pelletizers (Process Code 90.017, Calciners & Dryer and Mineral Processing Facilities) has add-on control for VOC (Methanol is also considered as a VOC compound), as indicated by Table 5.4-1.

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[6] Table C-3, Attachment C, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics, LLC. – King's Mill Facility.

Table 5.4-1: Best Methanol/VOC Control Technology Determination for Spray Dryers

Facility Name	Agency	Database	Process Type	Permit Date	Process Description	Controls/Type	Emission Limits/Description
Dalitalia LLC	OK, DEQ	RBLC	90.017	10/05	Spray Dryers	Pollution Prevention/Good Combustion Techniques	0.25 lbs/ton material
Dalitalia LLC	OK, DEQ	RBLC	90.017	10/05	Vertical Dryers	Pollution Prevention/Good Combustion Techniques	4.26 lbs/hr
Dalitalia LLC	OK, DEQ	RBLC	90.009	10/05	Vertical Dryers	Pollution Prevention/Good Combustion Techniques	5.1 lbs/hr
Dalitalia LLC	OK, DEQ	RBLC	90.009	10/05	Vertical Dryers	Pollution Prevention/Good Combustion Techniques	5.1 lbs/hr
Carbo Ceramics, Inc.- Toomsboro Plant	GA, EPD	N/A	90.017	12/09	Spray Dryers/ Pelletizers	Pollution Prevention	0.12 lbs. methanol/ton kiln feed not to exceed 10.04 tons methanol per kiln per 12-rolling months

According to EPA, there are no known cases of similar spray dryers using any add-on VOC/volatile HAPs control in clay and ceramic products manufacturing industries[7]. An information search also confirms that there are no known cases of add-on VOC control being utilized for similar calciners/kilns. Therefore, the MACT floor for the methanol emissions from PyraMax Ceramics' spray dryers/pelletizers is equal to "no control" since the group of similar sources on which the MACT floor determination is based on are not currently controlling HAP emissions. Consequently, a more detailed analysis is required in order to determine the appropriate level of control. Tier II of the analysis is required before moving on to Tier III.

Tier II: Considering all control technologies

Step 1 – Identify all commercially available and demonstrated control technologies that are reasonably applicable to such source

For controlling the methanol emissions from the spray dryers/pelletizers, regenerative thermal oxidation (RTO), catalytic oxidation, biofiltration using a biotrickling filter, quencher/scrubber system (direct contact condensation) and pollution prevention/substitute material are being considered as possible control technology options as listed in Table 5.4-2.

Table 5.4-2: Evaluated Control Options for Methanol Emissions from Spray Dryers/Pelletizers

Control Option No.	Control Technology	Estimated Control Efficiency, % wt.	Reference
1	Quencher/Scrubber System (Direct Contact Condensation)	various	EPA/625/6-91/014
2	Carbon Adsorption	98	EPA/625/6-91/014
3	Regenerative Thermal Oxidation (RTO)	95-99	EPA-452/F-03-021

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[7] Per a telephone conversion with Mr. Jeff Telander, Project Lead of 40 CFR Part 63, Subpart JJJJJ (NESHAP MACT standard for Brick & Structural Clay Products Manufacturing) and Subpart KKKKK (NESHAP MACT standard for Clay Ceramics Manufacturing), 919-541-5427, telander.jeff@epa.gov.

Control Option No.	Control Technology	Estimated Control Efficiency, % wt.	Reference
4	Catalytic Oxidation	95	EPA/625/6-91/014
5	Biofiltration	60-99	EPA-456/R-03-003
6	Pollution Prevention & Substitute Material	N/A	N/A

Step 2- Eliminate technically infeasible control technologies.

Option 1: Quencher/Scrubber System (Direct Contact Condensation): In theory, the methanol emissions from PyraMax Ceramics' spray dryers/pelletizers can be reduced by chilling the exhaust gas streams from the spray dryers/pelletizers. As the temperature of the exhaust gas streams is lowered, a portion of the methanol in the exhaust gas streams could be condensed and thus removed. Nevertheless, the methanol concentration in each of the exhaust gas streams from PyraMax Ceramics' spray dryers/pelletizers as estimated by the company is 12.2 ppm by volume, substantially below the low bound of the concentration range (1,000 ppm by volume) for VOC condensation control technology to be effective[8,9]. In addition to the low VOC/methanol concentration, the spray dryers/pelletizers' exhaust gas streams are rich in water vapor. Condensation of large quantity of water would make the operation of the condensation system even less cost-effective and practical. Based on these findings, condensation is deemed technically infeasible and not considered further for this MACT analysis.

Step 3- Determine efficiency of applicable control technologies

The control/removal efficiencies of the rest evaluated control options for the methanol emissions from PyraMax Ceramic's spray dryers/pelletizers are listed in Table 5.4-3 below:

Table 5.4-3: Efficiency of the Evaluated Applicable Control Options for Methanol Emissions from PyraMax Ceramics' Spray Dryers/Pelletizers

Control Option No.	Control Technology	Control Efficiency % wt.
2	Carbon Adsorption	98
3	Regenerative Thermal Oxidation (RTO)	95-99
4	Catalytic Oxidation	95
5	Biofiltration	60-99
6	Pollution Prevention & Substitute Material	N/A

Tier III - Identifying MACT

Step 1 - Identify the maximum emission reduction control technology

Option 2: Carbon Adsorption: Adsorption is a surface phenomenon where VOC compounds are selectively adsorbed on the surface of such materials (adsorbents) as activated carbon, silica gel or alumina. Activated carbon in various granular shapes/sizes is the most widely used adsorbent. Carbon adsorption technology has been used by industries for controlling VOC emissions from a variety of sources/processes, especially for solvent recovery from VOC-rich gas streams such as process exhaust/ventilation air flows from publication rotogravure and packaging rotogravure printing facilities and from large scale industrial surface coating operations.

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[8] Page 6-14, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics, LLC. – King's Mill Facility.

[9] EPA, *Survey of Control Technologies for Low Concentration Organic Vapor Streams*, EPA-456/R-95-003, May 1995.

A typical solvent recovery process consists of an activated carbon adsorption unit with multiple adsorber units, and if required, an air stripper or distillation unit.

VOC/solvent-laden air passes through a number of adsorber units in parallel or series where the VOC compound(s)/solvent vapors are adsorbed by the activated carbon. Once the carbon becomes saturated and solvent starts to slip, as detected by an optional gas analyzer, the VOC/solvent-laden air is routed to a freshly regenerated stand-by adsorber and the saturated adsorber is regenerated.

Solvents are recovered by regenerating the activated carbon on-site via steam or hot nitrogen. Steam heats the carbon and strips the solvent from it. The steam and solvent vapor are then condensed in a water or air cooler condenser and drained to a separator. Water immiscible solvents may be separated from water by simple decantation or distilled to purify them further, with the solvent being returned to the process for re-use, resale, or disposal; the resulting water layer may be disposed of/reused as is or may be treated in an air stripper or distilled to remove any dissolved solvent before disposal or reuse. Solvents that are water miscible are separated from the water and purified in a distillation system.

Options 3: Regenerative Thermal Oxidizer (RTO): A properly designed, constructed, maintained and operated thermal oxidizer such as RTO can readily oxidize/burn methanol in the spray dryers/pelletizers' exhaust gas streams into carbon dioxide and water vapor. The advantage of a RTO over a direct flame thermal oxidizer is RTO's increased thermal efficiency via effective heat recovery. The control efficiency of a RTO, when properly maintained and operated, can be as high as 99%[10]. Although the use of a RTO has been determined to be technically feasible in theory, RTO has not been employed to control VOC/methanol emissions in a process similar to PyraMax Ceramics' spray dryers/pelletizers.

Option 4. Catalytic Oxidizer: Like RTO, a catalytic oxidizer destroys methanol in the exhaust gas streams via oxidation in which methanol combusts with oxygen and turns into CO_2 and water vapor. The catalysts serves to reduce the activation energy required for the complete oxidation of methanol or other VOC compounds, thus enable the oxidation or burn-off of these compounds to take place at a relatively low temperature, which reduce the energy demand thus the cost of the control. The control efficiency of catalytic oxidizers can reach 95% when they are properly maintained and operated[11]. Although they are technically feasible in theory, no catalytic oxidizers have been found to control VOC/methanol emissions in a process unit/source similar to PyraMax Ceramics' spray dryers/pelletizers.

Option 5: Biofiltration: Biofiltration uses microbes to consume pollutants from a contaminated air stream. In suitable environment, Microbes can easily decompose organic compounds or VOCs into CO_2, water and biomass via metabolism. Depending on the nature of the pollutants and suitability of the working environment, the efficiency of the system could reach 90%. Factors that affect the performance of the biofiltration system include temperature, moisture, nutrients, acidity, and microbe population.

EPA identifies three types of biofiltration systems: the basic biofilter, the biotrickling filter and the bioscrubber. The basic biofilter consists of a large flat surface covered with bed media, such as peat, bark, coarse soil, or gravel for microbes to reside. Contaminated air flows through the bed and comes into contact with microbe population, which in turn decompose the pollutants in the air. Requiring large open areas and providing no continuous liquid flow to allow pH, moisture and nutrient adjustment, this system is not practical for controlling PyraMax Ceramics' methanol emissions. Bioscrubbers work like a chemical reactor which allows microbes rich

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[10] Page 4-2, EPA, *Handbook: Control Technologies for Hazardous Air Pollutants*, EPA/625/6-91/014, June 1991.

[11] Page 4-12, EPA, *Handbook: Control Technologies for Hazardous Air Pollutants*, EPA/625/6-91/014, June 1991.

suspends/slurry to be mixed or bubbled through by contaminated air. Discharging effluent is collected in a storage tank to allow additional time for the microbes to consume pollutants. Biotrickling system consist of a plastic media covered with a biofilm of the microbes, a liquid spray system for the media, and an air distributing system. As air passes through the media, pollutants are absorbed in to the liquid phase and come into contact with the microbes residing in the biofilm. The continuous flow of liquid allows easy pH adjustment and nutrient supplement. Among the three types of biofiltration systems, biotrickling filter is considered most suitable for the control of the methanol emissions from PyraMax Ceramics' spray dryers/pelletizers.

Option 6: Pollution Prevention and Substitute Materials: The additive used by PyraMax Ceramics in the slurry preparation process contains up to 1% by weight of methanol as impurity. Continuous use of an additive with the minimum amount of methanol is the primary mechanism available for minimizing the methanol emissions. Efforts to find a supplier which could provide the same chemical with less methanol as impurity were not successful because industry grades of this chemicals from different suppliers contain almost the same amount on methanol as impurity. Agent grades of the same chemicals contain much less impurities including methanol, but are too expensive to be used in large scale commercial production.

Step 2 - Conduct an impact analysis

Application No. 20584 dated July 21. 2011, included a cost impact analysis of each of the applicable control technologies discussed above, assuming a 95% removal efficiency for all the add-on control technologies evaluated and an estimated methanol emissions of 24 tons per year for each spray dryer/pelletizer. . The analysis was conducted in accordance with EPA's *"Air Pollution Control Coast manual (6 Edition)"*, as published in 2002. The cost of the biofilter was estimated using EPA Clean Air Technology Center's report and a 1999 report by Dr. Rakesh Govind of University of Cincinnati on *"Biofiltration from Ethanol Emissions from Bakery Ovens"*[12]. Table 5.4.-4 summarizes the results of the cost impact analysis.

Table 5.4-4: Cost Impact of the Evaluated Applicable Control Options for Methanol Emissions from PyraMax Ceramics' Spray Dryers/Pelletizers[13]

Control Option No.	Control Technology	Cost Effectiveness ($/ton Methanol reduced)
2	Carbon Adsorption	~$15,750
3	Regenerative Thermal Oxidation (RTO)	~$59,000
4	Catalytic Oxidation	~$38,000
5	Biotrickling Filter	>$10,000
6	Pollution Prevention & Substitute Material	N/A

The cost data indicate that the use of these technologies to control the methanol emissions from PyraMax Ceramics' spray dryers/pelletizers would impose a significant economic impact. The cost impact analyses are detailed in Appendix D of Application No. 20584 dated July 21, 2011.

Step 3 -- Establish the MACT emission limitation.

Due to the relatively small quantity of methanol emissions emitted from each spray dryer/pelletizer compare to the large exhaust gas flow of each of the spray dryers/pelletizers (Exhaust gas flow rate generally dictates the size of the control system and thus the cost of the system), option 2, 3 and 4 are economically infeasible and would pose a significant cost impact. As such, "no control" based on pollution prevention remains as the MACT floor for the methanol

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[12] http://www.prdtechinc.com/pdf/prdawmaethanolbiofiltrayionpaper(1999).pdf

[13] Pages 6-15 and 6-16, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics, LLC. – King's Mill Facility.

emissions from PyraMax Ceramics' spray dryers/pelletizers. As proposed by PyraMax Ceramics, the corresponding numerical MACT emission limits are 24.0 tons of methanol emissions for each spray dryer/pelletizer or process/kiln line during each period of 12-consecutive months and 0.23 lbs methanol per ton of calciner/kiln feed for each process/kiln line (monthly average). The second limit is necessary because it ensures the HAP emission performance or cleanness of the sources to be maintained at the designed level, i.e. the basis of this case-by-case MACT determination.

5.5 Case-by-Case MACT for Natural Gas-Fired Boilers – N/A

Pyramax conducted a 112(g) MACT analysis for the small natural gas fired boilers. Their conclusion was that firing natural gas represented the MACT floor and no other beyond the floor options were economically feasible. As discussed earlier, it is the determination of the Division that the final Boiler MACT, 40 CFR 63 DDDDD, negates the need for a 112(g) determination, even though the effective date is currently stayed. If this is not the case, EPD agrees that the work practice standards of the MACT represent MACT.

5.6 Case-by-Case MACT for Natural Gas-Fired Ceramic Calciners/Kilns

Each of the natural gas-fired dry process rotary ceramic calciner/kiln Nos. 1 and 2 is considered as a "new source" under 112(g) of CAA Amendment of 1990. According to the application No. 20584 dated July 21, 2011, each calciner/kiln has potential to emit approximately 7.87 TPY of HAPs, including 2.94 TPY of HCl, 4.52 TPY of HF, 0.39 TPY of Hexane and 0.02 TPY of other trivial volatile and solid HAPs[16].

For the same reason drawn for the natural gas-fired boilers discussed in the previous section, the case-by-case MACT for the HAP emissions from the natural gas combustion in the calciners/kilns is no control. No monitoring and compliance testing is necessary for these HAP emissions. When required, HAP emissions can be calculated using the appropriate emission factors in AP 42 and actual fuel usage records.

HF and HCl emissions are the results of release of fluorides and chlorides naturally existing in the clay being processed in the calciners/kilns at high temperature.

A literature survey conducted by EPD indicates that wet, semi-dry and dry alkaline scrubbers have been used to control acidic gas emissions mainly SO_2 from various calciners/kilns used in cement, lime, brick, tile and sanitaryware manufacturing facilities. The same control systems can also reduce emissions of other acidic gases including HCl and HF at the same time.

Wet scrubbing systems remove HCl and HF from exhaust gas streams via neutralization by utilizing an alkaline reagent. Wet scrubber systems will generate wastewater and wet sludge streams which require treatment and disposal. In addition, the need to drive and to reheat stack gases for proper atmospheric dispersion and corrosion prevention has a significant energy impact.

Dry injection based on dry scrubbing systems involves the continuous injection of a powdery dry alkaline reagent into the flue gas from the calciner/kiln. HF and HCl react directly with the powdery reagent, which is collected in a downstream PM control device such as baghouse. The "catalytic baghouse" systems proposed by PyraMax Ceramics' in the application No. 20584 to control acid gas emissions (mainly SO_2, HCl and HF) from the calciners/kilns is a typical dry

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[16] Table C-3, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics, LLC. – King's Mill Facility.

scrubbing system, as discussed in details in the NSR/PSD Preliminary Determination prepared for PyraMax Ceramics' King's Mill Facility.

A dry lime adsorber is a single tower with granular limestone (calcium carbonate $CaCO_3$) packed bed filter/adsorber for adsorption of HF and HCl. Normally crushed limestone with a mash size of 4 mm to 6 mm is used for the adsorption media. Above the adsorption cascade tower is a storage silo for continuous supply of fresh adsorption media by gravity. The adsorber itself consists of single gas tight cascades, which are connected in series. Exhaust gas is distributed evenly by an inlet cap over all the cascades and is drown out via an outlet cap. Table 5.6-1 ranks these control technology options by efficiency.

Table 5.6-1: Ranking of Technically Feasible Control Options for HCl And HF Emissions from PyraMax Ceramics' Calciners/Kilns

Ranking	Control Technology	Typical Control Efficiency
1	• Wet Scrubber; • "Catalytic Baghouse" System	90%
2	Semi-Dry Scrubber (Spray Dryer Type)	80%
3	Dry Scrubber (Injection System)	50%

PyraMax Ceramics proposed to use "catalytic baghouses" to control the SO_2 emissions from the calciners/kilns[17]. This control technology consists of an upstream dry powdery alkaline sorbent injection system followed by a downstream capture system for particulate matters, i.e., the "catalytic baghouse", and is expected to achieve 90% of removal efficiency. EPD has determined in the BACT analysis that this control technology is BACT for controlling the SO_2 emissions[18]. Because the "catalytic baghouse" can simultaneously remove other acid gases, e.g., HCl and HF from the same kiln exhaust gas stream with 90% or more efficiency, it was proposed by PyraMax Ceramics as MACT for the control of HCl and HF emissions from the same sources.

Carbo Ceramics, Inc.'s McIntyre Plant in Georgia is using a wet scrubber to control SO_2 as well as HCl and HF emissions from a ceramic proppant calciner/kiln. This case is considered a MACT floor for same emissions from similar sources because it would achieve the maximum reduction/control efficiency among all the feasible control technologies for the emissions. Since the "catalytic baghouse" control system proposed by PyraMax Ceramics will reportedly achieve the same level of control as a wet scrubber among all the feasible control technologies identified, the use of the "catalytic baghouse" control system will represent the use of the maximum emission reduction technology available for the HCl and HF emissions. Therefore, as the MACT floor for controlling the HCl and HF emissions has been established, and the control technology representing the MACT floor has been accepted by PyraMax Ceramics, no impacts analysis is necessary.

EPD has not identified any beyond-the-MACT-floor technology which could provide an HF and HCl emission control efficiency higher than that of the "catalytic baghouse".

Therefore, EPD has concluded that the case-by-case MACT for the HAP emissions from PyraMax Ceramic's natural gas–fired rotary ceramic calciners/kilns consists of:

- Use only natural gas and propane as fuel;

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[17] Page 5-19, Georgia Air Quality Permit Application No. 20584 dated July 21, 2011, PyraMax Ceramics, LLC. – King's Mill Facility.

[18] 4.8: SO_2 Emissions from Combustion Sources, *"Prevention of Significant Air Quality Deterioration Review – Preliminary Determination, PyraMax Ceramics, LLC – King's Mill Facility",* Georgia Environmental Protection Division – Air Protection Branch, November, 2011

- Use the "catalytic baghouse" to reduce the HF and HCl emissions at a control efficiency of no less than 90% by weight and to no more than 0.029 pounds of HCl emitted per ton of kiln feed and 0.044 pounds of HF emitted per ton of kiln feed); and
- Use the "catalytic baghouse" to reduce the HF and HCl emissions from each calciner/kiln to no more than 4.49 TPY and 2.96 TPY respectively.

PyraMax Ceramics will be required to conduct an initial performance test on each of the calciners/kilns to demonstrate compliance with the case-by-case MACT HCl and HF emission limits respectively, and subsequently, a similar test for HCl and HF emissions respectively on each calciner/kiln every 12 months to demonstrate continuous compliance with the MACT limits.

5.7 Summary of Preliminary MACT Determination

The 112(g) case-by-case MACT determinations are summarized in Table 5.7-1 below for easy reference:

Table 5.7-1: Section 112(g) Case-by-Case MACT Determinations for PyraMax Ceramics, LLC. – King's Mill Facility

Affected Source	Pollutant	Control Technology	Proposed 112(g) Limit	Compliance Method	Averaging Time
Each Spray Dryer/Pelletizer	Methanol	(1) Use only natural gas with propane as back-up Appropriate use of methanol-containing additive(s)	24.0 tons per 12-month rolling period for each spray dryers/ process line 0.23 lbs/ton kiln feed spray dryers/each process line	Mass balance based on material usage records and additive MSDS sheets	12-month rolling Monthly
Each 9.8 MMBtu/hr Natural Gas-Fired Boiler	Volatile Organic and Metal HAP compounds	Use only natural gas with propane as back-up	N/A	Fuel usage records	None
Each Calciner/Kiln	HCl	Use only natural gas with propane as back-up Controlled by the "catalytic baghouse" consisting of upstream injection of powdery sodium bicarbonate and downstream ceramic tube/baghouse unit	2.96 tons per year	Mass balance calculation based on annual testing result & production records	N/A
			0.029 lbs/ton kiln feed and 90% reduction	Method 26 or 26A of 40 CFR Part 60, Appendix A or Method 320 of 40 CFR Part 63, Appendix A	Average of at least three 1-hour test runs
	HF		4.49 tons per year	Mass balance calculation based on annual testing result & production records	N/A
			0.044 lbs/ton kiln feed and 90% reduction	Method 26 or 26A of 40 CFR Part 60, Appendix A or Method 320 of 40 CFR Part 63, Appendix A	Average of at least three 1-hour test runs

To demonstrate compliance with the case-by-case MACT limits, PyraMax Ceramics shall maintain fuel and HAP-containing materials usage records necessary for tracking the amount and type of HAP-containing additives used at least on a monthly basis. All the records shall be kept for a period of five years from the date of record.

Initial performance tests are required for each calciner/kiln to demonstrate compliance with the HCl and HF emission limits. Same performance tests are required every 12 months thereafter. Carbo Ceramics is required to submit the results of all initial and required periodic performance testing within 60 days of the test for Division's review. Any excess emissions, exceedances, or excursions as described in the Air Quality Permit No. 3295-163-0035-P-01-0 of the MACT emission limits and/or operating parameter limitations shall be reported during the quarterly reporting period.

6.0 AIR QUALITY ANALYSIS

Following the procedures as specified in the *"Guidelines for Ambient Impact Assessment of Toxic Air Pollutant Emissions"*, ambient impact modeling conducted by both the Division and the company indicate that the maximum ground level concentrations for the potential HAPs emissions involved in this 112(g) case-by-case MACT determination emitted from PyraMax Ceramics' facility are below the acceptable ambient concentrations. The toxic impact assessment (TIA) is addressed in the *Prevention of Significant Deterioration Preliminary Determination* included with Application No. 20584 dated July 21, 2011. Please refer to Part 7.0 of the Preliminary Determination for the discussion of the TIA and associated modeling.

APPENDIX B: Draft PSDand Case-by-Case MACT Permit No. 3295-163-0035-P-01-0

APPENDIX C: PyraMax Ceramics, LLC – King's Mill Facility
PSD Permit Application and Supporting Data

Contents Include:

1. PSD Permit Application No. 20584 dated July 21, 2011
2. Letter from applicant dated September 15, 2011 (In response to questions from EPD via e-mail on 8/30/2011 and 9/6/2011)
3. Letter to GA EPD from U.S. EPA Region 4 dated September 22, 2011
4. Letter to Applicant from Georgia EPD dated October 6, 2011
5. Letter from Applicant to Georgia EPD dated October 21, 2011

APPENDIX D: EPD'S PSD Dispersion Modeling and Air Toxics Assessment Review