



**TECHNICAL EVALUATION  
&  
PRELIMINARY DETERMINATION  
(TEPD)**

**APPLICANT**

CEMEX Materials and Construction, Florida, LLC  
1200 NW 137 Avenue  
Miami, Florida

Miami Cement Plant  
Facility ID No. 0250014

**PROJECT**

Project No. 0250014-045-AC  
Application for Minor Source Air Construction Permit  
Alternative Fuels

**COUNTY**

Miami-Dade County, Florida

**PERMITTING AUTHORITY**

Florida Department of Environmental Protection  
Division of Air Resource Management  
Office of Permitting and Compliance  
2600 Blair Stone Road, MS#5505  
Tallahassee, Florida 32399-2400

March 29, 2012

## 1. GENERAL PROJECT INFORMATION

### Air Pollution Regulations

Projects at stationary sources with the potential to emit air pollution are subject to the applicable environmental laws specified in Section 403 of the Florida Statutes (F.S.). The statutes authorize the Department of Environmental Protection (Department) to establish regulations regarding air quality as part of the Florida Administrative Code (F.A.C.), which includes the following applicable chapters: 62-4 (Permits); 62-204 (Air Pollution Control – General Provisions); 62-210 (Stationary Sources – General Requirements); 62-212 (Stationary Sources – Preconstruction Review); 62-213 (Operation Permits for Major Sources of Air Pollution); 62-296 (Stationary Sources - Emission Standards); and 62-297 (Stationary Sources – Emissions Monitoring). Specifically, air construction permits are required pursuant to Rules 62-4, 62-210 and 62-212, F.A.C.

In addition, the U. S. Environmental Protection Agency (EPA) establishes air quality regulations in Title 40 of the Code of Federal Regulations (CFR). Part 60 specifies New Source Performance Standards (NSPS) for numerous industrial categories. Part 61 specifies National Emission Standards for Hazardous Air Pollutants (NESHAP) based on specific pollutants. Part 63 specifies NESHAP based on the Maximum Achievable Control Technology (MACT) for numerous industrial categories. The Department adopts these federal regulations on a quarterly basis in Rule 62-204.800, F.A.C.

### Glossary of Common Terms

Because of the technical nature of the project, this document contains numerous acronyms and abbreviations, which are defined in Appendix A of the draft permit.

### Facility Description and Location

The Miami Cement Plant is an existing Portland cement manufacturing plant, which is categorized under Standard Industrial Classification Code No. 3241. The existing Miami Cement Plant is located in Miami-Dade County at 1200 NW 137 Avenue in Miami, Florida. The UTM coordinates Zone 17, 558.20 km East, and 2851.20 km North. This site is in an area that is in attainment (or designated as unclassifiable) for all air pollutants subject to state and federal Ambient Air Quality Standards (AAQS).

The CEMEX Miami Cement Plant operates a dry-process preheater/precalciner kiln with clinker cooler, manufactured by F.L. Smidth (FLS), which is capable of producing approximately 1,300,000 tons per year of clinker. The Department issued a permit on September 11, 1997 to modify the wet process plant by incorporating the modern dry process technology including the preheater and calciner along with indirect firing. The dry-process kiln system, installed in the year 2000, replaced the previously existing two wet process cement kilns and clinker coolers in operation at this location for over 30 years. The dry process preheater/calciner kiln is one of the most fuel-efficient cement pyroprocessing technologies currently available. Thermal efficiencies are superior with the preheater/calciner kiln and the amount of fuel combusted per ton of clinker produced is greatly reduced in comparison with the wet process. Clinker is part of the manufacturing of cement that meets the required technical specifications and standards of the industry for saleable cement product (e.g., Department of Transportation, American Society for Testing and Materials (ASTM), Leadership in Energy and Environmental Design (LEED) Green Building Rating Systems™). Also part of the facility is a limestone quarry and crushing system, material receiving facilities (both by rail and truck), open short-term material storage piles, a storage building for intermediate raw material and clinker storage, a stone dryer and soil thermal treatment plant, a raw mill system, six finish mills, two packhouses, thirty two cement silos, a rail and truck bulk loadout facility, and a liquid fuel tank farm. CEMEX also operates a concrete batch plant and a concrete block plant (Sweetwater). The plant is located on the adjacent property to the CEMEX, Miami Cement Plant. Long residence times at high temperatures are required to drive the thermo-chemistry necessary to transform the raw materials into the desired cement clinker. Coal and petroleum coke are



Figure 1. CEMEX Miami Cement Plant

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burned in the precalciner combustion chamber at the inlet to the kiln as well as at the main burner at the discharge end of the kiln. The start-up fuels include bituminous coal, natural gas, petroleum coke, propane, No. 2 fuel oil, residual fuel oil, and on-specification and off-specification used oil.

As stated above, the dry-process preheater/precalciner design improves the thermal efficiency and production capacity compared to previous wet kiln and non-precalciner kiln designs. As shown in Figure 2, hot exhaust gases generated in the kiln and precalciner pass through the raw material feed separators (i.e., cyclone vessels) in the preheater tower counter to the raw material flow, which provides optimized heat transfer between the gas and solid streams. The improved heat transfer in the preheater tower dries the raw materials and combined with the precalciner allows the kiln length to be reduced and dry the raw materials in the raw mill as a result.

Approximately 60% of the heat input is provided by the burner in the precalciner combustion chamber at the base of the preheater/precalciner tower (i.e., raw material inlet to the kiln). The remaining 40% of heat input is provided by the main kiln burner, which is located at the clinker discharge end of the kiln. Figure 2 also represents the thermal and temporal distribution of the combustion gas and raw materials, as well as the raw material flow in such a modern preheater/precalciner kiln. Gas temperatures in the preheater portion of the tower range from 600°F to 1800°F with a residence time of approximately 10 seconds. Gas temperatures in the precalciner range from 1800°F to 2200°F for approximately three seconds. The gas in the rotating kiln ranges from 2200°F to 3500°F for approximately 10 seconds. This distribution of temperature and time and impact on pollutant emissions is further discussed in the pollutants section.

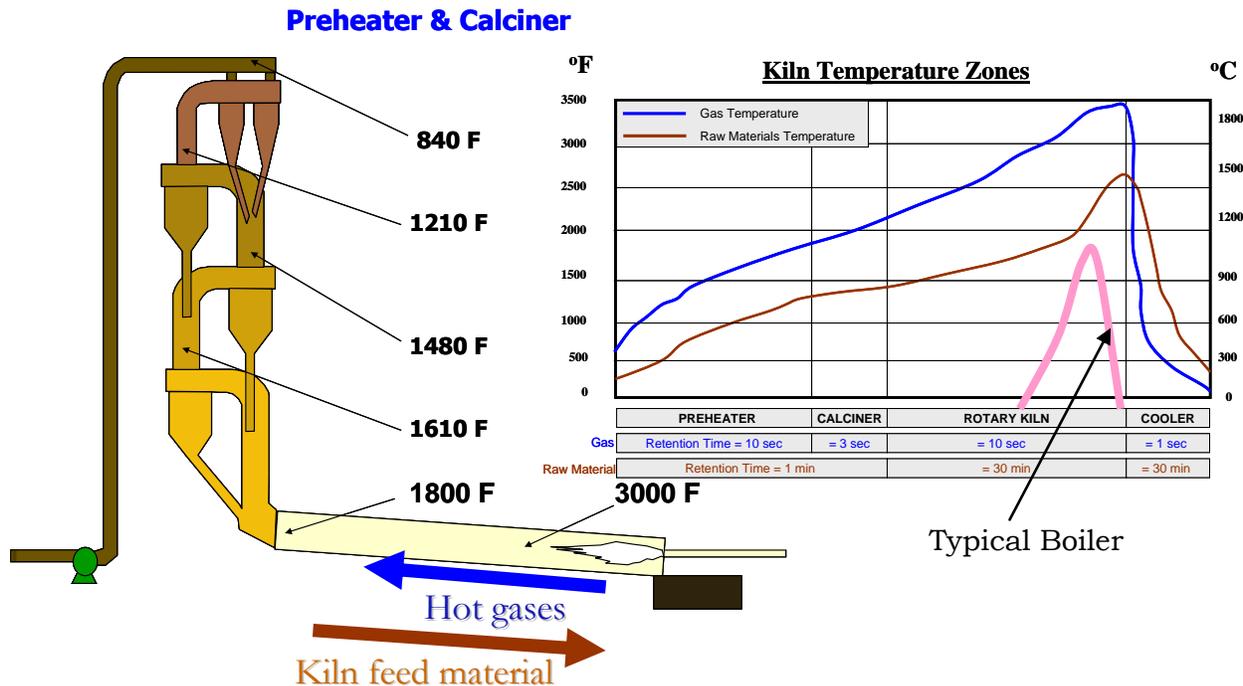


Figure 2. Temperature-Time Profile of Preheater/Precalciner Cement Kiln

A baghouse controls particulate matter (PM) emissions from the preheater/precalciner kiln exhaust as well as exhausts from the clinker cooler, raw mill and coal mill. Emissions of carbon monoxide (CO) and volatile organic compounds (VOC) are controlled by the efficient combustion design (long residence times at high temperatures) of the preheater/precalciner kiln and good operating practices. Nitrogen oxides (NO<sub>x</sub>) emissions are controlled by the combustion design of the FLS kiln (including indirect firing, multiple burn points and low-NO<sub>x</sub> precalciner) as well as ammonia injection for selective non-catalytic reduction (SNCR). Potential dioxin and furan emissions are controlled by the high-temperature combustion followed by rapid cooling. Acid gases such as sulfur dioxide (SO<sub>2</sub>) and hydrochloric acid (HCl) are controlled by limestone scrubbing as part of the raw material feed and clinker production. To demonstrate compliance with the emission limits specified in the permit,

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continuous emission monitoring systems (CEMS) in the main kiln/raw mill stack measure and record emissions of CO, NO<sub>x</sub>, SO<sub>2</sub>, total hydrocarbons or “THC” (which serves as a surrogate for volatile organic compounds or “VOC”). A continuous opacity monitoring system (COMS) measures and records the opacity of the flue gas exhaust in the main kiln/raw mill stack. Monitoring the baghouse inlet temperature to ensure that it is maintained below that of the most recent compliance stack test provides assurance of effective control of dioxins and furans.

The Miami Cement Plant was authorized under Air Permit No. 0250014-037-AC for short-term temporary trials to co-fire coal with clean woody biomass in the existing cement kiln to gather operational and emissions data. Air construction permit No. 0250014-042-AC was issued to allow CEMEX to burn clean biomass as a supplemental fuel in the cement kiln on a permanent basis. Whole tires and paper currency have been approved as alternative fuels. The successful trials allowed permanent use of these alternative fuels. The permittee is authorized through the current Title V permit to fire the following fuels: bituminous coal, propane, No. 2 fuel oil, residual oil, flyash, on-specification and off-specification used oil, natural gas, petroleum coke paper currency, oil filters, booms and rags from clean petroleum spill clean ups, unused paper by-products, clean non-chlorinated plastic by-products, whole tires, tire-derived fuel and clean biomass.

### Facility Regulatory Categories

- The facility is a major source of hazardous air pollutants (HAP) subject to the applicable provisions in NESHAP Subpart LLL of 40 CFR 63.
- The facility is an existing Title V major source of air pollution in accordance with Chapter 213, F.A.C.
- The facility is an existing major stationary source in accordance with Rule 62-212.400, F.A.C. for the Prevention of Significant Deterioration (PSD) of Air Quality.

### General Project Description

The permittee proposes to construct mechanical and pneumatic solid fuel handling and feed systems for the precalciner and main kiln burner and modification or installation of a new multi-fuel main kiln burner system to fire the following non-hazardous alternative fuels (AF) in the existing cement kiln:

- *Engineered Fuel (EF)* is a non-hazardous replacement for fossil fuels and is engineered to have targeted, consistent fuel properties such as: calorific value, moisture, particle size, ash content, and volatility. The specific targeted properties are established based on available alternative fuel material supply and are carefully controlled through blending of non-hazardous combustible materials or through separation of non-hazardous incombustible materials from combustible materials (mixes of any alternative fuels where the blending and processing may also include the addition of on-specification used oils and/or other non-hazardous liquids to ensure consistent and predictable fuel properties). EF is engineered largely from the materials listed below and could consist of animal meal, automotive manufacturing byproducts, clean-up debris from natural disasters, processed municipal solid waste, dried/sanitized biosolids, paint filter cake, hospital materials (non-infectious), pharmaceuticals (expired prescriptions), cosmetics, and confiscated narcotics.
- *Tire-Derived Fuel (TDF)*, which includes whole and shredded tires with or without steel belt material including portions of tires such as tirefluff. This is a currently permitted fuel.
- *Roofing Materials*, which consists of roofing shingles and related roofing materials with the bulk of the incombustible grit material separated and which is not subject to regulations as an asbestos-containing material per 40 CFR 61 subpart M.
- *Plastics*, which includes materials such as polyethylene plastic used in agricultural and silvicultural operations. This may include incidental amounts of chlorinated plastics.
- *Agricultural Biogenic Materials*, which includes materials such as peanut hulls, rice hulls, corn husks, citrus peels, cotton gin byproducts, animal bedding and other similar types of materials.
- *Cellulosic Biomass – Treated and Untreated*, Untreated cellulosic biomass includes materials such as untreated lumber, tree stumps, tree limbs, slash, bark, sawdust, sander dust, wood chips scraps, wood

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scraps, wood slabs, wood millings, wood shavings and processed pellets made from wood or other forest residues, green wood, forest thinnings, sawdust, trees trimmings, clean woody land clearing debris and clean construction and demolition (C&D) wood. This is a currently approved fuel. Treated cellulosic biomass includes preservative-treated wood that may contain treatments such as creosote, copper-chromium-arsenic (CCA), or alkaline copper quaternary (ACQ), painted wood, or C&D debris not meeting the definition of clean C&D wood, or resinated woods (plywood, particle board, medium density fiberboard, oriented strand board, laminated beams, finger-jointed trim and other sheet goods). The permittee shall not fire more than 1,000 lb/hour averaged on a 7-day block average basis of segregated streams of wood treated with copper-chromium-arsenic (CCA) compounds. Clean woody biomass is a currently permitted fuel. *{Note: The majority of CCA compounds are expected to be integrated into the cement clinker product.}*

- *Carpet-Derived Fuel*, which includes shredded new, reject or used carpet. *{Note: may contain incidental related materials (e.g., tack-down strips, nails, etc.)}*
- *Biosolids*, which only includes organic materials sanitized to meet EPA Class A sanitization standards and is derived from treatment processes of public treatment water systems.
- *Alternative Fuel (AF) Mix*, which includes a blended combination of two or more of any of the above materials. *{Note: Separate classification from an engineered fuel since the consistency of the material may not be designed/engineered to meet specific, targeted fuel properties.}*

The proposed construction represents a significant capital investment to construct, approximately four million dollars. Due to the substantial initial costs and investment in this equipment, the permittee requests permanent authorization to fire the AF and the permittee has conducted preliminary trial burns with the majority of the fuels listed and have reported success with the trial burns.

## 2. PSD APPLICABILITY

### Main Kiln Burner

A main kiln burner can be designed to co-fire AF blends with traditional fossil fuels. From an unloading hopper, the AF will be pneumatically conveyed to the pressurized main kiln burner along with coal, petcoke or other approved fuels. The AF feed rate will be determined by weight belt or other equivalent equipment (e.g., loss in weight). The feed rates will be monitored, recorded and tied into the main operator control room. The applicant has not yet selected a manufacturer on the burner design. Figure 3 on the following page shows an example of a main kiln multi-fuel burner manufactured by Pillard Feuerungen GmbH.

In the Pillard design, a portion of the primary air is guided in a separate jacket tube around the main waste fuel tube and then, just near the outlet, injected via nozzles around the waste fuel stream in order to expand and aerate the fuel jet. This design is capable of co-firing up to 80% AF with fossil fuel. The AF must be finely shredded and prepared in such a way that the particles are of limited dimensions – similar to pulverized coal. Pillard<sup>1</sup> also mentions:

- In order to supply the market with a flexible kiln burner, Pillard works closely with both the specialists from technical centers of cement and lime producers as well as with the kiln operators and production managers.
- Due to the high ratio between fuel costs and clinker production costs, as well as requirements to reduce carbon dioxide (CO<sub>2</sub>) emissions, the substitution of regular fuels by alternative fuels is continuously increasing.
- Since 2000, Pillard has evaluated the performance results of *over 200 new* ROTAFLAM<sup>®</sup> multi-fuel burners.

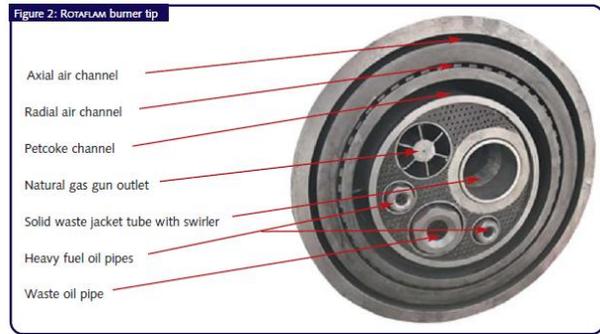
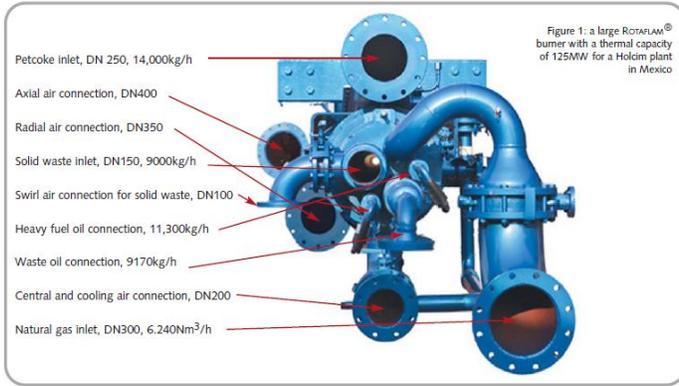


Figure 3. Example of Pillard ROTAFLM® Multi-Fuel Burner and Burner Tip for Firing AF<sup>1</sup>

### Precalciner Feed System

Fuel suppliers will deliver AF to the facility in a manner suitable for either mechanical or pneumatic injection into the pyroprocessing system through the constructed feed systems. All AF will be delivered in covered trucks or enclosed containers and will be stored separately under cover until fired in the pyroprocessing system or further processed. The AF materials will be physically transferred from the storage area by front-end loaders, or by similar means, to holding bins and then to a weigh belt or equivalent equipment (e.g., loss in weight) to determine the feed rate. The AF may be introduced to the precalciner tower by an enclosed bucket elevator feed system (or equivalent) or blown into these areas with the pneumatic feed system. The type of feed system and location of fuel injection will depend on various factors including fuel type, fuel size and heating value.

The mechanical and pneumatic feed systems will be enclosed to prevent the emission of fugitive dust. On the following pages, Figure 4 shows a Schenck feed/weigh system and Figure 5 shows a schematic of a gravimetric feed system. The design capacity of each feed system is approximately 15 tons per hour depending upon the density of the AF. The gravimetric bucket elevator feed system will be used for the heavier and bulkier AF. The pneumatic feed system will be used to introduce lighter less dense materials that will easily flow when combined with air. Based on the fuel properties (e.g., density, size and combustibility), the AF will be injected within the preheater/precalciner system at the location that the kiln operators determine most appropriate for the given material properties. The feed rates of both systems will be monitored, recorded and tied into the main operator control room.

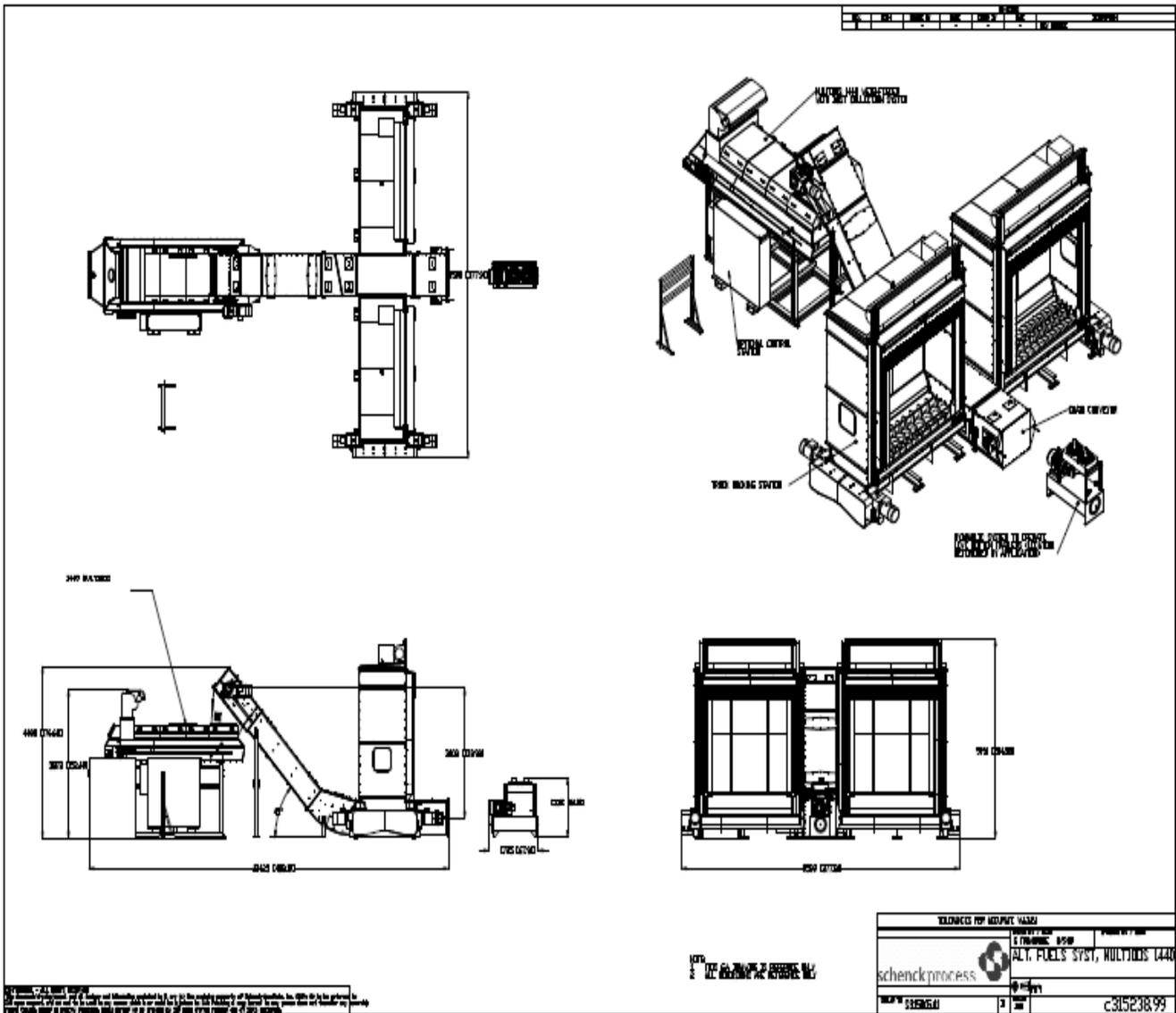
### Shredding/Sizing Equipment

The applicant will contract to have AF delivered that is pre-processed to the appropriate size with incombustible materials removed. However, as seen with the trial burns, re-shredding is usually necessary, so the applicant proposes to install shredding (approximately 630 brake-horsepower, bhp) and screening (approximately 100 bhp) equipment. The equipment will be powered by either electric motors (no on-site emissions) or engines firing appropriate fuel oil (emissions from combustion byproducts). In addition, shredding and screening will result in small amounts of fugitive dust emissions. This flexibility will allow the plant to process an off-sized AF delivery such as biomass rather than reject it and send it back to the supplier. Permit No. 0250014-042-AC authorized the shredding and screening equipment.

<sup>1</sup> “Burner Technology: Progressive Burning”; ROTAFLM® Multi-Fuel Burner; Pillard Feuerungen GmbH; February 2004; [http://www.pillard.de/bilder/kommunikation/pillard\\_in\\_den\\_medien/progressive-burning.pdf](http://www.pillard.de/bilder/kommunikation/pillard_in_den_medien/progressive-burning.pdf)

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Figure 4. Schenck Feed/Weigh System



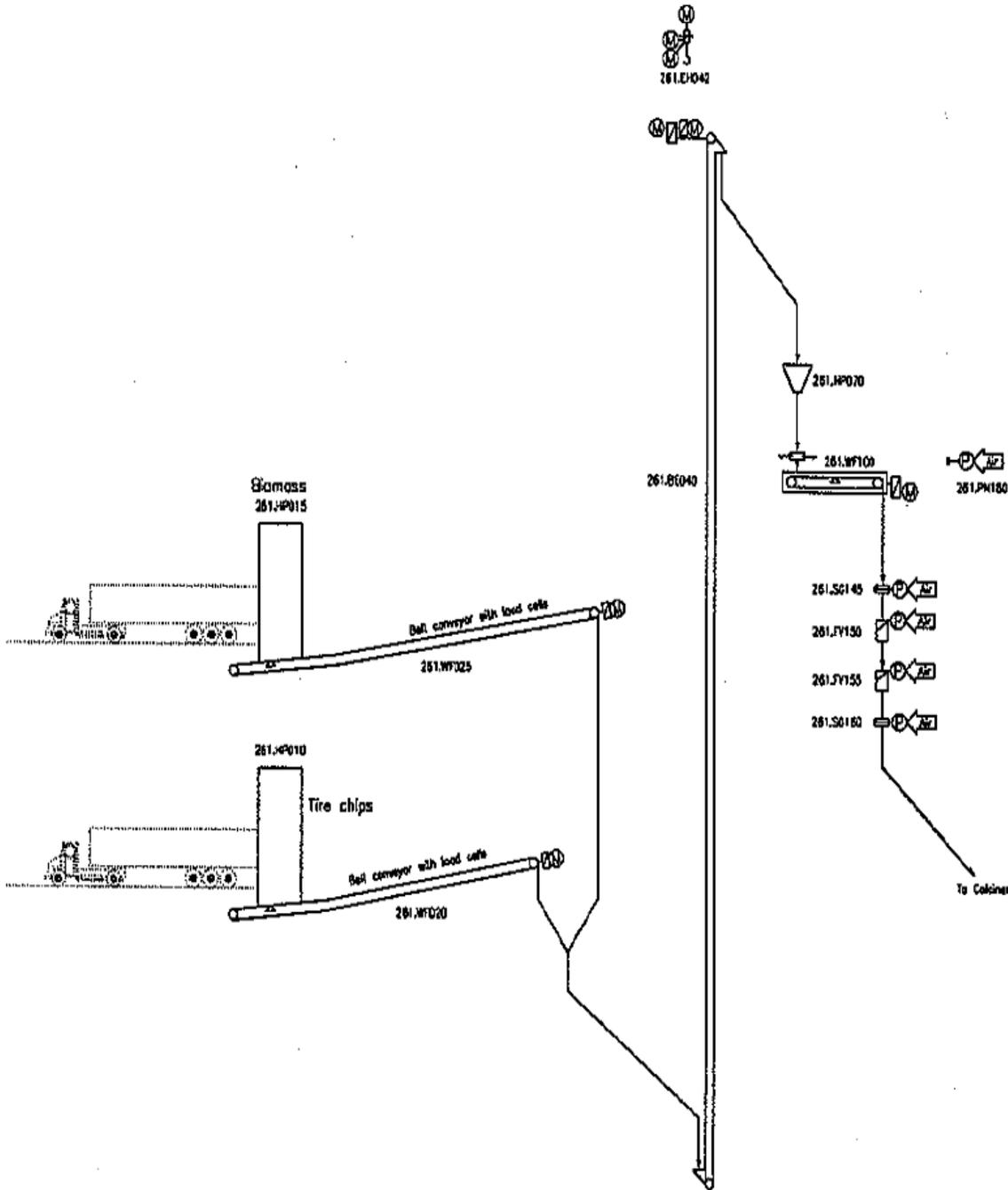


Figure 5. Gravimetric Feed System

Fuel Specification

The current Title V air operation permit specifies the following fuel for the kiln system: bituminous coal, propane, No. 2 fuel oil, residual oil, flyash, on-specification and off-specification used oil, natural gas, petroleum coke paper currency, oil filters, booms and rags from clean petroleum spill clean ups, unused paper by-products, clean non-chlorinated plastic by-products, whole tires, tire-derived fuel, and clean biomass. Non-startup fuels

include whole tires and tire-derived fuels, booms and rags from clean petroleum spill clean ups, oil filters, unused paper by-products, and clean non-chlorinated plastic by-products.

### **Processing Schedule**

December 27, 2011 Received application for a minor source air pollution construction permit.

January 20, 2012 Request for additional information sent.

January 24, 2012 Notice of application published.

February 23, 2012 Additional information received. Application complete.

## **2. PSD APPLICABILITY**

### **General PSD Applicability**

For areas currently in attainment with the state and federal AAQS or areas otherwise designated as unclassifiable, the Department regulates major stationary sources of air pollution in accordance with Florida's PSD preconstruction review program as defined in Rule 62-212.400, F.A.C. An existing, new or modified facility is considered a major stationary source with respect to PSD if it emits or has the potential to emit:

- 5 tons per year or more of lead;
- 250 tons per year or more of any regulated air pollutant; or
- 100 tons per year or more of any regulated air pollutant and the facility belongs to one of the listed 28 PSD-major facility categories (which include Portland cement plants).

The regulated PSD pollutants include: CO; NO<sub>x</sub>; SO<sub>2</sub>, PM; particulate matter with a mean particle diameter of 10 microns or less (PM<sub>10</sub>); VOC; lead (Pb); fluorides (F); sulfuric acid mist (SAM); hydrogen sulfide (H<sub>2</sub>S); total reduced sulfur (TRS) including H<sub>2</sub>S; reduced sulfur compounds including H<sub>2</sub>S; and mercury (Hg). There are additional PSD pollutants specific to municipal waste combustors and landfills.

A PSD applicability review is required for all projects at new and existing major and minor stationary sources. Once it is determined that the existing facility is, or that the new or modified facility will be, a major stationary source, the project emissions increases are then compared to the "significant emission rates" defined in Rule 62-210.200, F.A.C. for the PSD pollutants. If the actual emissions increase exceeds the defined significant emissions rate of a PSD pollutant, the project is considered "significant" for the pollutant. Also, note that significant emissions rate also means any emissions rate or any net emissions increase associated with a major stationary source or major modification which would construct within 10 kilometers of a Class I area and have an impact on such area equal to or greater than 1 µg/m<sup>3</sup>, 24-hour average. For each significant PSD pollutant, the applicant must employ the Best Available Control Technology (BACT) to minimize the emissions and evaluate the air quality impacts. Although a facility or project may be *major* with respect to PSD for only one regulated pollutant, it may be "significant" for several PSD pollutants.

### **PSD Applicability for Project**

Based on firing AF in similar cement kilns at plants in the United States and other countries, the applicant predicts that co-firing AF with coal and/or petcoke will result in negligible changes in the emission rates of PSD pollutants for the following reasons.

- Emissions of CO and VOC will be controlled by: long residence time at high temperatures in the kiln burner system (2200°F to 3500°F for 10 seconds), which will be specifically designed for firing AF; long residence time at high temperatures in the precalciner (1800°F to 2200° F for 3 seconds), which was originally designed with a separate precalciner chamber for firing AF; and long residence time at high temperatures in the precalciner (1500°F to 1800° F for 5 seconds). Emissions of CO and THC are continuously monitored by certified CEMS. Emissions of THC serve as a surrogate for regulated VOC emissions.

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- Emissions of NO<sub>x</sub> will be controlled by the kiln combustion design (including indirect firing, multiple burn points and a low-NO<sub>x</sub> precalciner) as well as SNCR. NO<sub>x</sub> emissions are continuously monitored by certified CEMS.
- Particulate matter emissions will be controlled with the existing baghouse. Although the combustion of AF may generate slightly more particulate matter than coal/petcoke combustion, particles generated from combustion represent only a minor fraction of the controlled emissions, in which the particles are primarily from the raw materials entrained in the countercurrent exhaust flow from the preheater tower. The stack opacity is continuously monitored by COMS as an indicator of the particulate matter emissions.
- Emissions of SO<sub>2</sub> and other acid gases will be controlled with the natural scrubbing from the highly alkaline limestone, which is used as a raw material in producing clinker. SO<sub>2</sub> emissions are continuously monitored by certified CEMS.
- Based on previous studies for this industry, more than 99.9% of the lead will eventually be captured and bound in the cement clinker and retained in the final cement product.

There will also be minimal amounts of fugitive dust from processing and handling AF as well as emissions from the potential combustion of fuel if engines are used to power the grinding and screening equipment. As provided in the application, the following table summarizes potential emissions and PSD applicability for the project.

**Table A. Summary of the Applicant’s PSD Applicability Analysis**

| Pollutant                     | Annual Emissions, Tons/Year  |                               |          |                            | Subject to PSD? |
|-------------------------------|------------------------------|-------------------------------|----------|----------------------------|-----------------|
|                               | Baseline Actual <sup>e</sup> | Projected Actual <sup>d</sup> | Increase | Significant Emissions Rate |                 |
| CO                            | 697.39                       | 771.61                        | 74.22    | 100                        | No              |
| NO <sub>x</sub>               | 1102.36                      | 1141.74                       | 39.38    | 40                         | No              |
| PM <sup>d</sup>               | 21.03                        | 38.96                         | 17.93    | 25                         | No              |
| PM <sub>10</sub> <sup>a</sup> | 9.46                         | 24.22                         | 14.76    | 15                         | No              |
| SO <sub>2</sub> <sup>b</sup>  | 11.50                        | 15.09                         | 3.59     | 40                         | No              |
| VOC                           | 41.00                        | 61.53                         | 20.53    | 40                         | No              |
| Pb                            | 15.5 lb/year                 | ----- <sup>c</sup>            | -----    | 1200 lb/year               | No              |
| Hg                            | 182 lb/year                  | ----- <sup>c</sup>            | -----    | 200 lb/year                | No              |

Notes:

- With regard to particulate matter with a mean particle diameter of 2.5 microns or less (PM<sub>2.5</sub>), the Department adopted by reference the federal ambient air quality standard for PM<sub>2.5</sub>, but has not yet promulgated the implementing regulations for PSD preconstruction review (e.g., define PM<sub>2.5</sub> as a PSD pollutant with a significant emission rate for PSD applicability). The Department is in the process of completing a rulemaking action to implement this remaining piece of the PM<sub>2.5</sub> program.
- Sulfur in the fuels and raw materials will typically be converted to SO<sub>2</sub>, so other PSD sulfur compounds are not shown.
- Lead in the raw materials is not expected to change and is based on a maximum in the raw material of approximately 50 ppm (90% is limestone at 30 ppm and other 10% is variable of other components at higher concentrations ranging from 14 to 6000 ppm).<sup>2</sup> Regarding lead in the fuel, the baseline fuel is coal and the Pb in coal from the USGS database: (<http://energy.er.usgs.gov/coalqual.htm#submit>). Coal has maximum Pb of 1900 ppm. The sampling and analysis of all fuels will ensure that the permittee does not exceed the significant emissions rate of 1200 lb/year for lead. The Hg emissions stack test and sampling or Hg CEMS will ensure that the permittee does not exceed the permitted limit of 0.091 tons/year (182 lb/year) for mercury.

<sup>2</sup> “Mercury and Lead Content in Raw Materials” - Portland Cement Association, Serial No. 2888, 2006.

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- d. The projected actual emissions include the emissions from the transport, storage, handling, shredding and screening operations, and fugitive emissions of 3.28 tons per year of SO<sub>2</sub>, 10.59 tons per year of NO<sub>x</sub>, and NMHC and 12.53 tons per year of CO.
- e. The years 2005 and 2006 were used for the maximum two year averages in calculating NO<sub>x</sub>, VOC and CO baseline emissions, years 2006 and 2007 were used for SO<sub>2</sub> and PM baseline emissions.

The applicant’s projected actual emissions include the physical changes of replacing the main kiln burner system, which is not expected to increase emissions. The Department notes that the applicant’s projected actual emissions are based on an annual clinker production rate that was the average clinker production spanning the years from 2005 to 2007, and used for the baseline emissions calculations. Total project emissions are not expected to exceed the PSD significant emissions rates; therefore, the project is not subject to PSD preconstruction review. For a period of five years following completion of construction, the Department will require a comparison of projected actual emissions to baseline actual emissions to ensure that the project did not cause a PSD-significant emissions increase.

**3. APPLICANT’S DETAILED PROJECT DESCRIPTION**

This section provides details describing each requested AF, the general fuel/material characteristics of each AF, the typical AF material analysis data, kiln operation, fate of pollutants and emissions monitoring.

**Table B. Current Florida Cement Plants Authorized for Firing AF**

| <b>Facility</b>          | <b>Location</b>   | <b>Fuel Types Used</b>  |
|--------------------------|-------------------|---|
| CEMEX                    | Brooksville, FL   | <ul style="list-style-type: none"> <li>· Whole Tires</li> <li>· Plastics - Agricultural Film</li> <li>· Tire Derived Fuel</li> <li>· Reject Roofing Shingles</li> <li>· Clean Woody Biomass</li> <li>· Agricultural Byproducts</li> <li>· Pre-consumer Reject Paper</li> <li>· Carpet Derived Fuel</li> </ul>   |
| Vulcan                   | Newberry, FL      | <ul style="list-style-type: none"> <li>· Whole Tires</li> <li>· Pre-consumer Reject Paper</li> </ul>  |
| American Cement Company  | Sumter county, FL | <ul style="list-style-type: none"> <li>· Whole Tires</li> </ul>   |
| Suwannee American Cement | Branford, FL      | <ul style="list-style-type: none"> <li>· Autofluff</li> <li>· Agricultural Film</li> <li>· Tire Derived Fuel</li> <li>· Reject Roofing Shingles</li> <li>· Used Roofing Shingle Scraps</li> <li>· Clean Woody Biomass</li> <li>· Agricultural Byproducts</li> <li>· Pre-consumer Paper</li> <li>· Post-consumer Paper</li> <li>· Carpet Derived Fuel</li> </ul> |
| Titan America            | Miami, FL         | <ul style="list-style-type: none"> <li>· Whole Tires</li> <li>· Plastics</li> <li>· Tire Derived Fuel</li> <li>· Clean Roofing Shingles</li> <li>· Cellulosic Biomass</li> <li>· Manufactured Cellulosic Biomass</li> <li>· Agricultural fibrous organic byproducts</li> <li>· Pre-consumer reject paper</li> </ul>   |

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|  |  |   |
|--|--|---|
|  |  | · Carpet Derived Fuel<br>· Engineered Fuels |
|--|--|---|

### Plastics

The plastics include materials such as polyethylene plastic used in agricultural and silvicultural operations. This may include incidental amounts of chlorinated plastics. These materials used in agricultural and silvicultural, sometimes referred to as plastic mulch, prevent weed growth as well as control soil erosion and moisture exposure. The agricultural films consist of non-chlorinated polyethylene plastic. The energy content of this plastic material is very high and can be 50% higher than coal or more. The high heating value makes it attractive as an alternative fuel. However, in accordance with current agricultural regulations and practices, this material is often burned in piles in the fields to avoid landfill costs. The Department's Waste Reduction Section supports the use of agricultural plastic as an alternative fuel for boilers or kilns. The applicant identified the following benefits from firing these polyethylene based plastics:

- Reduces air pollution associated with field burning agricultural plastic mulch;
- Conserves existing landfill space and saves farmers the disposal costs;
- Replaces traditional fossil fuels in the cement kiln, which conserves resources and reduces operating costs as well as the carbon dioxide footprint of the plant; and
- May potentially result in decreased air emission rates from the cement kiln when compared to firing coal and petcoke.



The farming operations could supply large amounts of agricultural plastic films. Many cement plants in the United States and Europe fire plastics as an AF.

- Michigan's Department of Environmental Quality issued Permit No. 242-09 to St. Mary's Cement for a trial burn of non-chlorinated plastic. The permit required analyses of the mercury, chlorine and heat content. The permit also required reporting of total chromium, lead, manganese and mercury emission rates.
- The Suwannee American Cement Plant under Permit No. 1210465-020-AC performed a trial burn of non-chlorinated plastic. Tests showed a very high heating value, steady kiln operation, and emissions consistent with firing coal. The plant continues to work through some processing issues to separate soil collected along with the plastic material. The soil is an inert material that can effectively be incorporated in the clinker; however, the soil can damage processing equipment (e.g., grinders, cutters, etc.) and must be consistently accounted for to prevent impacts to clinker quality. The plant demonstrated compliance with all emissions standards during the trials conducted to date.

The applicant proposes to contract with suppliers to provide pre-processed and sized plastics (with limited chlorine) ready for firing as an AF. Depending on the ability to size this material, plastics could be introduced in both the precalciner and cement kiln. The long residence times at high temperatures within the precalciner and cement kiln provide an environment conducive to the efficient combustion of plastic. Any incidental amounts of chlorine-containing materials would be scrubbed out by the limestone in the raw material feed. Chlorine containing dioxin/furan emissions are destroyed at the high temperatures and long residence times and rapid gas cooling in the preheater ensures that dioxin/furan emission will not reform. Therefore, air emissions are expected to be similar to or less than coal emissions.

### Tire-Derived fuel (TDF)

Tire-derived fuel means whole tires, chipped tires (with or without steel) or tire fluff (shredded tire crumb with only incidental amounts of steel). The metal from TDF may include the radial steel belt, which can be a

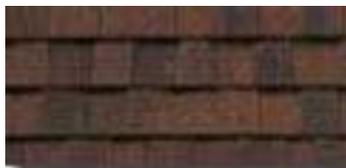
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beneficial ingredient in the production of cement clinker because iron is a necessary ingredient for making clinker. When scrap tires are used as an AF, approximately 550 pounds of iron per ton of scrap tires is “recovered”, conserving the quantity of iron required from mined mineral sources. For the Miami Cement Plant, Air Construction Permit No. 0250014-019-AC authorized the installation of a whole tire manual feed system for a trial burn of firing whole tires at the front end of the kiln and the plant currently burns whole tires.



Tire-derived fuel has a high heating value that is slightly higher than coal. The TDF will efficiently combust within the precalciner and the cement kiln due to the long residence times at high temperatures. Tire-derived fuel is a fairly common AF used in cement kilns throughout the world including the United States. At the Colton Plant in California, the air permit mandated the firing of scrap tires as a NO<sub>x</sub> control strategy. According to kiln manufactures, NO<sub>x</sub> emissions may be reduced by 30-50% when using tires as a fuel depending on the kiln design. The Miami Cement Plant had success in the trial burns of tire-derived fuel resulting in permanent authorization of tire-derived fuel.

### Roofing Material



This material consists of roofing shingles and related roofing materials with the bulk of the incombustible grit material separated and which is not subject to regulations as an asbestos-containing material per 40 CFR 61 subpart M. The manufacturer will certify that the reject shingles are not made with asbestos. A typical shingle consists of the following: 32-42% coating filler (limestone or fly ash); 28-42% granules (painted rocks and coal slag); 16-25% asphalt binder; 3-6%

backdust (limestone or silica sand); 2-15% mat (fiberglass, paper, cotton rags); and 0.2-2% adhesives (modified asphalt based)<sup>3</sup>. In an analysis conducted by Construction Technology Laboratories, Inc., the ash content consisted of approximately 40% silicone dioxide (SiO<sub>2</sub>) and 3% alkalines as disodium oxide (Na<sub>2</sub>O). The typical sulfur content of shingles is approximately 0.79% by weight, which is comparable to coal at approximately 0.67% sulfur by weight.

The supplier will grind the roofing material and remove the majority of the inert grit material. This leaves the asphalt binder and adhesive, which have a useful heating value. The emissions information in the report concluded that organic HAP emissions would be zero, NO<sub>x</sub> emissions would be reduced and emissions would remain about the same for CO and SO<sub>2</sub>.

In Permit No. 238-09, the Michigan Department of Environmental Quality authorized a trial burn of asphalt roofing shingles at the St. Mary’s Cement Plant. The permit required lab testing for ultimate analysis (including chlorine), heating value and trace elements. Emissions data of CO, NO<sub>x</sub> and SO<sub>2</sub> were collected by the existing CEMS. The plant found two primary issues: the shingles created some dust during the handling stages; and the level of lead was determined to be slightly higher than found in coal.

Lead will be combined with raw materials in the exhaust and effectively captured in the high-efficiency baghouse; however, it can be re-introduced when the baghouse dust is re-circulated to the preheater tower as raw material feed. Nevertheless, industry tests show that lead is captured by the pyroprocessing system with efficiencies greater than 99.9%<sup>4</sup> with nearly all of it eventually being bound to the clinker product.

### Cellulosic Biomass

Cellulosic Biomass includes clean cellulosic biomass and manufactured cellulosic biomass.

#### Clean Cellulosic Biomass

This material is readily available and includes clean untreated lumber, tree stumps, millings, shavings and

<sup>3</sup> Michigan Department of Environmental Quality Permit No. 238-09 for St. Mary’s Cement Plant.

<sup>4</sup> Environmental Data of the German Cement Industry, 2009. VDZ

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processed pellets made from wood or other forest residues. The biomass will come from permitted material recycling facilities or companies that service tree trimming operations. Depending on the material content, there may be slight increases of CO, PM/PM<sub>10</sub> and VOC when firing clean woody biomass versus firing an equivalent heat input rate of coal. If these materials have high moisture contents, this will reduce the effective heating value and increase the flue gas flow rates and velocities. Operators must be aware of high-moisture AF so that firing rates and oxygen levels may be adjusted to promote complete combustion.



### Manufactured Cellulosic Biomass



This material includes secondary wood residues such as plywood, particle board, medium density fiberboard, oriented strand board, laminated beams, finger-jointed trim, sheet goods, wood treated with creosote and incidental amounts of wood treated with copper-chromium and arsenic (CCA) compounds as a preservative.

The following manufactured materials have low moisture contents and a high heating value: plywood, particle board, medium density fiberboard, oriented strand board, laminated beams, finger-jointed trim and sheet goods. The adhesives used in production to join these materials add to the heating value and will be destroyed during combustion.

### Creosote



Creosote includes wood creosote and tar creosote. Most of the approximately 200 compounds in creosote are polycyclic aromatic hydrocarbons including phenanthrene, acenaphthalene, fluorene, anthracene and pyridine.<sup>5</sup> It is a wood preservative used only for commercial purposes. Coal tar is distilled at high temperatures to make creosote and is used as a fungicide, insecticide, miticide and sporicide to protect wood. It is used primarily for utility poles and railroad ties.

For the destruction of 99.99% and more of non-halogenated organic compounds, a temperature in excess of 1830°F for two seconds and an oxygen concentration of 2% or more is required.<sup>6</sup> Based on industry tests, these compounds are readily destroyed at the long residence times and high temperatures experienced in the pyroprocessing system.<sup>7</sup>

### Chromated Copper Arsenate (CCA)



Chromated copper arsenate is chemical wood preservative containing chromium, copper and arsenic used in pressure treated wood to protect it from rotting. The applicant provided the following additional information on CCA treated wood.<sup>8</sup> The concentrations of arsenic, copper and chromium is typically 0.4 lb/cubic foot (CF) of wood, but arsenic and chromium may range from 0.2 to 2.5 lb/cubic foot of wood depending on the specific product blend. The density of wood is approximately 35 lb/CF. The applicant estimated the following emissions from a

hypothetical case of firing 1000 pounds/hour (0.5 tons/hour) on a 7-operational day average of CCA treated wood. The applicant notes that excess chromium incorporated into the clinker would cause adverse impacts to

<sup>5</sup> Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Wood Creosote, Coal Tar Creosote, Coal Tar, Coal Tar Pitch, and Coal Tar Pitch Volatiles*, September, 2002.

<sup>6</sup> Mantus, E.K; Kelly, K.E.; Pascoe, G.A.; *All Fired Up – Burning Hazardous Waste in Cement Kilns*, Environmental Toxicology International, December, 1992.

<sup>7</sup> Cooper, P.A.; *Future of Wood Preservation in Canada – Disposal Issues*, 20th Annual Canadian Wood Preservation Association Conference, Oct. 25-26, 1999, Vancouver BC.

<sup>8</sup> Additional Information Provided by the Applicant, Koogler & Associates, Inc., Project No. 0250014-045-AC, Received June 6, 2011.

clinker quality and that most of the copper, chromium and arsenic are bound in the clinker. The applicant conservatively estimates that the maximum amount of CCA-treated wood that will not affect product quality is 10% of heat input and the applicant proposes approximately 1% of heat input.

### Other Treated Woods

The preservative wood market is predominantly creosote and CCA. Other treated woods besides creosote and CCA include, but are not limited to: natural preservatives (e.g., Tung oil), Alkaline Copper Quaternary (ACQ), Micronized Copper Quaternary (MCQ), Copper Boron Azole (CBA) and Sodium Borates (SBX). Commercial use of treated wood has shifted towards ACQ wood and away from CCA wood due to concerns over the leaching of arsenic into the environment.<sup>9</sup> ACQ contains copper and a quaternary ammonium compound.<sup>10</sup> ACQ treated wood protects against decay fungi and insects similar to CCA. However, ACQ treated wood does not generate any waste subject to the Resource Conservation and Recovery Act (RCRA) from production and treating facilities.<sup>11</sup>

### **Agricultural Biogenic Materials**



This includes materials such as peanut hulls, rice hulls, corn husks, citrus peels, cotton gin byproducts, animal bedding and other similar materials. The Miami Cement Plant is able to use these agricultural byproducts when they are readily available, based upon the farming season and transportation costs. The design and operation of the cement kilns make it possible to feed many different types of fuel into the system for energy recovery and results in decreased disposal costs to farmers. The emissions are expected to be similar to clean woody biomass. Such

materials with low moisture content can provide useful heating values and contain very low levels of contaminants.

### **Carpet-Derived Fuel (CDF)**



This material includes manufacturer reject carpet, new carpet remnants and scrap and used carpet along with related materials (e.g. nails, tack, strips, etc.)

Approximately, 2 million tons of carpets are replaced in the United States annually. The Carpet America Recovery Effort (CARE) is a joint industry-government effort to increase the amount of recycling and reuse of post-consumer carpet and reduce the amount of waste carpet going to landfills. The CARE 2007 Annual Report provides an overview of the collection and disposition of carpet scrap. In 2007, approximately 2.4 million pounds (1,200

short tons) of carpet scrap were reported as AF fired in cement kilns, representing approximately 1% of the total amount of material collected and diverted from landfill disposal. The total amount of material diverted from landfill disposal, approximately 296 million pounds, represented approximately 5.3% of the approximately 5,590 million pounds of material generated.

Carpet has a heating value comparable to coal and contains a significant fraction of calcium carbonate ( $\text{CaCO}_3$ ) in the backing material, which is a beneficial component of clinker production. The materials will be supplied by certified waste haulers in the form of processed CDF. Carpet-derived fuel has been tested at the Lehigh cement

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<sup>9</sup> "Pressure-treated Wood - Facts from the Encyclopedia - Yahoo! Education." *Yahoo! Education - Dictionary, Colleges, Scholarships, Homework Help, Schools, Reference, Thesaurus & More*. Web. 11 July 2011. <<http://education.yahoo.com/reference/encyclopedia/entry/prestrtwd>>

<sup>10</sup> United States Environmental Protection Agency, Chromated Copper Arsenate (CCA): ACQ - An Alternative to CCA, <http://www.epa.gov/oppad001/reregistration/cca/acq.htm>

<sup>11</sup> Environmental Management and Planning Decisions, December 2003, *A Market Evaluation of the Sale of Arsenic-Treated Wood in Maine*

plant in Evansville, Pennsylvania. The results showed insignificant changes in emissions of CO, NO<sub>x</sub> and PM and an incongruent increase of SO<sub>2</sub>. Actual emissions of SO<sub>2</sub> are not expected to increase since the sulfur content of carpet is typically 0.1% by weight while coal is typically 0.67% by weight. The chlorine content ranges from 52 to 77 parts per million (ppm) by weight, which is comparable to that of coal. Emissions from firing CDF are not expected to increase. The Georgia Institute of Technology presented a paper<sup>12</sup> at the 2005 Conference on Incineration and Thermal Treatment Technologies in Galveston, Texas which shows emissions from firing CDF to be lower than emissions from firing coal.

Geocycle supplies AF and raw materials to the Holcim cement plants in Utah, Montana and Colorado, which includes processing scrap carpet into AF. Geocycle analyzes the scrap carpet to create a “profile” for material management and process control/cement clinker quality control. Geocycle receives old carpet pads as well as cutting scraps, rolls, etc. from residential and commercial carpet replacement. The scrap carpet is preprocessed to remove metal strips, nails, wood and other foreign material from the carpet prior to processing. Geocycle then shreds the material for use at the Devil’s Slide Cement Plant in Utah. The Devil’s Slide cement plant reports a heating value of 12,000 to 15,000 Btu per pound of scrap carpet.

### **Alternative Fuels Mix**

The mix of alternative mix includes a blended combination of two or more of any of the alternative materials listed above. This is a separate classification from an engineered fuel since the consistency of the material may not be designed to meet specific, targeted fuel properties.

### **Engineered Fuels**

Engineered fuels will vary in content based upon availability of supply, fuel characteristic and needs of the kiln. This material will consist of a mix of the above fuels, but may also include other non-hazardous materials such as small amounts of animal meal, automotive manufacturing byproducts, clean-up debris from natural disasters, processed municipal solid waste, dried/sanitized biosolids, paint filter cake, hospital materials (non-infectious), pharmaceuticals (expired prescriptions), cosmetics, and confiscated narcotics (mixes of any alternative fuels where the blending and processing may also include the addition of on-specification and off-specification used oils or other non-hazardous liquids to ensure consistent and predictable fuel properties). A simple engineered fuel could consist of the following components that remain at a mixed waste Material Recovery Facility after valuable materials (e.g., wire, aluminum, steel, tin, glass, plastics, etc.) are recovered: scrap paper, scrap cardboard, residual plastic, rubber, foam, and small amounts of shingles. Generally, a mixed waste Material Recovery Facility receives a fairly consistent material stream. The process of recovering valuable materials improves the fuel quality by removing incombustible materials. Further processing may be conducted to remove unwanted materials before shredding, screening, and sizing. Engineered fuels typically have a heating value of approximately 6,000 Btu/lb with a relatively low moisture content of 11% by weight. There are also several manufacturers of engineered fuels.

### Hospital Materials

The permittee will only accept sorted, processed and treated hospital materials that are not waste. Any fuel materials derived from hospitals will be processed to remove unwanted materials and enhance the homogeneity and the consistency of the fuel. These materials will be a minor component of an engineered fuel composition and must meet internal composition and properties criteria to emissions, product quality, and kiln structure integrity impacts (e.g., low chlorine content). The permittee will not use hospital materials or wastes that have been deemed as infectious. The permittee views certain materials that are derive from hospitals which do meet the criteria to be used as alternative fuels should not be wasted and landfilled, but should be harnessed in a controlled and regulated environment. The permittee states that the materials must be treated and processed such that the material is not a health hazard and meets all regulatory limitations. In addition, the permittee states that

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<sup>12</sup> “Emissions from Combustion of Post-Consumer Carpet in a Cement Kiln”; P. Lemieux, R. Hall, M. Realff, K. Bruce, P. Smith, and G. Hinshaw; Georgia Institute of Technology; 2005.

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the material must be sorted for materials with valuable heat content, low levels of unwanted constituents (e.g., chlorine and sulfur, volatile metals, alkalies). Materials that meet these criteria are typically non-chlorinated plastics.

At the time of shipment to the facility, these materials will have been processed and blended (typically in minor quantities) for a specified engineered fuel. These materials will be handled and stored as fuel materials to meet all permitting requirements.

### Animal Meal

Animal meal is also known as meat and bone meal (MBM) which is derived from animal rendering facilities. This material may then be wasted to landfills<sup>13</sup>. Several alternative uses of this material exist such as the utilization in cement kilns and the co-combustion in industrial power plants<sup>14</sup>. MBM is considered a carbon/CO<sub>2</sub> neutral fuel. It can reduce the amount of greenhouse gases emitted from burning of fossil fuels at the Miami cement plant. In fact, if 40% of the coal fed to a rotary kiln was replaced on a long term basis, the total annual CO<sub>2</sub> emissions from the cement plant could be reduced near 10%<sup>14</sup>. Air pollutant emissions from such material are expected to be similar to fossil fuels. Table C below presents typical parameters and metals content of MBM.

**Table C. Characteristics of Animal Meal**

| LHV<br><i>mmBtu/ton</i> | Density<br><i>kg/m<sup>3</sup></i> | Moisture<br><i>%</i> | Ash<br><i>%</i> | Sulfur<br><i>%</i> | Fluoride<br><i>%</i> | Chlorine<br><i>%</i> | Volatile<br><i>%</i> |
|-------------------------|------------------------------------|----------------------|-----------------|--------------------|----------------------|----------------------|----------------------|
| 15.9                    | 720                                | 4                    | 27.2            | --                 | --                   | --                   | 60.8                 |
| 12.4                    | --                                 | 6                    | 20              | 0.4                | --                   | 0.3                  | 64                   |
| 11.2                    | --                                 | 6.8                  | 34.4            | 0.7                | --                   | 0.26                 | 32.7                 |
| 16.0                    | --                                 | --                   | 15.3            | 0.63               | 0.01                 | 0.95                 | --                   |

Note: LHV- Lower Heating Value

### IPP Enviro-Fuelcubes



International Paper Products Corporation (IPP) works with label converters in manufacturing scrap waste into an engineered fuel called “Enviro-Fuelcubes”. IPP manufactures these fuel cubes at a plant in Westfield, Massachusetts. The fuel cubes are manufactured not only from label matrix, but also from other non-recyclable waste materials such as coated and laminated papers, wax cardboard, textiles, Styrofoam, plastics, all types of packaging materials, wood products and process out-throws from various manufacturing process applications. These are typically materials with no recyclable value. Enviro-Fuelcubes have been supplied to power plants, cement kilns or process boilers as a clean alternative to fossil fuels such as oil and coal. Unlike fossil fuels, Enviro-Fuelcubes do not emit mercury or significant levels of sulfur. The heating value is high at 10,000 Btu/lb with low ash content (5% to 7%).<sup>15</sup>

### Geocycle – Holcim, Worldwide

Geocycle is a wholly owned subsidiary of Holcim Ltd. Geocycle operates in various countries including the U.S. Spain, Australia, Germany and Malaysia. Geocycle-Australia has more than 15 years of experience in manufacturing engineered fuels. Industrial by-products and discarded materials are transformed into alternative fuels and raw materials, providing a valuable thermal energy source for Cement Australia’s cement kilns. Within the cement manufacturing process, co-processing captures a material’s energy and mineral value. There is no

<sup>13</sup> [http://en.wikipedia.org/wiki/Meat\\_and\\_bone\\_meal](http://en.wikipedia.org/wiki/Meat_and_bone_meal)

<sup>14</sup> Fryda, L., Panopoulos, K., Vourliotis, P., Kakaras, E., Pavlidou, E. “Meat and bone meal as secondary fuel in fluidized bed combustion.” Proceedings of the Combustion Institute 31 (2007) 2829-2837

<sup>15</sup> “As label converters strive for sustainability, it’s important to take a look at what can become of the waste.”, Steve Katz, Label and Narrow Web, Waste Recycling, August 2008, web site: <http://www.labelandnarrowweb.com/articles/2008/07/waste-recycling>

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residual ash and, more importantly, the intense high temperatures and chemical nature of the cement making process, ensures the final cement product quality. Geocycle designs AF specifically for a given plant.<sup>16</sup>

### Vexor Fuels

Vexor Fuels started processing non-hazardous materials in 2000. In 2003, the company began blending non-hazardous secondary materials for cogeneration units, including the Covanta and Wheelabrator facilities. In 2005 Vexor Fuels supplied engineered fuel to Holcim's Holly Hill Cement Plant in South Carolina. Holcim now owns this facility and Vexor Fuels is contracted as an operations consultant. The Dorchester facility manufactures an engineered fuel with a consistent heating value of 6,500 Btu/lb, which is fed into the preheater/precalciner portion of the cement kiln.

In July of 2007, the CEMEX plant in Wampum, Pennsylvania conducted a test program using engineered fuel produced by Vexor Fuels. The engineered fuel looked like mulch and had the following specifications: a minimum heating value of 10,000 Btu/lb, maximum moisture content of 10% by weight and sized for introduction to the kiln through a four-inch pipe. The plant test was successful and the facility is now permitted by the Pennsylvania Department of Environmental Protection to use the engineered fuel.

Vexor Fuels operates a facility in Medina, Ohio that manufactures engineered fuel for cement kilns and cogeneration plants. The facility supplies the engineered fuel to nearby cement kilns in Pennsylvania. The engineered fuel consists of various types of non-hazardous materials including on-spec used oil, wood, biosolids, paper and plastic. Many engineered fuels made by Vexor Fuels may have as much as 40% biomass in it, depending on the AF feedstocks used. Vexor Fuels processes and blends AF to meet the specifications for a particular cement plant. Vexor's Engineered Fuel program received the award for Alternate Fuels Company of the Year at the Global Fuels Conference in Washington D.C. in June, 2010. In addition, Vexor Technology, Inc. was awarded the 2009 Medina County Business' Sustainability-Environmental Improvement Award.

For wet kilns without preheater/precalciners, the engineered fuel must be delivered into the main kiln along with coal. Such fuels for wet kilns must have different characteristics than for preheater/precalciner cement kilns. The cost to make an engineered fuel for a wet kiln is higher than for a preheater/precalciner kiln because wet kilns require a fuel with a heating value of at least 10,000 Btu/lb. For a dry process cement plant with a preheater/precalciner, this specification can be much lower, ranging between 6,500 to 8,000 Btu/lb. Vexor Fuels can mix more wet material into the engineered fuel in the dry kiln because this type of kiln has excellent drying capacity. For wet kilns, the engineered fuel must be more like coal and there is only one fuel entry point into the kiln. For dry kilns, Vexor Fuels can develop both types of fuel for precalciner and for the kiln. Other differences between wet kiln fuel and dry kiln fuel include the moisture content and particle size requirements. In 2008, the ESSROC cement kiln, a wet kiln in Bessemer, Pennsylvania also successfully tested an engineered fuel produced by Vexor Fuels.

### **General AF Fuel/Material Characteristics**

The following table, Table A, identifies typical fuel characteristics for the proposed AF including: heating value, moisture content, density, volatiles, and ash. It also identifies typical concentrations of the following contaminants in the proposed AF: sulfur, chlorine, fluorine, mercury, arsenic, cadmium, chromium, copper and lead. A discussion of the fuel characteristics and material properties follow this table.

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<sup>16</sup> "An effective solution – resource recovery from waste", Geocycle, Alternative Fuels, web site: <http://www.geocycle.com.au/wps/wcm/myconnect/Geocycle/About-Us/>

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**Table D. Typical AF Material Analysis Data**

| Fuel                            | Source  | Heating Value (BTU/lb) | Moisture (%) | Density (lb/ft <sup>3</sup> ) | Volatiles (%) | Ash (%)    | Sulfur (%)   | Chlorine (%)     | Fluorine (ppm)  | Mercury (ppm)  |
|---------------------------------|---------|------------------------|--------------|-------------------------------|---------------|------------|--------------|------------------|-----------------|----------------|
| Coal                            | Typical | 13,000                 | 5 to 12      | 50 to 58                      | 38 to 45      | 13 to 18   | 0.5 to 4     | 0.2              | 0.003 to 0.0060 | 0.1 to 0.5     |
| Engineered Fuel                 | 1       | 6,000 to 8,000         | 2 to 11      | 5                             | 60 to 70      | 10 to 20   | 0.1 to 0.25  | 0.1 & 0.38       | --              | 0.118          |
|                                 | 2       | 9,900                  | --           | --                            | --            | 5.4        | 0.11         | 0.16             | --              | 0              |
|                                 | 3       | 5,500 to 9,500         | 2.9 to 34    | --                            | --            | --         | 0.1 to 0.2   | 0.28 to 0.7      | --              | 0.1 to 0.4     |
|                                 | 4       | 7,200 to 10,100        | 7            | --                            | --            | 15 to 16.1 | 0.4 to 0.51  | 0.6 to 0.769     | --              | 0.7            |
|                                 | 5       | --                     | --           | --                            | --            | --         | 0.22 to 0.23 | --               | 0.08 to 0.1     | <10            |
|                                 | Min     | 5,500                  | 2            | 5                             | 60            | 5.4        | 0.1          | 0.1              | 0.08            | 0              |
| Max                             | 10,100  | 34                     | 5            | 70                            | 20            | 0.25       | 0.769        | 0.1              | <10             |                |
| Avg                             | 7,800   | 18                     | 5            | 65                            | 12.7          | 0.175      | 0.4345       | 0.09             | 5               |                |
| Agricultural Plastics           | 6       | 10,200 to 13,800       | --           | 36 to 46                      | --            | --         | --           | --               | --              | --             |
|                                 | 7       | 17,450                 | --           | 56                            | 100           | 0          | 0 to 0.08    | 0                | --              | --             |
|                                 | 8       | 12,000 to 19,000       | --           | --                            | --            | --         | --           | --               | --              | 0.1 - 0.2      |
|                                 | 9       | --                     | estimate <1  | --                            | --            | --         | --           | --               | estimate <100   | estimate <0.1* |
|                                 | Min     | 10,200                 | <1           | 36                            | 100           | 0          | 0            | 0                | <100            | 0.1            |
|                                 | Max     | 19,000                 | <1           | 56                            | 100           | 0          | 0.08         | 0                | <100            | 0.2            |
| Avg                             | 14,600  | <1                     | 46           | 100                           | 0             | 0.04       | 0            | --               | 0.15            |                |
| Agricultural Biogenic Materials | 10      | 6,200 to 9,100         | 10 to 35     | --                            | --            | 4.5 to 20  | --           | --               | --              | --             |
|                                 | 11      | 7,500 to 8,500         | --           | --                            | 69 to 80      | 0.6 to 13  | 0.03 to 0.12 | --               | --              | --             |
|                                 | 12      | --                     | 30 - 37      | --                            | --            | 11 to 12   | 0.3 - 0.35   | 0.16 - 0.36      | --              | --             |
|                                 | 13      | --                     | --           | --                            | --            | --         | --           | 0.14 - 1         | --              | 0              |
|                                 | 14      | --                     | --           | 18 to 50*                     | --            | --         | --           | --               | --              | --             |
|                                 | Min     | 6,200                  | 10           | 18                            | 69            | 0.6        | 0.03         | 0.14             | --              | 0              |
| Max                             | 9,100   | 37                     | 50           | 80                            | 20            | 0.35       | 1            | --               | 0               |                |
| Avg                             | 7,650   | 24                     | 34           | 74.5                          | 10.3          | 0.19       | 0.57         | --               | 0               |                |
| CDF                             | 15      | 7,300 to 12,000        | 0.2 to 0.8   | --                            | 61 to 70      | 21 to 25   | 0.07 to 0.11 | 0.0052 to 0.0077 | --              | --             |
|                                 | 16      | 7,600                  | --           | --                            | --            | 2.6        | --           | 0.13             | --              | --             |
|                                 | 17      | --                     | --           | --                            | --            | --         | --           | --               | estimate <100   | estimate <0.01 |
|                                 | 18      | --                     | --           | 25                            | --            | --         | --           | --               | --              | --             |
|                                 | Min     | 7,300                  | 0.2          | 25                            | 61            | 2.6        | 0.07         | 0.0052           | <100            | <0.01          |
|                                 | Max     | 7,600                  | 0.8          | 25                            | 70            | 25         | 0.11         | 0.13             | <100            | <0.01          |
| Avg                             | 7,450   | 1                      | 25           | 65.5                          | 13.8          | 0.09       | 0.0676       | <100             | <0.01           |                |
| Biosolids                       | 19      | 25,800                 | 70 - 80      | --                            | 67.6          | 32.4       | 0            | --               | --              | 2.45           |
|                                 | 20      | --                     | --           | --                            | --            | --         | --           | --               | --              | 5              |
|                                 | 21      | --                     | --           | --                            | --            | 31 - 44.6  | 0.8 - 1.1    | 0.1 - 0.17       | --              | 2.7            |
|                                 | 22      | --                     | 73           | --                            | 90.3          | 46         | 1.6          | 0.09             | --              | 1.2            |
|                                 | 23      | --                     | --           | 53.7                          | --            | --         | --           | --               | --              | 0.01           |
|                                 | 24      | 19,600                 | --           | --                            | --            | 48         | 1.22         | 0.078            | 0.026           | --             |
|                                 | 25      | 25,800                 | 70 - 80      | --                            | 67.6          | 32.4       | 0            | --               | --              | 2.45           |
|                                 | Min     | 70                     | 53.7         | 67.6                          | 31            | 0          | 0.078        | 0.026            | 0.01            | 70             |
| Max                             | 80      | 53.7                   | 90.3         | 48                            | 1.6           | 0.17       | 0.026        | 5                | 80              |                |
| Avg                             | 74.3    | 53.7                   | 79.0         | 40.4                          | 0.94          | 0.11       | 0.026        | 2.3              | 74.3            |                |

\*ethylene purified product

\*(-300 to 800 kg/m3)

## TECHNICAL EVALUATION AND PRELIMINARY DETERMINATION

| Fuel                            | Source | Heating Value (BTU/lb) | Moisture (%) | Density (lb/ft <sup>3</sup> ) | Volatiles (%) | Ash (%)    | Sulfur (%)   | Chlorine (%)   | Fluorine (ppm) | Mercury (ppm) | Arsenic (ppm) | Cadmium (ppm) | Chromium (ppm) | Copper (ppm) | Lead (ppm) |         |
|---------------------------------|--------|------------------------|--------------|-------------------------------|---------------|------------|--------------|----------------|----------------|---------------|---------------|---------------|----------------|--------------|------------|---------|
| TDF                             | 26     | 15,688                 | estimate < 5 | --                            | 66            | 4.2        | 1.92         | 0.07           | --             | --            | --            | --            | --             | --           | --         |         |
|                                 | 27     | --                     | --           | --                            | --            | --         | --           | --             | --             | 0.0076        | --            | --            | --             | --           | --         |         |
|                                 | 28     | 16,250                 | 0.62         | --                            | 67            | 4.8        | 1.23         | 0.15           | 10             | --            | --            | 6             | 97             | --           | 6.5        |         |
|                                 | 29     | --                     | --           | --                            | --            | --         | --           | --             | --             | --            | <5            | <5            | <5             | <5           | <30        |         |
|                                 | 30     | --                     | --           | 17 to 51                      | --            | --         | --           | 1.92           | 0.15           | 10            | --            | --            | 6, <5          | <5           | --         | 51      |
|                                 | 31     | 14,000                 | --           | --                            | --            | --         | 2 - 25       | 0.9 - 2.1      | 0.07 - 0.2     | --            | 0.05 - 0.5    | 2 - 4         | 3.5 - 6        | 3.2 - 80     | 30         | 38 - 65 |
|                                 | Min    | 14,000                 | 0.62         | 17                            | 66            | 2          | 0.9          | 0.07           | 10             | 0.0076        | 2             | 3.5           | 3.2            | 5            | 6.5        |         |
| Max                             | 16,250 | 5                      | 51           | 67                            | 25            | 2.1        | 0.2          | 10             | 0.5            | 5             | 6             | 97            | 30             | 65           |            |         |
| Avg                             | 15,125 | 3                      | 34           | 66.5                          | 13.5          | 1.5        | 0.135        | 10             | 0.2538         | 3.5           | 4.75          | 50.1          | 17.5           | 35.75        |            |         |
| Clean Cellulosic Biomass        | 32     | 7,700 to 8,800         | 13 to 50     | 20 to 40                      | 31 to 62      | 6 to 15    | 0.07 to 0.22 | 0.026 to 0.37  | --             | 0.1           | 2 to 34       | --            | 8 to 65        | 17 to 149    | --         |         |
|                                 | 33     | 6,900                  | --           | --                            | --            | 4.1        | --           | 0.15           | --             | --            | --            | 10            | 21             | 17           | 151        |         |
|                                 | 34     | --                     | --           | --                            | --            | --         | 0.01 to 0.2  | --             | 21             | 0.01 to 0.17  | 0 to 5        | 0.06 to 0.9   | 0.13 to 5.22   | --           | 0.3 to 4.4 |         |
|                                 | 35     | 6,400 to 11,500        | 0 to 71.2    | --                            | 54.9 to 94.9  | 0 to 39.4  | 0 to 0.88    | 0 to 1.189     | 0 to 490       | 0 to 2        | 0 to 6.8      | 0 to 3        | 0.3 to 130     | 0.3 to 400   | 0.2 to 340 |         |
|                                 | Min    | 6,400                  | 0            | 20                            | 31            | 0          | 0            | 0              | 0              | 0.01          | 0             | 0             | 0.13           | 0.3          | 0.2        |         |
| Max                             | 11,500 | 71.2                   | 40           | 94.9                          | 39.4          | 0.88       | 1.189        | 490            | 2              | 34            | 10            | 130           | 400            | 340          |            |         |
| Avg                             | 8,950  | 18.7*                  | 30           | 62.95                         | 2.2*          | 0.06*      | 0.054*       | 40*            | 0.1*           | 0.1*          | 5             | 17.8*         | 20.2*          | 24.4*        |            |         |
| Manufactured Cellulosic Biomass | 36     | 7,700 to 8,800         | 13 to 50     | 20 to 40                      | 31 to 62      | 6 to 15    | --           | --             | --             | --            | --            | --            | --             | --           | --         |         |
|                                 | 37     | --                     | --           | --                            | --            | 0.03 - 8   | 0.005 - 1.0  | 0.008          | 24             | 0 - 0.6       | 1.6 - 10      | 0.3 - 1.38    | 0.4 - 14.7     | 1.6 - 130    | <1.5 - 20  |         |
|                                 | 38     | 7,600 to 10,200        | 8.4          | --                            | 69.8 to 79.4  | 3.6 to 4   | 0.01         | 0.898 to 1.021 | --             | --            | --            | --            | --             | --           | --         |         |
|                                 | 39     | 3,200 to 8,700         | 42.9         | 11.24                         | 42.4 to 80    | 4.1 to 7.2 | 0.07 to 0.12 | 0.035 to 0.065 | 20 to 50       | --            | --            | --            | --             | --           | --         |         |
|                                 | 40     | --                     | --           | --                            | --            | --         | 0.015 to 0.2 | --             | --             | 0.09 - 1.9    | 0 - 37        | 0.13 - 5.12   | 0.13 - 495     | 0.01 - 3220  | 0.33 - 131 |         |
| Min                             | 3,200  | 8.4                    | 11.24        | 31                            | 0.03          | 0.002      | 0.008        | 20             | 0              | 0             | 0.13          | 0.13          | 0.001          | 0.33         |            |         |
| Max                             | 10,200 | 50                     | 40           | 80                            | 15            | 0.2        | 1.021        | 50             | 1.9            | 37            | 5.12          | 495           | 3220           | 131          |            |         |
| Avg                             | 6,700  | 29                     | 25.62        | 55.5                          | 7.515         | 0.101      | 0.515        | 35             | 0.95           | 18.5          | 2.625         | 247.6         | 1610.0         | 65.7         |            |         |
| Roofing Materials               | 41     | 5,800                  | 3            | --                            | --            | 70         | 0.8          | 0.04           | --             | <0.11         | <1            | <1.4          | 41             | --           | 21         |         |
|                                 | Min    | 5,800                  | 3            | --                            | --            | 70         | 0.8          | 0.04           | --             | <0.11         | <1            | <1.4          | 41             | --           | 21         |         |
|                                 | Max    | 5,800                  | 3            | --                            | --            | 70         | 0.8          | 0.04           | --             | <0.11         | <1            | <1.4          | 41             | --           | 21         |         |
|                                 | Avg    | 5,800                  | 3            | --                            | --            | 70         | 0.8          | 0.04           | --             | <0.11         | <1            | <1.4          | 41             | --           | 21         |         |

\* mean value based on Phyllis mean value, weighted average

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### Heating Value

From past applications, consistent quality clinker generally requires fuels with a heat content of 5,000 Btu/lb or greater. The physical design of the kiln (e.g., size of the combustion zones and gas flow rates) dictates the necessary fuel heating value to provide the temperatures needed for the chemical reactions to occur. Perhaps of even greater importance is the consistency of the fuel heat content in combination with the consistency of the moisture content to provide stable kiln operation. Both properties affect the heat input to the process, the chemical reaction rates and extent of reaction.

### Moisture

Lower moisture content in AF is desired because moisture in a fuel requires some of the energy in the fuel to vaporize the moisture, which diminishes the net heat output from the fuel. The moisture is converted to water vapor, which increases the exhaust gas flow rates and reduces the residence times in the kiln and preheater/precalciner. Therefore, past applications indicate the maximum effective moisture content is 30% to maintain operational efficiency. In addition, highly variable moisture causes heat input fluctuations that can negatively impact the clinker quality, but can also damage the kiln. So, consistent and low moisture content is a critical AF specification to ensure consistent, controlled combustion in the kiln and/or precalciner.

### Burnability

Several miscellaneous fuel characteristics affect the “burnability” of an AF. The volatility and the particle size of the AF affect how the fuel can be used. Fuel volatility affects thermal distribution, which restricts the rate and amount of the AF that can be fired. In the main kiln burner, the AF must be finely ground or pulverized (half inch or less) to a form that allows immediate combustion to provide an intense flame. In the precalciner, the AF can be greater in size (four inch or less) with a more variable volatility without affecting the overall combustion process.

Ash: The ash composition of fuels is important for clinker quality and is monitored to predict the clinker quality and composition. A cement kiln is unlike an industrial or utility boiler or municipal solid waste (MSW) or waste-to-energy (WTE) facility, in which the sole source of particulate to the particulate matter control device is the ash from the fuel. In a cement kiln, particulate matter can be derived from the fuel, but particulate matter is most significantly derived from the raw materials. The particulate matter loading from fuels is typically less than 10% of the total mass loading to the baghouse. As such, the potential increase of PM emissions from the ash content of the alternative fuels is within the 12 to 14% error of EPA Test Method 5, which is the appropriate method for quantifying PM emissions.<sup>17,18</sup> Particulate matter emissions do not proportionally increase with ash content because the efficiency of a baghouse is increased with particulate loading. U.S and European studies show that particulate matter emission rates are typically unaffected by use of AF.<sup>19,20</sup>

Sulfur: The ratio of sulfur to alkali is critical to prevent kiln buildup. Kiln buildup is the excessive amount of condensed solids within kiln that occur due to chemistry from out-of-balance chemical ratios of alkalis (i.e., sodium and potassium), sulfur and chlorine. The following equation, known as the sulfate modulus, shows the relationship of the three primary components that affect kiln buildup and the target range.

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<sup>17</sup> Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III. Stationary Sources Specific Methods. Section 3.16 EPA/600/4-77/027b.

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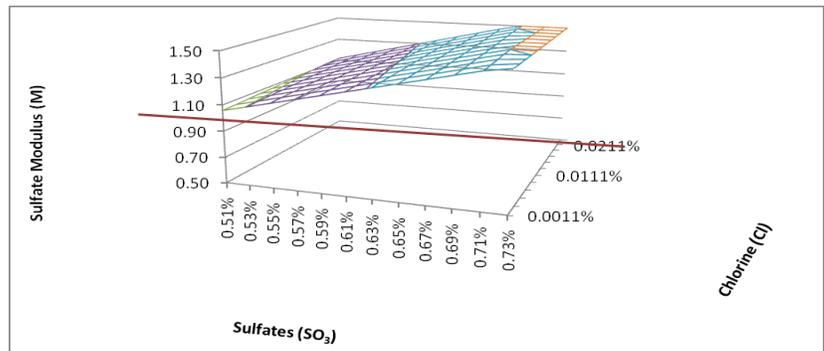
$$M = \left( \frac{\frac{SO_3}{80}}{\left( \frac{K_2O}{94} + \frac{Na_2O}{62} - \frac{0.5 \times Cl}{35.5} \right)} \right) = 0.8 \text{ to } 1.25^{21}$$

Where: chemical amounts are in units of mass.

The graph<sup>22</sup> below shows a modulus measuring at 1.30. This value is out of the “target range” of 0.8 to 1.25. Due primarily to the raw materials, this is on the edge of an unstable kiln condition of operation. Assuming a replacement of 10% of the fuel input with a high (2% or greater) sulfur and chlorine content, the modulus is further increased out of range at 1.40 to 1.42. If this balance is not maintained, deposits build up in the preheater tower consisting of condensed alkali chlorides (potassium and sodium chlorides) and further buildup will come from alkali sulfates.

Buildups can clog the preheater tower within minutes of a severe chemical imbalance and require shutdown of the kiln. Given these operational constraints, the typical sulfur content of the proposed materials and raw materials must be closely monitored.

Because the sulfur content of raw materials is not affected by the proposed project, the Department has assurance that CEMEX Miami Cement Plant will only introduce AF to the kiln such that overall sulfur input is within its preexisting range.



Graph 1. Sulfate Modulus

Given these operational constraints, fuels are monitored for sulfur content, along with the raw materials. The fuel sulfur content for both traditional and alternative fuels has been shown to not significantly impact SO<sub>2</sub> emissions.<sup>23,24,25,26</sup> This is evidenced by the current Best Available Control Technology applied to all Florida kilns that relies upon the inherent natural alkaline scrubbing of sulfur by the alkaline raw materials input to the kiln. Also, the Title V permit for the Miami Cement Plant limits SO<sub>2</sub> emissions to 0.5 lb/ton of clinker and 81.0 lb/hour. Furthermore, the efficiency of sulfur capture is affected by the sulfur modulus in which the balance of sulfur, chlorine and alkalis must be maintained to prevent sulfur condensation (i.e., buildup) in the kiln.

Sulfur compounds in raw materials are present mainly as sulfates such as calcium sulfate (CaSO<sub>4</sub>) or as sulfides such as pyrite or marcasite (FeS<sub>2</sub>). Sulfates in the raw materials are thermally stable up to temperatures of 1200°C and will thus enter the sintering zone of the rotary kiln where they are decomposed to produce SO<sub>2</sub>. Inorganic and organic sulfur compounds introduced with the fuels will be subject to the same internal cycle as sulfates in the raw materials: thermal decomposition, oxidation to SO<sub>2</sub> and reaction with alkalis or with calcium oxide. With this closed internal cycle, all the sulfur introduced as sulfates via fuels or via raw material will leave the kiln chemically incorporated into the clinker and will not be emitted as gaseous SO<sub>2</sub>.

However, sulfides (and also organic sulfur compounds) in raw materials enter the preheater tower and are decomposed and oxidized at 400°C to 600°C to produce SO<sub>2</sub> as the raw materials are heated by the exhaust gases

<sup>21</sup> Tokheim, L.A. “The Impact of Staged Combustion on the Operation of a Precalciner Cement Kiln”, 1999.

<sup>22</sup> Koogler and Associates, July 8, 2011.

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<sup>24</sup> Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, Figures 1.32, <http://eippcb.jrc.ec.europa.eu>  
<sup>25</sup> 6 Federal Register 28318, 28322 (May 17, 2011).

<sup>26</sup> National Policy on High Temperature Thermal Waste Treatment and Cement Kiln Alternative Use, Cement Production Technology, Report No. 66011-02; Issue 2, Dr. Kare Helge Karstensen.

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in the preheater tower. At these temperatures, not enough calcium oxide has been thermally generated to be present in the gas stream for reaction with the sulfide-generated SO<sub>2</sub>. Therefore, in a dry preheater kiln about 30% of the total sulfide input may leave the preheater section as gaseous SO<sub>2</sub> emissions.<sup>26</sup> In summary, SO<sub>2</sub> emissions are to a large extent determined by the sulfide content of the raw materials and not by the fuel composition and can be scrubbed out by the alkaline raw materials given sufficient residence time.

**Chlorine:** As stated above, the ratio of sulfate and chloride to alkali should be maintained at a sulfate modulus of 0.8 to 1.25 to prevent buildups in kiln system. The bulk of alkali input to the cement kiln is from raw materials; however, alkali levels are low in the limestone. Therefore, the chlorine content of all fuels and raw materials used must be monitored. The chlorine content of fuels used in the kiln is “process-limited” to ensure high-quality cement clinker and to limit kiln degradation. This provides assurance that AF will not be used in a manner that causes chlorine input to deviate from the existing range.

Regarding dioxin/furan emissions, EPA requires compliance with the dioxin/furan limit by continuously monitoring the baghouse inlet temperature, as required under the Portland Cement MACT (NESHAP Subpart LLL in 40 CFR 63). EPA has long recognized that the predominate factor affecting dioxin/furan emissions from a cement kiln is the flue gas temperature at the inlet to the control device.<sup>27</sup> Moreover, as EPA found when establishing the MACT floor for *hazardous* waste burning kilns that fuel type does not have an impact on dioxin/furan formation because dioxin/furan is formed post-combustion.<sup>28</sup> This is consistent with EPA’s recent position that “... burning alternative fuels ... does not appreciably affect cement kilns’ HAP emissions.”<sup>29</sup> A review of dioxin/furan emissions from cement kilns in United States, Europe and Australia shows no difference in dioxin/furan emissions when comparing conventional and alternative fuels.<sup>30,31, 32</sup>

**Fluorine:** Fluorine input to the kiln is from both raw materials and fuels. The emissions of hydrogen fluoride from cement kilns have been shown to be very low. This is apparent by EPA’s review of this HAP in the Portland Cement MACT for which hydrogen fluoride was not specifically regulated. Measurements of German kilns in 2004 showed most hydrogen fluoride levels below detection (0.04 to 0.06 mg/Nm<sup>3</sup>) and all values less than 0.5mg/Nm<sup>3</sup> (0.6 ppm).<sup>33</sup> In contrast, other industries such as aluminum smelters are regulated for hydrogen fluoride emissions, which is extremely acidic. The alkaline environment of the raw materials and product combined with high dust loading in cement kilns acts as an excellent scrubbing method. Fluoride input to the kiln from either fuel or raw materials is either captured in the clinker or reacted to calcium fluoride (CaF<sub>2</sub>), which is thermally stable in the burning process. Since high levels of fluoride (above 0.25 %) <sup>34</sup> adversely impact the quality of cement clinker, it is regularly analyzed in the clinker and product.

- **Mercury:** The Miami Cement Plant has a mercury emissions limit of 0.091 tons per year (182 pounds per year). Since mercury is a highly volatile metal, compliance with the limit is determined based on a material balance assuming that all mercury input is emitted. The current Title V operation permit requires stack tests and sampling or mercury CEMS for compliance with the mercury emission limit as required under Permit No. 0250014-041-AC. This requirement would extend to any AF used at the facility. The recently revised Portland Cement MACT requires installation of a mercury CEMS to demonstrate compliance with the new mercury standard of 55 pounds/million tons of clinker produced. At maximum production capacity

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<sup>27</sup> 63 Federal Register 14182, 14196 (Mar. 24, 1998)

<sup>28</sup> 64 Federal Register 52828, 52876 (Sep. 30, 1999)

<sup>29</sup> 76 Federal Register 28318, 28322 (May 17, 2011)

<sup>30</sup> “Air Emissions Summary for Portland Cement Pyro-processing”. Portland Cement Association. R&D SN3048.

<sup>31</sup> Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, Table 1.38, <http://eippcb.jrc.ec.europa.eu>.

<sup>32</sup> Dioxin and the Cement Industry in Australia. Technical Note. Cement Industry Federation. July 2002.

<sup>33</sup> Environmental Data of the German Cement Industry 2009. VDZ. Page 30.

<sup>34</sup> Javed I, Bhatty. “Role of Minor Elements in Cement Manufacture and Use”. PCA R&D Serial No. 1990.

(1,300,000 tons of clinker per year), the Miami Cement Plant would be limited to 71.5 pounds of mercury per year.

**Other Metals:** Other metals such as arsenic, cadmium, chromium, copper and lead may be introduced with AF; however, as shown in Table A, AF typically contains concentrations of these metals less than or comparable to coal and petcoke.

**Pesticides:** Plastics used in agricultural operations for weed control, etc. may contain residual pesticides from the farming operations. Currently, agricultural regulations allow these materials to be burned in open fields to reduce the waste volume. However, the cement kiln can effectively recover this thermal energy in the production of cement. Many reports indicate the extremely efficient destruction of pesticides in cement kilns.<sup>35</sup> Recent sampling/analyses of agricultural plastics show very low to non-detectable levels of residual pesticides, which provide greater assurance of complete destruction.

The applicant also notes that the thermal characteristics of cement kilns are such that when operated to achieve the combustion necessary to produce consistent quality clinker, organic compounds present in fuels are similarly destroyed. It is reported<sup>36</sup> that for the destruction (99.99+%) of non-halogenated organic compounds, a temperature in excess of 1830°F for two seconds and an oxygen concentration of 2% or more is required. The EPA Toxic Substance Control Act (TSCA) specifies that for the incineration of polychlorinated biphenyls (PCB) (99.9999% destruction), a temperature of 2200°F, a residence time of two seconds and an oxygen concentration of 2-3% is required.<sup>37</sup> Further related to the thermal destruction of PCBs, laboratory data from the University of Dayton Research Institute<sup>38</sup> demonstrates that PCB-type compounds are destroyed with efficiencies of greater than 99.99% at temperatures in excess of 1830°F with a residence time of two seconds and an oxygen concentration of 2-3%. Finally, the European Directive on Hazardous Waste Incineration (1994) requires a temperature in excess of 1560°F for two seconds for the incineration (greater than 99.99% destruction) of non-chlorinated organic wastes.<sup>1</sup> Fuel combustion in the precalciner and main burner of a modern precalciner/preheater kiln meets and generally exceeds these temperatures and residence times.

### **Preheater/Precalciner Kiln Operation**

The following figure shows the general operation of a preheater/precalciner cement kiln system. Note that the Miami Cement kiln uses a baghouse instead of an electrostatic precipitator to control particulate matter.

As shown in Figure 6, an induced draft fan pulls hot exhaust gases from the kiln through the preheater tower, the raw mill, a baghouse and out the stack. Raw materials (limestone, sand and iron ore) are fed into the raw mill, which grinds and mixes the raw materials to form raw meal. Instead of the typical practice for an in-line vertical raw mill, the FLS design incorporates a ball mill for the raw mill that has several benefits including assistance (by generated friction heat) in drying of the raw materials. Raw meal is transferred to the raw meal storage silo countercurrent to the hot exhaust gas, which is used to dry the raw meal. Raw meal is fed into the preheater tower, where the solid materials again flow countercurrent to the hot exhaust gas, which preheats the raw meal before being introduced to the pyroprocessing kiln. The kiln transforms the raw meal into cement clinker, which is cooled and eventually ground to size in the finish mill with other additives to form the final cement product.

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<sup>35</sup> Karstensen, K.H., et al., "Environmentally Sound Destruction of Obsolete Pesticides in Developing Countries using Cement Kilns." Environmental Science and Policy. 2006. pg 577-586.

<sup>36</sup> Mantus, E.K; Kelly, K.E.; Pascoe, G.A.; *All Fired Up – Burning Hazardous Waste in Cement Kilns*, Environmental Toxicology International, December, 1992.

<sup>37</sup> Karstensen, K.H., *Can Cement Kilns be used for PCB Disposal?*, SINTEF (undated)

<sup>38</sup> Rubey, W.A.; Dellinger, B., et al, *High-Temperature Gas – Phase Formation and Destruction of Polychlorinated Dibenzofurans*, Chemosphere, Vol. 14, No. 10, pp 1483-94, 1985.

## TECHNICAL EVALUATION AND PRELIMINARY DETERMINATION

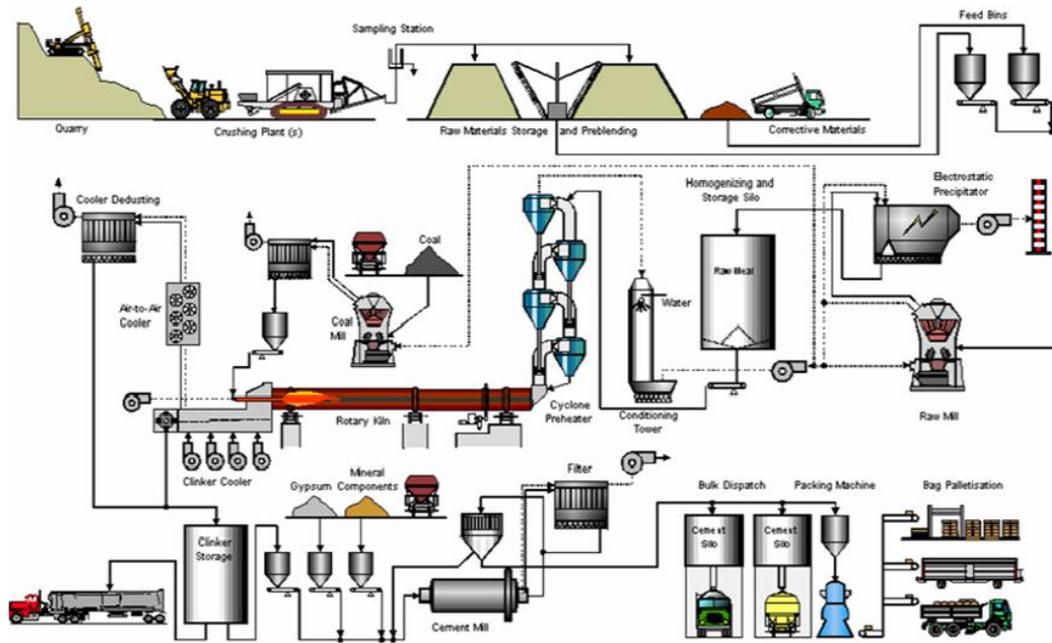


Figure 6. Process Flow Diagram - Dry Process Preheater/Precalciner Cement Plant<sup>39</sup>

The thermal characteristics of precalciner cement kilns include the following:<sup>40</sup>

- The gas temperatures and material temperatures in cement kilns are extremely high;
- The gas residence time in the kiln is on the order of ten seconds at temperatures in excess of 2200°F. At the precalciner, the temperature ranges from 1800°F to 2200°F for 3 second. In the preheater, the flue gas resides for 10 seconds at steadily changing temperatures from 1800 to 600 °F. The residence time of raw materials introduced at the feed end of the kiln is on the order of thirty minutes.
- There is extreme turbulence in the kiln assuring complete mixing of all combustible material.
- The emissions of non-volatile metals from alternative fuels and traditional fuels are comparable<sup>41,42</sup>. The metals, except highly volatile metals, bound to the cement dust go through the baghouse for capture<sup>43</sup>. Most of the metals are fixed in the clinker structure and become part of the finished cement<sup>44</sup>.
- There are no byproducts as all ash is incorporated in the clinker.

<sup>39</sup> National Policy on High Temperature Thermal Waste Treatment and Cement Kiln Alternative Use, Cement Production Technology, Report No. 66011-02; Issue 2, Dr. Kare Helge Karstensen

<sup>40</sup> Mantus, E.K; Kelly, K.E.; Pascoe, G.A.; *All Fired Up – Burning Hazardous Waste in Cement Kilns*, Environmental Toxicology International, December, 1992.

<sup>41</sup> Zemba, S., Ames, M., Green, L., Botelho, M.J., Gossman, D., Linkov, I., Palma-Oliveira, J., “Emissions of Metals and Polychlorinated Dibenzo(p)dioxins and furans (PCDD/Fs) from Portland cement manufacturing plants: Inter-kiln variability and dependence on fuel-types” *Science of the Total Environment*. 2011. Pg. 4198-4205

<sup>42</sup> International Cement Review, *Burning Issues*, February, 2000.

<sup>43</sup> Conesa, J.A., Galvez, A., Mateos, F., Martin-Gullon, I., Font, R., “Organic and inorganic pollutants from cement kiln stack feeding alternative fuels” *Journal of Hazardous Materials*. 2008. Pg. 585-592.

<sup>44</sup> Richards, J., Goshaw, D. Speer, D., Holder, T., “Air Emissions Data Summary for Portland Cement Pyroprocessing Operations Firing Tire –Derived Fuels.” *Environmental Science Technology*. 2004. Pg. 4734-4738. PCA R&D Serial No. 3050. 2008.

## TECHNICAL EVALUATION AND PRELIMINARY DETERMINATION

- Combustion in a cement kiln takes place under oxidizing conditions with the oxygen content of gases leaving the kiln typically in the range of 2-3%.
- The heating value of organic materials is recovered as energy, thus reducing the consumption of nonrenewable fossil fuel.

As previously shown, Figure 2 shows the temperature-time profile of the gas and raw material stream for a typical modern preheater/precalciner cement plant like the Miami Cement Plant. The temperature of the feed material entering the kiln from the preheater is in the range of 1650°F, a temperature demanded by the calcination temperature of calcium carbonate. From a temperature of 1650°F, the material temperature increases through the calcining zone and transition zone of the kiln and ultimately must reach a temperature of approximately 2650°F in the sintering zone. The temperature of the gas stream necessary to produce this material temperature is between 3000-3500°F in the sintering zone and decreases to approximately 2000°F at the back of the kiln where the gases leave the kiln and enter the preheater. In the preheater, the combustion gases from the kiln enter at approximately 2000°F and exit at approximately 600°F. Cumulatively, the gas temperature in the kiln exceeds 2000°F for approximately ten seconds, peaking at near 3500°F. As stated above, the combustion conditions within the kiln take place under oxidizing conditions with the oxygen content of the gas stream leaving the kiln (and entering the preheater) typically at 2-3%. The temperature conditions, the residence times and the oxygen concentrations typical in preheater-type cement kilns greatly exceed the guidelines/regulations referenced previously for assuring that organic compounds are adequately destroyed in a combustion process.

The general material reactions occurring through the temperature regions in the kiln system are as follows:

- $\leq 400^{\circ}\text{C}$  ( $752^{\circ}\text{F}$ ): water evaporation
- $400$  to  $750^{\circ}\text{C}$  ( $752^{\circ}\text{F}$  to  $1382^{\circ}\text{F}$ ): mineral dehydration
- $600$  to  $900^{\circ}\text{C}$  ( $1112^{\circ}\text{F}$  to  $1652^{\circ}\text{F}$ ): oxidation reactions, carbonate decomposition
- $800$  to  $1250^{\circ}\text{C}$  ( $1472^{\circ}\text{F}$  to  $2282^{\circ}\text{F}$ ): calcination of aluminates ( $\text{C}_x\text{A-X}$ ) and silicates ( $\text{C}_2\text{S}, \text{C}_3\text{S}$ )
- $1260^{\circ}\text{C}$  ( $2300^{\circ}\text{F}$ ): liquid phase clinker creation

The kiln operates about 90% of the time with the in-line raw mill operating and about 10% with the raw mill off. These two operation modes can affect emissions. With the raw mill on, exhaust gases are cooled and scrubbed to a greater extent. If the raw mill is off line, processed raw meal is transferred from storage silos to produce clinker. Generally, there is enough stored raw meal to continue operating the kiln for approximately two days or until the raw mill is brought back on line.

Unlike typical energy recovery combustion systems, exhaust gases from the kiln system are generated from fuel combustion and raw material thermo-chemistry. As previously mentioned under the applicant's PSD applicability analysis, emissions from the Miami Cement Plant will be controlled by the following methods:

- Emissions of CO and VOC will be controlled by: long residence at the high temperatures in the kiln ( $2200^{\circ}\text{F}$  to  $3500^{\circ}\text{F}$  for 10 seconds), which will be specifically designed for firing AF; and long residence at the high temperatures in the preheater/precalciner ( $1500^{\circ}\text{F}$  to  $2200^{\circ}\text{F}$  for 8 seconds).

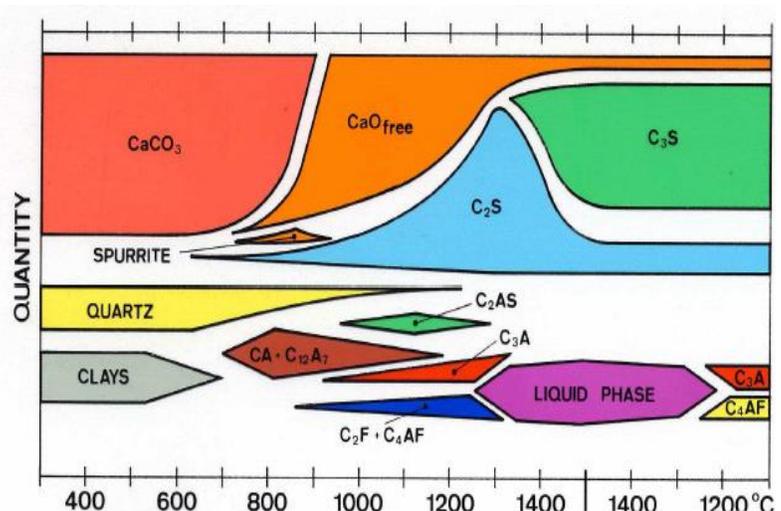


Figure 7. Thermo-chemical Reactions in the Formation of Four Major Clinker Components <sup>39</sup>

- Emissions of NO<sub>x</sub> will be controlled by the kiln combustion design, which includes indirect firing, multiple burn points and a low-NO<sub>x</sub> precalciner.
- Particulate matter emissions will be controlled with the existing baghouse.
- Emissions of SO<sub>2</sub> and other acid gases will be controlled with the natural scrubbing from the highly alkaline limestone, which is used as a raw material in producing clinker.
- Except for mercury and lead, metals will eventually be incorporated into the clinker at very high transfer rates (>99.99%). Mercury input will be tracked and mercury-containing AF will be minimized.

#### **4. APPLICANT'S REGULATORY ANALYSIS FOR PORTLAND CEMENT PLANTS**

##### **NSPS Subpart F in 40 CFR 60 - Portland Cement Plants**

This federal regulation applies to all Portland cement plants constructed, reconstructed or modified after August 17, 1971. Except as provided in paragraphs 40 CFR 63.1356(a)(1) and (a)(2), any affected source subject to the provisions of Subpart LLL in 40 CFR 63 (MACT for Portland Cement Plants) is exempt from any otherwise applicable new source performance standard contained in 40 CFR Part 60, Subpart F for particulate matter emissions (0.30 lb/ton of dry feed to the kiln). However, pursuant to 40 CFR 60.62(d), "If you have an affected source subject to this subpart with a different emission limit or requirement for the same pollutant under another regulation in title 40 of this chapter, you must comply with the most stringent emission limit or requirement and are not subject to the less stringent requirement." The particulate matter limit in 40 CFR 63, subpart LLL is more stringent; therefore the NSPS limit does not apply. The Miami Cement Plant is subject to NESHAP Subpart LLL and these requirements are established in the current Title V permit.

##### **40 CFR 51, 52, 70, and 71- Greenhouse Gas Tailoring Rule**

This project is not subject to regulation of GHGs until the source undertakes a physical change or change in the method of operations that will result in an emissions increase of 75,000 tons/year of CO<sub>2e</sub> (CO<sub>2</sub> equivalents).

##### **NSPS Subpart Eb - Large Municipal Waste Combustors**

This federal regulation applies to municipal waste combustors for which construction is commenced after September 20, 1994 or for which modification or reconstruction is commenced after June 19, 1996. This regulation could apply to cement kilns or boilers firing certain non-traditional solid fuels defined as municipal solid waste. However, 40 CFR 60.50b(p) of this regulation specifically states that, "Cement kilns firing municipal solid waste are not subject to this subpart."

##### **NSPS Subpart CCCC - Commercial and Industrial Solid Waste Incineration (CISWI) Units**

First promulgated on December 1, 2000, this federal regulation applies to municipal waste combustors for which construction is commenced after November 30, 1999 or for which modification or reconstruction is commenced on or after June 1, 2001. This regulation could apply to cement kilns or boilers firing certain non-traditional solid fuels defined as municipal solid waste. However, as promulgated in 2000, 40 CFR 60.2020(l) specifically provides that cement kilns regulated under NESHAP Subpart LLL in 40 CFR 63 (MACT for Portland Cement Plants) are exempt from compliance with the CISWI rules under NSPS Subpart CCCC. The Miami Cement Plant is subject to NESHAP Subpart LLL.

On March 21, 2011, EPA revised NSPS Subpart CCCC and the new Subpart CCCC requirements became effective on May 20, 2011. However, the 2011 version applies only to new, modified or reconstructed units, which are defined as units constructed after June 2010. EPA's preamble specifically provides that only "incinerators" and "small remote incinerators" remain subject to the standards in the 2000 NSPS Subpart CCCC rules. EPA also states that CISWI units falling within other subcategories, including cement kilns, "... will not in any case ..." be subject to the 2000 NSPS Subpart CCCC standards.

Also, in the 2011 version of NSPS Subpart CCCC, new, modified, reconstructed cement kilns will not be exempt

from the new CISWI rules. Paragraph (1) of 40 CFR 60.2020 that established the exemption from NSPS Subpart CCCC is now marked “reserved.” Waste-burning cement kilns constructed prior to June 4, 2010 are not considered to be “new” units subject to the 2011 NSPS Subpart CCCC standards *unless they are subsequently modified or reconstructed*. The CISWI rule under NSPS Subpart CCCC has been repropose.

#### **NSPS Subpart DDDD - Emissions Guidelines and Compliance Times for CISWI Units**

This federal regulation establishes “emission guidelines” and compliance schedules for the control of emissions from existing CISWI units. The emissions guidelines are established for states to develop rules that regulate emissions from existing CISWI units. The 2000 version of Subpart DDDD specifically exempts cement kilns.

Under the 2011 version of Subpart DDDD, waste-burning cement kilns that were constructed after November 30, 1999 and before June 4, 2010, will be required to comply with the standards and requirements for “existing units” established under the emissions guidelines as implemented by the state. The rules require state plans to be submitted by March 21, 2012 for CISWI units other than incinerator units (e.g., waste-burning kilns) that commenced construction on or before June 4, 2010. The compliance deadline is three years after the effective date of EPA’s approval of the state plan, but no later than March 21, 2016. Florida has not yet incorporated the revised emissions guidelines into its rules. For these waste-burning kilns, the standards in Table 8 of Subpart DDDD will apply once Florida adopts the rule and puts in place the approved plan or delegation. Currently, there is no mechanism for applicability of the 2011 version of Subpart DDDD in Florida for waste-burning kilns or a deadline for compliance with the applicable requirements under Subpart DDDD for waste-burning kilns. These issues must be resolved when Florida completes rulemaking to implement the 2011 version of Subpart DDDD through a state plan approved by EPA or direct delegation from EPA. However, as described below, EPA also promulgated new solid waste definitions to clarify that some solid waste materials may be processed to qualify as legitimate alternative fuels and ingredients, which would not subject the cement kiln to the CISWI.

#### **Vacatur of the CISWI Definitions Rule**

After a federal court vacatur in 2010, EPA recently revised its definitions of solid waste for determining applicability of Clean Air Act (CAA) Section 129(a) for combustion units burning non-hazardous secondary materials. The new definitions identify which secondary materials are nonhazardous “solid waste” for purposes of subtitle D (non-hazardous waste) of the Resource Conservation and Recovery Act (RCRA) when burned in a combustion unit. See *Federal Register Volume 75, No. 174, Thursday, September 9, 2010, Rules and Regulations and Volume 75, Page 31844, June 4, 2010*.

On December 23, 2011 the EPA published its reconsideration and request for comments on several provisions of the final new source performance standards and emission guidelines for commercial and industrial solid waste incineration units. In addition, the EPA is proposing amendments to the Non-Hazardous Secondary Materials rule. Originally promulgated on March 21, 2011, the Non-Hazardous Secondary Materials rule provides the standards and procedures for identifying whether Non-Hazardous Secondary Materials are solid waste under the Resource Conservation and Recovery Act when used as fuels or ingredients in combustion units. The purpose of these proposed amendments is to clarify several provisions in order to implement the Non-Hazardous Secondary Materials rule. See *Federal Register Volume 76, No. 247, Friday, December 23, 2011, Rules and Regulation, Pages 80452 to 80530*.

#### **40 CFR 241 - Non-Hazardous Discarded Materials That Are Solid Waste When Used as a Fuel or Ingredient**

When EPA updated the CISWI rules (NSPS Subpart CCCC provisions and the Emission Guidelines in Subpart DDDD), it also changed the definition of solid waste used in the rules to conform with the definition of solid waste under the Resource Conservation and Recovery Act (RCRA), “... any distinct operating unit of any commercial or industrial facility that combusts any solid waste as that term is defined in 40 CFR Part 241 [RCRA]...” In 40 CFR 241.3(b), the new RCRA definitions specify that the following non-hazardous secondary materials *are not* solid wastes when combusted:

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- Non-hazardous secondary materials used as a fuel in a combustion unit that remain within the control of the generator and that meet the legitimacy criteria specified in paragraph (d)(1) of this section.
- The following non-hazardous secondary materials that *have not been discarded and* meet the legitimacy criteria specified in paragraph (d)(1) of this section when used in a combustion unit (by the generator or outside the control of the generator):
  - Scrap tires used in a combustion unit that are removed from vehicles and managed under the oversight of established tire collection programs.
  - Resinated wood used in a combustion unit (resinated wood means wood products containing resin adhesives derived from primary and secondary wood products manufacturing such items as board trim, sander dust and panel trim).

The “legitimacy criteria” for non-hazardous secondary materials are:

- The non-hazardous secondary material must be managed as a valuable commodity based on the following factors:
  - The storage of the non-hazardous secondary material prior to use must not exceed reasonable time frames;
  - Where there is an analogous fuel, the non-hazardous secondary material must be managed in a manner consistent with the analogous fuel or otherwise be adequately contained to prevent releases to the environment; and
  - If there is no analogous fuel, the non-hazardous secondary material must be adequately contained so as to prevent releases to the environment.
- The non-hazardous secondary material must have a meaningful heating value and be used as a fuel in a combustion unit that recovers energy.
- The non-hazardous secondary material must contain contaminants at levels comparable in concentration to or lower than those in traditional fuels which the combustion unit is designed to burn. Such comparison is to be based on a direct comparison of the contaminant levels in the non-hazardous secondary material to the traditional fuel itself.

Florida has not yet adopted these federal definitions. As stated above, the rule is in the process of being amended to clarify provisions in order to implement the Non-Hazardous Secondary Materials rule.

### **Reconsideration Action on Cement NESHAP (Excerpts)**

When EPA revised the Portland Cement NESHAP in 2010, it classified all cement kilns, including those burning secondary materials, as “cement kilns” for the NESHAP rulemaking and explained why it was doing so. The EPA discussed the interplay between the cement kiln NESHAP and the forthcoming rules for incinerators which burn solid waste, noting that “some Portland cement kilns combust secondary materials as alternative fuels”. *74 FR at 21138*. The EPA then stated that because there was no regulatory definition of solid waste that would distinguish which of these alternative fuels burned by cement kilns was wastes and which were not, the EPA would therefore classify all of the units as cement kilns. *Id.* The EPA reasoned that unless and until the Agency adopts a definition of solid waste classifying the alternative fuels, cement kilns burning secondary materials as fuels or otherwise using secondary materials are lawfully classified as cement kilns and rules for cement kilns therefore would apply to them.

The EPA further found that combustion of secondary materials as alternative fuels by cement kilns “did not have any appreciable effect on the amount of hazardous air pollutants (HAP) emitted by any source.” *Id.* The record for the proposed rule included an inventory of every material burned by a large group of cement kilns over a 30-day period, including all of those comprising the pool of best performers for mercury.

A “secondary material” is a material that can potentially be classified as a solid waste under RCRA when recycled (*50 FR 616 n. 4 (Jan. 4, 1985)*). Under the newly adopted regulatory definition of solid waste, secondary materials encompass “any material that is not the primary product of a manufacturing or commercial process and can include post-consumer material, off-specification commercial chemical products or manufacturing chemical intermediates, post-industrial material and scrap” (*40 CFR section 241.2*).

As noted earlier, all cement kilns certified to EPA that they were cement kilns in compliance with the applicable section 112 (d) standards for cement kilns up to and through the time of the amendments to the Portland Cement NESHAP. Thus, cement kilns burning alternative fuels or other secondary materials were not classified as incinerators during the cement NESHAP rulemaking, but as cement kilns. Therefore, the Portland Cement NESHAP was, and is, based exclusively on the performance of cement kilns, as properly classified at the time of the rulemaking.

**NESHAP Subpart LLL in 40 CFR 63 - Portland Cement Manufacturing Industry (Cement MACT)**

This federal MACT applies to all new and existing Portland cement plants at major and area sources. The affected source includes the kiln, which is defined as a device that includes the preheater tower, precalciner and raw mill. The Miami Cement Plant is subject to NESHAP Subpart LLL (Portland Cement MACT), which is adopted by reference into Rule 62-204.800, F.A.C. The current NESHAP Subpart LLL limits are:

- PM: 0.3 lb/ton feed
- THC: 50 ppmvd
- Dioxin/Furans: 0.2 ng/dscm (TEQ)

By being subject to Subpart LLL, the kiln is not subject to the requirements of NSPS Subpart F, Standards of Performance for Portland Cement Plants, in 40 CFR 60.60 – 60.66.

In 2010, EPA revised this federal rule and the revisions would have taken effect in 2013, however, the rule was remanded by the courts. EPA must reconsider the standards and publish revised standards, taking into account the separate emissions databases of the Cement MACT versus CISWI kilns. The only part of the Cement MACT rule that is stayed (not in effect until a future rulemaking) is the clinker storage requirements, due to EPA’s failure to provide notice in the proposal on the requirements. The rest of the Cement MACT rule will follow the standards, compliance requirements and dates published in the September 9, 2010 rule. The Portland Cement MACT establishes emission standards that must be met and does not limit the types of non-hazardous materials that can be used as fuels or ingredients in the kiln. It does not prohibit the use of non-hazardous discarded materials, municipal solid waste, refuse-derived waste, or any other form of solid waste as a fuel. The MACT standards that were published for normal operation specify the following HAP emissions standards applicable to the Miami Cement Plant:

- Mercury: 55 lb/million tons of clinker produced
- PM: 0.04 lb/ton clinker(as a surrogate for metals such as cadmium and lead)
- THC: 24 ppmv (as a surrogate for other organic HAP emissions)
- HCl: 3 ppmv

**Rule 62-296.407, F.A.C. – Portland Cement Plants**

This state rule applies to Portland cement plants and establishes the following particulate matter emissions standards:

- New Kilns: 0.3 pounds per ton of feed (note: current Title V permit value is 0.093 pounds per ton feed for PM<sub>10</sub> and 0.11 pounds per ton feed for PM)
- New Clinker Coolers: 0.1 pounds per ton of feed

**Identification of Non-Hazardous Materials That Are Not Solid Waste – Florida Regulations**

According to 403.7045(1)(f), F.S., the following are considered “industrial byproducts” and not solid wastes, if:

- A majority of the industrial byproducts are demonstrated to be sold, used, or reused within one year.
- The industrial byproducts are not discharged, deposited, injected, dumped, spilled, leaked, or placed upon any land or water so that such industrial byproducts, or any constituent thereof, may enter other lands or be emitted into the air or discharged into any waters, including groundwaters, or otherwise enter the environment such that a threat of contamination in excess of applicable department standards and criteria or a significant threat to public health is caused.
- The industrial byproducts are not hazardous wastes as defined under 403.703, F.S. and rules adopted under this section.

Based on this rationale, the proposed alternative fuel materials are industrial byproducts or have specific exemptions from the definition of solid waste. Non-chlorinated plastics and agricultural fibrous organic byproducts have agricultural exemptions from the definition of solid waste rules. Reject roofing shingles and used roofing shingle scraps include raw material needed by the cement kiln would be considered an industrial byproduct. Tire-derived fuel has exemptions from solid waste permitting. Clean woody biomass is exempt from solid waste permitting. Pre-consumer reject paper, post-consumer paper carpet-derived fuel, a blended mix of the above alternative fuels and an engineered fuel are considered industrial byproducts, which are not solid wastes.

**NESHAP Subparts A and E in 40 CFR 61 – National Emission Standard for Mercury**

When combusting biosolids the permittee shall comply with all applicable requirements of 40 CFR 61, Subpart A, General Provisions, which have been adopted by reference in Rule 62-204.800(10)(d), F.A.C., except for 40 CFR 61.08 and except that the Secretary is not the Administrator for the purposes of 40 CFR 61.04, 40 CFR 61.11, and 40 CFR 61.18. In lieu of the process set forth in 40 CFR 61.08, the Department will follow the permit processing procedures of Rule 62-4.055, F.A.C. When combusting biosolids the permittee shall comply with all applicable provisions of Appendix C. 40 CFR 61 Subpart A - General Provisions included with the permit.

The permitted maximum allowable emission rate for mercury emissions from biosolids is 7.1 pounds per 24-hour period. The permittee shall test biosolids unless a waiver of emission testing is obtained under 40 CFR 61.13 from the Department. Such tests shall be conducted in accordance with the procedures set forth in 40 CFR 61 Subpart E. If mercury emissions exceed 3.5 pound per 24-hour period, demonstrated either by stack sampling according to 40 CFR 61.53 or biosolids sampling, the permittee shall monitor mercury emissions at intervals of at least once per year. The results of monitoring shall be reported and retained. The facility is limited, by permit, to 182 pounds per year of Hg based on material analysis. If the plant runs at least 50 percent of the time, the 24-hour emissions would average 0.997 pound/24-hour. This value (0.997 pound/24-hours) is less than 15 percent of the allowed Hg emissions of 40 CFR 61.52. The permittee is not expected to come near 7.1 pounds of Hg emissions per 24-hour period. As such, the current compliance method for Hg suffices for the compliance requirements of 40 CFR 61 Subpart E.

**NESHAP Subparts B and G in 40 CFR 279 and Rule 62-710, F.A.C. – Standards for the Management of Used Oil**

When combusting used oil the permittee shall comply with all applicable requirements of 40 CFR 279, Subparts B, Used Oil Specifications, and G, Standards for Used Oil Burners Who Burn Off-Specification Used Oil for Energy Recovery, part of Rule 62-710, F.A.C., Used Oil Management. The permittee is currently permitted to fire used oil and these requirements are in their permits.

**NSPS Subpart Ec in 40 CFR 60 – Standards of Performance for Hospital/Medical/Infectious Waste Incinerators for Which Construction is Commenced After June 20, 1996**

Cement kilns firing hospital waste and/or medical/infectious waste are not subject to this subpart according to 40 CFR 60.50c(g).

**Miami-Dade County Code**

The Miami-Dade County Code does not specifically regulate Portland cement kilns.

**5. DEPARTMENT REVIEW**

**Operating Capacity and Production**

According to the Portland Cement Association, cement production in Florida was more than 12 million tons in 2006. New plants were being constructed to meet the anticipated demand increase. Unfortunately, the economic downturn coincided with the construction of new plants, which lead to excess production capacity. Cement production has dropped each year to a low of just over 4 million tons in 2009. In addition to preventing the construction of several of the new kilns, this situation has caused the shutdown of some existing kilns and intermittent operation of most kilns. Currently, the Miami Cement Plant operates on a reduced schedule due to the decreased product demand.

**Applicant’s Stated Project Objective**

In response to the economic downturn and newly proposed regulations, the Miami Cement Plant is seeking to develop alternative fuel materials that will displace coal and fly ash to lower operating costs and eventually reduce mercury emissions. Energy use typically accounts for 30-40% of the production costs.<sup>45</sup> In addition, the applicant stated that the project will benefit the operation of the facility as well as the community for the following reasons:

- Increase in the availability and stability of energy sources through the use of locally generated, processed and transported energy sources in comparison to conventional fossil fuels (i.e., coal which is transported from around the world).
- Promotion of related recycling business activities (i.e., employment, taxable income) in the State of Florida.
- Reduction of greenhouse gas emissions by diverting and re-using biogenic material, reducing source material transportation and reducing methane emissions from land-filled materials.
- Increase in the demand for recovered materials. This matches the goals of the State efforts to increase waste diversion for re-use or recycling.<sup>46</sup>
- Promotion of a more diverse energy supply.

Recovering the energy in discarded materials for combustion processes is not new even to the United States. Based on a 2008 study<sup>47</sup> for the United States, 33.2% of municipal solid waste was recovered for reuse, 12.6%

**Table E. Material Substitution Rates in Cement Kilns Around the World**

| Nation                      | Substitution, % | Nation         | Substitution, % |
|-----------------------------|-----------------|----------------|-----------------|
| Netherlands                 | 83%             | United States  | 8%              |
| Switzerland                 | 47.8%           | Australia      | 6%              |
| Austria                     | 46%             | United Kingdom | 6%              |
| Norway                      | 35%             | Denmark        | 4%              |
| France                      | 34.1%           | Hungary        | 3%              |
| Belgium                     | 30%             | Finland        | 3%              |
| Germany                     | 42%             | Italy          | 2.1%            |
| Sweden                      | 29%             | Spain          | 1.3%            |
| Luxemburg                   | 25%             | Poland         | 1%              |
| Czech Republic              | 24%             | Ireland        | 0               |
| EU, prior to 2004 expansion | 12%             | Portugal       | 0               |
| Japan                       | 10%             | Greece         | < 1%            |

<sup>45</sup> “Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process”, Fuels and Raw Materials, Cement Sustainability Initiative (CSI), December 2005.

<sup>46</sup> <http://www.dep.state.fl.us/waste/recyclinggoal75/default.htm>.

<sup>47</sup> “Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008”, United States Environmental Protection Agency, Solid Waste and Emergency Response (5306P), EPA-530-F-009-021, November 2009, [www.epa.gov/wastes](http://www.epa.gov/wastes).

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was recovered for energy in combustion processes and 54.2% was ultimately discarded in a landfill. Table E shows the material substitution rates for cement kilns around the world in 2005.<sup>48</sup>

**General Summary of AF**

**Engineered Fuel (EF):** This is typically a product generated and sold by a third party as a high-energy fuel designed to customer specifications for quality and consistency. It may consist of the above identified AF or other non-hazardous materials that will meet target heating values and material content specifications. EF could consist of small amounts of animal meal, automotive manufacturing byproducts, clean-up debris from natural disasters, processed municipal solid waste, dried/sanitized biosolids, paint filter cake, hospital materials (non-infectious), pharmaceuticals (expired prescriptions), cosmetics, and confiscated narcotics. Vexor Fuels, Geocycle and IPP are examples of companies that produce engineered fuels which are suitable for firing in a preheater/precalciner cement kiln. Engineered fuels typically have moderate to high heating values (>6,500 Btu/lb) and moderate moisture contents (~18%). Levels of ash, sulfur, chlorine and metals will vary depending on the non-hazardous materials used to produce the engineered fuel.

*Animal Meal*

Animal meal includes the residues from the slaughter process and carcasses. With the past potential spread of Bovine Spongiform Encephalopathy (B.S.E) crisis, animal meal has been used as an alternative fuel mixed with traditional fuels in cement kilns regularly in Europe.<sup>49</sup> There is a ban in the United States on feeding animals with meat and bone meals. The high temperatures and adequate residence times of the cement process is a viable disposal option for animal meal and fat as well as providing heat content.

In Europe the cement kilns are required to accept animal meal and fat as national laws were enacted in most of the European Union countries. Animal meal is used in cement plants as a partial replacement of coal or other fossil

fuels with a replacement amount ranging from 10 to 15%. The benefit in the United States for this method of disposal is keeping it out of landfills while preventing the spread of B.S.E. The table<sup>50</sup> above compares animal meal to other fuels.

**Table F. Fuel Comparisons**

|                 | Units  | Coal       | Domestic waste | Sorting residues | Animal meal | Sewage sludge |
|-----------------|--------|------------|----------------|------------------|-------------|---------------|
| Carbon          | %      | 82 - 92    | 28 - 40        | 44 - 63          | 37.2        | 22 - 31       |
| Hydrogen        | %      | 3 - 6      | 4 - 5          |                  | 7.7         | 3 - 4         |
| Nitrogen        | %      | 1.3 - 1.9  | 1 - 2          | <0.1             | 5.8         | 1.9 - 6       |
| Sulphur, total  | %      | 0.6 - 1.1  | 0.3 - 0.5      | <0.1             | 0.5         | 0.5 - 1.3     |
| Oxygen          | %      | 2-10       | 16 - 22        |                  |             | 11 - 16       |
| Fluoride, total | %      | <0.03      |                |                  |             |               |
| Chlorine, total | %      | 0.01 - 0.3 | 0.4 - 1.0      | 1.2 - 2.2        | 0.5         | 0.05 - 0.4    |
| Cyanide, total  | mg/kg  |            |                |                  |             |               |
| Arsenic         | mg/kg  | 1 - 50     |                | 2.3 - 12.3       | 0.3         |               |
| Lead            | mg/kg  | 9 - 70     | 390 - 1830     | 14.5 - 258.5     | 4.25        | 206 - 390     |
| Cadmium         | mg/kg  | 0,1 - 2    | 1 - 33         | 8.5 - 66.2       | 0.43        | 3.6 - 4.3     |
| Chrome, total   | mg/kg  | 10 - 70    | 30 - 2760      | 15.4 - 68.6      | 8.31        | 64 - 72       |
| Copper          | mg/kg  | 5 - 70     | 60 - 2080      | 51.8 - 7278      | 29.4        | 322           |
| Nickel          | mg/kg  | 15 - 100   |                | 3.4 - 27.8       | 3.1         | 34            |
| Mercury         | mg/kg  | 0.08 - 2   | 0.5 - 12       | <0.1             | 0.18        | 2.3           |
| Zinc            | mg/kg  | 10 - 300   | 470 - 6530     |                  | 140         |               |
| Incandescent    | %      | 70 - 90    |                | 80 - 93          |             |               |
| Heat loss       | weight |            |                |                  |             |               |
| Calorific value | MJ/kg  | 25 - 30    | 7.5 - 15       | 18.2 - 28.2      | 15.7        | 8.0 - 11.5    |

<sup>48</sup> “Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process”, Fuels and Raw Materials, Cement Sustainability Initiative (CSI), December 2005.

<sup>49</sup> “Animal meal as alternative fuel in cement production”, [http://www.alf-cemind.com/cd/AF\\_and\\_ARM\\_animal\\_meal.htm](http://www.alf-cemind.com/cd/AF_and_ARM_animal_meal.htm)

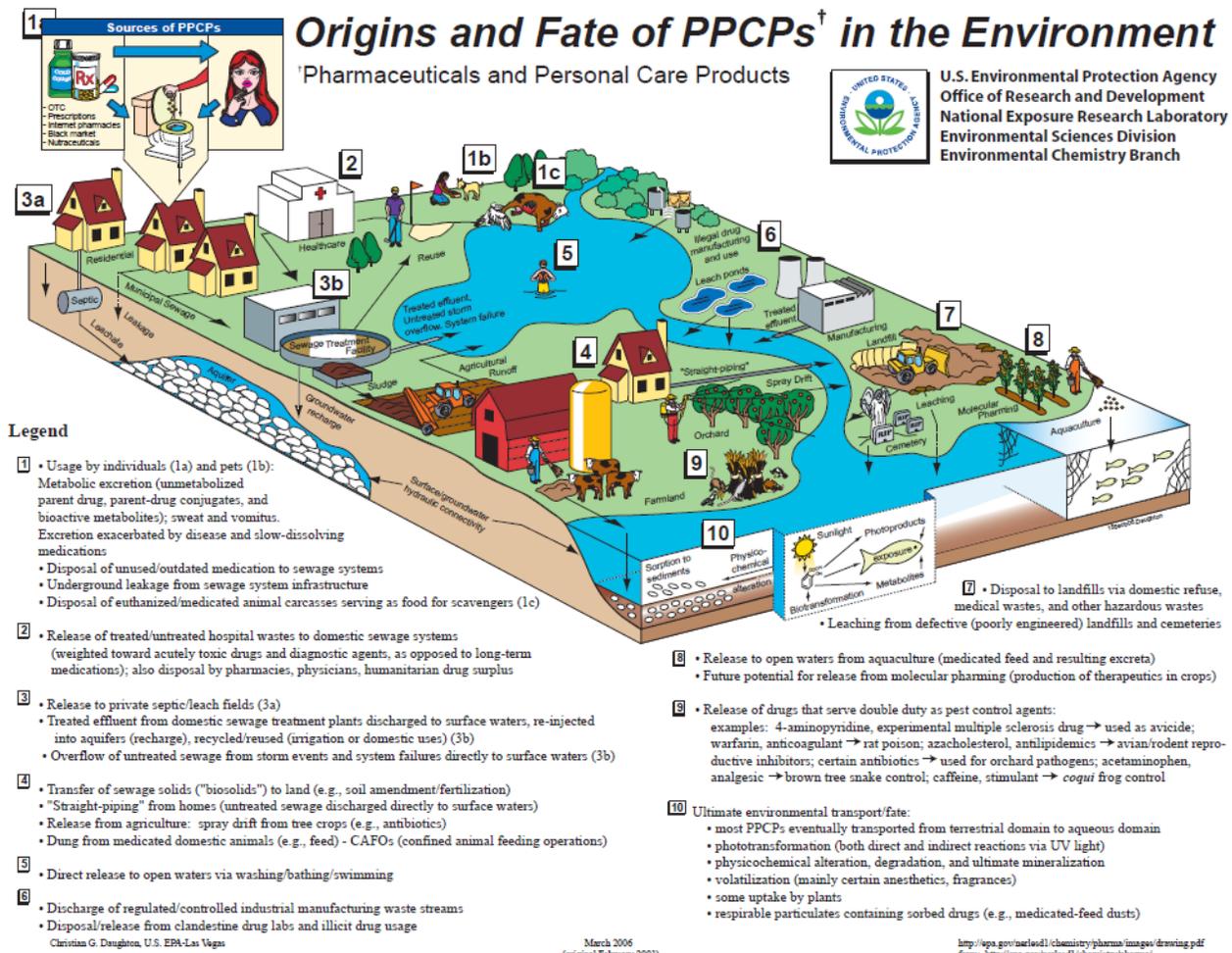
<sup>50</sup> Dr.-Ing. A. Nottrodt GmbH, Technical Requirements and General Recommendations for the Disposal of Meat and Bone Meal and Tallow Commissioned by the Federal Ministry for Environment, Nature Protection and Reactor Safety, 2001.

Paint Filter Cake

Filter cake is formed from the process of removing solid particles from liquid wastes through a membrane microfiltration system. The filter cake typically ranges from 40 to 60 percent solids. Past disposal of filter cake has been through land disposal. The Land Disposal Ban Notification and Certification (40 CFR 268.7 and 40 CFR 268.9) regulates abatement projects producing hazardous lead waste containing particles to meet the concentration-based extract standard for lead, which is 5 ppm (see 40 CFR 268.42). For this project, the paint filter cake shall be certified not to be hazardous waste by RCRA standards, such as passing the paint filter liquids test and the extraction procedure toxicity and toxicity characteristic leaching procedure (TCLP) tests.

Pharmaceuticals and personal care products (PPCPs)

U.S. EPA shows that bioactive chemicals, substances that have an effect on living tissue, are present in our nation's water bodies<sup>51</sup>. The effects of pharmaceuticals and personal care products (PPCPs) in the environment are still under research. PPCPs include such things as prescription and over-the counter therapeutic drugs, veterinary drugs, fragrances, cosmetics, sun-screen products, diagnostic agents, nutraceuticals (e.g. vitamins). EPA lists the sources of PPCPs as human activity, residues from pharmaceutical manufacturing (well defined and controlled), residues from hospitals, illicit drugs, veterinary drug use, especially antibiotics and steroids; and agribusiness.



<sup>51</sup> www.epa.gov/ppcp/basic2.html

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The Drug Enforcement Agency has regulations on the collection and disposal process. A cement kiln is an ideal environment for disposal of PPCPs due to the high temperatures and adequate residence times resulting in destruction of organic materials.

### *Auto fluff*

Automobile byproducts or auto fluff is a heterogeneous mixture of materials consisting of a shredded mixture of non-ferrous materials including plastics, foam, rubber, cloth, leather, cardboard, glass, sand and soil that comes from scrap automobiles. This material may include such contaminants as cadmium, chromium, copper, lead, mercury, nickel, chlorides, fluorides and PCBs. When properly processed, the heating value of auto fluff can approach 10,000 Btu per lb, which is more than sufficient for consideration as an alternative fuel to be co-fired in the kiln with the primary fuel of coal.

Chlorides and fluorides will be naturally scrubbed by the highly alkaline limestone used as a raw material. It is possible that high chloride content may cause an increase in dioxin/furan emissions; however, dioxin/furan emissions appear to be more of a function of post-combustion temperatures than chlorine feed<sup>52</sup>. Many of the metals (cadmium, chromium, copper, lead and nickel) will remain in the clinker product. Also, information gathered from short-term trial burns indicate that the beryllium and thallium contents of the processed auto fluff were typically below the detectable levels of the analytical methods. Mercury will be trapped in the baghouse dust, but re-circulated in the pyroprocessing system until the raw mill is shut down during which time mercury will be emitted. Based on EPA documents, the high temperatures and long residence time in the kiln will destroy any minimal amounts of PCB<sup>53</sup>.

There may be some minimal amounts of PCB in the auto fluff. PCB are man-made materials that were used extensively as coolants and insulating fluids for transformers and capacitors especially in components of early fluorescent light fittings and electrical transformers as well as flame retardants. In 1979, EPA banned the production of PCB. EPA regulates PCB under the federal Toxic Substance Control Act (TSCA) and is the compliance authority.

### *Class A and/or B Biosolids*



Biosolids are a byproduct of wastewater treatment making the production of the waste constant. Generally the waste is disposed of as a fertilizer for agriculture, in landfills, and through incineration<sup>54</sup>. When used as a fuel in cement kiln energy production is an added benefit. Biosolids are considered biomass and, used to offset greenhouse gases<sup>55</sup> when fired in kilns in other countries. The extremely high temperatures in the kiln and rapid cooling prevent the formation of dioxin-furans while the heavy metals in the sludge are mostly in the liquid fraction. There are two classes of biosolids, Class A and B, as defined in 40

CFR Part 503, Subpart D. Class A biosolids contain no detectable levels of pathogens and low levels of metals. Class A biosolids can be applied to agricultural land, private lawns, home gardens, and certain crops. Class B biosolids contain higher pathogen concentrations than Class A, but have levels low enough for such uses as land application with restrictions. A human health/risk benefit analysis study for a cement kiln in Vallcarca, Spain shows the emissions generated from 20% substitution of biosolids is comparable to 100% use of traditional fuels.<sup>56</sup> The permitted maximum allowable emission rate for mercury emissions from firing biosolids is 7.1

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<sup>52</sup> Waste Combustor MACT Rule, Federal Register, 64 FR 52876, September 30, 1999

<sup>53</sup> EPA Document No. EPN/600/S2-87/095, "Hazardous Waste Combustion in Industrial Processes: Cement and Lime Kilns", February 1988, Table 3 identifies 99.99% destruction efficiency of PCBs in the cement kiln.

<sup>54</sup> Morton, E.L., "a Sustainable use For Dried Biosolids", WEFTEC. 2006. Pg. 2060-2067.

<sup>55</sup> Zabaniotou, A., Theogilou, C., "Green energy at cement kiln in Cyprus – Use of sewage sludge as a conventional fuel substitute" Renewable and Sustainable Energy Reviews. 2008. Pg. 531-541.

<sup>56</sup> Rovira, J., Mari, M., Nadal, M., Schuhmacher, M. Domingo, J.L., "Use of sewage sludge as a secondary fuel in a cement plant: human health risks." Environmental International. 2011, Pg. 105-111.

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pounds per 24-hour period. If mercury emissions exceed 3.5 pound per 24-hour period, the permittee shall monitor mercury emissions at intervals of at least once per year.

The permittee will remain subject to the current Title V permit limitation of 182 pounds per year of Hg, based on stack testing or mercury CEMS. If the plant runs at least 50 percent of the time, the effective maximum permitted 24-hour emissions would average 0.997 pound/24-hour. This value (0.997 pound/24-hour period) is less than 15 percent of the allowed Hg emissions of 7.1 pounds/24-hour. As such the permittee is not expected to come near this limit.

**Table G. Biosolids Classifications**

| Metals          | “Class B” Biosolids Specification (limit) mg/kg <sup>1</sup> | “Class A” Biosolids Specification (limit) mg/kg <sup>1</sup> | “Class AA” Biosolids Specification (limit) mg/kg <sup>2</sup> |
|-----------------|--|--|---|
| Arsenic (As)    | 75   | 75   | 41  |
| Cadmium (Cd)    | 85   | 85   | 39  |
| Copper (Cu)     | 4300   | 4300   | 1500  |
| Lead (Pb)       | 840  | 840  | 300   |
| Mercury (Hg)    | 57   | 57   | 17  |
| Molybdenum (Mo) | 75   | 75   | N/A   |
| Nickel (Ni)     | 420  | 420  | 420   |
| Selenium (Se)   | 100  | 100  | 100   |
| Zinc (Zn)       | 7500   | 7500   | 2800  |

<sup>1</sup> The specification is based on a single sample. The metal constituent specifications are the same for Class B and Class A biosolids.

<sup>2</sup> The specification is based on a monthly average concentration.

These specifications are from Chapter 640, F.A.C. (see <http://www.dep.state.fl.us/legal/rules/wastewater/62-640.pdf>)

Lehigh Cement Company has tested biosolids as a fuel replacement in the cement kiln at Union Bridge, Maryland. Lehigh’s parent company, Heidelberg Cement, has been using biosolids as a fuel in Europe for many years. Biosolids have about two thirds the heating value of coal, but it has a very high volatile content making it as combustible as coal.

Mitsubishi Cement Corporation’s cement plant located in Lucerne Valley, California, processes up to 250 tons per day of dewatered biosolids. For approximately sixteen years to date, the plant has injected 10 tons of biosolids per hour. Typically biosolids are injected into the exhaust gases exiting the pre-calciner which reduces NOx emissions by approximately 35 percent. Biosolids contain ammonia (NH<sub>3</sub>), which controls the NOx emissions. In addition, the reduction of temperature of gases is due to the moisture content of biosolids, further reducing NOx emissions. Biosolids are destroyed through combustion with the non-combustible materials ending up in the cement product with no ash.<sup>57</sup>

The World Health Organization recognizes that cement kilns are ideal for the disposal of pharmaceuticals, chemical waste, used oil, and more. With the high temperatures and residence times the organic waste is broken down, while some of the combustion products are absorbed into the cement clinker or removed in the heat exchange equipment.<sup>58</sup>

In addition to the applicant’s details provided on Vexor Fuels and IPP engineered fuels, there many other engineered fuels.

<sup>57</sup> Kahn, R. “Biosolids Injection: A New Technology for Effective Biosolids Management”. 1998. Pg 1-7.

<sup>58</sup> World Health Organization: Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies WHO/EDM/PAR/99.2, 1999. Pg 15.

*ClimaFuel*<sup>59</sup>



Climafuel® is a waste-derived fuel made from household residual and commercial waste. It is produced using new technologies, such as Mechanical Biological Treatment (MBT). MBT is the umbrella term for processes that use mechanical and biological techniques to sort, separate and treat waste to remove biodegradable and incombustible matter. All recoverable materials are removed for recycling. The final products are a solid recovered fuel and a compostable material. The solid recovered fuel is a clean and non-hazardous fuel, which looks like shredded paper. It consists primarily of paper, cardboard, wood, carpet, textiles and plastics.

The fuel is manufactured to a tight specification by specialist waste management companies. At CEMEX’s United Kingdom (UK) cement plants it replaces 20-60% of the fossil fuels (15 to 30 tons per hour), such as coal or petcoke, currently used to heat the cement kilns, depending on the permits. CEMEX is using ClimaFuel® at both of its UK cement plants. The UK Environment Agency agreed that ClimaFuel can be used at the CEMEX Rugby cement works without harmful effects on the environment or human health. As well as reducing fossil fuel use, it has been shown to have a beneficial effect on NOx emissions, which were reduced by up to 30%.<sup>60</sup>

**Table H. ClimaFuel Properties**

| Parameter     | Level            |
|---------------|------------------|
| Heating Value | ~ 6500 Btu/lb    |
| Sulfur        | < 1% by weight   |
| Chlorine      | < 0.5% by weight |

*Green Circle Bio Energy Inc.*

Green Circle Bio Energy Inc. operates a wood pellet plant in Cottondale, Florida. Although this facility uses only wood to make its engineered fuel, it shows the level of processing that can go into an engineered fuel product. Logs from pulpwood trees, primarily yellow pine, are delivered to the facility. The trees are de-barked. The bark is then hogged to size in a hammer-mill and then screened to remove sand and other incombustible materials. Processed bark is used as fuel in dryers at the plant and must be cleaned to prevent ash deposits on the wood being dried. The green wood is chipped and re-chipped to initial size. The green wood is dried to 9% moisture in large rotary dryers, which exhaust to a heat recovery steam generator. Air pollution control equipment on the dryer emissions includes a wet electrostatic precipitator to control particulate matter and a regenerative thermal oxidizer to destroy organic compounds. Three pelletizing lines operate a series of hammer-mills to grind the dry wood chips. Steam is added to soften the ground wood, which is then pressed by large rotating press rolls into a durable, cylindrical wood pellet approximately 1.25 inches long by 0.3 inch wide. The manufactured wood fuel pellets have the following typical properties:<sup>61</sup> less than 1% bark content, approximately 7% to 10% moisture content, approximately 0.5% ash content and a heating value of approximately 7,300 Btu/lb.



*Comparison of Engineered Fuel Characteristics*

The following table compares typical fuel/material characteristics of coal with engineered fuels.

**Table I. Alternative Fuel Values**

| Fuel | Heating Value (Btu/lb) | Ash Content | Chlorine Content | Sulfur Content | Mercury Content |
|------|------------------------|-------------|------------------|----------------|-----------------|
|------|------------------------|-------------|------------------|----------------|-----------------|

<sup>59</sup> CEMEX United Kingdom; Web sites: [http://www.cemex.co.uk/su/su\\_af\\_cl.asp](http://www.cemex.co.uk/su/su_af_cl.asp) and [http://www.cemex.co.uk/su/pdf/South\\_Ferriby\\_Climafuel\\_Application.pdf](http://www.cemex.co.uk/su/pdf/South_Ferriby_Climafuel_Application.pdf) .

<sup>60</sup> “The Use of ClimaFuel as a Fuel at Rugby Cement Plant”, Draft Report for Consultation, CEMEX UK Cement Limited, November 2010.

<sup>61</sup> Green Circle Bio Energy Inc.; web site: <http://www.greencirclebio.com/products.php>

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|                       |        |       |         |       |           |
|-----------------------|--------|-------|---------|-------|-----------|
| Coal                  | 13,000 | 7.55% | 0.16%   | 0.70% | 0.02 ppm  |
| Vexor Fuel            | 10,000 | 5.8%  | 2.16%   | 0.38% | 0.012 ppm |
| Climafuel             | 6,500  | 15%   | 0.50%   | 1.0%  | < 10 ppm* |
| IPP Enviro-Fuel Cubes | 10,000 | 7%    | < 0.75% | 0.10% | < 10 ppm* |

\* Estimated based on typical maximum AF acceptance criteria.

**Tire-Derived Fuel (TDF):** Tires, tire chips and tire fluff have all been successfully fired in cement kilns as well as utility and industrial boilers. TDF has a high heating value (15,125 Btu/lb) and low moisture content (3%). The contents of sulfur, chlorine and metals are comparable to coal. Steel belt materials can be incorporated into the clinker product as an ingredient.

**Roofing Materials:** This AF consists of the asphalt binder/adhesives and fiberglass/paper backing with residual amounts of incombustible grit materials. This AF has a sufficient heating value (5800 Btu/lb) with low moisture content (3%) and the grit materials can be incorporated into the clinker product as an ingredient. The contents of sulfur, chlorine and metals are comparable to coal.

**Plastics:** Plastics, such as agricultural plastic mulch, consist of polyethylene and have a very high heating value (14,600 Btu/lb) with low moisture content (<1%). Some plastics can include chlorine. Only incidental amounts of chlorine containing plastics will be used. Analytical results indicate very low levels of residual pesticides remaining on this material. This is because most new pesticides are biodegradable and will breakdown prior to processing. Any residual pesticide will be destroyed by the long residence times at high temperatures in the kiln (~10 seconds at 2,800°F) and precalciner (~3 seconds at 1,800°F).<sup>62</sup> This AF contains very low levels of other contaminants.

**Agricultural Biogenic Materials:** This AF includes agricultural materials such as peanut hulls, rice hulls, corn husks, citrus peels, cotton gin byproducts, animal bedding, etc. This AF has a sufficient heating value (7650 Btu/lb), but may have a high moisture content (24%). Although this material typically burns well, the higher moisture content can greatly increase the flue gas volume and operators must carefully manage operations when firing high rates of this AF. This AF contains very low levels of other contaminants.

**Untreated Cellulosic Biomass:** This AF includes wood trimmings, sawdust, wood shavings, yard trash, clean construction and demolition debris, etc. This AF has a sufficient heating value (6700 Btu/lb), but may have elevated moisture contents (19%). Although this material typically burns well, higher moisture contents can greatly increase the flue gas volume and operators must carefully manage operations when firing high rates of this AF. This AF typically contains very low levels of other contaminants.

**Treated Cellulosic Biomass:** This AF includes secondary wood residues such as plywood, particle board, medium density fiberboard, oriented strand board, laminated beams, finger-jointed trim, sheet goods, construction and demolition materials, and wood treated with creosote and or copper-chromium and arsenic (CCA) compounds. The following manufactured materials have moderate moisture contents (~15%) and a moderate to high heating values (7000 to 10,200 Btu/lb): plywood, particle board, medium density fiberboard, oriented strand board, laminated beams, finger-jointed trim and sheet goods. The adhesives used in production to join these materials can add to the heating value and will be destroyed during combustion in the kiln.

- **Creosote-Treated Wood:** This wood has been preserved by pressure treatment anti-microbial pesticide products containing creosote. Creosote pressure-treated wood provides protection against attack by fungi, insects and marine borers. However, creosote can be biodegraded to some extent by a number of bacteria and

<sup>62</sup> Mantus, E.K; Kelly, K.E.; Pascoe, G.A.; *All Fired Up – Burning Hazardous Waste in Cement Kilns*, Environmental Toxicology International, December, 1992.

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fungi. The organics in creosote-treated wood will be destroyed by the high temperatures in the kiln (~10 seconds at 2,800°F) and precalciner (~3 seconds at 1,800°F).<sup>63</sup>

- **CCA-Treated Wood:** This wood is pressure treated with CCA as a preservative. Therefore, it has elevated amounts of these metals. Industry tests indicate that these metals eventually are incorporated into the clinker product.<sup>64</sup> Therefore, raw materials and fuels are carefully monitored for copper and chromium levels because high levels of chromium can adversely affect clinker quality. It is expected that nearly all of the chromium input will be captured in the clinker. Typically, clinker has 70 parts per million (ppm)<sup>65</sup> of chromium. The clinker quality specification of 100 ppm<sup>66</sup> would be exceeded if the CCA-treated wood input is above 10% of heat input.<sup>67</sup> The applicant indicates that the plant will fire limited amounts as part of a blended fuel mix or engineered fuel.

**Carpet-Derived Fuel:** This AF includes new carpet, reject carpet and used carpet scraps. The material has a moderate heating value (7450 Btu/lb) with low moisture content (1%). This AF contains very low levels of other contaminants.

**Mixes of the Above AF:** The above identified AF may be blended at the plant to produce a homogeneous fuel having more beneficial fuel properties. For example, plastics, untreated biomass and carpet could be blended to provide a high-energy fuel with moderate moisture content and low levels of contaminants.

### Regulated Emissions for Miami Cement Kiln

Currently, the Miami Cement kiln is subject to the following emissions standards and regulatory programs.

**Table J. Emissions Standards Table from Title V Permit No. 0250014-044-AV**

| Pollutant ID     | Fuel(s) [2]               | Allowable Emissions [1], [3], [5]            |       | Equivalent Emissions [4], [5] TPY | Basis                 |
|------------------|---------------------------|--|-------|-----------------------------------|-----------------------|
|                  |                           | Permit Limits                                | lb/hr |                                   |                       |
| PM               | coal/gas/WTDF/<br>oil/OWW | 0.152 lb/ton kiln <sub>ph</sub> feed *       | 40.6  | 163                               | Avoid PSD             |
|                  |                           | 0.10 lb/ton kiln feed (clinker cooler limit) | -     | -                                 | 40 CFR 63 Subpart LLL |
| PM <sub>10</sub> | coal/gas/WTDF/<br>oil/OWW | 0.121 lb/ton kiln <sub>ph</sub> feed *       | 32.3  | 130                               | Avoid PSD             |
| SO <sub>2</sub>  | coal/gas/WTDF/<br>oil/OWW | 0.50 lb/ton of clinker                       | 81.0  | 325                               | Avoid PSD             |
| NO <sub>x</sub>  | coal/gas/WTDF/<br>oil/OWW | 4.0 lb/ton of clinker                        | 648   | 2,600                             | Avoid PSD             |
| CO               | coal/gas/WTDF/<br>oil/OWW | 2.81 lb/ton clinker                          | 455   | 1,827                             | Avoid PSD             |
| VOC              | coal/gas/WTDF/<br>oil/OWW | 0.12 lb/ton clinker                          | 19.4  | 78                                | PSD-BACT              |

<sup>63</sup> Cooper, P.A.; *Future of Wood Preservation in Canada – Disposal Issues*, 20th Annual Canadian Wood Preservation Association Conference, Oct. 25-26, 1999, Vancouver BC.

<sup>64</sup> Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, <http://eippeb.jrc.ec.europa.eu>

<sup>65</sup> Bhatti, J.I. “Innovations in Portland Cement Manufacturing”, PCA Table 3.6.5. (undated)

<sup>66</sup> P. A. Longman, Training Manual from Heidelberg Cement Company. (undated)

<sup>67</sup> Wu, C.Y., et al. “Evaluation of Thermal Processes for CCA Wood Disposal in Existing Facilities”, Table 1-1 and 1-2. Florida Center for Solid and Hazardous Waste Management Contract No. 00053522. May 15, 2006.

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| Pollutant ID                        | Fuel(s) [2]               | Allowable Emissions [1], [3], [5]   |       | Equivalent Emissions [4], [5] TPY | Basis                  |
|-------------------------------------|---------------------------|---|-------|-----------------------------------|------------------------|
|                                     |                           | Permit Limits   | lb/hr |                                   |                        |
| H <sub>2</sub> SO <sub>4</sub> mist | coal/gas/WTDF/<br>oil/OWW | 0.020 lb/ton clinker  | 3.24  | 13.0                              | Avoid PSD              |
| Mercury                             | coal/gas/WTDF/<br>oil/OWW | 1.4x10 <sup>-4</sup> lb/ton clinker   | 0.023 | 0.091                             | Avoid PSD              |
| Lead                                | coal/gas/WTDF/<br>oil/OWW | 3.0x10 <sup>-6</sup> lb/ton clinker   | 0.049 | 0.195                             | Avoid PSD              |
| VE                                  | coal/gas/WTDF/<br>oil/OWW | 10% opacity (clinker cooler limit)  | ---   | ---                               | 40 CFR 63 Subpart LLL  |
| Dioxins/<br>Furans                  | coal/gas/WTDF/<br>oil/OWW | 0.20 ng/dscm TEQ or<br>0.40 ng/dscm TEQ (T<204 <sup>0</sup><br>C)<br>at 7% O <sub>2</sub> | ---   | ---                               | 40 CFR 63, Subpart LLL |

\* Kiln preheater feed rate (Kiln) ph

\* OWW = Oily Wastewater

**NOTES**

- [1] Based on the maximum preheater feed rate of 267 TPH and a conversion factor of 0.607, the maximum clinker production rate is 162 TPH (267 TPH, kiln ph x 0.607 = 162 TPH, clinker.)
  - [2] Fuel combustion as specified in Specific Condition No. B.6, and the protocols established by PERA. See also APPENDIX CG, Common and General Conditions.
  - [3] Compliance Units. This facility shall demonstrate compliance based on these standards.
  - [4] "Equivalent Emissions" represent annual emissions based on operation at the maximum permitted emissions and production rates. "Equivalent Emissions" are listed for informational purposes, for PSD applicability and recordkeeping/tracking purposes.
  - [5] The original air construction permit for the kiln modernization project is Permit No. 0250014-002-AC. Table 1-2 was modified by Permit No. 0250014-007-AC to remove the beryllium emissions limit. It was subsequently modified by Permit No. 0250014-008-AC to: revise the SO<sub>2</sub> limit from 0.7 lb/MMBtu to 2.23 lb/ton of clinker; revise the NO<sub>x</sub> emissions limit from 1.53 lb/MMBtu to 4.9 lb/ton of clinker; and revise the VOC emission limits from 0.1 to 0.12 lb/ton of clinker, 13.7 to 16.4 lb/hour, and 60 to 72 TPY (BACT).
- [Permit Nos. 0250014-016-AC/PSD-FL-324A, and 0250014-041-AC; Rules 62-4.070(3), 62-210.200(PTE), and 62-212.400(BACT), F.A.C.; 40 CFR 63, Subpart LLL]

Note: The above emissions limits, along with annual production limits, effectively limit annual emissions to: PM, 163; PM<sub>10</sub>, 130; SO<sub>2</sub>, 325; NO<sub>x</sub>, 2,600; CO, 1,827; and VOC, 78 tons per year. These equivalent ton per year numbers are based on 162 tons per hour and 1,300,000tons per year of clinker production.

The primary regulations for the existing kiln are: PM, SO<sub>2</sub>, NO<sub>x</sub>, CO, VOC, and VE BACT standards and the NESHAP Subpart LLL provisions, which represent MACT for controlling THC and HAP (metals and dioxin/furans) emissions. Note that NESHAP Subpart LLL establishes a PM/PM<sub>10</sub> emissions standard as a surrogate for controlling metal emissions. In 2010, EPA revised NESHAP Subpart LLL to include the following new standards that will apply in 2013. This rule is under reconsideration currently.

**Table K. Revised NESHAP Subpart LLL, MACT Standards for Existing Kilns at Normal Operation**

| HAP     | Average Emissions Top 12% of Kilns <sup>a</sup> | Final Standards <sup>b</sup>            |
|---------|---|---|
| Mercury | 32.1 lb/MM tons clinker                         | 55 lb/MM tons clinker <sup>c</sup>      |
| THC or  | 5.2 ppmvd@7% O <sub>2</sub>                     | 24 ppmvd@7% O <sub>2</sub> <sup>d</sup> |

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|-------------|------------------------------|--|
| Organic HAP | 1.8 ppmvd@7% O <sub>2</sub>  | 9 ppmvd@7% O <sub>2</sub> <sup>e</sup> |
| HCl         | 0.41 ppmvd@7% O <sub>2</sub> | 2 ppmvd@7% O <sub>2</sub> <sup>f</sup> |
| PM          | 0.02 lb/ton clinker          | 0.04 lb/ton clinker <sup>g</sup>       |

Notes:

- a. Serves as the basis for the MACT.
- b. The final standards are slightly higher to account for the variability in emissions and monitoring.
- c. Compliance with the mercury standard will be demonstrated by CEMS or other approved continual monitoring methods.
- d. Compliance with the THC standard will be demonstrated by CEMS.
- e. Compliance with the organic HAP standard will be demonstrated by complying with the THC standard.
- f. Compliance with the HCl standard will be demonstrated by CEMS.
- g. Compliance with the new PM standard will be demonstrated by CEMS.

### Kiln Operation and AF Firing Rates

#### Typical Kiln Operation

Cement manufacturing requires a delicate balance of raw material inputs combined with consistent kiln operation to provide the thermo-chemistry needed to produce a high-quality clinker. Flame temperatures in the main kiln can exceed 3500° F to raise the temperature of the raw materials by 2600° F or more. The raw materials include limestone, a silica source, an iron source and an alumina source. The intense heat is provided by traditional fossil fuels such as coal, petcoke, fuel oil and natural gas.

The preheater/precalciner kiln system is designed to provide approximately one minute residence for the raw materials introduced to the preheater/precalciner. This provides sufficient time to transfer heat from the hot exhaust gas exiting the kiln to the raw materials in the preheater tower and begin calcination of the raw materials in the precalciner. Raw materials entering the kiln from the precalciner are processed for approximately 30 minutes to produce the clinker exiting the kiln. As previously described, the hot exhaust gases flow counter-current to the raw material feed, which results in long residence times and temperatures. Pyroprocessing requires the following operating conditions:

- Main Kiln Exhaust Flow: approximately 10 seconds at an average of 2,800°F;
- Precalciner Exhaust Flow: approximately 3 seconds at an average of 1,800°F;
- Preheater Exhaust Flow: approximately 10 seconds from 600°F to 1800°F (approximately 6 seconds above 1,500°F); and
- Rotating kiln and preheater tower provides thorough mixing of fuels, raw materials and gases.

These conditions allow the kiln to accommodate large variations of the minerals and metals that naturally occur in the raw materials and fuels, while still producing high-quality clinker. However, this operating environment is also favorable for firing a wide variety of AF – recovering the useful energy content for clinker production while destroying, or incorporating into the clinker, most of the potential air pollutants from the AF.

Once stable kiln operation is achieved, these operating conditions promote the rapid combustion of AF. Moderate-energy, AF will be introduced by the enclosed bucket elevators system (high-density AF) or pneumatically (low-density AF) above the precalciner to gain heat for combustion in the precalciner. High-energy AF that can be processed into fine particles will be introduced directly into the precalciner or may be suitable for the main kiln burner. For consistent kiln operation, operators must carefully blend in the AF and then maintain a constant feed rate. The operating requirements that favor high-quality clinker production also promote good fuel combustion and low emissions.

#### Estimated Firing Rates

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The applicant estimates that the precalciner kiln system could initially fire approximately 200,000 tons of AF per year. The following table provides an example of the estimated AF firing rates assuming: an average AF heating value of 6,000 to 7,200 Btu/lb depending on the injection point, 30% fossil fuel replacement for the main kiln burner and 45% fossil fuel replacement for the precalciner burner.

**Table L. Example of Estimated Fuel Firing Rates and Fossil Fuel Replacement Rates**

| Parameter                       | Main Kiln      | Precalciner       | Total                    |
|---------------------------------|----------------|-------------------|--------------------------|
| Heat input rate, max.           | 290 MMBtu/hour | 385 MMBtu/hour    | 675 MMBtu/hour           |
| % AF*                           | 30%            | 45%               | 39%                      |
| Heat input rate, MMBtu/hour, AF | 87 MMBtu/hour  | 173.25 MMBtu/hour | 260.25 MMBtu/hour        |
| AF Heating Value                | 7200 Btu/lb    | 5200 Btu/lb       | ----                     |
| AF, tons/hour                   | 6.0 tons/hour  | 16.7 tons/hour    | 22.7 tons/hour           |
| AF, tons/year, max.             | 52,925         | 146,292           | <b>199,217 tons/year</b> |

\* Kilns throughout the world have had fossil fuel replacement of up to 50% or more in the main kiln burner and 100% in the precalciner.<sup>68</sup>

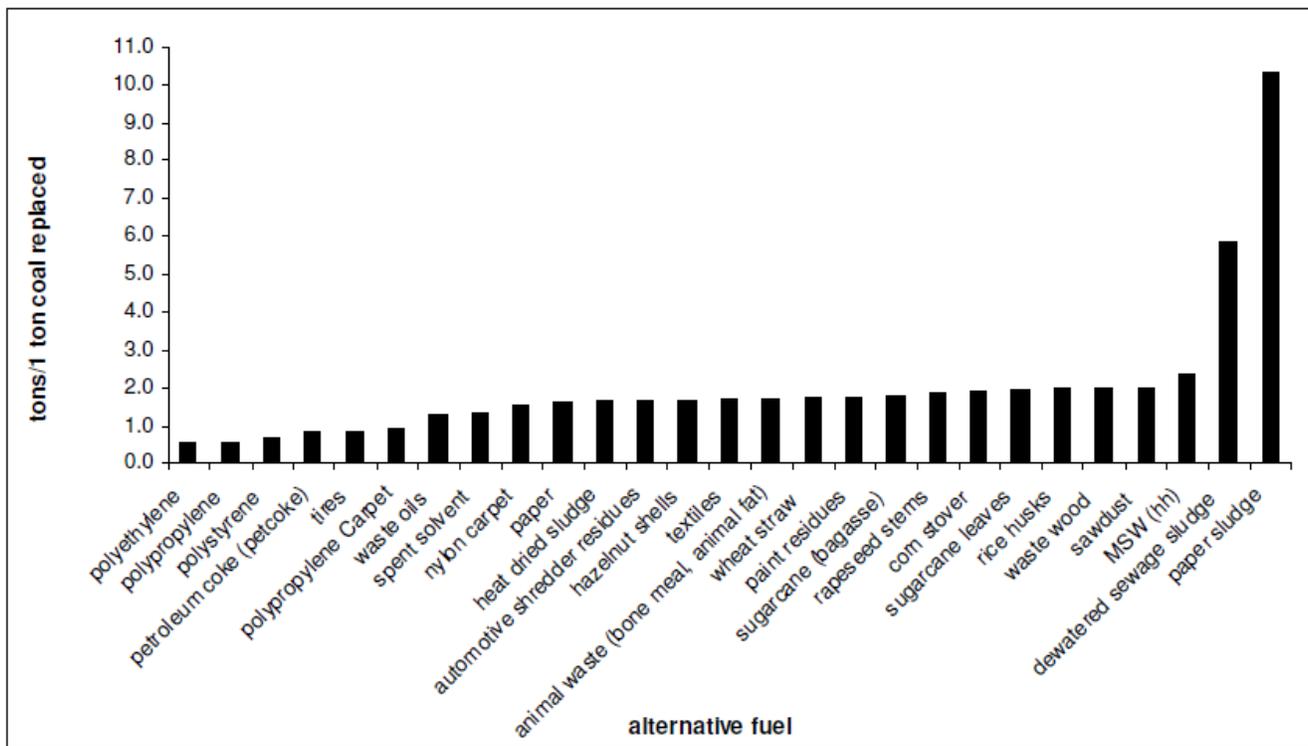


Figure 8. Estimated tons of alternative fuel required to replace 1 ton of coal. Values are dependent on material’s energy and water content.<sup>69</sup>

<sup>68</sup> “Use of Alternative Fuels in the Canadian and US Cement Industry: Opportunities and Barriers”, 2007.

<sup>69</sup> Murray, A., Price, L., “Use of Alternative Fuels in Cement Manufacture: Analysis of Fuel Characteristics and Feasibility for Use in the Chinese Cement Sector.” Ernest Orlando Lawrence Berkeley National Laboratory. 2008. Pg. 52

### AF Effects on Production Capacity<sup>70</sup>

For existing plants designed to operate on fossil fuels, switching to alternative fuels may decrease the production capacity because of limitations on the induced draft (ID) fan. This is mainly due to the increased amount of flue gas and pressure loss that are to be expected when switching from fossil to alternative fuels. The increase in flue gas flow using alternative fuels is mainly a consequence of the increased moisture content of the fuels. In addition, plants using alternative fuels may also employ a bypass to compensate for increased chlorine inputs, which will also increase the flue gas flow. It is therefore important that a thorough process analysis of the system is performed to avoid loss of production capacity. Whether it is a new plant or a retrofit, an analysis can be performed and system modifications recommended ensuring that the alternative fuels utilization will not have a severe impact on production capacity. When using alternative fuels, CO, NO<sub>x</sub> and mercury emissions are among the issues to be dealt with carefully.

### **Discussion of Emissions Generated from Firing AF**

In general, the types of emissions generated from firing AF will be similar to firing traditional fossil fuels.

Carbon Monoxide and Organic Compounds: CO, THC, VOC and organic HAP emissions will be generated from incomplete combustion of the AF. The FLS kiln design includes a long preheater loop, which provides an excellent residence time at relatively high temperatures to complete the burnout of CO and VOC emissions.

Particulate Matter: Particulate matter will be generated from ash present in the AF and caused by incomplete fuel combustion. Certain AF, for example biomass, may contain higher ash contents and lower heating values than coal, which will generate more particulate matter. However, this amount of particulate matter is small in comparison to the particles in the exhaust gas stream that are from the raw material feed. As the exhaust gas flows countercurrent to the raw material feed, small particles are picked up in the exhaust gas and filtered out by the baghouse along with particulate matter from combustion. The small addition of particulate matter generated from firing AF can easily be accommodated by the existing baghouse. Since baghouse dust contains mostly processed fine raw materials, it is returned to the preheater tower as raw material and eventually incorporated into the clinker.

Nitrogen Oxides: NO<sub>x</sub> emissions consist primarily of thermal NO<sub>x</sub>, which is generated due to the high temperatures in the kiln. NO<sub>x</sub> emissions are controlled by the FLS kiln design which includes indirect firing, multiple burn points and a low-NO<sub>x</sub> precalciner. However, nitrogen in the fuels may generate NO<sub>x</sub> emissions as well.

Acid Gases: SO<sub>2</sub> and HCl emissions will be generated as a function of the sulfur and chlorine contents of the AF. However, the impacts are expected to be negligible because the raw materials contain limestone, which creates an alkaline environment. Combined with the turbulence provided by the rotating kiln, preheater tower and precalciner, the alkaline atmosphere will act as a highly effective scrubber to remove these acid gases.

Dioxins/Furans: Dioxin/furans are HAP emissions consisting of long-chain organic compounds containing chlorine. When the necessary components are present, dioxin/furans can be formed at temperatures between 400° and 1000° F. EPA studies conclude that dioxin/furans are effectively destroyed when exposed to temperatures above 1400° F.<sup>71</sup> However, dioxins/furans may reform if not rapidly cooled through the temperature range of 400° and 1000° F. The preheater tower rapidly transfers the heat in the exhaust gas to the raw materials. The exhaust gas is quickly cooled to below 400° F and maintained below this temperature through the baghouse and out the exhaust stack. The downcomer has a water conditioning system to cool the gases if necessary (e.g., raw mill off). The EPA regulates the temperature of the baghouse inlet to ensure that the post-combustion gas condition controls dioxin/furan emissions.

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<sup>70</sup> “Possibilities for the Use of Alternative Fuels in the Cement Industry”, Global Fuels Magazine, Morten Kyhnau Hansen, FLS Alternative Fuels, Denmark, May 2008.

<sup>71</sup> EPA Course No. Re-100, “Basic Concepts in Environmental Sciences”; Module 6: Air Pollutants and Control Techniques - Dioxins and Furans; <http://www.epa.gov/apti/bces/index.htm>.

**Mercury:** Mercury is a highly volatile metal. If present in the AF, mercury will be vaporized during combustion, condense or be absorbed onto particles in the exhaust gas and then removed by the baghouse. However, as previously mentioned, baghouse dust is returned to the preheater tower as a raw material. Therefore, the mercury continues to re-circulate and build up in concentration within this loop and the raw meal storage silo, which serves as a sink for mercury. When excess levels accumulate, mercury vapor can escape past the baghouse or be emitted in a surge when the raw mill is taken off-line and the raw meal storage silo releases the stored mercury. Traditionally, mercury comes from three sources: it is naturally present in raw materials such as limestone; it is naturally present in fossil fuels such as coal; and it is present in power plant fly ash, which is added as an ingredient or sometimes used as a fuel if the carbon content is high. Many coal-fired power plants in Florida have recently added air pollution control systems to concentrate mercury on the fly ash, which is then removed by electrostatic precipitators. For this reason, cement plants have seen an increase in mercury emissions. This was recognized in the revised NESHAP Subpart LLL, which added mercury as a separately regulated HAP metal. Mercury can be controlled by several methods: “dust shuttling” in which a portion of the baghouse dust is added directly to the cement product (mercury is bound concrete products and does not leach out); use of low-mercury containing raw materials and fuels; injecting activated carbon to adsorb the mercury along with a secondary baghouse to remove the mercury containing carbon; and the addition of a wet scrubber after the existing baghouse. As mentioned in the application, one of the primary considerations of using AF is to find fuels containing less mercury than coal to comply with the new NESHAP Subpart LLL standard. The applicant is currently required to sample daily and analyze composite samples monthly of all raw materials and fuels to determine the mercury input. The mercury input is conservatively assumed to be entirely emitted.

**Semi-Volatile and Non-Volatile Metals:** Depending on the AF, a variety of semi-volatile and non-volatile metals may be present including: aluminum, antimony, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, thallium, tin, titanium, vanadium and zinc. Non-volatile metals are not emitted in the exhaust, but are incorporated into the clinker. Studies show that semi-volatile metals are also incorporated into the clinker at high transfer rates<sup>72</sup> (>99.9%)<sup>73</sup> for most metals. Small amounts of semi-volatile metals may vaporize and re-circulate like mercury. However, re-introducing the baghouse dust to the preheater tower affords another opportunity for the semi-volatile metal to eventually make it into the clinker. At low levels, these metals can all be successfully incorporated into the clinker. Excessive levels in the clinker can lead to poor concrete characteristics (e.g., high zinc levels can cause poor setting times). The AF described in the application typically contains low levels of metals. For many of the non-hazardous material streams that produce an AF, metals are either removed by hand or mechanically (e.g., magnets, eddy current technology, etc.). Although CCA-treated lumber may contain high levels of these metals, the applicant indicates that only minor amounts as part of an AF will be fired.

Given the differences in temperature at various points in the process, it is important that AF materials are introduced at the correct point in the process to ensure complete combustion or incorporation and to avoid unwanted emissions. For example, raw materials with volatile organic components may be introduced in the cement kiln at the main burner, in mid-kiln, in the riser duct, or at the precalciner. These should not be introduced with other raw materials except where tests demonstrate that this will have no effect on the off-gases.<sup>74</sup>

### **Summary of Cement Kiln Emissions - European Commission**

The European Commission, under a directive of the European Parliament and of the Council, created a summary report of the emissions data from cement kilns in over 23 European countries. The report provides summaries of the relative emissions differences from firing a broad range of alternative fuels at replacement rates of greater than

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<sup>72</sup> Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, <http://eippcb.jrc.ec.europa.eu>

<sup>73</sup> Environmental Data of the German Cement Industry 2009. VDZ.

<sup>74</sup> “Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process”, Fuels and Raw Materials, Cement Sustainability Initiative (CSI), December 2005.

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40 percent heat input to the kiln. A review of the summaries suggests the following comparison of emissions. The data values from tables in the report were estimated by the applicant to generate the following table.

**Table M. European Kilns Pollutant Emissions**

| Pollutant       | 0% Substitution    | 40 % Substitution  | Change in Emissions |
|-----------------|--------------------|--------------------|---------------------|
| PM              | 0.0183 grains/dscf | 0.0091 grains/dscf | 50% decrease        |
| SO <sub>2</sub> | 80.6 ppm           | 62.8 ppm           | 22% decrease        |
| NO <sub>x</sub> | 499.9 ppm          | 283.9 ppm          | 43% decrease        |
| TOC             | 16.7ppm            | 14.7 ppm           | 12% decrease        |

\* Summary based on review of tables.<sup>75</sup> Total Organic Compounds (TOC).

About 90% of the kilns represented in the summaries are dry process kilns with most re-circulating cement kiln dust (CKD), similar to the Miami kiln. The Department notes that NO<sub>x</sub> emissions levels may be the result of add-on controls at some of these plants.

### Impact of Co-processing on Kiln Emissions

From a January 2009 paper titled, “Processing of Alternative Fuels and Raw Materials in the European Cement Industry” and produced by CEMBUREAU, the European Cement Association based in Brussels (a representative organization of the cement industry in Europe).<sup>76</sup>

- Sulfur Oxides – SO<sub>2</sub>: Alternative fuels have no influence on total SO<sub>2</sub> emissions.
- Nitrogen Oxides – NO<sub>x</sub>: Alternative fuels do not lead to higher NO<sub>x</sub> emissions – in some cases, NO<sub>x</sub> emissions can even be lower.
- Total Organic Carbon – TOC: There is no correlation between the use of alternative fuels and emissions levels.
- Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (PCDD/PCDF): No difference has been found in dioxin emissions when alternative fuels are used compared to conventional fuels.
- Hydrogen Chloride – HCl: HCl emissions vary irrespective of the fuel used.
- Hydrogen Fluoride – HF: There is very little difference in HF emissions when using alternative fuels.
- Heavy Metals: Emissions vary irrespective of the fuel and raw materials used. However, nearly 100% of them remain either in the cement clinker matrix or the cement kiln dust as non leachable compounds. In any event, alternative fuels undergo a rigorous acceptance and inspection procedure before being used.
- Dust: Dust emissions taken under both fuel regimes indicate no difference between the two.

### Current Monitoring Methods

The following methods are used to monitor emissions from the Miami Cement kiln.

Carbon Monoxide and Organic Compounds: The existing stack contains probes that continuously pull exhaust gas samples through a CEMS to measure and record the emissions of CO and THC (measured as propane) to demonstrate compliance with the permit limits. The CEMS also sends a signal to the operator control system to show the emissions levels of these pollutants.

<sup>75</sup> Cement, Lime and Magnesium Oxide Manufacturing Facilities; May 2010; Tables 1.24, 1.32, 1.25, 1.38, <http://eippcb.jrc.ec.europa.eu>.

<sup>76</sup> “Processing of Alternative Fuels and Raw Materials in the European Cement Industry”, Sustainable Cement Production, CEMBUREAU, the European Cement Association based in Brussels (representative organization of the cement industry in Europe); January 2009

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Particulate Matter: At least once a year, a third party contractor conducts a stack test in accordance with EPA Method 5. The team inserts a probe to pull the exhaust gas through a filter and conditioning equipment (impingers). The filter is desiccated and weighed. The probe is washed and the wash collected to account for particles trapped on the probe. The contributions from the filter and wash are added to provide the total mass emission rate. In the future, a CEMS shall be required to measure and record PM emissions to demonstrate compliance with the new standard in revised NESHAP Subpart LLL.

Nitrogen Oxides: The existing stack contains a probe that continuously pulls an exhaust gas sample through a CEMS to measure and record the NO<sub>x</sub> emissions (measured as NO<sub>2</sub>) to demonstrate compliance with the permit limits. The CEMS also sends a signal to the operator control system to show the emissions levels of this pollutant.

Acid Gases: The existing stack contains a probe that continuously pulls an exhaust gas sample through a CEMS to measure and record the SO<sub>2</sub> emissions to demonstrate compliance with the permit limits. The CEMS also sends a signal to the operator control system to show the emissions levels of these pollutants. In the future, a CEMS shall be required to measure and record HCl emissions to demonstrate compliance with the new standard in revised NESHAP Subpart LLL.

Dioxins/Furans: Every 30 months, a 3<sup>rd</sup> party contractor conducts a stack test in accordance with EPA Method 23. This test method is similar to EPA Method 5, but the sample is then sent to an independent laboratory where it is analyzed by gas chromatograph coupled to a mass spectrometer. During the test, the temperature of the exhaust gas at the baghouse inlet is continuously monitored. If the test demonstrates compliance, the operator is required to maintain the temperature of the exhaust gas at the baghouse inlet at this temperature or below 400° F.

Mercury: Currently, the plant shows compliance with the mercury emission limit by stack test and sampling or Hg CEMS. In the future, a CEMS is required to measure and record mercury emissions to demonstrate compliance with the new standard in revised NESHAP Subpart LLL. The revised NESHAP also allows a continual mercury measurement method.

Semi-Volatile and Non-Volatile Metals: The EPA discussed in the 1999 Portland Cement NESHAP that PM is a surrogate for metal emissions. Again, a third party contractor currently conducts a stack test in accordance with EPA Method 5 at least once a year to determine PM emissions. The revised NESHAP Subpart LLL establishes a much lower PM emissions standard as a surrogate for metal emissions other than mercury. The PM emissions standard will be reduced from 0.053 lb/ton of dry kiln feed (equivalent to approximately 0.11 lb/ton of clinker) to 0.04 lb/ton of clinker. In the future, a CEMS shall be required to measure and record PM emissions to demonstrate compliance with the new standard in revised NESHAP Subpart LLL as it was published.

**EPA Report on the Use of Alternative Fuels in Cement Kilns**

EPA’s sector report, “Cement Sector Trends in Beneficial use of Alternative Fuels and Raw Materials”, summarizes the beneficial use of industrial materials, transferring industrial byproducts from one industrial sector to another. EPA refers to AF and raw materials as industrial byproducts used as alternative fuels and alternative raw materials. Another term used is engineered fuel, fuels derived from many different industrial byproduct streams into a homogenous single fuel. EPA states, “... the preparation process used to produce this fuel adjusts for the technical and administrative specifications of cement, and guarantees that environmental standards are met independent of the specific industrial byproduct streams used in its production.” EPA also states that it “... values such beneficial reuse, and recognizes the many opportunities associated with converting waste products into valuable commodities.” EPA also indicates that the use of AF results in reduced emissions of greenhouse gases (mainly carbon dioxide), especially with “carbon neutral” alternative fuels such as biosolids or scrap paper and wood.

By using alternative fuels, these materials are no longer disposed in landfills and the air emissions and other environmental impacts of production and transport of virgin (mined) raw materials is reduced. Industrialized countries have utilized AF successfully for more than 20 years. However, the cement industry in the U.S. lags behind several countries in the percentage of thermal energy substituted by alternative fuels, as shown in the table.

Cement manufacturers using AF reduce energy costs and emissions. The cement companies are seeking new sources of AF due to the increasing cost of coal, petroleum coke and other conventional fuels used in cement production. In addition, some alternative fuels contain useful minerals such as calcium, silica, alumina and iron. These materials replace some of the raw materials such as sand, shale and limestone.

Complete combustion of the alternative fuels due to the high temperatures in the kiln results in lower emissions. In comparison, incinerators or boilers have lower residence times and temperatures and using the same fuel would require expensive flue gas cleaning systems. While some chemicals are thermally destroyed in the cement kiln due to the long residence times at high temperatures, the raw materials used in the process are capable of absorbing many chemicals and impurities and incorporating these into the cement clinker. See Table J for examples of metal emission factors and metal transfer coefficients for preheater/precalciner cement kilns.<sup>78</sup>

The following cement plants in the United States have fired and are firing alternative fuels.

**Table O. Cement Plants Firing AF**

| Cement Plant        | Location    | Permitted Alternative Fuels  |
|---------------------|-------------|--|
| Lehigh Cement Plant | Redding, CA | Wood, other biogenic materials, agricultural byproducts, rice hulls, |

**Table N. AF Share of Total Fuel Demand in the Cement Industry, Selected Countries<sup>77</sup>**

| Country       | Year | Thermal Energy Substituted by AFR |
|---------------|------|-----------------------------------|
| France        | 2003 | 32%                               |
| Germany       | 2004 | 42%                               |
| Norway        | 2003 | 45%                               |
| Switzerland   | 2002 | 47%                               |
| United States | 2003 | 25%                               |

| Component | EF in %           | TC in % |
|-----------|-------------------|---------|
| Cadmium   | < 0.01 to < 0.2   | 0.003   |
| Thallium  | < 0.01 to < 1     | 0.02    |
| Antimony  | < 0.01 to < 0.05  | 0.0005  |
| Arsenic   | < 0.01 to 0.02    | 0.0005  |
| Lead      | < 0.01 to < 0.2   | 0.002   |
| Chromium  | < 0.01 to < 0.05  | 0.0005  |
| Cobalt    | < 0.01 to < 0.05  | 0.0005  |
| Copper    | < 0.01 to < 0.05  | 0.0005  |
| Manganese | < 0.001 to < 0.01 | 0.0005  |
| Nickel    | < 0.01 to < 0.05  | 0.0005  |
| Vanadium  | < 0.01 to < 0.05  | 0.0005  |

Table J. Emission factors (EF), emitted portion of total input and transfer coefficient (TC), emitted portion of fuel input for rotary kiln systems with cyclone pre-heater. (German Cement Works Association – Metals Emissions/Retention)

<sup>77</sup> Guidelines on Co-Processing Waste Materials in Cement Production; CEMBUREAU, SINTEF, as presented in The GTZ-Holcim Private Partnership; page 4; 2006.

<sup>78</sup> Veijonen, K. Biomass to Replace Fossil Fuels in Cement Industry, Finnsementti Oy, Parainen, Finland, EUBIONET III - IEE/07/777/SI2.499477, 02/2009.

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| <b>Cement Plant</b>               | <b>Location</b>            | <b>Permitted Alternative Fuels</b>  |
|-----------------------------------|----------------------------|---|
|                                   |                            | · sawdust and whole scrap tires.  |
| Lehigh Cement Plant               | Fleetwood, PA              | · Ground scrap creosote-treated wood.   |
| Lafarge Cement Plant              | Sugar Creek, MO            | · Plastics from industrial plants, cardboard, rubber scrap, paper, related materials and landfill gas.  |
| California Portland Cement Plant  | Rillito, AZ and Mojave, CA | · Wood, on-spec surplus oil and surplus jet fuel.   |
| Lehigh Cement Plant               | York, PA                   | · Plastics  |
| Holcim Cement Plants              | Midlothian, TX and Ada, OK | · Non-hazardous alternative fuels and raw materials including tire chips, wood, spent activated carbon, spent filter cake solids and oil filter fluff. Used oil, glycols and glycerin.  |
| Lafarge Cement Plant              | Seattle, WA                | · Chipped scrap tires, whole tires.   |
| California Portland Cement Plant  | Colton, CA                 | · Whole scrap tires   |
| Lafarge Cement Plant              | Tulsa, OK                  | · Whole scrap tires, landfill gas, on-site generated oils and greases.  |
| Holcim Devil's Slide Cement Plant | Devil's Slide, UT          | · Scrap tire chips and diaper scrap (cubed), plastics, textiles, scrap from mattress companies, including fluff, foam, fabric and engineered fuel from Geocycle. For introduction of a new alternative fuel, Holcim submits "ultimate/proximate" analysis of fuel to the state regulatory agency. |
| Ash Grove Cement                  | Inkom, ID                  | · Whole Tires   |
| Ash Grove Cement                  | Durkee, OR                 | · Whole Tires   |
| Ash Grove Cement                  | Midlothian, TX             | · Whole Tires   |
| Ash Grove Cement                  | Leamington, UT             | · Whole Tires   |
| Ash Grove Cement                  | Seattle, WA                | · Whole Tires   |
| Buzzi Unicem                      | Oglesby, IL                | · Whole Tires   |
| Buzzi Unicem                      | Pryor, OK                  | · Whole Tires   |
| California Portland Cement        | Colton, CA                 | · Whole Tires   |
| CEMEX                             | New Braunfels, TX          | · Tire Derived Fuel   |
| CEMEX                             | Knoxville, TN              | · Whole Tires   |
| CEMEX (closed)                    | Wampum, PA                 | · Engineered Fuel   |
| CEMEX                             | Brooksville, FL            | · Agricultural Film<br>· Tire Derived Fuel<br>· Reject Roofing Shingles<br>· Biomass<br>· Agricultural Byproducts<br>· Pre-consumer Reject Paper  |

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| <b>Cement Plant</b> | <b>Location</b>   | <b>Permitted Alternative Fuels</b>  |
|---------------------|-------------------|---|
|                     |                   | · Carpet Derived Fuel   |
| CEMEX               | Miami, FL         | · Tire Fluff<br>· Biomass<br>· Whole Tires  |
| CEMEX               | Clinchfield, GA   | · Peanut Hulls<br>· Carpet Fiber<br>· Tire Derived Fuel   |
| CEMEX               | Demopolis, AL     | · Wood<br>· Railroad Ties<br>· Engineered Fuel<br>· Tire Fluff  |
| CEMEX               | Victorville, CA   | · Wood<br>· Biosolids<br>· Tires  |
| Essroc (closed)     | Bessemer, PA      | · Tire Derived Fuel<br>· Coal Tar   |
| Essroc              | Frederick, MD     | · Whole Tires   |
| Florida Rock        | Newberry, FL      | · Whole Tires   |
| Hercules            | Stockertown, PA   | · Chipped Tires   |
| Holcim              | Morgan, UT        | · Tire Derived Fuel   |
| Holcim              | Midlothian, TX    | · Chipped Tires<br>· Wood<br>· Spent Activated Carbon<br>· Oil Filter Fluff                           |
| Holcim              | Devil's Slide, UT | · Scrap Carpet<br>· Chipped Tires<br>· Diaper Scrap (cubed)<br>· Plastics<br>· Mattress Scrap         |
| Holcim              | Ada, OK           | · Whole Tires   |
| Holcim              | Hagerstown, MD    | · Whole Tires   |
| Lafarge             | Sugar Creek, MO   | · Plastics<br>· Cardboard<br>· Rubber Scrap<br>· Paper<br>· Other Related Materials<br>· Landfill Gas |
| Lafarge             | Cementon, PA      | · Whole Tires<br>· Plastic Derived Fuel   |
| Lafarge             | Seattle, WA       | · Chipped Tires<br>· Biodiesel<br>· Used Oil  |
| Lafarge             | Calera, AL        | · Tire Derived Fuel   |

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| <b>Cement Plant</b>      | <b>Location</b>    | <b>Permitted Alternative Fuels</b>  |
|--------------------------|--------------------|---|
| Lafarge                  | Harleyville, SC    | · Whole Tires<br>· Plastics   |
| Lafarge                  | Joppa, IL          | · Whole Tires   |
| Lafarge                  | Whitehall, PA      | · Whole Tires   |
| Lafarge                  | Tulsa, OK          | · Whole Tires   |
| Lehigh Cement            | Redding, CA        | · Scrap Paper<br>· Wood<br>· Agricultural Byproducts<br>· Rice Hulls<br>· Chipped Tires<br>· Whole Tires  |
| Lehigh Cement            | Fleetwood, PA      | · Wood<br>· Biosolids<br>· Carpet   |
| Lehigh Cement            | Leeds, AL          | · Whole Tires   |
| Lehigh Cement            | York, PA           | · Plastics  |
| Mitsubishi Cement        | Lucerne Valley, CA | · Whole Tires   |
| Monarch Cement           | Humboldt, KS       | · Whole Tires   |
| National Cement of CA    | Encino, CA         | · Tire Derived Fuel   |
| Portland Cement          | Skokie, IL         | · Tire Derived Fuel   |
| Suwannee American Cement | Branford, FL       | · Autofluff<br>· Agricultural Film<br>· Tire Derived Fuel<br>· Reject Roofing Shingles<br>· Used Roofing Shingle Scraps<br>· Clean Woody Biomass<br>· Agricultural Byproducts<br>· Pre-consumer Paper<br>· Post-consumer Paper<br>· Carpet Derived Fuel |
| Titan America (Tarmac)   | Miami, FL          | · Whole Tires<br>· Wastewater Treatment Solids  |

**Conclusion**

It has been documented that the following AF have been approved for use in similar cement kilns within the United States: plastics with limited chlorine content, tire-derived fuel, manufacturer reject roofing shingles, agricultural fibrous organic byproducts (e.g., peanut hulls), pre-consumer reject paper, carpet-derived fuel, creosote-treated wood products and various engineered fuels. Cement kilns around the world have been using a wide variety of AF including these non-hazardous materials and much more. Given the following, the responsible introduction and use of AF into the pyroprocessing system as described in the application will allow the plant to comply all conditions in the current Title V air operation permit:

- AF as described in the application;
- Current kiln design and operating conditions;
- New AF feed system equipment and main kiln burner;
- Routine monitoring of incoming AF;
- Ensuring that the AF has a useful heating value and low mercury levels;

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- Careful introduction of AF and operator control;
- Current air pollution control equipment and techniques;
- Current emissions monitoring systems and methods; and
- Current analyses of cement clinker and product.

Based on available technical information regarding the use of AF in cement kilns, the conditions of the draft permit and reasonable assurance provided by the applicant, the Department concludes that the addition and use of AF described in the application shall:

- Not cause a PSD-significant emissions increase in accordance with Rule 62-212.400, F.A.C.;
- Allow the plant to continue to comply with the standards and requirements specified in the current Title V air operation permit;
- Allow the plant to continue to comply with the provisions of NESHAP Subpart LLL in 40 CFR 63, which regulates HAP emissions; and
- Eventually allow the plant to comply with the revised provisions of NESHAP Subpart LLL in 40 CFR 63 (effective 2012), which adds more stringent requirements to regulate HAP emissions.

Practical experience at many similar facilities shows that careful firing of AF (from non-hazardous materials) rarely affects clinker chemistry or results in increased emissions.<sup>79, 80, 81, 82, 83</sup>

### SECTION 6. CONSIDERATIONS AND SUMMARY OF DRAFT PERMIT REQUIREMENTS

This section outlines the rationale and primary conditions and requirements of the draft permit that will provide confidence in the characteristics and constituents of AF as well as reasonable assurance of compliance with the applicable regulatory requirements.

#### Issues with AF<sup>84</sup>

The following issues may arise when firing AF. However, careful attention by the operators during initial AF firing can lead to the development of good operating practices to mitigate any problems.

- High AF moisture contents cause an increase in gas volumes and flow rates. Increased gas velocities mean less residence time in the system with the potential for higher CO emissions from less burnout. High velocities may also require increased equipment maintenance including ductwork, cyclones and baghouses. Higher gas volumes can also reduce clinker production if the induced draft (ID) fan is limited. Some AF processing and feed systems will dry the high-moisture materials before firing as fuel.
- Fluctuations in AF feed rates make it difficult for operators to properly adjust the oxygen levels resulting in less efficient combustion and higher CO and possibly THC levels. The tertiary air flow and mixing may need

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<sup>79</sup> Hansen, M.K., *Possibilities for the Use of Alternative Fuels in the Cement Industry*, Global Fuels Magazine, May 2008.

<sup>80</sup> Cement, Lime and Magnesium Oxide Manufacturing Facilities; May 2010; Tables 1.24, 1.32, 1.25, 1.38, <http://eippcb.jrc.ec.europa.eu>

<sup>81</sup> "Processing of Alternative Fuels and Raw Materials in the European Cement Industry", Sustainable Cement Production, CEMBUREAU, the European Cement Association based in Brussels (representative organization of the cement industry in Europe); January 2009.

<sup>82</sup> "Cement Sector Trends in Beneficial Use of Alternative Fuels and Raw Materials", U.S. EPA, Revised Draft, October 2008.

<sup>83</sup> Cement Australia, Sustainable Development, Alternative Fuel and Raw Materials, web site: <http://www.cementaustralia.com.au/wps/wcm/connect/website/cement/home/sustainable-development/resource-conservation/alternative-fuel/alternative-fuel.html>.

<sup>84</sup> "A Practical Guide to Alternative Fuels", Wilfred Zieri, A TEC Production & Services, Austria, World Cement, November 2008.

to be adjusted.

- AF with high ash contents must be accounted for in the raw material/fuel composition of the feed to the kiln for steady operations and high-quality clinker.
- High sulfur and chlorine levels can cause buildups, unstable operation and require shutdown.
- Additional sulfides in raw materials may increase SO<sub>2</sub> emissions.
- Organic carbon in raw materials may increase CO and VOC emissions.
- Cold air may be introduced with pneumatic feed systems, which leads to operational fluctuations and inefficient combustion (higher CO levels). The tertiary air flow and mixing may need to be adjusted.
- Particle sizes in the main kiln burner should be no more than ¾ inch or less for efficient combustion and to maintain proper flame shape and length.
- For the precalciner, the maximum recommended particle size for highly volatile 2-dimensional AF (e.g., plastics) is approximately 3 inches.
- For the precalciner, the maximum recommended particle size for 3-dimensional AF is approximately 2 inches.
- With the proper injection system, the kiln can accept large materials such as whole tires.

For these reasons, knowing what goes into the pyroprocessing system is essential to knowing what is emitted. Also, careful operation of the kiln system is necessary to produce high-quality clinker. Many of these same operating conditions ensure reduced emission impacts.

### **Alkali/Metals Bypass Duct**

Chlorine, sulfur and alkali content (fuel or raw material) may cause buildups in the kiln system, leading to accumulation, clogging, unstable operation and more frequent shutdowns. Excess chlorine or alkali may produce cement kiln dust that requires installation of a bypass. Depending on the actual chlorine, sulfur and alkali contents, it may later be necessary to install a bypass duct to break this internal cycle and minimize kiln startups/shutdowns. Such a bypass can also break the internal cycle of volatile metals and reduce emissions. The bypassed exhaust would have to be controlled (e.g. baghouse) and a permit would be required.

### **Prohibited Materials**

The following materials are prohibited from being fired in the pyroprocessing system and shall not be used to manufacture engineered fuels: hazardous waste, nuclear and radioactive waste. Furthermore, other materials shall not knowingly be fired in the system: biomedical waste, asbestos-containing waste, whole batteries, and unsorted municipal garbage. CCA treated wood shall only be fired in limited amounts.

### **AF Acceptance Criteria<sup>85</sup>**

The draft permit will authorize: the construction of mechanical and pneumatic solid fuel handling and feed systems; installation of a new multi-fuel main kiln burner system; and the firing of a variety of AF including combinations tire-derived fuel; plastics; roofing materials; agricultural biogenic materials (e.g., peanut hulls, rice hulls, corn husks, citrus peels, cotton gin byproducts, animal bedding, etc.); untreated cellulosic biomass (e.g., green wood, forest thinnings, sawdust, trees trimmings, clean woody land clearing debris and clean construction and demolition (C&D) wood); treated cellulosic biomass (e.g. CCA-treated wood, creosote-treated wood, C&D debris not meeting the definition of clean C&D wood, plywood, particle board, medium density fiberboard, oriented strand board, laminated beams, finger-jointed trim and sheet goods); carpet-derived fuels and engineered fuels.

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<sup>85</sup> “Practical Guidance for Cement Manufacturers”, Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process, Cement Sustainability Initiative (CSI), December 2005.

**Table P. AF Material Properties**

| <b>Parameter</b>     | <b>Target Levels<sup>a</sup></b> |
|----------------------|----------------------------------|
| Higher Heating Value | > 5,000 Btu/lb                   |
| Arsenic              | < 2,000 ppm by weight            |
| Beryllium            | < 20 ppm by weight               |
| Cadmium              | < 200 ppm by weight              |
| Chromium             | < 200 ppmw (mg/kg)               |
| Lead                 | < 1,000 ppmw (mg/kg)             |
| Mercury              | < 0.3 ppm by weight              |

Notes:

- a. Targets levels are the desired AF properties that suppliers should try to achieve. Target levels are not enforceable.
- b. All concentrations are dry.

**Receiving AF – Sampling/Analysis Frequency**

The operator shall accept AF only after the supplier has clearly identified the AF and the associated chemical and physical properties of the materials.

- Each AF material received shall be sampled and analyzed in a manner consistent with industry standards for quality assurance and quality control to ensure that representative data is collected. The sampling and analysis of the AF shall be performed prior to the initial delivery, quarterly for the first year, and annually in January thereafter if the quarterly analysis meets permit requirements, if that material is present. All records and results of the analysis shall be maintained at the facility as required for currently permitted fuels.
- Stack tests and sampling or CEMS is used for compliance with the mercury emission limit as required under Permit No. 0250014-041-AC.
- The permittee shall test biosolids for mercury, current sampling methods suffice, unless a waiver of emission testing is obtained under 40 CFR 61.13 from the Department.
- Analytical results may be provided by the supplier or the plant.

The following information shall be included when reporting the analytical results for an AF: higher heating value (Btu/lb) of AF; moisture, ash, volatiles, fixed carbon, sulfur and chlorine content (percent by weight); arsenic, beryllium, cadmium, chromium, lead, and mercury contents (ppm). All concentrations are on a dry basis. Roofing materials shall include a certification from the manufacturer to be made without asbestos.

**Receiving, Accepting and Storing AF**

- Shipments may consist of several truckloads. All AF shall be received in covered trucks and/or enclosed containers.
- When unloading and handling AF, reasonable precautions shall be taken to prevent fugitive dust emissions.
- Operators shall reject AF that does not meet the AF acceptance criteria.
- Operators shall also visually check the delivered AF for particle size and components.
- Operators shall record the date, type, amount, and supplier of AF delivered.
- The AF shall be stored:
  - Under cover or in covered trailers or containers;
  - On top of a paved or compacted clay surface;

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- Separately from other AF unless purposely being mixed for firing;
  - To promote containment and prevent contamination of air, water and soil;
  - In an area with a fire suppression plan (e.g., pile dimensions, buffers, water sprinkler systems, CO<sub>2</sub> blanketing); and
  - Storage design should be appropriate to maintain the quality of the materials (i.e., first in, first out).
- Using “good housekeeping” measures, operators shall maintain the receiving and storage areas to prevent the re-entrainment of dust.

### Material Handling and Feed Systems

- Handling systems and feed systems shall be designed to provide stable and controlled input of AF to the pyroprocessing system.
- Handling systems and feed systems shall be enclosed to the extent practicable. The operator shall take reasonable precautions to control fugitive emissions.
- AF feed systems and the new main kiln burner system shall be integrated with the existing kiln data system so that operators will know the AF feed rates and can make adjustments accordingly.

### Operating Conditions

- Operators will carefully select the appropriate AF feed system and feed location according to the nature of the AF being fired to promote efficient combustion and reduce emissions impacts. Key AF parameters include the heating value, particle size, ash content and moisture content. AF will be introduced only in the high-temperature combustion zone of the main kiln burner, the precalciner burner or the secondary firing points in the precalciner.
- Operators will not fire AF during startup, shutdown, other non-steady state conditions or when the kiln system is unable to produce high-quality cement clinker.
- Operators will gradually introduce AF under steady-state kiln operations. Once the desired AF fuel feed rate is achieved, the operator will maintain a constant feed rate to promote efficient combustion and minimize emissions. Indicators of complete combustion include flue gas oxygen content, CO levels and THC levels.
- Operators shall discontinue firing AF if:
  - One of the CEMS, COMS or other continuous monitors indicates a non-compliance issue;
  - One of the CEMS, COMS or other continuous monitors is down for more than two consecutive hours; or
  - The operator is made aware that the kiln is producing off-specification clinker due to AF. The firing of that AF may resume once the issue is addressed and corrective action taken.
- Alternative fuels with highly stable molecules (e.g., highly chlorinated compounds) should be introduced only at the main burner to ensure complete combustion due to the high combustion temperature and the long kiln retention time. Other feed points are appropriate only where tests have shown high destruction and removal efficiency rates.
- Alternative raw materials with volatile organic components should not be introduced with other raw materials in the process, unless tests show no significant increases in CO or VOC emissions.
- Operators will consider the moisture content of AF being fired and adjust operations to account for increased flue gas volume/velocity and promote stable operation.
- Operators will consider the AF ash content, which affects the chemical composition of the cement and may require an adjustment of the composition of the raw materials mix; otherwise, off-specification clinker could be produced.

**Applicable Regulations**

The existing kiln system is subject to the applicable provisions of NESHAP Subpart LLL. The particulate matter emission standard in NESHAP Subpart LLL is more stringent than that in NSPS Subpart F; therefore, the existing kiln system is not subject to the corresponding provisions in NSPS Subpart F. The project is not expected to increase the maximum hourly particulate matter emission rate, so the project is not an NSPS modification. The existing kiln system must comply with the NESHAP Subpart LLL provisions published in the September 9, 2010 rule and the revised rule is currently under reconsideration. The existing kiln system must comply with the requirements specified in the current Title V air operation permit.

**7. PRELIMINARY DETERMINATION**

The Department makes a preliminary determination that the proposed project will comply with all applicable state and federal air pollution regulations as conditioned by the draft permit. This determination is based on a technical review of the complete application, reasonable assurances provided by the applicant, and the conditions specified in the draft permit. No air quality modeling analysis is required because the project does not result in a significant increase in emissions. Christy DeVore, the project engineer, is responsible for reviewing the application and drafting the permit. Additional details of this analysis may be obtained by contacting the project engineer at the Department's Office of Permitting and Compliance at Mail Station #5505, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.