BTEC Inc.

# Kiln 19 (EU FUEL PULV 19, 36-K19) and Kiln 20 (EU FUEL PULV 20, 36-K20) Particulate Matter Emissions Test Summary Report

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*Prepared for:*

**Lafarge**

Alpena Plant
1435 Ford Avenue
Alpena, Michigan

Project No. 16-4952.00
January 25, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(248) 548-8070

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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# RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

*Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.*

**Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating (RO) Permit program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.**

Source Name Lafarge Midwest Inc. County Alpena

Source Address 1435 Ford Ave. City Alpena

AQD Source ID (SRN) B1477 RO Permit No. MI-ROP-B1477-2012a RO Permit Section No. _____

Please check the appropriate box(es):

☐ **Annual Compliance Certification (General Condition No. 28 and No. 29 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (General Condition No. 23 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 12/13/2016 To 12/14/2016

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:

Kiln 19 (EU FUEL PULV 19, 36-K19) and Kiln 20 (EU PUEL PULV 20, 36-K20)

Particulate Matter Emission Test Summary Report

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete.

| Paul Rogers | Plant Manager | 989-354-4171 |
|---|---|---|
| Name of Responsible Official (print or type) | Title | Phone Number |
| Signature of Responsible Official | | Date 1/28/2017 |

* Photocopy this form as needed.

EQP 5736 (Rev 9/01)

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## EXECUTIVE SUMMARY

Lafarge North America (Lafarge) operates five dry process cement kilns (Kilns 19-23) at its plant in Alpena, Michigan (EPA Facility ID #MID005379607). Kiln Nos. 19, 20, and 21 are collectively known as Kiln Group 5 (KG5). Kiln Nos. 22 and 23 are collectively known as Kiln Group 6 (KG6). The Kiln Group 5 kilns are smaller than the Kiln Group 6 kilns but are of similar overall design. Each kiln has had an indirect firing system added to the low side of the kiln to preheat the coal before it goes into the kiln.

Lafarge retained BT Environmental Consulting, Inc. (BTEC) to measure filterable and condensable particulate matter emission rates from each fuel handling system dust collector for each of the five kilns. BTEC measured filterable and condensable particulate matter emission rates from the Kilns 19 and 20 fuel handling system dust collectors (stacks 36-K19 and 36-K20) on December 13 and 14, 2016.

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

Testing for the Kiln 19 system was conducted on December 13, 2016. The average Kiln 19 system filterable PM emission rate was 0.01 lbs/1,000 lbs, dry. The average Kiln 19 system total PM emission rate was 0.8 lbs/hr. Consequently, these test runs demonstrated compliance with the emission limitations for filterable PM and $PM_{10}$.

Testing for the Kiln 20 system was conducted on December 13, 2016 and December 14, 2016. Two test runs were conducted on December 13. For these two test runs, the average Kiln 20 system filterable PM emission rate was 0.12 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 9.8 lbs/hr. Consequently, these two test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

Three additional test runs were conducted on the Kiln 20 system on December 14, 2016. For these three test runs, the average Kiln 20 system filterable PM emission rate was 0.06 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 4.6 lbs/hr. Consequently, these three test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

It should be noted that, for all Kiln 20 test runs, the filterable portion of the total particulate emission rate was a minimum of 98%. It is almost certain that the majority of the filterable portion was greater than 10 microns in diameter. In summary, the emissions testing

demonstrated compliance with the emission limitations for Kiln 19 but were inconclusive with respect to the emission limitations for Kiln 20.

## 1. Introduction

Lafarge North America (Lafarge) operates five dry process cement kilns (Kilns 19-23) at its plant in Alpena, Michigan (EPA Facility ID #MID005379607). Kiln Nos. 19, 20, and 21 are collectively known as Kiln Group 5 (KG5). Kiln Nos. 22 and 23 are collectively known as Kiln Group 6 (KG6). The Kiln Group 5 kilns are smaller than the Kiln Group 6 kilns but are of similar overall design. Each kiln has had an indirect firing system added to the low side of the kiln to preheat the coal before it goes into the kiln.

Lafarge retained BT Environmental Consulting, Inc. (BTEC) to measure filterable and condensable particulate matter emission rates from each fuel handling system dust collector for each of the five kilns. BTEC measured filterable and condensable particulate matter emission rates from the Kilns 19 and 20 fuel handling system dust collectors (stacks 36-K19 and 36-K20) on December 13 and 14, 2016.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

### 1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on December 13 and 14, 2016 at the Lafarge facility located in Alpena, Michigan.

### 1.b Purpose of Testing

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

### 1.c Source Description

The control devices are baghouse dust collectors.

### 1.d Test Program Contacts

The contacts for the source and test report are:

Mr. Travis Weide
Area Environmental & Public Affairs Manager
LafargeHolcim
1435 Ford Avenue
Alpena, Michigan 49707

Mr. Brian Joyce
Area Environmental Coordinator
LafargeHolcim
1435 Ford Avenue
Alpena, Michigan 49707

Mr. Barry Boulianne
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(313) 449-2361

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

**Table 2**
**Test Personnel**

| Name and Title | Affiliation | Telephone |
|---|---|---|
| Mr. Barry Boulianne<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Matt Young<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Steve Smith<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Mike Nummer<br>Environmental Technician | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Shane Rabideau<br>Environmental Technician | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Brian Joyce<br>LafargeHolcim | Lafarge – Alpena Plant<br>1435 Ford Avenue<br>Alpena, Michigan 49707 | (989) 916-4854 |

## 2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

### 2.a Operating Data

Kiln production rate and baghouse pressure drop is available in Appendix E.

### 2.b Applicable Permit

AQD issued Renewable Operating Permit MI-ROP-B1477-2012b to Lafarge North America.

### 2.c Results

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

Testing for the Kiln 19 system was conducted on December 13, 2016. The average Kiln 19 system filterable PM emission rate was 0.01 lbs/1,000 lbs, dry. The average Kiln 19 system total PM emission rate was 0.8 lbs/hr. Consequently, these test runs demonstrated compliance with the emission limitations for filterable PM and $PM_{10}$.

Testing for the Kiln 20 system was conducted on December 13, 2016 and December 14, 2016. Two test runs were conducted on December 13. For these two test runs, the average Kiln 20 system filterable PM emission rate was 0.12 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 9.8 lbs/hr. Consequently, these two test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

Three additional test runs were conducted on the Kiln20 system on December 14. For these three test runs, the average Kiln 20 system filterable PM emission rate was 0.06 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 4.6 lbs/hr. Consequently, these three test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

It should be noted that, for all Kiln 20 test runs, the filterable portion of the total particulate emission rate was a minimum of 98%. It is almost certain that the majority of the filterable portion was greater than 10 microns in diameter. In summary, the emissions testing

demonstrated compliance with the emission limitations for Kiln 19 but were inconclusive with respect to the emission limitations for Kiln 20.

## 3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

### 3.a Process Description

A mixture of pulverized bituminous coal, petroleum coke, and asphalt shingles with a heating value of approximately 11,750 Btu per pound, serves as the primary fuel fed to the kilns. Coal and coke are fed to a Raymond bowl mill and ground to a fineness of approximately 95% passing a 200-mesh sieve. Each kiln includes an indirectly fired fuel pre-heater system.

### 3.b Process Flow Diagram

A process flow diagram is available on request.

### 3.c Raw and Finished Materials

A mixture of pulverized bituminous coal, petroleum coke, and asphalt shingles with a heating value of approximately 11,750 Btu per pound, serves as the primary fuel fed to the kilns. Coal and coke are fed to a Raymond bowl mill and ground to a fineness of approximately 95% passing a 200-mesh sieve. Each kiln includes an indirectly fired fuel pre-heater system.

### 3.d Process Capacity

Each baghouse is rated for the maximum exhaust gas flowrate from each system and the efficiencies are equivalent to that necessary to achieve the corresponding emission limitations.

### 3.e Process Instrumentation

Proper operation of the baghouse dust collectors is verified by baghouse pressure drop monitoring.

## 4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

### 4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources" (Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2 (see Figure 2 and 3 for a schematic of the sampling location). S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2, Section 4.1.1, were used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

A cyclonic flow check was performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angle is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

Molecular weight was determined according to USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the PM and lead sampling trains and passed through the impinger configuration (see Figure 1). Exhaust gas moisture content was then determined gravimetrically.

### 4.b Particulate Matter (USEPA Method 17/202)

40 CFR 60, Appendix A, Method 17, *"Determination of Particulate Emissions from Stationary Sources"* and40 CFR 51, Appendix M, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 1 for a schematic of the sampling train). Triplicate60-minute test runs were conducted on each source.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) an in stack stainless-steel filter housing, (3) a steel probe, (4) a vertical condenser, (5) an empty pot bellied impinger, (6) an empty modified Greenburg-

BTEC Inc.

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*Prepared for:*

**Lafarge**

Alpena Plant
1435 Ford Avenue
Alpena, Michigan

Project No. 16-4952.00
January 25, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
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Source Name: Lafarge Midwest Inc. County: Alpena

Source Address: 1435 Ford Ave. City: Alpena

AQD Source ID (SRN): B1477 RO Permit No.: MI-ROP-B1477-2012a RO Permit Section No.:

Please check the appropriate box(es):

☐ **Annual Compliance Certification (General Condition No. 28 and No. 29 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

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☐ **Semi-Annual (or More Frequent) Report Certification (General Condition No. 23 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

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☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 12/13/2016 To 12/14/2016

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:

Kiln 19 (EU FUEL PULV 19, 36-K19) and Kiln 20 (EU PUEL PULV 20, 36-K20)

Particulate Matter Emission Test Summary Report

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete.

| Paul Rogers | Plant Manager | 989-354-4171 |
|---|---|---|
| Name of Responsible Official (print or type) | Title | Phone Number |
| Signature of Responsible Official | | Date 1/28/2017 |

* Photocopy this form as needed.

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## EXECUTIVE SUMMARY

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The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

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Three additional test runs were conducted on the Kiln 20 system on December 14, 2016. For these three test runs, the average Kiln 20 system filterable PM emission rate was 0.06 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 4.6 lbs/hr. Consequently, these three test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

It should be noted that, for all Kiln 20 test runs, the filterable portion of the total particulate emission rate was a minimum of 98%. It is almost certain that the majority of the filterable portion was greater than 10 microns in diameter. In summary, the emissions testing

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## 1. Introduction

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### 1.c Source Description

The control devices are baghouse dust collectors.

### 1.d Test Program Contacts

The contacts for the source and test report are:

Mr. Travis Weide
Area Environmental & Public Affairs Manager
LafargeHolcim
1435 Ford Avenue
Alpena, Michigan 49707

Mr. Brian Joyce
Area Environmental Coordinator
LafargeHolcim
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Alpena, Michigan 49707

Mr. Barry Boulianne
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(313) 449-2361

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

**Table 2**
**Test Personnel**

| Name and Title | Affiliation | Telephone |
|---|---|---|
| Mr. Barry Boulianne<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Matt Young<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Steve Smith<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Mike Nummer<br>Environmental Technician | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Shane Rabideau<br>Environmental Technician | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Brian Joyce<br>LafargeHolcim | Lafarge – Alpena Plant<br>1435 Ford Avenue<br>Alpena, Michigan 49707 | (989) 916-4854 |

## 2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

### 2.a Operating Data

Kiln production rate and baghouse pressure drop is available in Appendix E.

### 2.b Applicable Permit

AQD issued Renewable Operating Permit MI-ROP-B1477-2012b to Lafarge North America.

### 2.c Results

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

Testing for the Kiln 19 system was conducted on December 13, 2016. The average Kiln 19 system filterable PM emission rate was 0.01 lbs/1,000 lbs, dry. The average Kiln 19 system total PM emission rate was 0.8 lbs/hr. Consequently, these test runs demonstrated compliance with the emission limitations for filterable PM and $PM_{10}$.

Testing for the Kiln 20 system was conducted on December 13, 2016 and December 14, 2016. Two test runs were conducted on December 13. For these two test runs, the average Kiln 20 system filterable PM emission rate was 0.12 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 9.8 lbs/hr. Consequently, these two test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

Three additional test runs were conducted on the Kiln20 system on December 14. For these three test runs, the average Kiln 20 system filterable PM emission rate was 0.06 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 4.6 lbs/hr. Consequently, these three test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

It should be noted that, for all Kiln 20 test runs, the filterable portion of the total particulate emission rate was a minimum of 98%. It is almost certain that the majority of the filterable portion was greater than 10 microns in diameter. In summary, the emissions testing

demonstrated compliance with the emission limitations for Kiln 19 but were inconclusive with respect to the emission limitations for Kiln 20.

## 3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

### 3.a Process Description

A mixture of pulverized bituminous coal, petroleum coke, and asphalt shingles with a heating value of approximately 11,750 Btu per pound, serves as the primary fuel fed to the kilns. Coal and coke are fed to a Raymond bowl mill and ground to a fineness of approximately 95% passing a 200-mesh sieve. Each kiln includes an indirectly fired fuel pre-heater system.

### 3.b Process Flow Diagram

A process flow diagram is available on request.

### 3.c Raw and Finished Materials

A mixture of pulverized bituminous coal, petroleum coke, and asphalt shingles with a heating value of approximately 11,750 Btu per pound, serves as the primary fuel fed to the kilns. Coal and coke are fed to a Raymond bowl mill and ground to a fineness of approximately 95% passing a 200-mesh sieve. Each kiln includes an indirectly fired fuel pre-heater system.

### 3.d Process Capacity

Each baghouse is rated for the maximum exhaust gas flowrate from each system and the efficiencies are equivalent to that necessary to achieve the corresponding emission limitations.

### 3.e Process Instrumentation

Proper operation of the baghouse dust collectors is verified by baghouse pressure drop monitoring.

## 4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

### 4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources" (Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2 (see Figure 2 and 3 for a schematic of the sampling location). S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2, Section 4.1.1, were used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

A cyclonic flow check was performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angle is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

Molecular weight was determined according to USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the PM and lead sampling trains and passed through the impinger configuration (see Figure 1). Exhaust gas moisture content was then determined gravimetrically.

### 4.b Particulate Matter (USEPA Method 17/202)

40 CFR 60, Appendix A, Method 17, *"Determination of Particulate Emissions from Stationary Sources"* and40 CFR 51, Appendix M, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 1 for a schematic of the sampling train). Triplicate60-minute test runs were conducted on each source.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) an in stack stainless-steel filter housing, (3) a steel probe, (4) a vertical condenser, (5) an empty pot bellied impinger, (6) an empty modified Greenburg-

Smith (GS) impinger, (7) unheated filter holder with a teflon filter, (8) a second modified GS impinger with 100 ml of deionized water, and a third modified GS impinger containing approximately 300 g of silica gel desiccant, (9) a length of sample line, and (10) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The impinger train was then purged with nitrogen for one hour at a flow rate of 14 liters per minute. The CPM filter was recovered and placed in a petri dish. The back half of the filter housing, the condenser, the pot bellied impinger, the moisture drop out impinger, and the front half of the CPM filter housing and all connecting glassware were double rinsed with deionized water which was collected in a pre-cleaned sample container. The same glassware was then rinsed with acetone which was collected in a pre-cleaned sample container labeled as the organic fraction. The glassware was then double rinsed with hexane which was added to the same organic fraction sample bottle.

BTEC labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition blank samples of the acetone and filter were collected. BTEC personnel carried all samples to BTEC's laboratory (for filter and acetone gravimetric analysis) in Royal Oak, Michigan. 40 CFR 60, Appendix A, Method 17, *"Determination of Particulate Emissions from Stationary Sources"* and40 CFR 60, Appendix A, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 1 for a schematic of the sampling train). Triplicate 60-minute test runs were conducted for each source.

The 202 samples were sent to Maxxam Analytical in Ontario, Canada.

### 4.c Recovery and Analytical Procedures

Filterable particulate matter samples were processed at BTEC's laboratory in Royal Oak, Michigan. Condensable particulate matter samples were sent to Maxxam Laboratories in Ontario, Canada.

### 4.d Sampling Ports

Diagrams of the stacks showing sampling ports in relation to upstream and downstream disturbances are included as Figures 2 and 3.



### 4.e Traverse Points

Diagrams of the stacks indicating traverse point locations and stack dimensions are included as Figures 2 and 3.

## 5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

### 5.a Results Tabulation

Detailed results for the emissions test program are summarized by Tables 4, 5, and 6.

### 5.b Discussion of Results

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

Testing for the Kiln 19 system was conducted on December 13, 2016. The average Kiln 19 system filterable PM emission rate was 0.01 lbs/1,000 lbs, dry. The average Kiln 19 system total PM emission rate was 0.8 lbs/hr. Consequently, these test runs demonstrated compliance with the emission limitations for filterable PM and $PM_{10}$.

Testing for the Kiln 20 system was conducted on December 13, 2016 and December 14, 2016. Two test runs were conducted on December 13. For these two test runs, the average Kiln 20 system filterable PM emission rate was 0.12 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 9.8 lbs/hr. Consequently, these two test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

Three additional test runs were conducted on the Kiln20 system on December 14, 2016. For these three test runs, the average Kiln 20 system filterable PM emission rate was 0.06 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 4.6 lbs/hr. Consequently, these three test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

It should be noted that, for all Kiln 20 test runs, the filterable portion of the total particulate emission rate was a minimum of 98%. It is almost certain that the majority of the filterable portion was greater than 10 microns in diameter. In summary, the emissions testing demonstrated compliance with the emission limitations for Kiln 19 but were inconclusive with respect to the emission limitations for Kiln 20.

### 5.c Sampling Procedure Variations

Following completion of two test runs on Kiln 20 on December 13, 2016 it appeared that the particulate loading on the filters was greater than anticipated. Consequently, testing was discontinued and baghouse maintenance was completed. The Kiln 20 system was shut down and a baghouse inspection was completed to determine why it was malfunctioning. This was performed before prior to conducting an additional three test runs on December 14, 2016.

### 5.d Process or Control Device Upsets

It appeared there was more particulate on the filters than normal after the first two test runs were completed for the stack testing.

### 5.e Control Device Maintenance

The bags in the baghouse dust collector were inspected for holes and were replaced as needed.

### 5.f Re-Test

The emissions test program was not a re-test.

### 5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

### 5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix B.

### 5.i Sample Calculations

Sample calculations are provided in Appendix C.

### 5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

### 5.k Laboratory Data

Laboratory analytical results for this test program are presented in Appendix D.

**Table 4**
**Kiln 19 Particulate Matter Emission Rates**

| | | | | |
|---|---|---|---|---|
| **Company** | **Lafarge** | | | |
| **Source Designation** | **Kiln 19** | | | |
| **Test Date** | **12/13/2016** | **12/13/2016** | **12/13/2016** | |
| **Meter/Nozzle Information** | Run 1 | Run 2 | Run 3 | Average |
| Meter Temperature Tm (F) | 58.5 | 56.9 | 55.2 | 56.9 |
| Meter Pressure - Pm (in. Hg) | 29.7 | 29.7 | 29.7 | 29.7 |
| Measured Sample Volume (Vm) | 55.4 | 53.5 | 56.2 | 55.0 |
| Sample Volume (Vm-Std ft3) | 56.4 | 54.6 | 57.6 | 56.2 |
| Sample Volume (Vm-Std m3) | 1.60 | 1.55 | 1.63 | 1.59 |
| Condensate Volume (Vw-std) | 1.910 | 1.829 | 1.730 | 1.823 |
| Gas Density (Ps(std) lbs/ft3) (wet) | 0.0736 | 0.0736 | 0.0737 | 0.0737 |
| Gas Density (Ps(std) lbs/ft3) (dry) | 0.0745 | 0.0745 | 0.0745 | 0.0745 |
| Total weight of sampled gas (m g lbs) (wet) | 4.29 | 4.16 | 4.37 | 4.27 |
| Total weight of sampled gas (m g lbs) (dry) | 4.21 | 4.07 | 4.29 | 4.19 |
| Nozzle Size - An (sq. ft.) | 0.000241 | 0.000241 | 0.000241 | 0.000241 |
| Isokinetic Variation - I | 101.1 | 101.0 | 100.7 | 100.9 |
| **Stack Data** | | | | |
| Average Stack Temperature - Ts (F) | 138.4 | 136.8 | 136.7 | 137.3 |
| Molecular Weight Stack Gas- dry (Md) | 28.8 | 28.8 | 28.8 | 28.8 |
| Molecular Weight Stack Gas-wet (Ms) | 28.5 | 28.5 | 28.5 | 28.5 |
| Stack Gas Specific Gravity (Gs) | 0.983 | 0.984 | 0.985 | 0.984 |
| Percent Moisture (Bws) | 3.27 | 3.24 | 2.92 | 3.14 |
| Water Vapor Volume (fraction) | 0.0327 | 0.0324 | 0.0292 | 0.0314 |
| Pressure - Ps ("Hg) | 29.4 | 29.4 | 29.4 | 29.4 |
| Average Stack Velocity -Vs (ft/sec) | 76.9 | 74.3 | 78.2 | 76.4 |
| Area of Stack (ft2) | 4.1 | 4.1 | 4.1 | 4.1 |
| **Exhaust Gas Flowrate** | | | | |
| Flowrate $ft^3$(Actual) | 19,010 | 18,368 | 19,352 | 18,910 |
| Flowrate $ft^3$ (Standard Wet) | 16,483 | 15,971 | 16,828 | 16,427 |
| Flowrate $ft^3$ (Standard Dry) | 15,943 | 15,453 | 16,338 | 15,911 |
| Flowrate $m^3$ (standard dry) | 451 | 438 | 463 | 451 |
| **Total Particulate Weights (mg)** | | | | |
| Total Nozzle/Probe/Filter | 15.0 | 14.0 | 15.9 | 15.0 |
| Organic Condensible Particulate | 0.8 | 0.6 | 1.3 | 0.9 |
| Inorganic Condensible Particulate | 4.3 | 4.8 | 8.9 | 6.0 |
| Condensible Blank Correction | 2.0 | 2.0 | 2.0 | 2.0 |
| Total Condensible Particulate | 3.1 | 3.4 | 8.2 | 4.9 |
| Total Filterable and Condensible Particulate | 18.1 | 17.4 | 24.1 | 19.9 |
| **Filterable Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.008 | 0.007 | 0.008 | 0.008 |
| lb/1000 lb (dry) | 0.008 | 0.008 | 0.008 | 0.008 |
| mg/dscm (dry) | 9.4 | 9.1 | 9.8 | 9.4 |
| gr/dscf | 0.0041 | 0.0040 | 0.0043 | 0.0041 |
| **Filterable Particulate Emission Rate** | | | | |
| lb/ hr | 0.56 | 0.53 | 0.60 | 0.56 |
| **Condensible Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.002 | 0.002 | 0.004 | 0.003 |
| lb/1000 lb (dry) | 0.002 | 0.002 | 0.004 | 0.003 |
| mg/dscm (dry) | 1.9 | 2.2 | 5.0 | 3.1 |
| gr/dscf | 0.0008 | 0.0010 | 0.0022 | 0.0013 |
| **Condensible Particulate Emission Rate** | | | | |
| lb/ hr | 0.12 | 0.13 | 0.31 | 0.18 |
| **Total Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.009 | 0.009 | 0.012 | 0.010 |
| lb/1000 lb (dry) | 0.009 | 0.009 | 0.012 | 0.010 |
| mg/dscm (dry) | 11.3 | 11.3 | 14.8 | 12.5 |
| gr/dscf | 0.0050 | 0.0049 | 0.0065 | 0.0054 |
| **Total Particulate Emission Rate** | | | | |
| lb/ hr | 0.68 | 0.65 | 0.91 | 0.75 |

**Table 5**
**Kiln 20 Particulate Matter Emission Rates – December 13, 2016**

| **Company** | **Lafarge** | | |
|---|---|---|---|
| **Source Designation** | **Kiln 20** | | |
| **Test Date** | **12/13/2016** | **12/13/2016** | |
| **Meter/Nozzle Information** | Run 1 | Run 2 | Average |
| Meter Temperature Tm (F) | 38.0 | 39.5 | 38.7 |
| Meter Pressure - Pm (in. Hg) | 29.6 | 29.6 | 29.6 |
| Measured Sample Volume (Vm) | 46.5 | 39.7 | 43.1 |
| Sample Volume (Vm-Std ft3) | 49.0 | 41.7 | 45.3 |
| Sample Volume (Vm-Std m3) | 1.39 | 1.18 | 1.28 |
| Condensate Volume (Vw-std) | 1.608 | 1.542 | 1.575 |
| Gas Density (Ps(std) lbs/ft3) (wet) | 0.0736 | 0.0735 | 0.0736 |
| Gas Density (Ps(std) lbs/ft3) (dry) | 0.0745 | 0.0745 | 0.0745 |
| Total weight of sampled gas (m g lbs) (wet) | 3.73 | 3.18 | 3.45 |
| Total weight of sampled gas (m g lbs) (dry) | 3.65 | 3.10 | 3.38 |
| Nozzle Size - An (sq. ft.) | 0.000197 | 0.000167 | 0.000182 |
| Isokinetic Variation - I | 101.0 | 101.4 | 101.2 |
| **Stack Data** | | | |
| Average Stack Temperature - Ts (F) | 130.2 | 130.4 | 130.3 |
| Molecular Weight Stack Gas- dry (Md) | 28.8 | 28.8 | 28.8 |
| Molecular Weight Stack Gas-wet (Ms) | 28.5 | 28.4 | 28.5 |
| Stack Gas Specific Gravity (Gs) | 0.984 | 0.982 | 0.983 |
| Percent Moisture (Bws) | 3.18 | 3.57 | 3.37 |
| Water Vapor Volume (fraction) | 0.0318 | 0.0357 | 0.0337 |
| Pressure - Ps ("Hg) | 29.4 | 29.4 | 29.4 |
| Average Stack Velocity -Vs (ft/sec) | 80.4 | 80.6 | 80.5 |
| Area of Stack (ft2) | 4.3 | 4.3 | 4.3 |
| **Exhaust Gas Flowrate** | | | |
| Flowrate $ft^3$(Actual) | 20,622 | 20,673 | 20,647 |
| Flowrate $ft^3$ (Standard Wet) | 18,126 | 18,164 | 18,145 |
| Flowrate $ft^3$ (Standard Dry) | 17,550 | 17,516 | 17,533 |
| Flowrate $m^3$ (standard dry) | 497 | 496 | 496 |
| **Total Particulate Weights (mg)** | | | |
| Total Nozzle/Probe/Filter | 215.0 | 165.2 | 190.1 |
| Organic Condensible Particulate | 0.6 | 0.7 | 0.7 |
| Inorganic Condensible Particulate | 2.9 | 4.0 | 3.5 |
| Condensible Blank Correction | 2.0 | 2.0 | 2.0 |
| Total Condensible Particulate | 1.5 | 2.7 | 2.1 |
| Total Filterable and Condensible Particulate | 216.5 | 167.9 | 192.2 |
| **Filterable Particulate Concentration** | | | |
| lb/1000 lb (wet) | 0.127 | 0.115 | 0.121 |
| lb/1000 lb (dry) | 0.130 | 0.117 | 0.124 |
| mg/dscm (dry) | 155.0 | 140.1 | 147.5 |
| gr/dscf | 0.0678 | 0.0612 | 0.0645 |
| **Filterable Particulate Emission Rate** | | | |
| lb/ hr | 10.23 | 9.22 | 9.73 |
| **Condensible Particulate Concentration** | | | |
| lb/1000 lb (wet) | 0.001 | 0.002 | 0.001 |
| lb/1000 lb (dry) | 0.001 | 0.002 | 0.001 |
| mg/dscm (dry) | 1.1 | 2.3 | 1.7 |
| gr/dscf | 0.0005 | 0.0010 | 0.0007 |
| **Condensible Particulate Emission Rate** | | | |
| lb/ hr | 0.07 | 0.15 | 0.11 |
| **Total Particulate Concentration** | | | |
| lb/1000 lb (wet) | 0.128 | 0.117 | 0.122 |
| lb/1000 lb (dry) | 0.131 | 0.119 | 0.125 |
| mg/dscm (dry) | 156.1 | 142.4 | 149.2 |
| gr/dscf | 0.0682 | 0.0622 | 0.0652 |
| **Total Particulate Emission Rate** | | | |
| lb/ hr | 10.30 | 9.37 | 9.84 |

**Table 6**
**Kiln 20 Particulate Matter Emission Rates – December 14, 2016**

| | | | | |
|---|---|---|---|---|
| **Company** | **Lafarge** | | | |
| **Source Designation** | **Kiln 20** | | | |
| **Test Date** | **12/14/2016** | **12/14/2016** | **12/14/2016** | |
| **Meter/Nozzle Information** | Run 3 | Run 4 | Run 5 | Average |
| Meter Temperature Tm (F) | 59.7 | 46.7 | 46.1 | 50.8 |
| Meter Pressure - Pm (in. Hg) | 29.3 | 29.3 | 29.3 | 29.3 |
| Measured Sample Volume (Vm) | 39.0 | 37.5 | 38.8 | 38.4 |
| Sample Volume (Vm-Std ft3) | 38.2 | 37.6 | 39.0 | 38.3 |
| Sample Volume (Vm-Std m3) | 1.08 | 1.06 | 1.11 | 1.08 |
| Condensate Volume (Vw-std) | 1.589 | 1.867 | 1.872 | 1.776 |
| Gas Density (Ps(std) lbs/ft3) (wet) | 0.0734 | 0.0732 | 0.0732 | 0.0733 |
| Gas Density (Ps(std) lbs/ft3) (dry) | 0.0745 | 0.0745 | 0.0745 | 0.0745 |
| Total weight of sampled gas (m g lbs) (wet) | 2.92 | 2.89 | 3.00 | 2.94 |
| Total weight of sampled gas (m g lbs) (dry) | 2.84 | 2.80 | 2.91 | 2.85 |
| Nozzle Size - An (sq. ft.) | 0.000167 | 0.000167 | 0.000167 | 0.000167 |
| Isokinetic Variation - I | 101.8 | 102.1 | 102.0 | 102.0 |
| **Stack Data** | | | | |
| Average Stack Temperature - Ts (F) | 137.6 | 136.2 | 136.1 | 136.6 |
| Molecular Weight Stack Gas- dry (Md) | 28.8 | 28.8 | 28.8 | 28.8 |
| Molecular Weight Stack Gas-wet (Ms) | 28.4 | 28.3 | 28.3 | 28.4 |
| Stack Gas Specific Gravity (Gs) | 0.981 | 0.978 | 0.979 | 0.979 |
| Percent Moisture (Bws) | 4.00 | 4.73 | 4.58 | 4.43 |
| Water Vapor Volume (fraction) | 0.0400 | 0.0473 | 0.0458 | 0.0443 |
| Pressure - Ps ("Hg) | 29.1 | 29.1 | 29.1 | 29.1 |
| Average Stack Velocity -Vs (ft/sec) | 75.5 | 74.5 | 77.3 | 75.8 |
| Area of Stack (ft2) | 4.3 | 4.3 | 4.3 | 4.3 |
| **Exhaust Gas Flowrate** | | | | |
| Flowrate $ft^3$(Actual) | 19,361 | 19,109 | 19,825 | 19,432 |
| Flowrate $ft^3$ (Standard Wet) | 16,663 | 16,486 | 17,107 | 16,752 |
| Flowrate $ft^3$ (Standard Dry) | 15,997 | 15,706 | 16,324 | 16,009 |
| Flowrate $m^3$ (standard dry) | 453 | 445 | 462 | 453 |
| **Total Particulate Weights (mg)** | | | | |
| Total Nozzle/Probe/Filter | 89.4 | 79.2 | 75.4 | 81.3 |
| Organic Condensible Particulate | 0.5 | 0.8 | 0.9 | 0.7 |
| Inorganic Condensible Particulate | 3.4 | 3.1 | 3.0 | 3.2 |
| Condensible Blank Correction | 2.0 | 2.0 | 2.0 | 2.0 |
| Total Condensible Particulate | 1.9 | 1.9 | 1.9 | 1.9 |
| Total Filterable and Condensible Particulate | 91.3 | 81.1 | 77.3 | 83.2 |
| **Filterable Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.068 | 0.060 | 0.055 | 0.061 |
| lb/1000 lb (dry) | 0.069 | 0.062 | 0.057 | 0.063 |
| mg/dscm (dry) | 82.7 | 74.4 | 68.2 | 75.1 |
| gr/dscf | 0.0361 | 0.0325 | 0.0298 | 0.0328 |
| **Filterable Particulate Emission Rate** | | | | |
| lb/ hr | 4.97 | 4.39 | 4.19 | 4.52 |
| **Condensible Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.001 | 0.001 | 0.001 | 0.001 |
| lb/1000 lb (dry) | 0.001 | 0.001 | 0.001 | 0.001 |
| mg/dscm (dry) | 1.8 | 1.8 | 1.7 | 1.8 |
| gr/dscf | 0.0008 | 0.0008 | 0.0008 | 0.0008 |
| **Condensible Particulate Emission Rate** | | | | |
| lb/ hr | 0.11 | 0.11 | 0.11 | 0.11 |
| **Total Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.069 | 0.062 | 0.057 | 0.063 |
| lb/1000 lb (dry) | 0.071 | 0.064 | 0.059 | 0.064 |
| mg/dscm (dry) | 84.5 | 76.2 | 69.9 | 76.9 |
| gr/dscf | 0.0369 | 0.0333 | 0.0306 | 0.0336 |
| **Total Particulate Emission Rate** | | | | |
| lb/ hr | 5.08 | 4.50 | 4.29 | 4.62 |

BTEC Inc.

# Kiln 19 (EU FUEL PULV 19, 36-K19) and Kiln 20 (EU FUEL PULV 20, 36-K20) Particulate Matter Emissions Test Summary Report

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*Prepared for:*

**Lafarge**

Alpena Plant
1435 Ford Avenue
Alpena, Michigan

Project No. 16-4952.00
January 25, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(248) 548-8070

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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# RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

*Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.*

**Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating (RO) Permit program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.**

Source Name: Lafarge Midwest Inc. County: Alpena

Source Address: 1435 Ford Ave. City: Alpena

AQD Source ID (SRN): B1477 RO Permit No.: MI-ROP-B1477-2012a RO Permit Section No.:

Please check the appropriate box(es):

☐ **Annual Compliance Certification (General Condition No. 28 and No. 29 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (General Condition No. 23 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 12/13/2016 To 12/14/2016

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:

Kiln 19 (EU FUEL PULV 19, 36-K19) and Kiln 20 (EU PUEL PULV 20, 36-K20)

Particulate Matter Emission Test Summary Report

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete.

| Paul Rogers | Plant Manager | 989-354-4171 |
|---|---|---|
| Name of Responsible Official (print or type) | Title | Phone Number |
| Signature of Responsible Official | | Date: 1/28/2017 |

* Photocopy this form as needed.

EQP 5736 (Rev 9/01)

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## EXECUTIVE SUMMARY

Lafarge North America (Lafarge) operates five dry process cement kilns (Kilns 19-23) at its plant in Alpena, Michigan (EPA Facility ID #MID005379607). Kiln Nos. 19, 20, and 21 are collectively known as Kiln Group 5 (KG5). Kiln Nos. 22 and 23 are collectively known as Kiln Group 6 (KG6). The Kiln Group 5 kilns are smaller than the Kiln Group 6 kilns but are of similar overall design. Each kiln has had an indirect firing system added to the low side of the kiln to preheat the coal before it goes into the kiln.

Lafarge retained BT Environmental Consulting, Inc. (BTEC) to measure filterable and condensable particulate matter emission rates from each fuel handling system dust collector for each of the five kilns. BTEC measured filterable and condensable particulate matter emission rates from the Kilns 19 and 20 fuel handling system dust collectors (stacks 36-K19 and 36-K20) on December 13 and 14, 2016.

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

Testing for the Kiln 19 system was conducted on December 13, 2016. The average Kiln 19 system filterable PM emission rate was 0.01 lbs/1,000 lbs, dry. The average Kiln 19 system total PM emission rate was 0.8 lbs/hr. Consequently, these test runs demonstrated compliance with the emission limitations for filterable PM and $PM_{10}$.

Testing for the Kiln 20 system was conducted on December 13, 2016 and December 14, 2016. Two test runs were conducted on December 13. For these two test runs, the average Kiln 20 system filterable PM emission rate was 0.12 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 9.8 lbs/hr. Consequently, these two test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

Three additional test runs were conducted on the Kiln 20 system on December 14, 2016. For these three test runs, the average Kiln 20 system filterable PM emission rate was 0.06 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 4.6 lbs/hr. Consequently, these three test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

It should be noted that, for all Kiln 20 test runs, the filterable portion of the total particulate emission rate was a minimum of 98%. It is almost certain that the majority of the filterable portion was greater than 10 microns in diameter. In summary, the emissions testing

demonstrated compliance with the emission limitations for Kiln 19 but were inconclusive with respect to the emission limitations for Kiln 20.

## 1. Introduction

Lafarge North America (Lafarge) operates five dry process cement kilns (Kilns 19-23) at its plant in Alpena, Michigan (EPA Facility ID #MID005379607). Kiln Nos. 19, 20, and 21 are collectively known as Kiln Group 5 (KG5). Kiln Nos. 22 and 23 are collectively known as Kiln Group 6 (KG6). The Kiln Group 5 kilns are smaller than the Kiln Group 6 kilns but are of similar overall design. Each kiln has had an indirect firing system added to the low side of the kiln to preheat the coal before it goes into the kiln.

Lafarge retained BT Environmental Consulting, Inc. (BTEC) to measure filterable and condensable particulate matter emission rates from each fuel handling system dust collector for each of the five kilns. BTEC measured filterable and condensable particulate matter emission rates from the Kilns 19 and 20 fuel handling system dust collectors (stacks 36-K19 and 36-K20) on December 13 and 14, 2016.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

### 1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on December 13 and 14, 2016 at the Lafarge facility located in Alpena, Michigan.

### 1.b Purpose of Testing

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

### 1.c Source Description

The control devices are baghouse dust collectors.

### 1.d Test Program Contacts

The contacts for the source and test report are:

Mr. Travis Weide
Area Environmental & Public Affairs Manager
LafargeHolcim
1435 Ford Avenue
Alpena, Michigan 49707

Mr. Brian Joyce
Area Environmental Coordinator
LafargeHolcim
1435 Ford Avenue
Alpena, Michigan 49707

Mr. Barry Boulianne
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(313) 449-2361

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

**Table 2**
**Test Personnel**

| Name and Title | Affiliation | Telephone |
|---|---|---|
| Mr. Barry Boulianne<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Matt Young<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Steve Smith<br>Project Manager | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Mike Nummer<br>Environmental Technician | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Shane Rabideau<br>Environmental Technician | BTEC<br>4949 Fernlee<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Brian Joyce<br>LafargeHolcim | Lafarge – Alpena Plant<br>1435 Ford Avenue<br>Alpena, Michigan 49707 | (989) 916-4854 |

## 2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

### 2.a Operating Data

Kiln production rate and baghouse pressure drop is available in Appendix E.

### 2.b Applicable Permit

AQD issued Renewable Operating Permit MI-ROP-B1477-2012b to Lafarge North America.

### 2.c Results

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

Testing for the Kiln 19 system was conducted on December 13, 2016. The average Kiln 19 system filterable PM emission rate was 0.01 lbs/1,000 lbs, dry. The average Kiln 19 system total PM emission rate was 0.8 lbs/hr. Consequently, these test runs demonstrated compliance with the emission limitations for filterable PM and $PM_{10}$.

Testing for the Kiln 20 system was conducted on December 13, 2016 and December 14, 2016. Two test runs were conducted on December 13. For these two test runs, the average Kiln 20 system filterable PM emission rate was 0.12 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 9.8 lbs/hr. Consequently, these two test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

Three additional test runs were conducted on the Kiln20 system on December 14. For these three test runs, the average Kiln 20 system filterable PM emission rate was 0.06 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 4.6 lbs/hr. Consequently, these three test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

It should be noted that, for all Kiln 20 test runs, the filterable portion of the total particulate emission rate was a minimum of 98%. It is almost certain that the majority of the filterable portion was greater than 10 microns in diameter. In summary, the emissions testing

demonstrated compliance with the emission limitations for Kiln 19 but were inconclusive with respect to the emission limitations for Kiln 20.

## 3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

### 3.a Process Description

A mixture of pulverized bituminous coal, petroleum coke, and asphalt shingles with a heating value of approximately 11,750 Btu per pound, serves as the primary fuel fed to the kilns. Coal and coke are fed to a Raymond bowl mill and ground to a fineness of approximately 95% passing a 200-mesh sieve. Each kiln includes an indirectly fired fuel pre-heater system.

### 3.b Process Flow Diagram

A process flow diagram is available on request.

### 3.c Raw and Finished Materials

A mixture of pulverized bituminous coal, petroleum coke, and asphalt shingles with a heating value of approximately 11,750 Btu per pound, serves as the primary fuel fed to the kilns. Coal and coke are fed to a Raymond bowl mill and ground to a fineness of approximately 95% passing a 200-mesh sieve. Each kiln includes an indirectly fired fuel pre-heater system.

### 3.d Process Capacity

Each baghouse is rated for the maximum exhaust gas flowrate from each system and the efficiencies are equivalent to that necessary to achieve the corresponding emission limitations.

### 3.e Process Instrumentation

Proper operation of the baghouse dust collectors is verified by baghouse pressure drop monitoring.

## 4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

### 4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources" (Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2 (see Figure 2 and 3 for a schematic of the sampling location). S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2, Section 4.1.1, were used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

A cyclonic flow check was performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angle is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

Molecular weight was determined according to USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the PM and lead sampling trains and passed through the impinger configuration (see Figure 1). Exhaust gas moisture content was then determined gravimetrically.

### 4.b Particulate Matter (USEPA Method 17/202)

40 CFR 60, Appendix A, Method 17, *"Determination of Particulate Emissions from Stationary Sources"* and40 CFR 51, Appendix M, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 1 for a schematic of the sampling train). Triplicate60-minute test runs were conducted on each source.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) an in stack stainless-steel filter housing, (3) a steel probe, (4) a vertical condenser, (5) an empty pot bellied impinger, (6) an empty modified Greenburg-

Smith (GS) impinger, (7) unheated filter holder with a teflon filter, (8) a second modified GS impinger with 100 ml of deionized water, and a third modified GS impinger containing approximately 300 g of silica gel desiccant, (9) a length of sample line, and (10) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The impinger train was then purged with nitrogen for one hour at a flow rate of 14 liters per minute. The CPM filter was recovered and placed in a petri dish. The back half of the filter housing, the condenser, the pot bellied impinger, the moisture drop out impinger, and the front half of the CPM filter housing and all connecting glassware were double rinsed with deionized water which was collected in a pre-cleaned sample container. The same glassware was then rinsed with acetone which was collected in a pre-cleaned sample container labeled as the organic fraction. The glassware was then double rinsed with hexane which was added to the same organic fraction sample bottle.

BTEC labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition blank samples of the acetone and filter were collected. BTEC personnel carried all samples to BTEC's laboratory (for filter and acetone gravimetric analysis) in Royal Oak, Michigan. 40 CFR 60, Appendix A, Method 17, *"Determination of Particulate Emissions from Stationary Sources"* and40 CFR 60, Appendix A, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 1 for a schematic of the sampling train). Triplicate 60-minute test runs were conducted for each source.

The 202 samples were sent to Maxxam Analytical in Ontario, Canada.

### 4.c Recovery and Analytical Procedures

Filterable particulate matter samples were processed at BTEC's laboratory in Royal Oak, Michigan. Condensable particulate matter samples were sent to Maxxam Laboratories in Ontario, Canada.

### 4.d Sampling Ports

Diagrams of the stacks showing sampling ports in relation to upstream and downstream disturbances are included as Figures 2 and 3.



### 4.e Traverse Points

Diagrams of the stacks indicating traverse point locations and stack dimensions are included as Figures 2 and 3.

## 5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

### 5.a Results Tabulation

Detailed results for the emissions test program are summarized by Tables 4, 5, and 6.

### 5.b Discussion of Results

The objective of the emissions test program was to demonstrate compliance with emission limitations for each stack for filterable particulate matter (0.15 lbs/1,000 lbs, dry) and particulate matter less than 10 microns in diameter (1.8 lbs/hr). Because of stack and exhaust gas conditions, it was proposed to test for filterable and condensable particulate matter emission rates and compare those total PM results to the $PM_{10}$ emission limitation with the result being a conservative comparison of total PM to a $PM_{10}$ limitation.

Testing for the Kiln 19 system was conducted on December 13, 2016. The average Kiln 19 system filterable PM emission rate was 0.01 lbs/1,000 lbs, dry. The average Kiln 19 system total PM emission rate was 0.8 lbs/hr. Consequently, these test runs demonstrated compliance with the emission limitations for filterable PM and $PM_{10}$.

Testing for the Kiln 20 system was conducted on December 13, 2016 and December 14, 2016. Two test runs were conducted on December 13. For these two test runs, the average Kiln 20 system filterable PM emission rate was 0.12 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 9.8 lbs/hr. Consequently, these two test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

Three additional test runs were conducted on the Kiln20 system on December 14, 2016. For these three test runs, the average Kiln 20 system filterable PM emission rate was 0.06 lbs/1,000 lbs, dry. The average Kiln 20 system total PM emission rate was 4.6 lbs/hr. Consequently, these three test runs demonstrated compliance with the emission limitation for filterable PM and were inconclusive with respect to demonstrating compliance with the emission limitations for $PM_{10}$.

It should be noted that, for all Kiln 20 test runs, the filterable portion of the total particulate emission rate was a minimum of 98%. It is almost certain that the majority of the filterable portion was greater than 10 microns in diameter. In summary, the emissions testing demonstrated compliance with the emission limitations for Kiln 19 but were inconclusive with respect to the emission limitations for Kiln 20.

### 5.c Sampling Procedure Variations

Following completion of two test runs on Kiln 20 on December 13, 2016 it appeared that the particulate loading on the filters was greater than anticipated. Consequently, testing was discontinued and baghouse maintenance was completed. The Kiln 20 system was shut down and a baghouse inspection was completed to determine why it was malfunctioning. This was performed before prior to conducting an additional three test runs on December 14, 2016.

### 5.d Process or Control Device Upsets

It appeared there was more particulate on the filters than normal after the first two test runs were completed for the stack testing.

### 5.e Control Device Maintenance

The bags in the baghouse dust collector were inspected for holes and were replaced as needed.

### 5.f Re-Test

The emissions test program was not a re-test.

### 5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

### 5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix B.

### 5.i Sample Calculations

Sample calculations are provided in Appendix C.

### 5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

### 5.k Laboratory Data

Laboratory analytical results for this test program are presented in Appendix D.

**Table 4**
**Kiln 19 Particulate Matter Emission Rates**

| | | | | |
|---|---|---|---|---|
| **Company** | **Lafarge** | | | |
| **Source Designation** | **Kiln 19** | | | |
| **Test Date** | **12/13/2016** | **12/13/2016** | **12/13/2016** | |
| **Meter/Nozzle Information** | Run 1 | Run 2 | Run 3 | Average |
| Meter Temperature Tm (F) | 58.5 | 56.9 | 55.2 | 56.9 |
| Meter Pressure - Pm (in. Hg) | 29.7 | 29.7 | 29.7 | 29.7 |
| Measured Sample Volume (Vm) | 55.4 | 53.5 | 56.2 | 55.0 |
| Sample Volume (Vm-Std ft3) | 56.4 | 54.6 | 57.6 | 56.2 |
| Sample Volume (Vm-Std m3) | 1.60 | 1.55 | 1.63 | 1.59 |
| Condensate Volume (Vw-std) | 1.910 | 1.829 | 1.730 | 1.823 |
| Gas Density (Ps(std) lbs/ft3) (wet) | 0.0736 | 0.0736 | 0.0737 | 0.0737 |
| Gas Density (Ps(std) lbs/ft3) (dry) | 0.0745 | 0.0745 | 0.0745 | 0.0745 |
| Total weight of sampled gas (m g lbs) (wet) | 4.29 | 4.16 | 4.37 | 4.27 |
| Total weight of sampled gas (m g lbs) (dry) | 4.21 | 4.07 | 4.29 | 4.19 |
| Nozzle Size - An (sq. ft.) | 0.000241 | 0.000241 | 0.000241 | 0.000241 |
| Isokinetic Variation - I | 101.1 | 101.0 | 100.7 | 100.9 |
| **Stack Data** | | | | |
| Average Stack Temperature - Ts (F) | 138.4 | 136.8 | 136.7 | 137.3 |
| Molecular Weight Stack Gas- dry (Md) | 28.8 | 28.8 | 28.8 | 28.8 |
| Molecular Weight Stack Gas-wet (Ms) | 28.5 | 28.5 | 28.5 | 28.5 |
| Stack Gas Specific Gravity (Gs) | 0.983 | 0.984 | 0.985 | 0.984 |
| Percent Moisture (Bws) | 3.27 | 3.24 | 2.92 | 3.14 |
| Water Vapor Volume (fraction) | 0.0327 | 0.0324 | 0.0292 | 0.0314 |
| Pressure - Ps ("Hg) | 29.4 | 29.4 | 29.4 | 29.4 |
| Average Stack Velocity -Vs (ft/sec) | 76.9 | 74.3 | 78.2 | 76.4 |
| Area of Stack (ft2) | 4.1 | 4.1 | 4.1 | 4.1 |
| **Exhaust Gas Flowrate** | | | | |
| Flowrate $ft^3$(Actual) | 19,010 | 18,368 | 19,352 | 18,910 |
| Flowrate $ft^3$ (Standard Wet) | 16,483 | 15,971 | 16,828 | 16,427 |
| Flowrate $ft^3$ (Standard Dry) | 15,943 | 15,453 | 16,338 | 15,911 |
| Flowrate $m^3$ (standard dry) | 451 | 438 | 463 | 451 |
| **Total Particulate Weights (mg)** | | | | |
| Total Nozzle/Probe/Filter | 15.0 | 14.0 | 15.9 | 15.0 |
| Organic Condensible Particulate | 0.8 | 0.6 | 1.3 | 0.9 |
| Inorganic Condensible Particulate | 4.3 | 4.8 | 8.9 | 6.0 |
| Condensible Blank Correction | 2.0 | 2.0 | 2.0 | 2.0 |
| Total Condensible Particulate | 3.1 | 3.4 | 8.2 | 4.9 |
| Total Filterable and Condensible Particulate | 18.1 | 17.4 | 24.1 | 19.9 |
| **Filterable Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.008 | 0.007 | 0.008 | 0.008 |
| lb/1000 lb (dry) | 0.008 | 0.008 | 0.008 | 0.008 |
| mg/dscm (dry) | 9.4 | 9.1 | 9.8 | 9.4 |
| gr/dscf | 0.0041 | 0.0040 | 0.0043 | 0.0041 |
| **Filterable Particulate Emission Rate** | | | | |
| lb/ hr | 0.56 | 0.53 | 0.60 | 0.56 |
| **Condensible Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.002 | 0.002 | 0.004 | 0.003 |
| lb/1000 lb (dry) | 0.002 | 0.002 | 0.004 | 0.003 |
| mg/dscm (dry) | 1.9 | 2.2 | 5.0 | 3.1 |
| gr/dscf | 0.0008 | 0.0010 | 0.0022 | 0.0013 |
| **Condensible Particulate Emission Rate** | | | | |
| lb/ hr | 0.12 | 0.13 | 0.31 | 0.18 |
| **Total Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.009 | 0.009 | 0.012 | 0.010 |
| lb/1000 lb (dry) | 0.009 | 0.009 | 0.012 | 0.010 |
| mg/dscm (dry) | 11.3 | 11.3 | 14.8 | 12.5 |
| gr/dscf | 0.0050 | 0.0049 | 0.0065 | 0.0054 |
| **Total Particulate Emission Rate** | | | | |
| lb/ hr | 0.68 | 0.65 | 0.91 | 0.75 |

**Table 5**
**Kiln 20 Particulate Matter Emission Rates – December 13, 2016**

| | | | |
|---|---|---|---|
| **Company** | **Lafarge** | | |
| **Source Designation** | **Kiln 20** | | |
| **Test Date** | **12/13/2016** | **12/13/2016** | |
| | | | |
| **Meter/Nozzle Information** | Run 1 | Run 2 | Average |
| Meter Temperature Tm (F) | 38.0 | 39.5 | 38.7 |
| Meter Pressure - Pm (in. Hg) | 29.6 | 29.6 | 29.6 |
| Measured Sample Volume (Vm) | 46.5 | 39.7 | 43.1 |
| Sample Volume (Vm-Std ft3) | 49.0 | 41.7 | 45.3 |
| Sample Volume (Vm-Std m3) | 1.39 | 1.18 | 1.28 |
| Condensate Volume (Vw-std) | 1.608 | 1.542 | 1.575 |
| Gas Density (Ps(std) lbs/ft3) (wet) | 0.0736 | 0.0735 | 0.0736 |
| Gas Density (Ps(std) lbs/ft3) (dry) | 0.0745 | 0.0745 | 0.0745 |
| Total weight of sampled gas (m g lbs) (wet) | 3.73 | 3.18 | 3.45 |
| Total weight of sampled gas (m g lbs) (dry) | 3.65 | 3.10 | 3.38 |
| Nozzle Size - An (sq. ft.) | 0.000197 | 0.000167 | 0.000182 |
| Isokinetic Variation - I | 101.0 | 101.4 | 101.2 |
| **Stack Data** | | | |
| Average Stack Temperature - Ts (F) | 130.2 | 130.4 | 130.3 |
| Molecular Weight Stack Gas- dry (Md) | 28.8 | 28.8 | 28.8 |
| Molecular Weight Stack Gas-wet (Ms) | 28.5 | 28.4 | 28.5 |
| Stack Gas Specific Gravity (Gs) | 0.984 | 0.982 | 0.983 |
| Percent Moisture (Bws) | 3.18 | 3.57 | 3.37 |
| Water Vapor Volume (fraction) | 0.0318 | 0.0357 | 0.0337 |
| Pressure - Ps ("Hg) | 29.4 | 29.4 | 29.4 |
| Average Stack Velocity -Vs (ft/sec) | 80.4 | 80.6 | 80.5 |
| Area of Stack (ft2) | 4.3 | 4.3 | 4.3 |
| **Exhaust Gas Flowrate** | | | |
| Flowrate $ft^3$(Actual) | 20,622 | 20,673 | 20,647 |
| Flowrate $ft^3$ (Standard Wet) | 18,126 | 18,164 | 18,145 |
| Flowrate $ft^3$ (Standard Dry) | 17,550 | 17,516 | 17,533 |
| Flowrate $m^3$ (standard dry) | 497 | 496 | 496 |
| **Total Particulate Weights (mg)** | | | |
| Total Nozzle/Probe/Filter | 215.0 | 165.2 | 190.1 |
| Organic Condensible Particulate | 0.6 | 0.7 | 0.7 |
| Inorganic Condensible Particulate | 2.9 | 4.0 | 3.5 |
| Condensible Blank Correction | 2.0 | 2.0 | 2.0 |
| Total Condensible Particulate | 1.5 | 2.7 | 2.1 |
| Total Filterable and Condensible Particulate | 216.5 | 167.9 | 192.2 |
| **Filterable Particulate Concentration** | | | |
| lb/1000 lb (wet) | 0.127 | 0.115 | 0.121 |
| lb/1000 lb (dry) | 0.130 | 0.117 | 0.124 |
| mg/dscm (dry) | 155.0 | 140.1 | 147.5 |
| gr/dscf | 0.0678 | 0.0612 | 0.0645 |
| **Filterable Particulate Emission Rate** | | | |
| lb/ hr | 10.23 | 9.22 | 9.73 |
| **Condensible Particulate Concentration** | | | |
| lb/1000 lb (wet) | 0.001 | 0.002 | 0.001 |
| lb/1000 lb (dry) | 0.001 | 0.002 | 0.001 |
| mg/dscm (dry) | 1.1 | 2.3 | 1.7 |
| gr/dscf | 0.0005 | 0.0010 | 0.0007 |
| **Condensible Particulate Emission Rate** | | | |
| lb/ hr | 0.07 | 0.15 | 0.11 |
| **Total Particulate Concentration** | | | |
| lb/1000 lb (wet) | 0.128 | 0.117 | 0.122 |
| lb/1000 lb (dry) | 0.131 | 0.119 | 0.125 |
| mg/dscm (dry) | 156.1 | 142.4 | 149.2 |
| gr/dscf | 0.0682 | 0.0622 | 0.0652 |
| **Total Particulate Emission Rate** | | | |
| lb/ hr | 10.30 | 9.37 | 9.84 |

**Table 6**
**Kiln 20 Particulate Matter Emission Rates – December 14, 2016**

| **Company** | **Lafarge** | | | |
|---|---|---|---|---|
| **Source Designation** | **Kiln 20** | | | |
| **Test Date** | **12/14/2016** | **12/14/2016** | **12/14/2016** | |
| **Meter/Nozzle Information** | Run 3 | Run 4 | Run 5 | Average |
| Meter Temperature Tm (F) | 59.7 | 46.7 | 46.1 | 50.8 |
| Meter Pressure - Pm (in. Hg) | 29.3 | 29.3 | 29.3 | 29.3 |
| Measured Sample Volume (Vm) | 39.0 | 37.5 | 38.8 | 38.4 |
| Sample Volume (Vm-Std ft3) | 38.2 | 37.6 | 39.0 | 38.3 |
| Sample Volume (Vm-Std m3) | 1.08 | 1.06 | 1.11 | 1.08 |
| Condensate Volume (Vw-std) | 1.589 | 1.867 | 1.872 | 1.776 |
| Gas Density (Ps(std) lbs/ft3) (wet) | 0.0734 | 0.0732 | 0.0732 | 0.0733 |
| Gas Density (Ps(std) lbs/ft3) (dry) | 0.0745 | 0.0745 | 0.0745 | 0.0745 |
| Total weight of sampled gas (m g lbs) (wet) | 2.92 | 2.89 | 3.00 | 2.94 |
| Total weight of sampled gas (m g lbs) (dry) | 2.84 | 2.80 | 2.91 | 2.85 |
| Nozzle Size - An (sq. ft.) | 0.000167 | 0.000167 | 0.000167 | 0.000167 |
| Isokinetic Variation - I | 101.8 | 102.1 | 102.0 | 102.0 |
| **Stack Data** | | | | |
| Average Stack Temperature - Ts (F) | 137.6 | 136.2 | 136.1 | 136.6 |
| Molecular Weight Stack Gas- dry (Md) | 28.8 | 28.8 | 28.8 | 28.8 |
| Molecular Weight Stack Gas-wet (Ms) | 28.4 | 28.3 | 28.3 | 28.4 |
| Stack Gas Specific Gravity (Gs) | 0.981 | 0.978 | 0.979 | 0.979 |
| Percent Moisture (Bws) | 4.00 | 4.73 | 4.58 | 4.43 |
| Water Vapor Volume (fraction) | 0.0400 | 0.0473 | 0.0458 | 0.0443 |
| Pressure - Ps ("Hg) | 29.1 | 29.1 | 29.1 | 29.1 |
| Average Stack Velocity - Vs (ft/sec) | 75.5 | 74.5 | 77.3 | 75.8 |
| Area of Stack (ft2) | 4.3 | 4.3 | 4.3 | 4.3 |
| **Exhaust Gas Flowrate** | | | | |
| Flowrate $ft^3$(Actual) | 19,361 | 19,109 | 19,825 | 19,432 |
| Flowrate $ft^3$ (Standard Wet) | 16,663 | 16,486 | 17,107 | 16,752 |
| Flowrate $ft^3$ (Standard Dry) | 15,997 | 15,706 | 16,324 | 16,009 |
| Flowrate $m^3$ (standard dry) | 453 | 445 | 462 | 453 |
| **Total Particulate Weights (mg)** | | | | |
| Total Nozzle/Probe/Filter | 89.4 | 79.2 | 75.4 | 81.3 |
| Organic Condensible Particulate | 0.5 | 0.8 | 0.9 | 0.7 |
| Inorganic Condensible Particulate | 3.4 | 3.1 | 3.0 | 3.2 |
| Condensible Blank Correction | 2.0 | 2.0 | 2.0 | 2.0 |
| Total Condensible Particulate | 1.9 | 1.9 | 1.9 | 1.9 |
| Total Filterable and Condensible Particulate | 91.3 | 81.1 | 77.3 | 83.2 |
| **Filterable Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.068 | 0.060 | 0.055 | 0.061 |
| lb/1000 lb (dry) | 0.069 | 0.062 | 0.057 | 0.063 |
| mg/dscm (dry) | 82.7 | 74.4 | 68.2 | 75.1 |
| gr/dscf | 0.0361 | 0.0325 | 0.0298 | 0.0328 |
| **Filterable Particulate Emission Rate** | | | | |
| lb/ hr | 4.97 | 4.39 | 4.19 | 4.52 |
| **Condensible Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.001 | 0.001 | 0.001 | 0.001 |
| lb/1000 lb (dry) | 0.001 | 0.001 | 0.001 | 0.001 |
| mg/dscm (dry) | 1.8 | 1.8 | 1.7 | 1.8 |
| gr/dscf | 0.0008 | 0.0008 | 0.0008 | 0.0008 |
| **Condensible Particulate Emission Rate** | | | | |
| lb/ hr | 0.11 | 0.11 | 0.11 | 0.11 |
| **Total Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.069 | 0.062 | 0.057 | 0.063 |
| lb/1000 lb (dry) | 0.071 | 0.064 | 0.059 | 0.064 |
| mg/dscm (dry) | 84.5 | 76.2 | 69.9 | 76.9 |
| gr/dscf | 0.0369 | 0.0333 | 0.0306 | 0.0336 |
| **Total Particulate Emission Rate** | | | | |
| lb/ hr | 5.08 | 4.50 | 4.29 | 4.62 |

BTEC Inc.

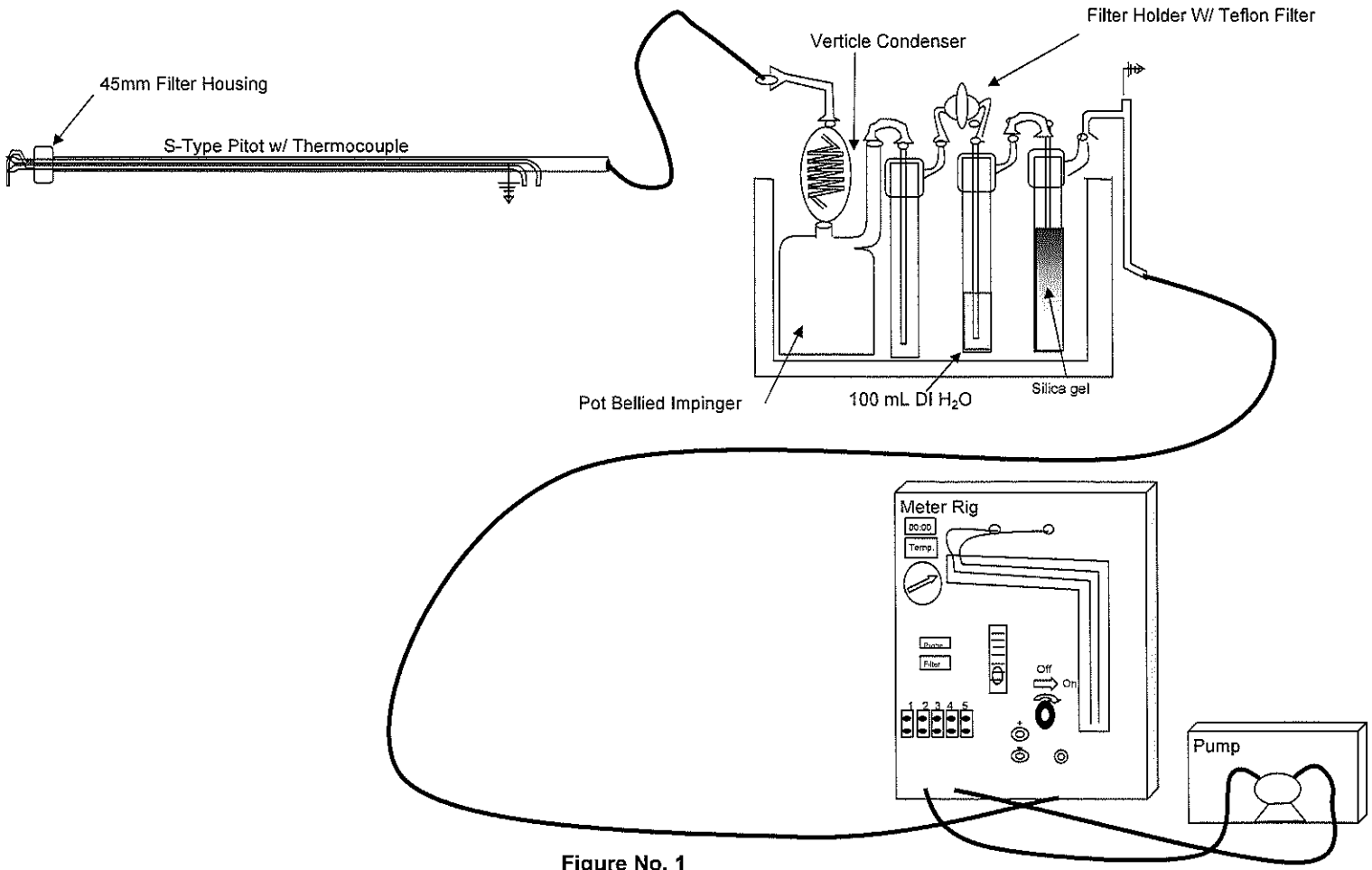
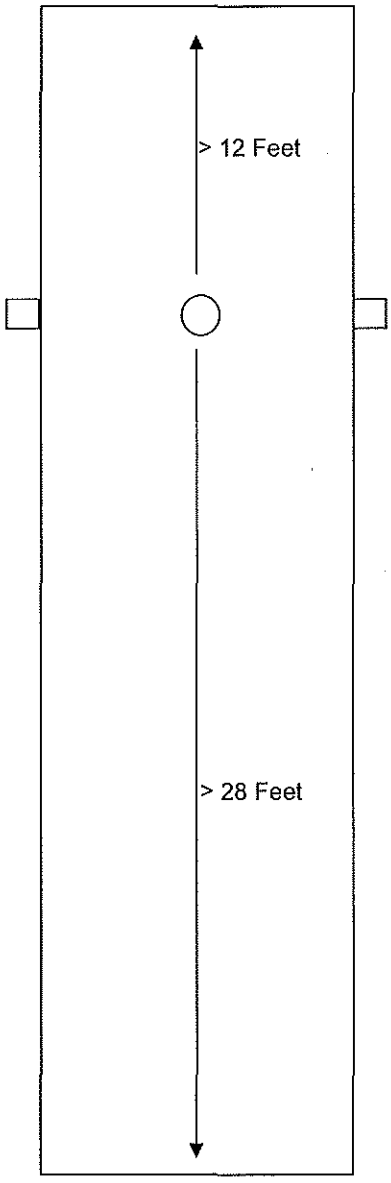


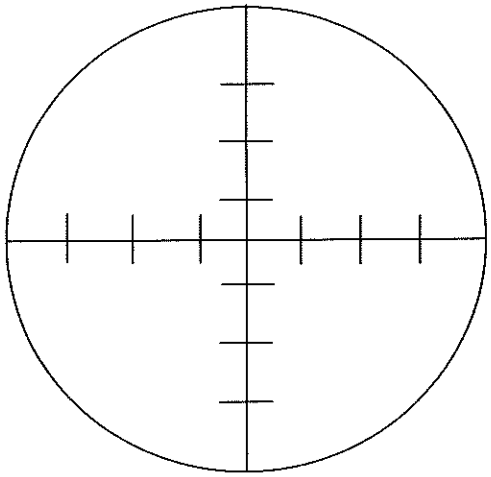

**Figure No. 1**

| | | |
|---|---|---|
| **Site:**<br>**USEPA Method 17**<br>**Lafarge Holcim**<br>**Alpena, Michigan** | **Sampling Date:**<br>**December 13-14, 2016** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan** |

BTEC Inc.

Diameter = 27.5



Not to Scale

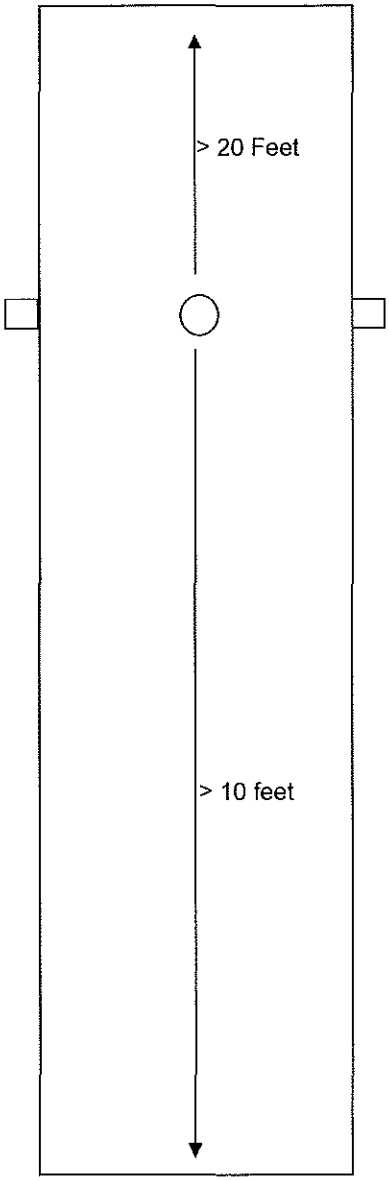
| Points | Distance " |
|---|---|
| 1 | 1.2 |
| 2 | 4.0 |
| 3 | 8.1 |
| 4 | 19.4 |
| 5 | 23.5 |
| 6 | 26.3 |

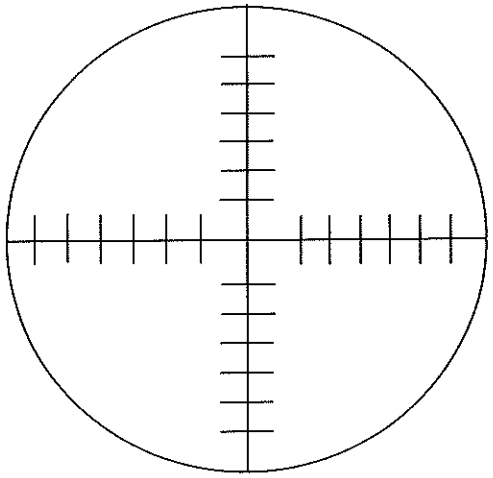
**Figure 2**

| | | |
|---|---|---|
| **Site:**<br>**Lafarge Holcim**<br>**Alpena, Michigan**<br>**Kiln 19** | **Sampling Dates:**<br>**December 13, 2016** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee**<br>**Royal Oak, Michigan** |

BTEC Inc.

Diameter = 28"



Not to Scale

| Points | Distance " |
|---|---|
| 1 | 0.6 |
| 2 | 1.9 |
| 3 | 3.3 |
| 4 | 5.0 |
| 5 | 7.0 |
| 6 | 10.0 |
| 7 | 18.0 |
| 8 | 21.0 |
| 9 | 23.0 |
| 10 | 24.7 |
| 11 | 26.1 |
| 12 | 27.4 |

**Figure 3**

| | | |
|---|---|---|
| **Site:**<br>**Lafarge Holcim**<br>**Alpena, Michigan**<br>**Kiln 20** | **Sampling Dates:**<br>**December 13-14, 2016** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee**<br>**Royal Oak, Michigan** |