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REPORT ON COMPLIANCE TESTING

Detroit Refinery

Coker Heater Stack

Marathon Petroleum Company LP

1300 South Fort Street

Detroit, MI 48217

Client Reference No. 4101379616

CleanAir Project No. 13647-3

A2LA ISO 17025 Certificate No. 4342.01

A2LA / STAC Certificate No. 4342.02

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October 30, 2018

1. PROJECT OVERVIEW

Test Program Summary

Marathon Petroleum Company LP (MPC) contracted CleanAir Engineering (CleanAir) to complete testing on the Coker Heater (EU70-COKERHTR-S1) at the Detroit Refinery. The test program included the following objective:

- Perform particulate matter testing to demonstrate compliance with the Michigan Department of Environmental Quality (DEQ) Permit No. MI-ROP-A9831-2012c.

A summary of the test program results is presented below. Section 2 Results provides a more detailed account of the test conditions and data analysis. Test program information, including the test parameters, on-site schedule and a project discussion, begins below Table 1-1.

Table 1-1:
Summary of Compliance Results

Source Constituent (Units)	Sampling Method (USEPA)	Average Emission[2]	Permit Limit[1]
Coker Heater Stack			
PM (lb/MMBtu)	5	0.0017	0.0019
PM_{10} (lb/MMBtu)	5 / 202	0.0039	0.0076

[1] Permit limits obtained from MDEQ Permit No: MI-ROP-A9831-2012c.

[2] Average of Runs 2 and 3.

Test Program Details

Parameters

The test program included the following emissions measurements:

- particulate matter (PM), assumed equivalent to filterable particulate matter (FPM) only
- total particulate matter less than 10 microns in diameter (PM_{10}), assumed equivalent to the sum of the following constituents:
  - FPM
  - condensable particulate matter (CPM)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas temperature
- flue gas flow rate

Schedule

Testing was performed on August 15, 2018. The on-site schedule followed during the test program is outlined in Table 1-2.

Table 1-2:
Test Schedule

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	Coker Heater Stack	USEPA Method 5 / 202	FPM / CPM	08/15/18	09:42	11:55
2	Coker Heater Stack	USEPA Method 5 / 202	FPM / CPM	08/15/18	12:41	14:55
3	Coker Heater Stack	USEPA Method 5 / 202	FPM / CPM	08/15/18	15:40	18:26

Discussion

Project Synopsis

PM & PM_{10} Testing

A total of three (3) 120-minute EPA Method 5/202 test runs were performed. FPM/CPM emission results were calculated in units of pounds per million Btu (lb/MMBtu). Run 1 front-half rinse sample fraction was deemed contaminated. Run 1 results, along with a detailed explanation of this occurrence and a composition analysis from RJ Lee Group, are presented in Appendix I of this report. The analysis indicated the contaminating residue was most likely crude or lubricating oil. It should be noted crude or lubricating oil at heater temperatures would be combusted, which suggests the residue did not originate from the Coker process. The final result was expressed as the average of Run 2 and Run 3.

PM_{10} is assumed equivalent to the sum of FPM and CPM. The Method 5/202 sample train yields a front-half, FPM result and a back-half, CPM result. The total PM result (FPM plus CPM) from Method 5/202 can be used as a worst-case estimation of total PM_{10} since Method 5 collects all FPM present in the flue gas (regardless of particle size).

Fuel Analysis

Emission results in units of dry volume-based concentration (lb/dscf, ppmdv) were converted into units of pound per million Btu (lb/MMBtu) by calculating an oxygen-based fuel factor (F_d) for refinery gas per EPA Method 19 specifications. The heat content and F_d factor were calculated from percent volume composition analytical data provided by MPC and tabulated heating values for each of the measured constituents.

Test Conditions

The unit was operated at the maximum normal operating capacity during each of the emissions compliance test runs. MPC was responsible for logging any relevant process-related data and providing it to CleanAir for inclusion in the test report.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices, specifically Appendix C Parameters.

Table 2-1:
Coker Heater – PM & PM_{10} Emissions

Run No.		1*	2	3	Average
Date (2018)			Aug 15	Aug 15	
Start Time (approx.)			12:41	15:40	
Stop Time (approx.)			14:55	18:26	
Process Conditions					
P_1	Charge rate (BPD)		35,600	35,500	**35,600**
P_2	Heater duty (MMBtu/hr)		201	198	**200**
F_d	Oxygen-based F-factor (dscf/MMBtu)		8,328	8,328	
Gas Conditions					
O_2	Oxygen (dry volume %)		7.9	6.8	**7.4**
CO_2	Carbon dioxide (dry volume %)		7.5	8.1	**7.8**
T_s	Sample temperature (°F)		425	423	**424**
B_w	Actual water vapor in gas (% by volume)		13.8	13.7	**13.8**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)		88,200	86,000	**87,100**
Q_s	Volumetric flow rate, standard (scfm)		52,500	51,300	**51,900**
Q_{std}	Volumetric flow rate, dry standard (dscfm)		45,300	44,300	**44,800**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)		66.31	64.42	**65.37**
%I	Isokinetic sampling (%)		103.1	102.4	**102.7**
Laboratory Data					
m_{FPM}	Total FPM (g)		0.00393	0.00386	
m_{CPM}	Total CPM (g)		0.00559	0.00480	
m_{Part}	Total particulate matter (as PM_{10}) (g)		0.00952	0.00866	
FPM Results					
C_{sd}	Particulate Concentration (lb/dscf)		1.31E-07	1.32E-07	**1.31E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)		0.355	0.351	**0.353**
E_{Fd}	Particulate Rate - F_d-based (lb/MMBtu)		0.00175	0.00163	**0.00169**
CPM Results					
C_{sd}	Particulate Concentration (lb/dscf)		1.86E-07	1.64E-07	**1.75E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)		0.505	0.437	**0.471**
E_{Fd}	Particulate Rate - F_d-based (lb/MMBtu)		0.00249	0.00203	**0.00226**
Total Particulate Matter (as PM_{10}) Results					
C_{sd}	Particulate Concentration (lb/dscf)		3.17E-07	2.96E-07	**3.07E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)		0.860	0.788	**0.824**
E_{Fd}	Particulate Rate - F_d-based (lb/MMBtu)		0.00424	0.00366	**0.00395**

Average includes 2 runs. * indicates that the run is not included in the average.

End of Section

3. DESCRIPTION OF INSTALLATION

Process Description

MPC's facility in Detroit, Michigan, produces refined petroleum products from crude oil. MPC must continue to demonstrate that select process units are in compliance with permitted emission limits.

The Coker unit (EU70-COKER) converts Vacuum Resid (Crude Vacuum Tower Bottoms), a product normally sold as asphalt or blended into residual fuel oil, into lighter, more valuable products. The Vacuum Resid feedstock is heated before it enters the main fractionator, where lighter material vaporizes. The fractionator bottoms are routed through a fired heater and then into a coke drum. This emission unit consists of process vessels (fractionators), coke drums, heater (EU70-COKERHTR-S1), cooling tower, compressors, pumps, piping, drains and various components (pumps and compressor seals, process valves, pressure relief valves, flanges, connectors, etc.). This emission group includes the Coke Handling System, which collects, sizes and transports the petroleum coke created during the coking process. The system consists of a coke pit, storage pad, enclosed crusher, enclosed conveyors and surge bins.

The Coker Heater is fired by refinery fuel gas. Emissions are vented to the atmosphere via the Coker Heater Stack (SV70-H1) where testing was performed.

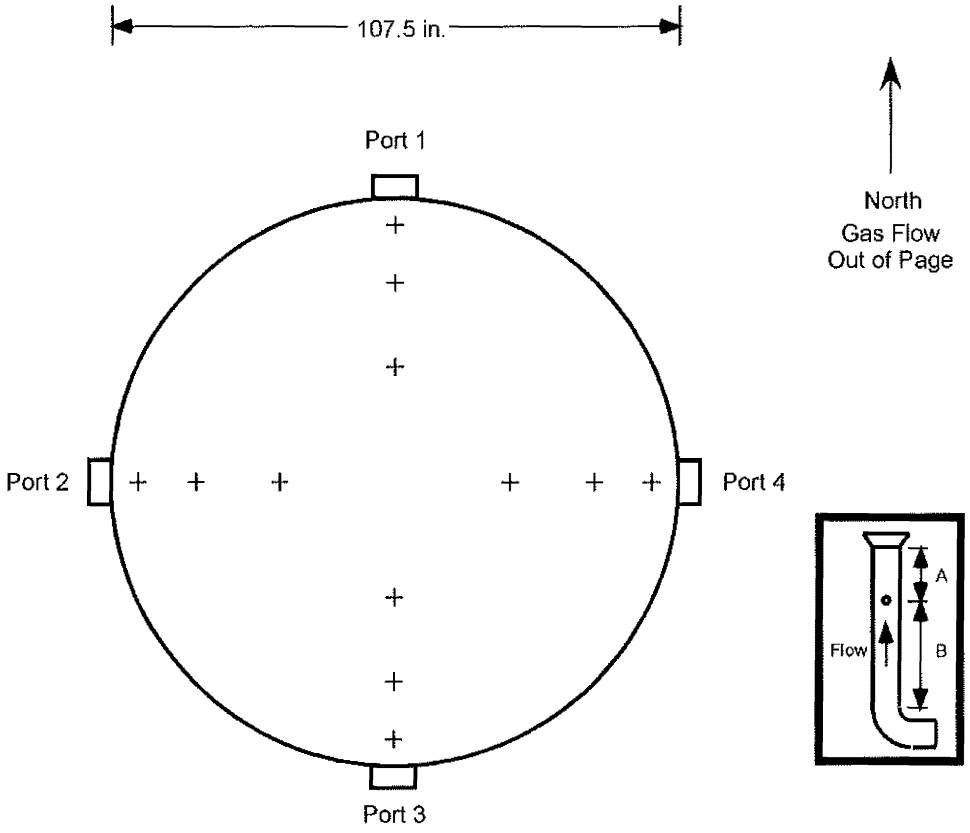
Test Location

The sample point locations were determined by EPA Method 1. Table 3-1 presents the sampling information for the test location described in this report. The figure shown on page 5 represents the layout of the test location.

Table 3-1:
Sampling Point Information

Source Constituent	Method (USEPA)	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Coker Heater Stack							
FPM / CPM	5 / 202	1-3	4	6	5	120	3-1

Figure 3-1:
PM & PM_{10} Sample Point Layout



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	29.6	31.8
2	14.6	15.5
3	4.4	4.7

Duct diameters upstream from flow disturbance (A): 5.2 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 8.3 Limit: 2.0

End of Section

4. METHODOLOGY

Procedures and Regulations

The test program sampling measurements followed procedures and regulations outlined by the United States Environmental Protection Agency (USEPA) and the DEQ. These methods appear in detail in Title 40 of the CFR and at https://www.epa.gov/emc.

Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery, and analytical procedures. Any modifications to standard test methods are explicitly indicated in this appendix.

In accordance with ASTM D7036 requirements, CleanAir included a description of any such modifications, along with the full context of the objectives and requirements of the test program in the test protocol submitted prior to the measurement portion of this project. Modifications to standard methods are not covered by the ISO 17025 and TNI portions of CleanAir's A2LA accreditation.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

Title 40 CFR Part 60, Appendix A

Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 3	"Gas Analysis for the Determination of Dry Molecular Weight"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 5	"Determination of Particulate Matter Emissions from Stationary Sources"

Title 40 CFR Part 51, Appendix M

Method 202	"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"

Methodology Discussion

PM and PM_{10} Testing – USEPA Method 5/202

PM emissions were determined using EPA Method 5. PM_{10} emissions were determined using EPA Method 5/202. PM_{10} is equivalent to the sum of FPM less than 10 micrometers (µm) in diameter (FPM_{10}) and CPM. The Method 5/202 sample train yields a front-half, FPM result and a back-half, CPM result. Where appropriate, the total PM result (FPM plus CPM) from Method 5/202 can be used as a worst-case estimation of total PM_{10} since Method 5 will collect all FPM present in the flue gas (regardless of particle size).

The front-half (Method 5 portion) of the sampling train consists of a glass nozzle, glass liner and filter holder heated to 248°F ± 25°F and a quartz fiber filter. Flue gas samples are extracted isokinetically per Method 5 requirements.

The back-half (Method 202 portion) of the sampling train is designed to mimic ambient conditions and collect only the particles that would truly form CPM in the atmosphere by minimizing the sulfur dioxide (SO_2) and nitrogen oxides (NO_X) interferences observed with earlier versions of the method, in which flue gas is bubbled through cold water, and SO_2 and NO_X are absorbed and partially oxidized before they could be purged out with nitrogen (N_2).

Flue gas exiting the front-half heated filter passes through a coiled condenser and dry impinger system jacketed by water continually circulated at ambient temperature. Moisture was removed from the flue gas without bubbling through the condensed water. Flue gas then passes through a tetrafluoromethane (TFE) membrane filter at ambient temperature. The temperature of the flue gas at the exit of the filter was directly measured with an in-line thermocouple and maintained in the temperature range of 65°F to 85°F.

After exiting the ambient filter, the flue gas passes through two (2) additional impingers surrounded by ice in a "cold" section of the impinger bucket. The moisture collected in these impingers is not analyzed for CPM, and is only collected to determine the flue gas moisture and to thoroughly dry the gas. The sample gas then flows into a calibrated dry gas meter where the collected sample gas volume is determined.

The front-half portion of the sample train (nozzle, probe and heated filter) was recovered per Method 5 requirements using acetone as the recovery solvent. The back-half of the sample train (heated filter outlet, condenser, dry impingers and TFE membrane filter) was recovered per Method 202 requirements. The impinger train was purged with N_2 at a rate of 14 liters per minute (LPM) for one (1) hour following each test run and prior to recovery.

A field train blank was assembled, purged and recovered as if it were an actual test sample; analysis of the field train blank was used to blank-correct the test run results. Reagent blanks were also collected to quantify background contamination. All samples and blanks were returned to CleanAir Analytical Services in Palatine, Illinois, for gravimetric analysis. Method 202 samples were maintained at a temperature < 85°F during transport to the laboratory.

End of Section