PCA
America's Cement Manufacturers™

Portland Cement Association
1150 Connecticut Avenue, NW, Suite 500
Washington, DC 20036-4104
202.408.9494 Fax 202.408.0877
www.cement.org

April 1, 2019

The Honorable Andrew Wheeler
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Mail Code 1101A
Washington, DC 20460

RE: Petition for Determination Identifying Non-Hazardous Secondary Materials as Non-Waste for Categorical Listing under 40 CFR 241.4(a)

Administrator Wheeler:

The Portland Cement Association (PCA), on behalf of the portland cement manufacturing industry, submits the following rulemaking petition in accordance with 40 CFR 241.4(b) for a determination that the alternative fuels described herein are categorical non-hazardous secondary materials (NHSM) when used as a fuel in a cement kiln combustion unit. The PCA requests addition of the described alternative fuel categories to the list contained at 40 CFR 241.4(a). Each proposed alternative fuel stream has not been discarded or has been sufficiently processed to transform the material into a non-waste fuel as detailed in the definition of processing in 40 CFR 241.2. In addition, each stream satisfies the legitimacy criteria specified in 40 CFR 241.3(d)(1) or is functionally the same as comparable traditional fuels and can be determined to be a non-waste fuel based on balancing other relevant factors as provided in the petition.

PETITION CONTENTS & PROCEDURES

Per 40 CFR 241.4(b)(1), any rulemaking petition to identify additional specific materials to be listed as a non-waste in 40 CFR 241.4(a) must include the contents provided in the following subsections.

Petitioner Information – 40 CFR 241.4(b)(1)(i)

Portland Cement Association
1150 Connecticut Avenue NW, Suite 500
Washington, DC 20036
www.cement.org

Petitioner Interest in Proposed Action – 40 CFR 241.4(b)(1)(ii)

The PCA, founded in 1916, is the premier policy, research, education, and market intelligence organization serving America's cement manufacturers. PCA members represent 91 percent of U.S. cement production capacity with facilities in all 50 states. PCA promotes safety, sustainability, and innovation in all aspects of construction, fosters continuous improvement in cement manufacturing and distribution, and generally promotes economic growth and sound infrastructure investment. As background for PCA's proposed action, a description of the cement manufacturing process and alternative fuel utilization is provided.

Cement manufacturing is a raw material and fuel intensive industry. Cement is produced from various naturally abundant raw materials, including limestone, shale, clay, silica sand, and/or other additives. The raw materials contribute the major chemical constituents of calcium, silica, alumina and iron necessary to manufacture clinker, the principal ingredient in cement. Minor constituents, generally in a total amount of less than 5% by weight of the mixture, include magnesium, sulfur, sodium and potassium. Also, due to the raw materials originating from the earth's crust, a wide variety of trace elements can be found in the cement (generally totaling less than 1% by weight of the mixture). The cement clinker is ground with gypsum and smaller amounts of other ingredients to create the final portland cement product.

The critical process involved in portland cement manufacturing occurs in the cement kiln system, where large volumes of fuel are needed to raise the process (raw material) temperature in the kiln system to over 2700°F to achieve the required chemical reactions to produce clinker. The kiln is a slightly inclined, slowly rotating steel tube that is lined with refractory materials to protect the steel shell and retain heat within the kiln. The raw material mix enters the kiln system at the elevated (cold) end, and fuels are supplied to transfer heat to the solids at the lower or discharge end of the kiln. The materials are continuously and slowly moved to the lower end of the kiln system in a countercurrent flow to fuels and combustion gases by rotation of the kiln. As raw materials move down the kiln they are changed to cementitious or hydraulic minerals as a result of the increasing temperature within the kiln. Heating the raw materials requires flame temperatures as high as 3500°F. The sintering (or clinkering) zone nearest the flame in the rotary kiln has the highest temperatures, typically in the range of 2800°F-3200°F. These temperatures, plus residence times of the combustion gases in excess of 2 seconds, provide for nearly complete destruction of organic components while providing the necessary heat input. Inorganic components of the fuels that do not burn, are incorporated into the clinker or captured in the kiln system particulate air pollution control device (e.g., baghouse or electrostatic precipitator). The process is highly efficient in recovering heat from the fuels to make the product clinker.

The most commonly used traditional fuels in cement kiln systems are coal, coke, natural gas, and fuel oil with facilities also having the ability to utilize other traditional fuels such as wood, other cellulosic materials, and other liquid petroleum sources. The use of alternative fuels has increased considerably in the last 3 decades for use as a replacement, or partial replacement of traditional fuels, particularly within the European Union where the established fuel substitution rate is 44%.[1] Within the United States, the average fuel substitution rate is roughly 15%[2], though some plants have been able to replace fossil fuels in substantial amounts, suggesting that there is considerable opportunity to increase alternative fuel use.

The large growth in the use of alternative fuels in the cement industry, both nationally and internationally, is driven by several factors. First, cement kilns are uniquely suited to adaptively and beneficially use energy-bearing alternative fuels as part of their fuel mix, due to the large amount of energy needed to heat raw materials, the need for consistently high heating temperatures within the kiln system, and the kiln system's combustion efficiency. These characteristics, plus the industry's core focus of producing a quality product, ensure that the purpose of any fuels used as energy inputs go toward manufacturing a product, not simply destruction of wastes materials or contaminants. In addition, transitioning from fossil fuels to alternative fuels provides one of the key opportunities available to cement plants to continue sustainability improvement efforts. Indeed, the International Energy Agency has concluded that "the use of alternative fuels in cement production must more than double by 2030 to meet its sustainable development scenarios." [3]

In short, the beneficial use of paper, plastics, and fibers as alternative fuel sources is well document in the cement industry. For many years, PCA's members have utilized a range of alternative fuels as legitimate NHSM fuels providing meaningful heat value in the production of portland cement. To support the industry's efforts to further expand its use of these valuable, sustainable alternative sources, PCA submits this petition for an EPA determination that the subsequently named alternative fuels are legitimate NHSM and to list each as a categorical non-waste fuel under 40 CFR 241.4(a).

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[1] IFC, *Increasing The Use Of Alternative Fuels At Cement Plants: International Best Practice (2017).*
[2] PCA, *2017 U.S. Labor-Energy Input Survey (2019)*
[3] IEA, *Technology Roadmap - Low-Carbon Transition in the Cement Industry* (2018).

Description of Proposed Action – 40 CFR 241.4(b)(1)(iii)

PCA requests that the following regulatory language be added to 40 CFR 241.4(a) for non-hazardous secondary materials that are not solid wastes when used as a fuel in a combustion unit:

- Paper and cardboard streams including industrial scrap, off-specification items and pre-consumer recovery of paper products including those materials that are coated or treated and which are combusted in a cement kiln system (Paper/Cardboard)
- Non-PVC plastics including industrial scrap, off-specification items, by-product plastic and pre-consumer material originating from manufacturers or industrial recovery operations and which are combusted in a cement kiln system. (Pre-Consumer Plastics)
- Non-PVC plastics that are sufficiently processed in accordance with the definition in 40 CFR 241.2 for processing and then combusted in a cement kiln system. Sufficient processing must include, at a minimum, PVC separation, non-plastic material removal and shredding or other size-reducing operations. (Post-Consumer Plastics)
- Fabric and fiber streams including industrial or commercial scrap such as cuttings, trimmings, fibers and fillers from pre-consumer recovery of carpet, textiles, fabrics, upholstery or furnishings and which are combusted in a cement kiln system (Fabric/Fiber)

Proposed Action Need and Justification – 40 CFR 241.4(b)(1)(iv)

Need for Proposed Actions

This PCA request for non-waste determinations for certain categories of non-hazardous secondary materials to be used as fuels coincides with the sustainable manufacturing objectives promoted by EPA to benefit the environment.[4] Energy recovery of alternative fuels conserves natural resources while minimizing negative environmental impacts. Despite sustainable manufacturing practices, manufacturers generate waste streams which are not recyclable or are not *economically* recyclable, and are therefore placed into landfills. Placement of such materials into landfills ignores the substantial value the materials offer as commodity fuels, particularly where the fuels can be used in a manufacturing process that maximizes industrial heat value while simultaneously destroying contaminants as is the case in the portland cement industry.[5]

EPA has acknowledged key benefits of alternative fuel:

> *…both greenhouse gas (GHG) and particulate matter (PM) emissions have been reduced as a co-benefit of the use of secondary materials. The use of secondary materials, such as use as a fuel in industrial processes may also result in other benefits. These may include reduced fuel imports, reducing negative environmental impacts caused by previous dumping (e.g., tires), and reduced methane gas generation from landfills.*[6]

Furthermore, in regard to the benefits of use of secondary materials as an effective substitute or supplement for primary materials, EPA has stated:

> *…monetary savings resulting from reduced resources would, theoretically, be applied to a higher and better use in the economy. This helps advance economic growth as a result of improved industrial efficiency, which, in turn, helps move the country toward material sustainability and energy self-sufficiency, while protecting human health and the environment.*[6]

Justification for Proposed Actions

In accordance with 40 CFR 241.4(b)(1)(iv), the waste streams proposed for the non-waste determination must meet the three (3) legitimacy criteria as defined in 40 CFR 241.3(d)(1) or must justify not meeting one or more of the criteria with

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[4] https://www.epa.gov/sustainability/sustainable-manufacturing
[5] ICF, EPA, 2008. *Cement Sector Trends in Beneficial Use of Alternative Fuels and Raw Materials*, ICF International, Washington, DC.
[6] 75 FR 31849, June 4, 2010

other relevant factors. The legitimacy criteria and justification for each fuel category is discussed in the subsequent sections.

Legitimacy Criteria 1 – Managed as a Valuable Commodity – 40 CFR 241.3(d)(1)(i)

The alternative fuel categories contained in this petition represent groups of byproducts that are common to US industrial and commercial facilities. Each individual stream is a homogeneous byproduct stream managed within an established system that has been developed to ensure that the materials are not discarded or receive sufficient processing to transform each into a non-waste fuel. Furthermore, streams are managed as a valuable commodity comparable to traditional fuels for industrial combustion processes, including being stored for a reasonable time frame. Handling and storage are designed to prevent the loss of materials and adequately contain streams to prevent releases to the environment such as controlling fugitive loss through wind-blown dispersion and contaminant leaching to surface waters.

Management occurs from origination to delivery under a contractual relationship between the generator of the secondary material and/or their post-production handler and the portland cement facility, similar to the established collection programs used in the scrap tire markets. The agreement may also be in the form of an executed purchase order. Receiving facilities have programs in place (e.g. acceptance procedures, inbound inspections, etc.) to ensure that only the appropriate materials are included in the shipment.

Legitimacy Criteria 2 – Heating Value – 40 CFR 241.3(d)(1)(ii)

The EPA states that for meaningful heating value, 5,000 Btu per pound (Btu/lb) as burned is automatically considered valid energy recovery (e.g., meaningful heating value) as addressed in the NHSM criteria, where an alternative fuel with a heat content greater than or equal to 5,000 Btu/lb is presumed to be used for legitimate energy recovery.[7,8] As demonstrated in the subsequent table, the proposed categorical non-waste fuels each has a documented heat value in excess of 5,000 Btu/lb.

Table 1. Heat Content of Alternative Fuels

Alternative Fuel Category	Example Heat Content (LHV - Btu/lb)	Notes
Paper/Cardboard	7,000 - 8,500 [a,d]	Dry
Non-PVC Plastics (Pre-Consumer)	18,700 [a]	Polyethylene
	12,000 [a]	Mixed non-chlorinated
	7,221 – 19,988 [c,d]	Non-Recycled Plastics
Non-PVC Plastics (Post-Consumer)	8,250 – 19,000 [b,d]	Scrap plastic
Fabric/Fibers	7,300 – 12,000 [d]	Nylon; Polypropylene

a. ICF, EPA, 2008. *Cement Sector Trends in Beneficial Use of Alternative Fuels and Raw Materials*, Table ES-4, page 11.
b. EPA, 2011. *Materials Characterization Paper In Support of the Final Rulemaking: Identification of Nonhazardous Secondary Materials That Are Solid Waste Scrap Plastics*, Docket EPA-HQ-RCRA-2008-0329-1821.
c. Tsiamis, D.A., Castaldi, M.J., 2016. Determining Accurate Heating Values of Non-Recycled Plastics (NRP). Earth Engineering Center - City College of New York.
d. Individual stream test results provided to PCA.

Legitimacy Criteria 3 – Contaminant Comparison – 40 CFR 241.3(d)(1)(iii)

To meet the comparable contaminants part of the NHSM rule legitimacy criteria, alternative fuels must be documented to have contaminant concentrations comparable to traditional fuels which the plant is *designed to burn*. "Designed to

[7] 48 FR 11157-11160, March 16, 1983 – Identified as the low end of the woods fuel range of heating values which would not be considered sham recycling
[8] 76 FR 15541 (March 21, 2011), 78 FR 9172 (February 7, 2013), and various EPA Response & Clarification Letters ("Comfort Letters")

burn" means having a method to feed the fuel into the combustion system (e.g., a way to load solid fuel of a particular size into the unit). This method does not have to be permitted, but must be a part of documented system design.[9]

The overall set of contaminants subject to comparison between traditional fuels and alternative fuels include:

- 187 Hazardous Air Pollutants (HAPs) identified in Section 112(b) of the Clean Air Act[10]
- Nine (9) pollutants (PM, SO_2, HCl, NOx, CO, Pb, Cd, Hg, D/F) known to impact human health and the environment identified in Section 129(a)(4) of the Clean Air Act[11]
- PM is not considered for the NHSM rule and the metals and D/F are already listed as HAPs, so only HCl, nitrogen, and sulfur are additional contaminants considered

Testing of alternative fuels for all possible contaminants is not required. A facility can use expert or process knowledge to justify decisions to rule out contaminants that are not present, or are present at very low levels compared to traditional fuels. This is similar to the *generator knowledge* concept of a RCRA hazardous waste determination.[12] The concept of *de minimis* contamination (i.e., present at very low levels) is included in EPA preamble discussions, stating that materials can contain *de minimis* amounts of contaminants provided the legitimacy criterion for contaminant levels is met.[13]

A list of 22 contaminants "known" by the EPA to be present in solid traditional fuels has been used to compare to the concentration ranges for each contaminant identified in the alternative fuels being considered. PCA members provided analytical results for the alternative fuel categories being considered in this petition. The following table lists the separate analytical tests received from PCA members for each non-waste fuel type (plastics, paper, fabric/fiber), including a description of the type of non-waste fuel tested.

Sample ID	Description
PL1	Plastics from medical device manufacture
PL2	Polyol - Plastics from medical device manufacture
PL3	Plastic waste - Nylon 35%, PET 25%, PP20%, PE 15% and wood 5%
PL4	Scrap Plastic Trim - PE 35% , PP 35% glycol terephthalate 30%, paper 5% from food film
PL5	Plastics Scrap - Plastic 95% latex paint 5%
PL6	Plastic Film - combination of PE,PP and polystyrene from curbside recycling
PL7	PET 100%
PL8	Plastic/rubber coating from wire manufacturing
PL9	Plastic scrap from auto manufacturing
PL10	#5 and #7 Plastic
PL11	Film plastic
PL12	Misc. plastics
PL13	Plastics
PL14	Ground toilet seat rejects
PL15	Post-industrial
PL16	Non-woven polypropylene

[9] 76 FR 80481 (December 23, 2011)
[10] https://www.epa.gov/haps/initial-list-hazardous-air-pollutants-modifications
[11] Particulate Matter (PM), Sulfur Dioxide (SO_2), Nitrogen Oxides (NOx), Carbon Monoxide (CO), Lead (Pb), Cadmium (Cd), Mercury (Hg), Dioxins and Furans (D/F)
[12] This process is common to the generator knowledge component of RCRA hazardous waste determinations outlined in 40 CFR 262.11(c)(2).
[13] 76 FR 15486, March 21, 2011.

Sample ID	Description
PL17	Plastic bottles
PL18	Non-chlorinated plastic
PA1	Shredded money
PA2	Wax coated paper
PA3	Rolls of packing labels/label backings
PA4	Mixed paper
PA5	Currency paper
PA6	Paper cubes
PA7	Paper fluff
PA8	Fiber polymer
PA9	Mixed paper/cardboard
FF1	Carpet Scrap - carpet 50%, nylon 50%
FF2	Carpet trimmings, carpet manufacturing scrap made from PP, PE, nylon
FF3	Rags/absorbent cloths
FF4	Carpet materials
FF5	Consumer Carpet
FF6	Geotextile Fabric
FF7	Industrial Carpet
FF8	Carpet
FF9	Mattress shreds including plastic, wood, cloth fabric
FF10	Auto carpet scrap - nylon based products

The ranges for each contaminant represents the span of concentrations observed, from non-detect to the maximum concentration exhibited by a sample. Analyses were accomplished using USEPA standard methods for determining metal and organic concentrations in a solid material. The comprehensive analytical data is included as an Appendix to this petition.

The following discussion presents the results of the comparison for each alternative fuel category. Those contaminants which could be excluded due to generator knowledge have not been included.

Paper/Cardboard: paper and cardboard streams including industrial scrap, off-specification items and pre-consumer recovery of paper products including those materials that are coated or treated and which are combusted in a cement kiln system.

Contaminant concentrations found in this category of alternative fuels are comparable to or less than the concentrations found in traditional solid fuels. A direct comparison of pre-combustion concentrations indicates that maximum concentrations found in the alternative fuel are generally an order of magnitude less than those found in the traditional solid fuels that a cement kiln is designed to burn. Thus, the alternative fuel satisfies the third legitimacy criteria defined in 40 CFR 241.3(d)(1)(iii).

Table 2. Contaminant Comparison of Traditional Solid Fuels and Paper/Cardboard Alternative Fuels

Contaminant	Traditional Solid Fuel[14]		Paper/Cardboard [15]	
	Minimum Concentration (ppm)	Maximum Concentration (ppm)	Minimum Concentration (ppm)	Maximum Concentration (ppm)
Antimony	Non Detect	26	Non Detect	4.21
Arsenic	Non Detect	298	Non Detect	1.8
Beryllium	Non Detect	206	Non Detect	0.05
Cadmium	Non Detect	19	Non Detect	1.01
Chromium	Non Detect	340	Non Detect	12
Cobalt	Non Detect	213	Non Detect	20
Lead	Non Detect	340	Non Detect	33
Manganese	Non Detect	15,800	Non Detect	103
Mercury	Non Detect	3.1	Non Detect	0.6
Nickel	Non Detect	730	Non Detect	12
Selenium	Non Detect	74.3	Non Detect	4.2
Chlorine	Non Detect	9,080	Non Detect	7,318
Fluorine	Non Detect	300	Non Detect	29.5
Nitrogen	Non Detect	54,000	Non Detect	17,800
Sulfur	Non Detect	99,000	Non Detect	4,500
Benzene	5	38	Non Detect	5
Ethyl Benzene	0.7	5.4	Non Detect	5
Formaldehyde	1.6	27	Non Detect	14.7
POM (PAH)	14	2,090	Non Detect	Non Detect
Styrene	1	26	Non Detect	Non Detect
Toluene	8.6	56	Non Detect	0.195
Xylene	4	28	Non Detect	Non Detect

Non-PVC Plastics: pre-consumer plastics including industrial scrap, off-specification items, by-product plastic and pre-consumer material originating from manufacturers or industrial recovery operations and which are combusted in a cement kiln system.

Contaminant concentrations found in this category are comparable to or less than the concentrations found in traditional solid fuels. A direct comparison of pre-combustion concentrations indicates that maximum concentrations of metals and halogens found in the alternative fuel are generally less half the levels found in the traditional solid fuels that a cement kiln is designed to burn. In addition, the organic constituents for which there are analytical results exhibit concentrations an order of magnitude less than traditional solid fuel. Based on waste stream knowledge and origin, it is expected that the organic constituents for which there are no analytical results would have similar concentrations or can be excluded based on generator knowledge. Thus, the alternative fuel satisfies the third legitimacy criteria defined in 40 CFR 241.3(d)(1)(iii).

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[14] USEPA, Contaminant Concentrations in Traditional Fuels: Tables for Comparison; Literature Sources for Coal, November 29, 2011 including coal, coke, pet coke, wood and clean cellulosic biomass.
[15] Ranges represent analytical data compiled from results provided by PCA members. Data will be provided upon request to USEPA.

Table 3. Contaminant Comparison of Traditional Solid Fuels and Pre-Consumer Plastic Alternative Fuels

Contaminant	Traditional Solid Fuel[16]		Non-PVC Pre-Consumer Plastic [17]	
	Minimum Concentration (ppm)	Maximum Concentration (ppm)	Minimum Concentration (ppm)	Maximum Concentration (ppm)
Antimony	Non Detect	26	Non Detect	26.4
Arsenic	Non Detect	298	Non Detect	18.4
Beryllium	Non Detect	206	Non Detect	0.177
Cadmium	Non Detect	19	Non Detect	3.51
Chromium	Non Detect	340	Non Detect	101
Cobalt	Non Detect	213	Non Detect	15
Lead	Non Detect	340	Non Detect	71
Manganese	Non Detect	15,800	Non Detect	88
Mercury	Non Detect	3.1	Non Detect	0.3
Nickel	Non Detect	730	Non Detect	327
Selenium	Non Detect	74.3	Non Detect	15.7
Chlorine	Non Detect	9,080	Non Detect	4,356
Fluorine	Non Detect	300	Non Detect	43
Nitrogen	Non Detect	54,000	Non Detect	12,800
Sulfur	Non Detect	99,000	Non Detect	2,045
Benzene	5	38	Non Detect	Non Detect
Ethyl Benzene	0.7	5.4	Non Detect	0.789
Formaldehyde	1.6	27	Non Detect	Non Detect
POM (PAH)	14	2,090	Non Detect	22
Styrene	1	26	Non Detect	0.82
Toluene	8.6	56	Non Detect	0.17
Xylene	4	28	Non Detect	6.69

Non-PVC Plastics: post-consumer plastics that are sufficiently processed in accordance with the definition in 40 CFR 241.2 for processing and then combusted in a cement kiln system. Sufficient processing must include, at a minimum, PVC separation, non-plastic material removal and shredding or other size-reducing operations.

Contaminant concentrations found in this category are comparable to or less than the concentrations found in traditional solid fuels. A direct comparison of pre-combustion concentrations indicates that maximum concentrations of metals and halogens found in alternative fuel are generally not found or less than those found in the traditional solid fuels that a cement kiln is designed to burn. In addition, the organic constituents for which there are analytical results exhibit concentrations are an order of magnitude less than traditional solid fuel. Based on waste stream knowledge and origin, it is expected that the organic constituents for which there are no analytical results would have similar concentrations or can be excluded based on generator knowledge. Thus, the alternative fuel satisfies the third legitimacy criteria defined in 40 CFR 241.3(d)(1)(iii).

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[16] USEPA, Contaminant Concentrations in Traditional Fuels: Tables for Comparison; Literature Sources for Coal, November 29, 2011.
[17] Ranges represent analytical data compiled from results provided by PCA members. Data will be provided upon request to USEPA.

Table 4. Contaminant Comparison of Traditional Solid Fuels and Post-Consumer Plastic Alternative Fuels

Contaminant	Traditional Solid Fuel[18]		Non-PVC Plastic Post Consumer [19]	
	Minimum Concentration (ppm)	Maximum Concentration (ppm)	Minimum Concentration (ppm)	Maximum Concentration (ppm)
Antimony	Non Detect	26	Non Detect	46.2
Arsenic	Non Detect	298	Non Detect	Non Detect
Beryllium	Non Detect	206	Non Detect	Non Detect
Cadmium	Non Detect	19	Non Detect	Non Detect
Chromium	Non Detect	340	Non Detect	12.5
Cobalt	Non Detect	213	Non Detect	Non Detect
Lead	Non Detect	340	Non Detect	13.3
Manganese	Non Detect	15,800	Non Detect	10.5
Mercury	Non Detect	3.1	Non Detect	0.049
Nickel	Non Detect	730	Non Detect	10.1
Selenium	Non Detect	74.3	Non Detect	Non Detect
Chlorine	Non Detect	9,080	Non Detect	2,331
Fluorine	Non Detect	300	Non Detect	Non Detect
Nitrogen	Non Detect	54,000	Not Analyzed[20]	Not Analyzed [16]
Sulfur	Non Detect	99,000	Non Detect	878
Benzene	5	38	Non Detect	Non Detect
Ethyl Benzene	0.7	5.4	Non Detect	Non Detect
Formaldehyde	1.6	27	Non Detect	Non Detect
POM (PAH)	14	2,090	Non Detect	Non Detect
Styrene	1	26	Non Detect	Non Detect
Toluene	8.6	56	Non Detect	Non Detect
Xylene	4	28	Non Detect	Non Detect

In addition, the post-consumer plastics will be sufficiently processed using operations that transform the alternative fuel into a non-waste fuel. In general, processing steps will include:

1. **Segregation of non-plastic waste stream components such as metallic materials, wood, glass, paper and cardboard from the plastic components.** This is achieved by applying a range of methods which may include but is not limited to manual sorting, screening, magnet application, edy current analyzer, calibrated optical sorting, granulizer, drum separators, fluidized bed separators, and/or air separation.

2. **Separation of PVC plastic from non-PVC plastic.** This is achieved by applying a range of methods which may include but is not limited to near infrared spectroscopy (NIRS) system, calibrated optical sorter, air sorting, sink/float separation systems and/or manual sorting.

3. **Preparation into a fuel material that can be conveyed to the burner in the cement kiln system.** This is achieved by shredding, grinding and blending such that the plastic stream has uniform properties of granular size, energy content and density.

Not all processors will need to employ every step mentioned above.

[18] USEPA, Contaminant Concentrations in Traditional Fuels: Tables for Comparison; Literature Sources for Coal, November 29, 2011.
[19] Ranges represent analytical data compiled from results provided by PCA members. Data will be provided upon request to USEPA.
[20] Although the post-consumer plastic samples were not analyzed for nitrogen, it is expected that the range of nitrogen concentrations will be similar to that of pre-consumer plastic as found in Table 3.

Fabric/Fibers streams including industrial or commercial scrap such as cuttings, trimmings, fibers and fillers from pre-consumer recovery of carpet, textiles, fabrics, upholstery or furnishings and which are combusted in a cement kiln system.

Contaminant concentrations found in this category of alternative fuel are comparable to or less than the concentrations found in traditional solid fuels. A direct comparison of pre-combustion concentrations indicates that maximum concentrations of metals and halogens found in the fabric/fibers alternative fuel are generally less than those found in the traditional solid fuels that a cement kiln is designed to burn. In addition, the organic constituents for which there are analytical results exhibit concentrations an order of magnitude less than traditional solid fuel. Based on waste stream knowledge and origin, it is expected that organic constituents for which there are no analytical results would have similar concentrations or can be excluded based on generator knowledge. Thus, the alternative fuel satisfies the third legitimacy criteria defined in 40 CFR 241.3(d)(1)(iii).

Table 5. Contaminant Comparison of Traditional Solid Fuels and Fabric/Fiber Alternative Fuels

Contaminant	Traditional Solid Fuel[21]		Fabric/Fibers [22]	
	Minimum Concentration (ppm)	Maximum Concentration (ppm)	Minimum Concentration (ppm)	Maximum Concentration (ppm)
Antimony	Non Detect	26	Non Detect	45.4
Arsenic	Non Detect	298	Non Detect	2.9
Beryllium	Non Detect	206	Non Detect	0.071
Cadmium	Non Detect	19	Non Detect	0.41
Chromium	Non Detect	340	Non Detect	64
Cobalt	Non Detect	213	Non Detect	11.6
Lead	Non Detect	340	Non Detect	20.5
Manganese	Non Detect	15,800	Non Detect	99
Mercury	Non Detect	3.1	Non Detect	0.065
Nickel	Non Detect	730	Non Detect	75.1
Selenium	Non Detect	74.3	Non Detect	41.9
Chlorine	Non Detect	9,080	Non Detect	3,263
Fluorine	Non Detect	300	Non Detect	Non Detect
Nitrogen	Non Detect	54,000	Non Detect	43,200
Sulfur	Non Detect	99,000	Non Detect	Non Detect
Benzene	5	38	Non Detect	Non Detect
Ethyl Benzene	0.7	5.4	Non Detect	0.57
Formaldehyde	1.6	27	Non Detect	Non Detect
POM (PAH)	14	2,090	Non Detect	28
Styrene	1	26	Non Detect	Non Detect
Toluene	8.6	56	Non Detect	0.82
Xylene	4	28	Non Detect	2.31

Other Relevant Factors

The information in the above tables for each of the categories indicates that the concentrations of contaminants in the alternative fuel streams are less than or comparable to those found in traditional solid fuels. There are data indicating slightly higher concentrations of antimony in plastics and fabric/fiber streams. Trace amounts of antimony are present in the fabric/fibers streams due to the application of fire retardant and protective products containing the metal on the materials. Trace amounts of antimony are present in the plastics streams due to the use of antimony oxide as a catalyst for the reactions producing the plastic. The trace levels of antimony exist as part of the production of the material, are

[21] USEPA, Contaminant Concentrations in Traditional Fuels: Tables for Comparison; Literature Sources for Coal, November 29, 2011.
[22] Ranges represent analytical data compiled from results provided by PCA members. Data will be provided upon request to USEPA.

not significantly greater than the levels in traditional fuels and, therefore, are comparable to the range of antimony found in traditional solid fuels.

For the cement industry there are many relevant factors contributing to the utilization of alternative fuels which is driving the effort to obtain non-waste determinations for prevalent alternative fuel streams. When considering whether the categories of alternative fuels addressed by this petition are non-wastes, the agency can be assured that the fuel value is being recovered without an increased environmental or health impact. Of primary consideration, emissions of the contaminants are inherently controlled or incorporated into the product in the cement manufacturing process. Kiln systems are subject to the PC MACT emission standards (40 CFR 63, Subpart LLL), regardless of fuel type (historically for all non-hazardous waste fuel). The PC MACT emissions limits include PM as a surrogate for metals emissions, THC as a surrogate for non-dioxin organic emissions, D/F, HCl, and Hg. As part of the most recent regulatory development process updating the LLL rules, EPA has demonstrated that the limits set forth in the PC MACT rules are technologically advanced and protective of human health and the environment. Priority pollutants and GHG emissions are also controlled through industry CAA regulation and industry initiatives to reduce emissions.

Moreover, unlike any other "combustors" identified in the CISWI and NHSM rules, the cement kiln system's primary function is to make quality cement product. As such, the cement manufacturer monitors what goes into the kiln system in order to ensure that the elements for the chemical reactions taking place are conducive to yielding a product that meets quality specifications. Constituents that are detrimental to the quality of the product or that do not contribute to providing energy are not welcome in the cement kiln system as alternative fuels and are avoided by cement manufacturers. Accordingly, the cement industry has spent decades studying and understanding the fate of constituents in the manufacturing process, and has developed an extensive body of knowledge about system inputs and emissions.

This industrial process is unique among "combustors" identified in the CISWI and NHSM rules due to the use of large quantities of raw materials and fuels that contain organic and inorganic constituents and the inherent operating characteristics of the system. The operating conditions used to make high quality cement utilize, as fuel or incorporate into the clinker, most of the potential air pollutants that are part of the fuels and raw materials. Some of these operating conditions include (World Business Council 2005):[23]

- High temperatures (2,700°F to 3,500°F)
- Good mixing – of fuels, raw materials, and gases
- High residence time – Although the specific residence times of the various kilns systems varies, combustion gases in the kiln systems are typically at temperatures greater than 1800°F for at least 3-5 seconds, which is a longer period of time than the typical incinerator (approximately two seconds). The residence time for solid materials at or above 1800°F varies from tens of minutes to more than three hours. Consequently, the various materials in the kiln have a significant amount of time to interact to assure good combustion.
- Ability to accommodate large variations in the complex mixture of minerals and metals that naturally occur in fuels and raw materials.
- Inherent scrubbing effect of materials in the process which results in potential air pollutants being adsorbed into the product.

The high temperatures in combination with sufficient residence times result in complete combustion of alternative fuels, such as starch, vegetable oil, wood chips, or other forms of biomass/organic material. These alternative fuels have chemical bonds that are broken by the high temperature and retention times of the system. The products of complete combustion are carbon dioxide (CO_2) and water.[24] Cement kilns have continually shown through decades of testing that the high temperatures and long residence times are conducive to fully utilizing the value in the alternative fuel.

The following additionally documents industry knowledge on inherent emissions control for specific pollutants:

[23] As published in PCA R&D Serial No. SN3083.
[24] As published in PCA R&D Serial No. SN3083.

- Metals: There is a significant body of data and knowledge on the fate of metals that enter the kiln system through minor concentrations in the raw feed and fuels. Metal particles are either retained by the system as valuable ingredients in the clinker or collected in the air pollution control device. Large masses of ultra-fine solids in the kiln system, in combination with intense mixing also result in scrubbing of the relatively small concentrations of low volatility metals in fuel including chromium, beryllium, and nickel (which have boiling points over 4,000°F). These metals will primarily become intrinsically and permanently bound in the clinker and leave the system. Consequently, these and other constituents with similar properties are directly incorporated into the clinker as product rather than being emitted.[25] The high temperature clinkering reactions also allow incorporation of ash and in particular the chemical binding of metals to the clinker that prevent the metals from being emitted.
- Mercury: Volatile metals have low boiling points, can remain in the vapor phase throughout the process due to the high temperatures and can be emitted from the stack. Alternative fuels (generally with insignificant Hg content) replacing traditional fuels would result in lower Hg emissions when it replaces a fossil fuel with a higher naturally occurring Hg content.[26]
- Dioxins/Furans: Numerous studies have shown and EPA has recognized that there is no significant difference in the emissions of D/F from kilns using conventional fuels versus alternative fuels.[27] [28]

CONCLUSION

The NHSM alternative fuels that PCA has identified in this petition are not wastes when managed and combusted for energy recovery in accordance with 40 CFR 241.4(b)(1). The alternative fuels within the described categories are:

- not discarded or have been sufficiently processed, as necessary, and are managed in systems similar to traditional fuels,
- combusted for legitimate energy recovery,
- managed by all market participants as valuable commodities,
- comparable to and have the same fuel characteristics as commercial traditional fuels, and
- used within a reasonable time frame.

Also, the combustion of these alternative fuels supports sustainability objectives promoted by EPA, reducing diversion of these streams to landfills and lessening air pollution due to use of cleaner alternative fuels in place of fossil fuel at combustion facilities. PCA respectfully requests EPA's review and concurrence of the submitted information in support of this rulemaking petition for a non-waste determination for these additional NHSM fuels.

If you have any questions or comments about the information presented in this letter, please do not hesitate to contact me at cfranklin@cement.org or (202) 719-1977.

Sincerely,

Charles Franklin
Vice President & Counsel, Government Affairs
Portland Cement Association
Attachments

cc: Kathy Strubberg, Trinity Consultants, Inc.

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[25] As published in PCA R&D Serial No. SN3083.
[26] 64 FR 52858, September 30, 1999.
[27] EPA Assistant Administrator Bodine, Letter to the U.S. Green Building Council
[28] 64 FR52876, September 30, 1999.

ATTACHMENT

Data Summaries

PCA Petition for Determination Identifying Non-Hazardous Secondary Materials as Non-Waste for Categorical Listing under 40 CFR 241.4(a)

Data Summary for Paper/Cardboard Aternative Fuels

Parameter	Units	Coal Range [1]	Paper PA1	Paper PA2	Paper PA3	Paper PA4	Paper PA5	Paper PA6	Paper PA7	Paper PA8	Paper PA9
Energy Content	BTU/lb	---	7,041	10,000	7,435	8,020	7,078	---	---	---	15,656
Antimony (Sb)	mg/kg	0.5 - 10	< 10	< 10	< 10	< 5	< 5	< 1	Not anlayzed	4.21	12.9
Arsenic (As)	mg/kg	0.5 - 80	< 10	< 10	< 10	< 5	< 5	0.646	1.8	0.79	< 10
Beryllium (Be)	mg/kg	0.1 - 15	< 1	< 1	< 1	< 0.1	< 0.01	< 0.09	< 0.015	0.05	< 1
Cadmium (Cd)	mg/kg	0.1 - 3	< 1	< 1	< 1	< 5	< 5	0.107	1.01	0.04	< 1
Chromium (Cr)	mg/kg	0.5 - 60	< 10	< 10	< 10	< 5	< 5	9.9	12	Not anlayzed	< 10
Cobalt (Co)	mg/kg	0.5 - 30	< 10	< 10	< 10	< 20	< 20	< 10	Not anlayzed	Not anlayzed	< 10
Lead (Pb)	mg/kg	2 - 80	< 10	< 10	< 10	< 5	< 5	10.6	33	0.36	< 10
Manganese (Mn)	mg/kg	5 - 300	< 10	< 10	< 10	< 20	103	19	95	Not anlayzed	< 10
Mercury (Hg)	mg/kg	0.02 - 1	0.05	0.029	< 0.02	< 0.1	0.046	0.013	0.599	< 0.01	< 0.02
Nickel (Ni)	mg/kg	0.5 - 50	< 10	< 10	< 10	< 5	12.7	1.3	8.8	0.63	< 10
Selenium (Se)	mg/kg	0.2 - 10	< 10	< 10	< 10	< 5	< 5	Not analyzed	4.2	0.43	< 10
Chlorine (Cl)	mg/kg	ND - 9,080	1,149	< 500	3,329	< 1,000	2,570	747	2,987	601	7,318
Fluorine (F)	mg/kg	ND - 178	< 500	< 500	< 500	< 200	< 178	Not analyzed	29.5	Not analyzed	< 500
Sulfur (S)	mg/kg	740 - 61,300	4,160	2,500	1,031	1,031	3,500	700	4,500	0.1	567
Nitrogen	mg/kg	13,600 - 54,000	Not analyzed	Not analyzed	Not analyzed	Not analyzed	17,800	1,549	8400	0.2	Not analyzed
Benzene	mg/kg	ND - 38	ND	ND	ND	Not analyzed	Not analyzed	< 0.1	Not analyzed	Not analyzed	ND
Cumene	mg/kg		ND	ND	ND	Not analyzed	Not analyzed	ND	Not analyzed	Not analyzed	ND
Ethyl benzene	mg/kg	0.7 - 5.4	ND	ND	ND	Not analyzed	Not analyzed	ND	Not analyzed	Not analyzed	ND
Formaldehyde	mg/kg		ND	ND	ND	Not analyzed	Not analyzed	ND	Not analyzed	Not analyzed	ND
Hexane	mg/kg		ND	ND	ND	Not analyzed	Not analyzed	ND	Not analyzed	Not analyzed	ND
Naphthalene	mg/kg		ND	ND	ND	Not analyzed	Not analyzed	< 0.1	Not analyzed	Not analyzed	ND
PAH	mg/kg	14 - 2,090	ND	ND	ND	Not analyzed	Not analyzed	< 0.1	Not analyzed	Not analyzed	ND
Phenol	mg/kg		ND	ND	ND	Not analyzed	Not analyzed	ND	Not analyzed	Not analyzed	ND
Styrene	mg/kg	1.0 - 26	ND	ND	ND	Not analyzed	Not analyzed	ND	Not analyzed	Not analyzed	ND
Toluene	mg/kg	8.6 - 56	ND	ND	ND	Not analyzed	Not analyzed	0.195	Not analyzed	Not analyzed	ND
Xylenes	mg/kg	4.0 - 28	ND	ND	ND	Not analyzed	Not analyzed	ND	Not analyzed	Not analyzed	ND

[1] USEPA, Contaminant Concentrations in Traditional Fuels: Tables for Comparison; Table 1, Literature Sources for Coal, November 29, 2011.

Data Summary for Non-PVC Pre-Consumer and Post-Consumer Plastic Aternative Fuels

Parameter	Units	Coal Range [1]	Plastics PL1	Plastics PL2	Plastics PL3	Plastics PL4	Plastics PL5	Plastics PL6	Plastics PL7	Plastics PL8	Plastics PL9	Plastics PL10	Plastics PL11	Plastics PL12	Plastics PL13	Plastics PL14	Plastics PL15	Plastics PL16	Plastics PL17	Plastics PL18
Energy Content	BTU/lb	---	12,744	12,727	16,085	19,200	12,181	19,492	9,840	8,282	14,658	12,119	14,693	17,431				8,217	14,648	10,600
Antimony (Sb)	mg/kg	0.5 - 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	1.81	0.37	< 5	3	1.29	10	33.4	46.2	26.4
Arsenic (As)	mg/kg	0.5 - 80	< 10	< 10	< 10	18.4	< 10	< 10	< 10	< 10	< 10	0.13	1.04	< 5	5.2	0.85	3	< 10	< 10	< 10
Beryllium (Be)	mg/kg	0.1 - 15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0.142	0.177	< 0.1	< 0.24	< 0.18	< 0.21	< 1	< 1	< 1
Cadmium (Cd)	mg/kg	0.1 - 3	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0.13	3.51	< 5	1.6	< 0.22	< 0.44	< 1	< 1	< 1
Chromium (Cr)	mg/kg	0.5 - 60	< 10	< 10	< 10	< 10	< 10	< 10	< 10	101.4	13.6	3.83	27.4	< 5	19	0.8	59	< 10	12.5	< 10
Cobalt (Co)	mg/kg	0.5 - 30	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	0.7	1.76	< 5	1.8	0.71	15	< 10	< 10	< 10
Lead (Pb)	mg/kg	2 - 80	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	1.19	71.4	< 5	19	< 0.45	43	13.3	< 10	< 10
Manganese (Mn)	mg/kg	5 - 300	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	2.84	68.1	< 5	110	88.2	22	< 10	10.5	< 10
Mercury (Hg)	mg/kg	0.02 - 1	0.0442	0.2076	0.034	0.1	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.043	0.303	< 0.1	0.16	< 0.013	< 0.14	0.049	0.023	< 0.02
Nickel (Ni)	mg/kg	0.5 - 50	< 10	< 10	< 10	< 10	< 10	< 10	< 10	40.1	36.3	2.16	18.9	< 5	8.6	1.16	327	< 10	10.1	< 10
Selenium (Se)	mg/kg	0.2 - 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	15.7	< 10	1.01	0.12	< 5	< 1.9	< 0.45	< 6.78	< 10	< 10	< 10
Chlorine (Cl)	mg/kg	ND - 9,080	< 500	532	1,873	1,000	1,533	1,952	4,356	2,127	1,260	720	1,670	320	2,728	400	1,307	2,331	1,091	< 500
Fluorine (F)	mg/kg	ND - 178	< 500	< 500	< 500	< 500	< 500	< 500	1,075	< 500	< 500	43	36	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 500	< 500	< 500
Sulfur (S)	mg/kg	740 - 61,300	< 500	< 500	878	< 500	2,045	811	734	919	< 500	100	400	300	1,600	100	Not analyzed	< 500	510	< 500
Nitrogen	mg/kg	13,600 - 54,000	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	12,800	11,300	2,300	600	3,600	Not analyzed	Not analyzed	Not analyzed	Not analyzed
Benzene	mg/kg	ND - 38	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 1.1	< 0.57	Not analyzed	< 0.05	< 0.1	Not analyzed	ND	ND	ND
Biphenyl	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	Not analyzed	Not analyzed	Not analyzed				ND	ND	ND
Cumene	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	< 1.1	< 0.57	Not analyzed				ND	ND	ND
Ethyl benzene	mg/kg	0.7 - 5.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 1.1	< 0.57	Not analyzed	< 0.05	0.789	Not analyzed	ND	ND	ND
Formaldehyde	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	Not analyzed	Not analyzed	Not analyzed				ND	ND	ND
Hexane	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	Not analyzed	Not analyzed	Not analyzed				ND	ND	ND
Naphthalene	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	< 1.1	< 0.57	Not analyzed				ND	ND	ND
PAH	mg/kg	14 - 2,090	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6 -15	4.3 - 22	Not analyzed	< 0.05	< 0.05	Not analyzed	ND	ND	ND
Phenol	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	Not analyzed	Not analyzed	Not analyzed				ND	ND	ND
Styrene	mg/kg	1.0 - 26	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 1.1	0.82	Not analyzed	< 0.05	< 0.1	Not analyzed	ND	ND	ND
Toluene	mg/kg	8.6 - 56	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 1.1	0.17	Not analyzed	< 0.05	< 0.1	Not analyzed	ND	ND	ND
Xylenes	mg/kg	4.0 - 28	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 1.1	0.2	Not analyzed	< 0.05	6.69	Not analyzed	ND	ND	ND

[1] USEPA, Contaminant Concentrations in Traditional Fuels: Tables for Comparison; Table 1, Literature Sources for Coal, November 29, 2011.

Data Summary for Fabric / Fiber Aternative Fuels

Parameter	Units	Coal Range [1]	Fabric/Fiber FF1	Fabric/Fiber FF2	Fabric/Fiber FF3	Fabric/Fiber FF4	Fabric/Fiber FF5	Fabric/Fiber FF6	Fabric/Fiber FF7	Fabric/Fiber FF8	Fabric/Fiber FF9	Fabric/Fiber FF10
Energy Content	BTU/lb	---	9,600	14,028	14,419	9,870				12,667	10,546	15,009
Antimony (Sb)	mg/kg	0.5 - 10	< 10	29.8	< 10	< 5	< 0.01	< 0.01	3.2	9.9	40.7	45.4
Arsenic (As)	mg/kg	0.5 - 80	< 10	< 10	< 10	< 5	< 0.01	1.6	1.2	2.9	< 10	< 10
Beryllium (Be)	mg/kg	0.1 - 15	< 1	< 1	< 1	0.071	< 0.01	< 0.01	< 0.01	< 0.018	< 1	< 1
Cadmium (Cd)	mg/kg	0.1 - 3	< 1	< 1	< 1	< 5	0.41	< 0.01	< 0.01	< 0.25	< 1	< 1
Chromium (Cr)	mg/kg	0.5 - 60	10	< 10	64	23.5	8	5.5	15	2.8	< 10	< 10
Cobalt (Co)	mg/kg	0.5 - 30	< 10	< 10	11.6	< 20	10	1.8	1	0.71	< 10	< 10
Lead (Pb)	mg/kg	2 - 80	< 10	< 10	20.5	7	3.1	15	1.1	3.4	< 10	< 10
Manganese (Mn)	mg/kg	5 - 300	< 10	< 10	< 10	< 20	50	99	87	Not analyzed	26.4	< 10
Mercury (Hg)	mg/kg	0.02 - 1	0.04	< 0.02	0.028	0.039	< 0.01	0.065	< 0.01	0.11	0.061	0.039
Nickel (Ni)	mg/kg	0.5 - 50	< 10	< 10	75.1	< 5	1.7	7.6	0.99	11	< 10	< 10
Selenium (Se)	mg/kg	0.2 - 10	< 10	< 10	41.9	< 5	< 0.01	< 0.01	< 0.01	< 1.7	< 10	< 10
Chlorine (Cl)	mg/kg	ND - 9,080	< 500	2,635	1,658	1,400	Not analyzed	Not analyzed	Not analyzed	400	3,263	850
Fluorine (F)	mg/kg	ND - 178	< 500	< 500	< 500	< 178	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 500	< 500
Sulfur (S)	mg/kg	740 - 61,300	< 500	5,646	1,353	1,700	900	12,400	500	500	1539	< 500
Nitrogen	mg/kg	13,600 - 54,000	Not analyzed	Not analyzed	Not analyzed	43,200	6,880	3,000	5,930	9,150	Not analyzed	Not analyzed
Benzene	mg/kg	ND - 38	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	< 1.2	Not analyzed
Biphenyl	mg/kg		Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	Not analyzed	Not analyzed
Cumene	mg/kg		Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	< 1.2	Not analyzed
Ethyl benzene	mg/kg	0.7 - 5.4	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	0.57	Not analyzed
Formaldehyde	mg/kg		Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	Not analyzed	Not analyzed
Hexane	mg/kg		Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	Not analyzed	Not analyzed
Naphthalene	mg/kg		Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	< 1.2	Not analyzed
PAH	mg/kg	14 - 2,090	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	6.6 - 28	Not analyzed
Phenol	mg/kg		Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	Not analyzed	Not analyzed
Styrene	mg/kg	1.0 - 26	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	< 1.2	Not analyzed
Toluene	mg/kg	8.6 - 56	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	0.82	Not analyzed
Xylenes	mg/kg	4.0 - 28	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed	< 0.20	2.31	Not analyzed

[1] USEPA, Contaminant Concentrations in Traditional Fuels: Tables for Comparison; Table 1, Literature Sources for Coal, November 29, 2011.