TECHNICAL EVALUATION
&
PRELIMINARY DETERMINATION
(TEPD)

APPLICANT

Tarmac American, LLC
455 Fairway Drive, Suite 200
Deerfield Beach, Florida 33441

Pennsuco Complex
Facility ID No. 0250020

PROJECT

Project No. 0250020-031-AC
Application for Minor Source Air Construction Permit
Addition of Miscellaneous Alternative Solid 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

July 15, 2011

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 Pennsuco Cement Plant is an existing Portland cement manufacturing plant, which is categorized under Standard Industrial Classification Code No. 3241. The existing Pennsuco Cement Plant is located in Miami-Dade County at 11000 Northwest 121 Way in Medley, Florida. The UTM coordinates of the existing facility are Zone 17, 562.3 kilometers East and 2861.7 kilometers 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).

Figure 1. Pennsuco Cement Plant

Tarmac operates a dry-process preheater/precalciner kiln manufactured by FLSmidth that produces clinker in the manufacture 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™). Long residence times at high temperatures are required to drive the thermo-chemistry necessary to transform the raw materials into the desired cement clinker. Temperatures at the main kiln burner approach 3500°F. Such elevated temperatures require high heat input rates and large amounts of fuel. Typically, less expensive fossil fuel such as coal and petcoke are fired.

The FLSmidth 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 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 FLSmidth preheater/precalciner kiln and good operating practices. Nitrogen oxides (NOx) emissions are controlled by the combustion design of the FLSmidth kiln, which includes indirect firing, multiple burn points and low- NOx precacliner. Potential dioxin and furan emissions are controlled by the high-temperature combustion followed by rapid cooling. Acid gases such as sulfur dioxide (SO_2) 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, continuous emission monitoring systems (CEMS) in the main kiln/raw mill stack measure and record emissions of CO, NOx, SO_2, 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.

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 fire the following non-hazardous alternative solid fuels (ASF) in the existing cement kiln:

- Plastics such as agricultural plastic film (mulch) with incidental amounts of chlorine;
- Tire-derived fuel such as tires, tire chips and tire fluff - with or without steel belts;
- Manufacturer reject roofing shingles;
- Agricultural fibrous organic byproducts such as peanut hulls, rice hulls, corn husks, citrus peels, cotton gin byproducts, animal bedding, etc.;
- Pre-consumer reject paper;
- Carpet-derived fuel including new, reject and used shredded carpet and related materials (e.g. nails, tack, strip, etc.);
- Clean cellulosic biomass such as wood trimmings, sawdust, wood shavings, yard trash, etc.;
- Manufactured cellulosic biomass which includes materials such as preservative-treated wood that may contain treatments such as creosote, copper-chromium-arsenic (CCA), or AQC, painted wood, or resinated woods (plywood, particle board, medium density fiberboard, oriented strand board, laminated beams, finger-jointed trim and other sheet goods);
- Engineered Fuel, which is a composition of carefully blended ASF and other non-hazardous byproducts and materials;
- Fuel Mix, which includes a blend of any of the above.

The permittee proposes to install and operate a permanent mechanical gravimetric and pneumatic feed system to introduce ASF to the precalciner. The feed systems represent a significant capital investment to construct, approximately $2 million each. The applicant is also requesting authorization to replace the main kiln burner with one specifically designed to introduce ASF estimated at a cost of $1 million. Due to the substantial initial costs and investment in this equipment, the permittee requests permanent authorization to fire the ASF without conducting preliminary trial burns.

<u>Main Kiln Burner</u>

A main kiln burner can be designed to co-fire ASF blends with traditional fossil fuels. From an unloading hopper, the ASF will be pneumatically conveyed to the pressurized main kiln burner along with coal, petcoke or other approved fuels. The ASF 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 is working with FLSmidth on the burner design and has not yet selected a manufacturer. 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% ASF with fossil fuel. The ASF must be finely shredded and prepared in such a way that the particles are of limited dimensions – similar to pulverized coal. Pillard [1] 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 the requirement to reduce carbon dioxide (CO_2) 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® multi-fuel burners.

Figure 3. Example of Pillard ROTAFLM® Multi-Fuel Burner and Burner Tip for Firing ASF [1]

Precalciner Feed System

Fuel suppliers will deliver ASF to the facility in a manner suitable for either mechanical or pneumatic injection into the pyro-processing system through the constructed feed systems. All ASF will be delivered in covered trucks or enclosed containers and will be stored separately under cover until fired in the pyro-processing system or further processed. The ASF 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 ASF 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 ASF. The gravimetric bucket elevator feed system will be used for the heavier and bulkier ASF. 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 ASF 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 conservatively estimates that 200,000 tons per year of ASF will be delivered to the site. The applicant will contract to have ASF delivered that is pre-processed to the appropriate size with incombustible materials removed. However, as a precaution, the applicant proposes to install shredding (approximately 630 brake-horsepower, bhp) and screening (approximately 100 bhp) equipment to allow further processing of ASF on site should this be necessary. 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 ASF delivery such as biomass rather than reject it and

[1] "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*

send it back to the supplier. The applicant proposes to process (grind/screen) no more than 75,000 tons of ASF per year, which results in emissions of less than five tons per year of CO, NOx, PM, SO_2 and VOC, including fugitive PM.

Figure 4. Schenck Feed/Weigh System

Figure 5. Gravimetric Feed System

Coal Specification

The current Title V air operation permit specifies the following fuel for the kiln system: bituminous coal, petroleum coke, natural gas, No. 2 fuel oil, No. 6 fuel oil, on-specification used oil and blends of these oils. The applicant indicates that the kiln is also capable of firing other coals such as subbituminous coal. The applicant notes that permits for other similar cement plants only generically identify coal as an authorized fuel (e.g., the

Suwannee American Cement Company's Branford Cement Plant and CEMEX's Brooksville South Cement Plant). Therefore, the applicant requests removal of the term "bituminous" to generically identify coal as an authorized fuel for the existing kiln.

Processing Schedule

April 20, 2011 Received application for a minor source air pollution construction permit.

May 12, 2011 Requested additional information.

June 6, 2011 Received additional information; 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_X; SO_2, PM; particulate matter with a mean particle diameter of 10 microns or less (PM_{10}); VOC; lead (Pb); fluorides (F); sulfuric acid mist (SAM); hydrogen sulfide (H_2S); total reduced sulfur (TRS) including H_2S; reduced sulfur compounds including H_2S; 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 $\mu g/m^3$, 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 ASF in similar cement kilns at plants in the United States and other countries, the applicant predicts that co-firing ASF 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 at high temperatures in the kiln burner system (2200°F to 3500°F for 10 seconds), which will be specifically designed for firing ASF; long residence 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 ASF; and long residence 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.

- Emissions of NOx will be controlled by the FLSmidth kiln combustion design, which includes indirect firing, multiple burn points and a low-NOx precalciner. NO_X emissions are continuously monitored by certified CEMS.
- Particulate matter emissions will be controlled with the existing baghouse. Although the combustion of ASF 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_2 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_2 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 ASF 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	Projected Actual [c]	Increase	Significant Emissions Rate	
CO	727.1	731.21	4.11	100	No
NO_X	1,719.7	1,723.23	3.53	40	No
PM	47.9	53.4	5.50	25	No
PM_{10} [a]	40.7	46.2	5.50	15	No
SO_2 [b]	10.9	11.98	1.08	40	No
VOC	81.0	84.53	3.53	40	No
Pb	7.0 lb/yr	3.3 lb/yr [c]	-3.7 lb/yr	1200 lb/year	No
Hg	118.8 lb/yr	110.2 lb/yr	-8.6 lb/yr	200 lb/year	No

Notes:

a. With regard to particulate matter with a mean particle diameter of 2.5 microns or less ($PM_{2.5}$), the Department adopted by reference the federal ambient air quality standard for $PM_{2.5}$, but has not yet promulgated the implementing regulations for PSD preconstruction review (e.g., define $PM_{2.5}$ 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 $PM_{2.5}$ program.

b. Sulfur in the fuels and raw materials will typically be converted to SO_2, so other PSD sulfur compounds are not shown.

c. 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).[2] 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.

d. The projected actual emissions include the following emissions from the shredding and screening operations: 4.1 tons/year of CO; 3.5 tons/year of NOx; 5.5 tons/year of PM/PM_{10}; 1.08 tons/year of SO_2; 3.5 tons/year of VOC; and

[2] "Mercury and Lead Content in Raw Materials" - Portland Cement Association, Serial No. 2888, 2006.

negligible amounts of lead, fluorides and mercury. The estimated emissions are based on grinding/screening 75,000 tons of ASF per year (approximately 1500 hours of operation at 50 tons/hour).

The applicant's projected actual emissions include the physical change of replacing the main kiln burner, 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 is less than the baseline period due to the economic downturn. This is the reason for the projected "reductions". However, the applicant estimates that short-term emissions would not increase; therefore, there would be no significant net emissions increases even when assuming an equivalent production rate. 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 ASF, the general fuel/material characteristics of each ASF, the typical ASF material analysis data, kiln operation, fate of pollutants and emissions monitoring.

Current Florida Cement Plants Authorized for Firing ASF

Facility	Location	Fuel Types Used
CEMEX	Brooksville, FL	· Whole Tires · Plastics - Agricultural Film · Tire Derived Fuel · Reject Roofing Shingles · Clean Woody Biomass · Agricultural Byproducts · Pre-consumer Reject Paper · Carpet Derived Fuel
Vulcan	Newberry, FL	· Whole Tires · Pre-consumer Reject Paper
American Cement Company	Sumter county, FL	· Whole Tires
CEMEX	Miami, FL	· Tire Fluff · Biomass · Whole Tires
Suwannee American Cement	Branford, FL	· Autofluff (expired permit) · Plastics Agricultural Film · Tire Derived Fuel · Reject Roofing Shingles · Used Roofing Shingle Scraps · Clean Woody Biomass · Agricultural Byproducts · Pre-consumer Paper · Post-consumer Paper · Carpet Derived Fuel
Titan America	Miami, FL	· Whole Tires

Plastics – Agricultural Film

These materials, sometimes referred to as plastic mulch, are used in agriculture and silviculture to 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 solid 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 Stated and Europe fire plastics as an ASF.

- 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 Company operates the Branford Cement Plant in Branford, Florida. Permit No. 1210465-020-AC authorized a trial burn of non-chlorinated plastic. Early tests show 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 ASF. 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 beneficial ingredient in the production of cement clinker because iron is a necessary ingredient for making clinker. When scrap tires are used as an ASF, approximately 550 pounds of iron per ton of scrap tires is "recovered", conserving the quantity of iron required from mined mineral sources. For the Pennsuco Cement Plant, Air Construction Permit No. 0250020-029-AC currently authorizes the installation of a tire injection system for firing whole tires in the precalciner 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 ASF 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 NOx control strategy. According to kiln manufacturer FLSmidth, NO_X emissions may be reduced by 30-50% when using tires as a fuel depending on the kiln design.

Manufacturer Reject Roofing Shingles

This material consists of new shingles that were rejected at the manufacturing plant due to some minor defect. 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)[3]. In an analysis conducted by Construction Technology Laboratories, Inc., the ash content consisted of approximately 40% silcone dioxide (SiO_2) and 3% alkalines as disodium oxide (Na_2O). The typical sulfur content of shingles is approximately 0.79% by weight, which is comparable to coal at approximately 0.67% sulfur by weight. New shingles do not contain asbestos and the manufacturers can provide this certification.

The supplier will grind the reject shingles 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_X emissions would be reduced and emissions would remain about the same for CO and SO_2.

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_X and SO_2 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 pyro-processing system with efficiencies greater than 99.9%[4] with nearly all of it eventually being bound to the clinker product.

Clean Cellulosic Biomass

This material is readily available and includes clean untreated lumber, tree stumps, millings, shavings and 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_{10} 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 ASF 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,

[3] Michigan Department of Environmental Quality Permit No. 238-09 for St. Mary's Cement Plant.
[4] Environmental Data of the German Cement Industry, 2009. VDZ

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.[5] 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.[6] Based on industry tests, these compounds are readily destroyed at the long residence times and high temperatures experienced in the pyro-processing system.[7]

Chromated Copper Arsenate (CCA)

Chromated copper arsenate is a 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.[8] 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 5 tons/hour of CCA treated wood: 0.004 lb/hour and 35 lb/year of copper, chromium or arsenic. The applicant notes that excess chromium incorporated into the clinker would cause adverse impacts to clinker quality. The applicant conservatively estimates that the maximum amount of CCA-treated wood that will not affect product quality is 0.25 tons/hour of CCA treated wood, which is a maximum capacity of less than 2200 tons per year (equivalent to estimated emissions of 0.0002 lb/hour and 1.75 lb/year of copper, chromium or arsenic). After researching this issue and providing this information, the applicant is really only interested in being able to burn limited amounts of CCA treated wood (~500 lb/hour).

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5 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.

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

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

8 Additional Information Provided by the Applicant, Koogler & Associates, Inc., Project No. 0250020-031-AC, Received June 6, 2011.

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.[9] ACQ contains copper and a quaternary ammonium compound.[10] 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.[11]

Agricultural Fibrous Organic Byproducts

This includes materials such as peanut hulls, rice hulls, corn husks, citrus peels, cotton gin byproducts, animal bedding and other similar materials. The Pennsuco Cement Plant is near farming areas in which these agricultural byproducts are readily available, which reduces the 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.

Pre-Consumer Reject Paper

This material will be supplied by companies such as International Paper Products Corporation or waste handlers that certify and manifest to only supply pre-consumer reject paper. These materials are typically outdated paper printings or products with minor flaws preventing sale. This may include printing and writing paper, pre-consumer household and sanitary paper, wrapping and packaging paper, linerboard, Kraft liner and fluting. The emissions are expected to be similar to clean woody biomass. The chlorine content of coal and reject paper are similar.

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 carpet 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

[9] "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>

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

[11] Environmental Management and Planning Decisions, December 2003, *A Market Evaluation of the Sale of Arsenic-Treated Wood in Maine*

short tons) of carpet scrap were reported as ASF 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 ($CaCO_3$) 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 plant in Evansville, Pennsylvania. The results showed insignificant changes in emissions of CO, NO_X and PM and an incongruent increase of SO_2. Actual emissions of SO_2 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[12] 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 ASF and raw materials to the Holcim cement plants in Utah, Montana and Colorado, which includes processing scrap carpet into ASF. 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.

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. 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. Disregarding changes in material packaging and consumer waste habits, a given 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. This ASF has been shown to 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.

<u>IPP Enviro-Fuelcubes</u>

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

[12] "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.

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%).[13]

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 Malasyia. 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 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 ASF specifically for a given plant.[14]

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, a 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 manufacturers 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 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 ASF feedstocks used. Vexor Fuels processes and blends ASF 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.

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13 "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

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

General ASF Fuel/Material Characteristics

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

Table A. Typical ASF Material Analysis Data

Tarmac, Application No. 0250020-031-AC
Additional Information Provided June 6, 2011

Fuel	Source	Heating Value (BTU/lb)	Moisture (%)	Density (lb/ft^3)	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*	*ethylene purified product
	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 Byproducts	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*	--	--	--	--	--	--	*(~300 to 800 kg/m3)
	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 to70	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	
Pre-Consumer Paper	19	7000 to 12000	4	--	84	8	<1	0.073	0.18*	<0.18	*total halogens
	20	1290 to 6880	--	--	--	--	--	--	--	--	
	Min	1,290	4	--	84	8	<1	0.073	0.18	<0.18	
	Max	7,600	4	--	84	8	<1	0.073	0.18	<0.18	
	Avg	4,445	4	--	84	8	<1	0.073	<100	<0.18	

Fuel	Source	Heating Value (BTU/lb)	Moisture (%)	Density (lb/ft^3)	Volatiles (%)	Ash (%)	Sulfur (%)	Chlorine (%)	Fluorine (ppm)	Mercury (ppm)	Arsenic (ppm)	Cadmium (ppm)	Chromium (ppm)	Copper (ppm)	Lead (ppm)
TDF	21	15,688	estimate < 5	--	66	4.2	1.92	0.07	--	--	--	--	--	--	--
	22	--	--	--	--	--	--	--	--	0.0076	--	--	--	--	--
	23	16,250	0.62	--	67	4.8	1.23	0.15	10	--	--	6	97		6.5
	24	--	--	--	--	--	--	--	--	--	<5	<5	<5	<5	<30
	25	--	--	17 to 51	--	--	1.92	0.15	10	--	--	6, <5	<5	--	51
	26	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	27	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	--
	28	6,900	--	--	--	4.1	--	0.15	--	--	--	10	21	17	151
	29	--	--	--	--	--	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
	30	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*	17	5	17.8*	20.2*	24.4*
Manufacturered Cellulosic Biomass	31	7,700 to 8,800	13 to 50	20 to 40	31 to 62	6 to 15	--	--	--	--	--	--	--	--	--
	32	--	--	--	--	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
	33	7,600 to 10,200	8.4	--	69.8 to 79.4	3.6 to 4	0.01	0.898 to 1.021	--	--	--	--	--	--	--
	34	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	--	--	--	--	--	--
	35	--	--	--	--	--	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
Shingles, Manufacturer Rejects	36	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

According to the application, 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 ASF 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, the application indicates 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 ASF specification to ensure consistent, controlled combustion in the kiln and/or precalciner.

Burnability

Several miscellaneous fuel characteristics affect the "burnability" of an ASF. The volatility and the particle size of the ASF affect how the fuel can be used. Fuel volatility affects thermal distribution, which restricts the rate and amount of the ASF that can be fired. In the main kiln burner, the ASF 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 ASF 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 solid fuels is within the 12 to 14% error of EPA Test Method 5, which is the appropriate method for quantifying PM emissions.[15,16] 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 ASF.[17],[18]

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.

[15] Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III. Stationary Sources Specific Methods. Section 3.16 EPA/600/4-77/027b.

[16] Lanier, S.; Hendricks, C. Reference Method Accuracy and Precision (ReMAP): Phase I. February 2001. ASME International.

[17] Attachment B, Lafarge Sugarcreek, MO and Lafarge, Whitehall, PA Facilities Alternative Fuel Testing.

[18] Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, Figures 1.23 and 1.24, http://eippcb.jrc.ec.europa.eu.

$$M = \left(\frac{\frac{SO_3}{80}}{\left(\frac{K_2O}{94} + \frac{Na_2O}{62} - \frac{0.5 \times Cl}{35.5} \right)} \right) = 0.8 \ to \ 1.25$$ [19]

Where: chemical amounts are in units of mass.

The graph[20] below shows the modulus measuring at 1.30 for the Pennsuco Cement Plant. This value is out of the "target range" of 0.8 to 1.25. Due primarily to the raw materials, Tarmac 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 Tarmac will only introduce ASF 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 solid fuels has been shown to not significantly impact SO_2 emissions.[21,22,23,24] 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 Pennsuco Cement Plant limits SO_2 emissions to 0.5 lb/ton of clinker and 320 lb/hour without any limit on the sulfur content of coal or petroleum coke, noting that petroleum coke can readily contain up to 7% sulfur by weight. 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 ($CaSO_4$) or as sulfides such as pyrite or marcasite (FeS_2). 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_2. 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_2 and reaction with alkalis or with calcium

[19] Tokheim, L.A. "The Impact of Staged Combustion on the Operation of a Precalciner Cement Kiln", 1999.
[20] Koogler and Associates, July 8, 2011.
[21] EPA Report No. 600/R-97-115 entitled "Air Emissions From Scrap Tire Combustion".
[22] Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, Figures 1.32, http://eippcb.jrc.ec.europa.eu
[23] 6 Federal Register 28318, 28322 (May 17, 2011).
[24] 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.

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_2.

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_2 as the raw materials are heated by the exhaust gases 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_2. Therefore, in a dry preheater kiln about 30% of the total sulfide input may leave the preheater section as gaseous SO_2 emissions.[24] In summary, SO_2 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 reaction 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 from the quarry at the Pennsuco Cement Plant. Therefore, the chlorine content of all fuels and raw materials used must be monitored. The chlorine content of fuels used in the kiln at the Pennsuco Cement Plant is "process-limited" to ensure high-quality cement clinker and to limit kiln degradation. This provides assurance that ASF 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.[25] 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.[26] This is consistent with EPA's recent position that "… burning alternative fuels ... does not appreciably affect cement kilns' HAP emissions."[27] 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 solid fuels.[28,29, 30]

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^3) and all values less than 0.5mg/Nm^3 (0.6 ppm).[31] 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_2), which is thermally stable in the burning process. Since high levels of fluoride (above 0.25 %)[32] adversely impact the quality of cement clinker, it is regularly analyzed in the clinker and product.

Mercury: The Pennsuco Cement Plant has a mercury emissions limit of 229 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 sampling, analysis and monitoring of

[25] 63 Federal Register 14182, 14196 (Mar. 24, 1998)

[26] 64 Federal Register 52828, 52876 (Sep. 30, 1999)

[27] 76 Federal Register 28318, 28322 (May 17, 2011)

[28] "Air Emissions Summary for Portland Cement Pyro-processing". Portland Cement Association. R&D SN3048.

[29] Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, Table 1.38, http://eippcb.jrc.ec.europa.eu.

[30] Dioxin and the Cement Industry in Australia. Technical Note. Cement Industry Federation. July 2002.

[31] Environmental Data of the German Cement Industry 2009. VDZ. Page 30.

[32] Javed I, Bhatty. "Role of Minor Elements in Cement Manufacture and Use". PCA R&D Serial No. 1990.

consumption for all fuels and raw materials. This requirement would extend to any ASF used at the facility. The recently revised Portland Cement MACT requires future installation of a mercury CEMS to demonstrate compliance with the new mercury standard of 55 lb/million tons of clinker produced. At maximum production capacity (2,190,000 tons of clinker per year), the Pennsuco Cement Plant would be limited to 120.45 pounds of mercury per year.

Other Metals: Other metals such as arsenic, cadmium, chromium, copper and lead may be introduced with ASF; however, as shown in Table A, ASF 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.[33] 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[34] 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.[35] Further related to the thermal destruction of PCBs, laboratory data from the University of Dayton Research Institute[36] 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.[1] 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 Pennsuco 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 FLSmidth 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 pyro-processing 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

[33] Karstensen, K.H., et al., "Environmentally Sound Destruction of Obselete Pesticides in Developing Countries using Cement Kilns." Environmental Science and Policy. 2006. pg 577-586.

[34] Mantus, E.K; Kelly, K.E.; Pascoe, G.A.; *All Fired Up – Burning Hazardous Waste in Cement Kilns,* Environmental Toxicology International, December, 1992.

[35] Karstensen, K.H., *Can Cement Kilns be used for PCB Disposal?,* SINTEF (undated)

[36] 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.

product.

Figure 6. Process Flow Diagram - Dry Process Preheater/Precalciner Cement Plant[37]

The thermal characteristics of precalciner cement kilns include the following:[38]

- 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.
- Metals, with the exception of volatile metals, are fixed in the clinker structure and become part of the finished cement.
- There are no byproducts as all ash is incorporated in the clinker.
- 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 Pennsuco Cement Plant. The temperature of the feed material

[37] 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

[38] Mantus, E.K; Kelly, K.E.; Pascoe, G.A.; *All Fired Up – Burning Hazardous Waste in Cement Kilns*, Environmental Toxicology International, December, 1992.

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:

- ≤ 400°C (752°F): water evaporation
- 400 to 750°C (752°F to 1382°F): mineral dehydration
- 600 to 900°C (1112°F to 1652°F): oxidation reactions, carbonate decomposition
- 800 to 1250°C (1472°F to 2282°F): calcination of aluminates (C_xA-X) and silicates (C_2S,C_3S)
- 1260°C (2300°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.

Figure 7. Thermo-chemical Reactions in the Formation of Four Major Clinker Components [37]

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 Pennsuco 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°F to 3500°F for 10 seconds), which will be specifically designed for firing ASF; and long residence at the high temperatures in the preheater/precalciner (1500°F to 2200° F for 8 seconds).
- Emissions of NOx will be controlled by the FLSmidth kiln combustion design, which includes indirect firing, multiple burn points and a low-NOx precalciner.
- Particulate matter emissions will be controlled with the existing baghouse.
- Emissions of SO_2 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, metals will eventually be incorporated into the clinker at very high transfer rates

(>99.99%). Mercury input will be tracked and mercury-containing ASF 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 Pennsuco Cement Plan is subject to NESHAP Subpart LLL.

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 Pennsuco 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 (l) 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*.

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*.

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:

- 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. Based on initial reactions, this rule is likely to be challenged by both industrial and environmental groups.

Reconsideration Action on Cement NESHAP (Excerpts)

When EPA the revised 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 were 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

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 Pennsuco 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 will take effect in 2013. 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 for normal operation specify the following HAP emissions standards applicable to the Pennsuco 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

Although this NESHAP is final, EPA is currently reconsidering portions and it will likely be challenged by industry as well as environmental groups.

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 0.053 pounds per ton feed for PM_{10} and 0.063 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.

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. The Miami-Dade Department of Environmental Resources Management issued a permit for Pennsuco Cement Plant's Kiln 1 on May 1, 2001 to modify the existing wet process plant by incorporating the modern dry process technology including a preheater and precalciner along with indirect firing. The 2001 permit was actually a modification and re-issuance of a permit issued in 1999 for a modernization project that was smaller in scope. Currently, the Pennsuco 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 Pennsuco Cement Plant is seeking to develop alternative solid 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.[39] In addition, the applicant stated that the project will benefit the operation of the facility as well as the community for the following reasons:

Table B. 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%

- 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.[40]
- Promotion of a more diverse energy supply.

[39] "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.

[40] http://www.dep.state.fl.us/waste/recyclinggoal75/default.htm.

Recovering the energy in discarded materials for combustion processes is not new even to the United States. Based on a 2008 study[41] for the United States, 33.2% of municipal solid waste was recovered for reuse, 12.6% was recovered for energy in combustion processes and 54.2% was ultimately discarded in a landfill. Table B shows the material substitution rates for cement kilns around the world in 2005.[42]

General Summary of ASF

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).[43] This ASF contains very low levels of other contaminants.

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.

Manufacturer Reject Roofing Shingles: This ASF consists of the asphalt binder/adhesives and fiberglass/paper backing with residual amounts of incombustible grit materials. This ASF has a sufficient heating value (5800 Btu/lb) with a 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.

Agricultural Fibrous Organic Byproducts: This ASF includes agricultural materials such as peanut hulls, rice hulls, corn husks, citrus peels, cotton gin byproducts, animal bedding, etc. This ASF 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 ASF. This ASF contains very low levels of other contaminants.

Pre-Consumer Reject Paper: This ASF consists of a wide variety of unused paper products, which typically have high heating values (7000 – 12,000 Btu/lb) with a low moisture content (4%). Some specialty products may have lower heating values (1290 Btu/lb), but these materials would be blended with other paper products to improve burnability. This ASF typically contains low levels of other contaminants.

Carpet-Derived Fuel: This ASF 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 ASF contains very low levels of other contaminants.

Clean Cellulosic Biomass: This ASF includes wood trimmings, sawdust, wood shavings, yard trash, etc. This ASF 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 ASF. This ASF typically contains very low levels of other contaminants.

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41 "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.

42 "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.

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

Manufactured Cellulosic Biomass: This ASF includes secondary wood residues such as plywood, particle board, medium density fiberboard, oriented strand board, laminated beams, finger-jointed trim, sheet goods 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 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).[44]
- *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.[45] 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)[46] of chromium. The clinker quality specification of 100 ppm[47] would be exceeded if the CCA-treated wood input is above 10% of heat input.[48] The applicant indicates that the plant will fire limited amounts as part of a blended fuel mix or engineered fuel.

Engineered Fuel: 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 ASF or other non-hazardous materials that will meet target heating values and material content specifications. 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.

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

ClimaFuel[49]

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,

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

45 Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, http://eippcb.jrc.ec.europa.eu

46 Bhatty, J.I. "Innovations in Portland Cement Manufacturing", PCA Table 3.6.5. (undated)

47 P. A. Longman, Training Manual from Heidelberg Cement Company. (undated)

48 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.

49 CEMEX United Kingdom; Web sites: http://www.cemex.co.uk/su/su_af_cl.asp and http://www.cemex.co.uk/su/pdf/South_Ferriby_Climafuel_Application.pdf .

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%.[50]

Table C. 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:[51] less than 1% bark content, approximately 7% to 10% moisture content, approximately 0.5% ash content and a heating value of approximately 7300 Btu/lb.

Comparison of Engineered Fuel Characteristics

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

Table D. Alternative Solid Fuel Values

Fuel	Heating Value (Btu/lb)	Ash Content	Chlorine Content	Sulfur Content	Mercury Content
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 ASF acceptance criteria.

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

[50] "The Use of Climafuel as a Fuel at Rugby Cement Plant", Draft Report for Consultation, CEMEX UK Cement Limited, November 2010.

[51] Green Circle Bio Energy Inc.; web site: http://www.greencirclebio.com/products.php

Regulated Emissions for Pennsuco Cement Kiln

Currently, the Pennsuco cement kiln is subject to the following emissions standards and regulatory programs.

Table E. Emissions Standards Table from Title V Permit No. 0250020-026-AV

Parameter	Emission Limit	Averaging Time	Compliance Method	Limit Basis
Opacity[6]	10%	6-minute block	COMS, Method 9	PTE, Avoid PSD 40 CFR Subpart LLL
PM[6]	0.063 lb/ton of dry kiln feed	3 hours[5]	Annual Method 5	PTE, Avoid PSD 40 CFR Subpart LLL
	26.8 lb/hr			
PM_{10}[6]	0.053 lb/ton of dry kiln feed	3 hours[5]	Annual Method 5	PTE, Avoid PSD 40 CFR Subpart LLL
	22.5 lb/hr			
SO_2	0.50 lb/ton of clinker	30 days[2]	CEMS Method 6 or 6C	PTE, Avoid PSD
	320 lb/hour	24 hours[1]		
NO_X (as NO_2)	2.17 lb/ton of clinker	12-months[3]	CEMS Method 7 or 7E	PTE, Avoid PSD
	720 lb/hour	24 hours[1]		
CO	2.0 lb/ton of clinker	30 days[2]	CEMS/Method 10	BACT
	576 lb/hour [1]	24 hours[1]		
VOC[4]	0.16 lb/ton of clinker [2]	30 days[2]	CEMS Method 25 or 25A	PTE, Avoid PSD
	40 lb/hour	24 hours[1]		
Mercury (Hg)	229 lb/yr (base + 199 lb/yr)	12-month	Fuels, Materials[8]	PTE, Avoid PSD
Temperature[7]	Baghouse Temperature (T) $\leq$ T during Dioxin/Furan Tests	Continuous	Established during Method 23	40 CFR 63, Subpart LLL
Dioxin/Furan	0.2 ng TEQ/dscm (T$\geq$204 ^oC)	3 hours	30 Months, Method 23	40 CFR 63, Subpart LLL
	0.4 ng TEQ/dscm (T<204 ^oC)			

1. Compliance with the short-term emission limit for SO_2, NO_X, CO and VOC shall be based on a 24-hour block average computed in accordance with Specific Condition B.11. Compliance with lb/hr SO_2 emissions limitations in this condition will insure compliance with Miami-Dade County Code, Section 24-41.3(2)(a)(i) limiting emissions to 1.2 l/hr SO_2/MMBtu heat input when solid fuel is fired, or 0.8 lb/hr SO_2/MMBtu heat input when liquid fuel is fired, based on a 24 hour average.
2. Compliance with the long-term emission limit for SO_2, CO and VOC shall be based on a 30 operating-day block average computed in accordance with Specific Condition B.11.
3. Compliance with the long-term emission limit for NO_X as nitrogen dioxide (NO_2) shall be based on 12 month rolling average computed in accordance with Specific Condition B.11.
4. VOC emissions shall be expressed as propane.
5. The averaging times for PM and PM_{10} correspond to the required length of sampling for the initial and subsequent emission tests (e.g., a minimum of 3 one-hour test runs). Compliance demonstration with these limits shall be conducted pursuant to 40 CFR 63.1349(b)(1).
6. Compliance with the Opacity, PM and PM_{10} permit limits given for in-line kiln/raw mill will insure compliance with applicable limits from 40 CFR 63, Subpart LLL for the in-line kiln/raw mill and clinker cooler and 40 CFR 60,

Subpart Y for the coal mill.

7. The temperature requirements for the operation of in-line kiln/raw mill are in accordance with 40 CFR 63.1344(a) & (b) and 63.1349(b)(3).
8. Compliance method for Hg determined by raw materials and fuels entering the process.

The preheater/precalciner kiln was constructed to replace an old wet-process kiln. Emissions reductions from shutting down the old kiln were legally used in a netting analysis to avoid PSD preconstruction review for the new kiln for all pollutants except CO. Therefore, the primary regulations for the existing kiln are: a CO BACT standard; site-specific mass emissions rates for NOx, PM/PM_{10}, SO_2 and VOC to ensure that the kiln properly avoids PSD preconstruction review; and the NESHAP Subpart LLL provisions, which represent MACT for controlling HAP emissions (metals and dioxin/furans). Note that NESHAP Subpart LLL establishes a PM/PM_{10} 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.

Table F. Revised NESHAP Subpart LLL, MACT Standards for Existing Kilns at normal operation.

HAP	Average Emissions Top 12% of Kilns [a]	Final Standards [b]
Mercury	32.1 lb/MM tons clinker	55 lb/MM tons clinker [c]
THC or Organic HAP	5.2 ppmvd@7% O_2	24 ppmvd@7% O_2 [d]
	1.8 ppmvd@7% O_2	9 ppmvd@7% O_2 [e]
HCl	0.41 ppmvd@7% O_2	2 ppmvd@7% O_2 [f]
PM	0.02 lb/ton clinker	0.04 lb/ton clinker [g]

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 ASF 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. Pyro-processing 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 ASF – recovering the useful energy content for clinker production while destroying, or incorporating into the clinker, most of the potential air pollutants from the ASF.

Once stable kiln operation is achieved, these operating conditions promote the rapid combustion of ASF. Moderate-energy, ASF will be introduced by the enclosed bucket elevators system (high-density ASF) or pneumatically (low-density ASF) above the precalciner to gain heat for combustion in the precalciner. High-energy ASF 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 ASF 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

The applicant estimates that the precalciner kiln system could initially fire approximately 200,000 tons of ASF per year. The following table provides an example of the estimated ASF firing rates assuming: an average ASF 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 G. 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
% ASF*	30%	45%	39%
Heat input rate, MMBtu/hour, ASF	87 MMBtu/hour	173.25 MMBtu/hour	260.25 MMBtu/hour
ASF Heating Value	7200 Btu/lb	5200 Btu/lb	----
ASF, tons/hour	6.0 tons/hour	16.7 tons/hour	22.7 tons/hour
ASF, tons/year, max.	52,925	146,292	**199,217 tons/year**

* 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.[52]

ASF Effects on Production Capacity - FLSmidth[53]

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, FLSmidth can perform this analysis and recommend system modifications to ensure that the alternative fuels utilization will not have a

[52] "Use of Alternative Fuels in the Canadian and US Cement Industry: Opportunities and Barriers", 2007.

[53] "Possibilities for the Use of Alternative Fuels in the Cement Industry", Global Fuels Magazine, Morten Kyhnau Hansen, FLSmidth Alternative Fuels, Denmark, May 2008.

severe impact on production capacity. When using alternative fuels, CO, NOx and mercury emissions are among the issues to be dealt with carefully.

Discussion of Emissions Generated from Firing ASF

In general, the types of emissions generated from firing ASF 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 ASF. The FLSmidth 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 ASF and caused by incomplete fuel combustion. Certain ASF, 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 ASF 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: NOx emissions consist primarily of thermal NOx, which is generated due to the high temperatures in the kiln. NOx emissions are controlled by the FLSmidth kiln design which includes indirect firing, multiple burn points and a low-NOx precalciner. However, nitrogen in the fuels may generate NOx emissions as well.

Acid Gases: SO_2 and HCl emissions will be generated as a function of the sulfur and chlorine contents of the ASF. 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.[54] 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.

Mercury: Mercury is a highly volatile metal. If present in the ASF, 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.

[54] 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.

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 the 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 ASF 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 ASF, 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[55] (>99.9%)[56] 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 ASF described in the application typically contain low levels of metals. For many of the non-hazardous material streams that produce an ASF, 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 ASF will be fired.

Given the differences in temperature at various points in the process, it is important that ASF 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.[57]

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 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 H. European Kilns Pollutant Emissions

Pollutant	0% Substitution	40 % Substitution	Change in Emissions
PM	0.0183 grains/dscf	0.0091 grains/dscf	50% decrease
SO_2	80.6 ppm	62.8 ppm	22% decrease
NOx	499.9 ppm	283.9 ppm	43% decrease
TOC	16.7ppm	14.7 ppm	12% decrease

55 Cement, Lime and Magnesium Oxide Manufacturing Facilities, May 2010, http://eippcb.jrc.ec.europa.eu

56 Environmental Data of the German Cement Industry 2009. VDZ.

57 "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.

* Summary based on review of tables.[58] 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 Pennsuco kiln. The Department notes that NOx 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).[59]

- Sulfur Oxides – SO_2: Alternative solid fuels have no influence on total SO_2 emissions.
- Nitrogen Oxides – NOx: Alternative fuels do not lead to higher NOx emissions – in some cases, NOx 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 Pennsuco 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.

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 NOx emissions (measured as NO_2) 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

[58] Cement, Lime and Magnesium Oxide Manufacturing Facilities; May 2010; Tables 1.24, 1.32,1.25, 1.38, http://eippcb.jrc.ec.europa.eu.

[59] "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

pollutant.

Acid Gases: The existing stack contains a probe that continuously pulls and exhaust gas sample through a CEMS to measure and record the SO_2 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 3rd 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 estimates mercury emissions by material balance. Each raw material and fuels is sampled daily and analyzed monthly for the mercury content. Mercury emissions are estimated each month by calculating the mercury introduced to the kiln system (from the mercury content and use of raw materials and fuels) and assuming that all mercury input was exhausted through the stack. 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.

EPA Report on the Use of Alternative Solid 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 ASF 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 ASF results in reduced emissions of greenhouse gases (mainly carbon dioxide), especially with "carbon neutral" alternative solid fuels such as biosolids or scrap paper and wood.

Table I. ASF Share of Total Fuel Demand in the Cement Industry, Selected Countries[60]

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

By using alternative solid 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 ASF 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 solid fuels, as shown in the

[60] *Guidelines on Co-Processing Waste Materials in Cement Production*; CEMBUREAU, SINTEF, as presented in The GTZ-Holcim Private Partnership; page 4; 2006.

table.

Cement manufacturers using ASF reduce energy costs and emissions. The cement companies are seeking new sources of ASF due to the increasing cost of coal, petroleum coke and other conventional fuels used in cement production. In addition, some alternative solid 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.

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)

Complete combustion of the alternative solid 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.[61]

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

Cement Plant	**Location**	**Permitted Alternative Solid Fuels**
Lehigh Cement Plant	Redding, CA	· Wood, other biogenic materials, agricultural byproducts, rice hulls, 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 solid 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

[61] Veijonen, K. *Biomass to Replace Fossil Fuels in Cement Industry*, Finnsementti Oy, Parainen, Finland, EUBIONET III - IEE/07/777/SI2.499477, 02/2009.

Cement Plant	Location	Permitted Alternative Solid Fuels
		Geocycle. For introduction of a new alternative solid 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 · Tire Derived Fuel · Reject Roofing Shingles · Biomass · Agricultural Byproducts · Pre-consumer Reject Paper · Carpet Derived Fuel
CEMEX	Miami, FL	· Biosolids · Tire Fluff · Biomass · Whole Tires
CEMEX	Clinchfield, GA	· Peanut Hulls · Carpet Fiber · Tire Derived Fuel
CEMEX	Demopolis, AL	· Wood · Railroad Ties · Engineered Fuel · Tire Fluff
CEMEX	Victorville, CA	· Wood · Biosolids · Tires
Essroc (closed)	Bessemer, PA	· Tire Derived Fuel · Coal Tar
Essroc	Frederick, MD	· Whole Tires
Florida Rock	Newberry, FL	· Whole Tires
Hercules	Stockertown, PA	· Chipped Tires
Holcim	Morgan, UT	· Tire Derived Fuel

Cement Plant	Location	Permitted Alternative Solid Fuels
Holcim	Midlothian, TX	· Chipped Tires · Wood · Spent Activated Carbon · Oil Filter Fluff
Holcim	Devil's Slide, UT	· Scrap Carpet · Chipped Tires · Diaper Scrap (cubed) · Plastics · Mattress Scrap
Holcim	Ada, OK	· Whole Tires
Holcim	Hagerstown, MD	· Whole Tires
Lafarge	Sugar Creek, MO	· Plastics · Cardboard · Rubber Scrap · Paper · Other Related Materials · Landfill Gas
Lafarge	Cementon, PA	· Whole Tires · Plastic Derived Fuel
Lafarge	Seattle, WA	· Chipped Tires · Biodiesel · Used Oil
Lafarge	Calera, AL	· Tire Derived Fuel
Lafarge	Harleyville, SC	· Whole Tires · Plastics
Lafarge	Joppa, IL	· Whole Tires
Lafarge	Whitehall, PA	· Whole Tires
Lafarge	Tulsa, OK	· Whole Tires
Lehigh Cement	Redding, CA	· Scrap Paper · Wood · Agricultural Byproducts · Rice Hulls · Chipped Tires · Whole Tires
Lehigh Cement	Fleetwood, PA	· Wood · Biosolids · 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

Cement Plant	Location	Permitted Alternative Solid Fuels
Suwannee American Cement	Branford, FL	· Autofluff · Agricultural Film · Tire Derived Fuel · Reject Roofing Shingles · Used Roofing Shingle Scraps · Clean Woody Biomass · Agricultural Byproducts · Pre-consumer Paper · Post-consumer Paper · Carpet Derived Fuel
Titan America	Miami, FL	· Whole Tires · Wastewater Treatment Solids

Trial Burns

Trial burns allow the installation of temporary equipment and provide limited authorization to fire an ASF. During such trials, temporary operational and emissions data is gathered to determine: fuel characteristics, fuel processing issues, fuel handling and feeding issues, operational impacts, effects on clinker quality, changes in air emission rates and overall viability an alternative fuel. If the material shows promise as an ASF, this information is used to help design the permanent fuel processing, handling and feeding systems. Trial burns afford the opportunity to test non-hazardous ASF and gather information showing no process or production issues and compliance with pollutant emissions standards.

Conclusion

It has been documented that the following ASF 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 ASF including these non-hazardous materials and much more. Given the following, the responsible introduction and use of ASF into the pyro-processing system as described in the application will allow the plant to comply all conditions in the current Title V air operation permit:

- ASF as described in the application;
- Current kiln design and operating conditions;
- New ASF feed system equipment and main kiln burner;
- Routine monitoring of incoming ASF;
- Ensuring that the ASF has a useful heating value and low mercury levels;
- Careful introduction of ASF 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 ASF 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 ASF 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 ASF (from non-hazardous materials) rarely affects clinker chemistry or results in increased emissions.[62, 63, 64, 65, 66]

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 ASF as well as reasonable assurance of compliance with the applicable regulatory requirements.

Issues with ASF[67]

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

- High ASF 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 ASF processing and feed systems will dry the high-moisture materials before firing as fuel.
- Fluctuations in ASF 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 to be adjusted.
- ASF 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_2 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

[62] Hansen, M.K., *Possibilities for the Use of Alternative Fuels in the Cement Industry*, Global Fuels Magazine, May 2008.

[63] Cement, Lime and Magnesium Oxide Manufacturing Facilities; May 2010; Tables 1.24, 1.32,1.25, 1.38, http://eippcb.jrc.ec.europa.eu

[64] "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.

[65] "Cement Sector Trends in Beneficial Use of Alternative Fuels and Raw Materials", U.S. EPA, Revised Draft, October 2008.

[66] Cement Australia, Sustainable Development, Alternative Fuel and Raw Mmaterials, web site: http://www.cementaustralia.com.au/wps/wcm/connect/website/cement/home/sustainable-development/resource-conservation/alternative-fuel/alternative-fuel.html.

[67] "A Practical Guide to Alternative Fuels", Wilfred Zieri, A TEC Production & Services, Austria, World Cement, November 2008.

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 ASF (e.g., plastics) is approximately 3 inches.
- For the precalciner, the maximum recommended particle size for 3-dimensional ASF 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 pyro-processing 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 pyro-processing 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, explosive materials and unsorted municipal garbage. CCA treated wood shall only be fired in limited amounts.

ASF Acceptance Criteria[68]

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 ASF including combinations of plastics, tire-derived fuel, reject roofing shingles, clean cellulosic biomass, manufactured cellulosic biomass, agricultural fibrous organic byproducts, pre-consumer reject paper, carpet-derived fuel, engineered fuels and mixes of these fuels.

ASF Material Properties

Parameter	Target Levels[a]	Acceptance Criteria[b]
Lower Heating Value, Btu/lb	> 5000	> 3500
Mercury, ppmw mg/kg	< 0.3	
Moisture Content, % by weight	< 30%	
Ash, % by weight	< 25%	
Sulfur, % by weight	< 4.0%	
Chlorine, % by weight	< 0.50%	
Chromium, ppmw	< 100	
Lead, ppmw	< 50	

[68] "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.

Notes:

a. Targets levels are the desired ASF properties that suppliers should try to achieve. Target levels are not enforceable.

b. The ASF must meet the acceptance criteria or the operator is required to reject the shipment.

c. All concentrations are dry.

Receiving ASF – Sampling/Analysis Frequency

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

- TDF: No sampling/analysis is required for TDF since there is adequate information on this manufactured product.
- Plastics, Reject Roofing Shingles, Agricultural Organic Fibrous Byproducts, Pre-Consumer Paper and Carpet-Derived Fuel: One representative sample will be analyzed for each ASF assessment. Afterwards, one representative sample will be analyzed during each subsequent calendar year that an ASF is fired.
- Clean Cellulosic Biomass, Manufactured Cellulosic Biomass and Engineered Fuel: Two representative samples will be analyzed for each ASF assessment (at least 15 days apart). For every subsequent 10,000 tons of each ASF received on site, the permittee will obtain the analytical results for a representative sample of the ASF.
- ASF Mix: No sampling/analysis is required for ASF mixes since analytical results will be available for individual ASF.
- Analytical results may be provided by the supplier or the plant.

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

Receiving, Accepting and Storing ASF

- Shipments may consist of several truckloads. All ASF shall be received in covered trucks and/or enclosed containers.
- When unloading and handling ASF, reasonable precautions shall be taken to prevent fugitive dust emissions.
- Operators shall reject ASF that does not meet the ASF acceptance criteria.
- Operators shall also visually check the delivered ASF for particle size and components.
- Operators shall record the date, type, amount and supplier of ASF delivered.
- The ASF shall be stored:
  - Under cover or in covered trailers or containers;
  - On top of a paved or compacted clay surface;
  - Separately from other ASF 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_2 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 ASF to the pyro-processing system.
- Handling systems and feed systems shall be enclosed to the extent practicable. The operator shall take reasonable precautions to control fugitive emissions.
- ASF feed systems and the new main kiln burner system shall be integrated with the existing kiln data system so that operators will know the ASF feed rates and can make adjustments accordingly.

Operating Conditions

- Operators will carefully select the appropriate ASF feed system and feed location according to the nature of the ASF being fired to promote efficient combustion and reduce emissions impacts. Key ASF parameters include the heating value, particle size, ash content and moisture content. ASF 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 ASF 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 ASF under steady-state kiln operations. Once the desired ASF 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 ASF 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 ASF. The firing of that ASF 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 ASF being fired and adjust operations to account for increased flue gas volume/velocity and promote stable operation.
- Operators will consider the ASF 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 revised NESHAP Subpart LLL provisions for "existing units" by September 9, 2013. 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, and Jeff Koerner, the program administrator, are 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 Bureau of Air Regulation at Mail Station #5505, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.