AECOM

40 CFR 63 Subpart ZZZZ Reciprocating Internal Combustion Engines (RICE MACT) Diversion Diesel Pump Engine A (D-200A) Engine B (D-200B)

Project number: 60699646

March 7, 2023

The Dow Chemical Company
Michigan Operations
Midland, MI

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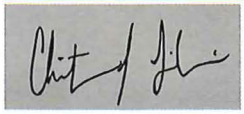		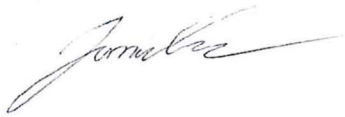	
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1. Introduction

1.1 Summary of Test Program

The Dow Chemical Company (Dow) in Midland, Michigan, is a large complex with manufacturing and utility plants, including an on-site Wastewater Treatment plant. Dow's Michigan Operations (MiOps) is a major source of Hazardous Air Pollutants (HAPS).

AECOM was contracted to conducted compliance sampling on two 1050 horsepower (hp) non-emergency diesel engines (called Engine A and Engine B) to demonstrate compliance with the RICE MACT, 40CFR63, Subpart ZZZZ. The engines are operated to divert influent wastewater and storm water away from the on-site wastewater treatment plant (WWTP) to wastewater storage tanks for a variety of reasons. The testing was conducted to demonstrate compliance with emissions and operating limits found in 63.6600(d), Table 2c of the RICE MACT, 40CFR63, Subpart ZZZZ.

The following table summarizes the pertinent data for this compliance test:

Table 2-1. General Summary Information

Responsible Groups	• The Dow Chemical Company • Michigan Department of Energy, Great Lakes, and Environment. (EGLE) • Environmental Protection Agency (EPA)
Applicable Regulations	• ROP- MI-A4033-2017b • 40 CFR 63 Subpart ZZZZ (RICE MACT)
Industry / Plant	• Environmental Operations Plant (EVO)
Plant Location	• The Dow Chemical Company Midland, MI, 48667
Unit Installation Date	• Engine A 6/2/2021 • Engine B 3/17/2022
Unit Initial Compliance Date	• Engine A 11/18/2021 • Engine B 8/03/2022
Air Pollution Control Equipment	• All engines are equiped with dual single stage catalytic reduction and closed crankcase filtration emission control system
Emission Points	• P200 Diesel Engine A • P200 Diesel Engine B
Pollutants/Diluent Measured	• Carbon Monoxide (CO) • Oxygen (O_2)
Test Dates	• Feb 15, 2023 (Engine A) • Feb 14, 2023 (Engine B)

1.2 Key Personnel

Names and affiliations of personnel, including their roles in the test program, are summarized in the following table.

Table 2-2. Test Program Personnel Summary

Role	Role Description	Name	Affiliation
Process Focal Point	• Coordinate plant operation during the test. • Ensure the unit is operating at the agreed upon conditions in the test plan. • Collect any process data required. • Provide all technical support related to process operation.	Morgan Raup	Dow Chemical
Environmental Focal Point	• Ensure all regulatory requirements and citations are reviewed and considered for the testing.	Becky Meyerholt	Dow Chemical
Air SME	• Leadership of the sampling program. • Develop the overall testing plan. • Determine the correct sample methods.	Chuck Glenn	Dow Chemical
Technical Reviewer	• Completes technical review of the test data.	Chris Trevillian	AECOM
Field Team Leader	• Ensures field sampling meets the quality assurance objectives of the plan.	Jack Hoard	AECOM
Sample Project Leader	• Ensures data generated meets the quality assurance objectives of the plan.	James Edmister	AECOM

2. Plant and Sampling Location Description

2.1 Facility Description

Dow operates a chemical manufacturing facility in Midland, Michigan. Environmental Operations (EVO) operates two diesel 1050 hp engines to divert influent wastewater and storm water away from the on-site wa stewater treatment plant (WWTP) to wastewater storage tanks for a variety of reasons.

In the months leading up to the test, the speed sensors were replaced on both engines with a new technolog y to increase the reliability of the speed sensor. It is not expected that this replacement will impact the operat ion or compliance of the engine.

The testing was conducted to demonstrate compliance with emissions and operating limits found in 63.6600(d), Table 2b of the RICE MACT, 40CFR63, Subpart ZZZZ.

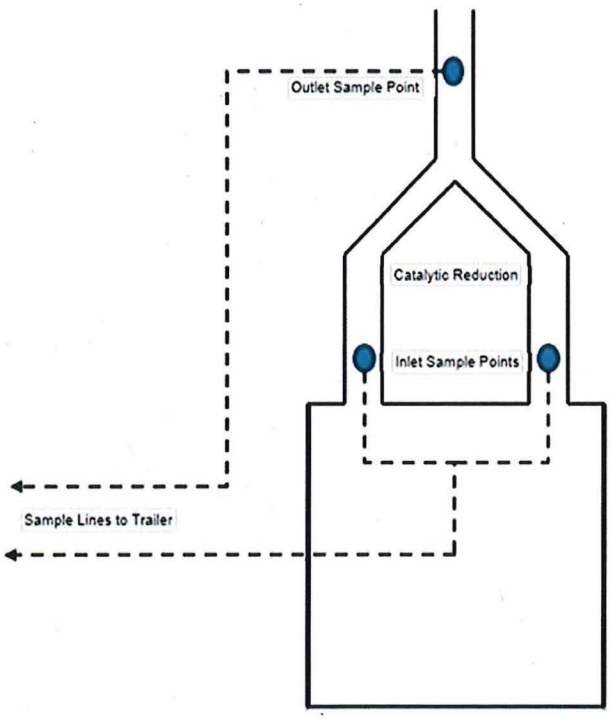
2.2 Control Equipment

CO e missions are controlled by catalytic reduction.

2.3 Flue Gas Sampling Locations

Sampling was conducted on Engine A and Engine B prior to and after the dual (in parallel) single stage catalytic reduction. Flue gas sample locations met the minimum guidelines for carbon monoxide (CO) and o xygen (O_2) sampling.

Figure 2-1. Sampling Location Diagram



3. Summary and Discussion of Test Results

3.1 Objectives and Test Matrix

Under contract with Dow, Midland Operations, AECOM, Inc., conducted compliance sampling on the engines located at the Environmental Operations Plant (EVO) at Dow's Michigan Operations facility (MiOps). These engines are operated in non-emergency situations to manage wastewater and storm water at the MiOps site. The testing was conducted to demonstrate compliance with emissions and operating limits found in 63.6600(d), Table 2c. The specific objectives of this test were to:

- Verify the reduction efficiency (RE) for CO is greater than 70%

3.2 Facility Operations

For engines >500HP the facility must:

- Minimize idle time at startup to <30 minutes
- Maintain the catalyst so the pressure drop across the catalyst does not change by more than 2 inches of water at 100 percent load plus or minus 10 percent from the pressure drop across the catalyst measured during the initial performance test; AND
- Exhaust maintained such that 450°F ≥ catalyst inlet temperature ≤ 1350°F

3.3 Comments / Exceptions

- As allowed by 40 CFR Part 60 ZZZZ, this Compliance Test consisted of three, one hour test runs.

Table 3-1. Summary of Results

SAMPLE TYPE	TEST METHOD	*ACTUAL EMISSION REDUCTION	REQUIRED EMISSION REDUCTION
CO Emissions (RE) Engine A	EPA Method 10	95.99 %	70 %
CO Emissions (RE) Engine B	EPA Method 10	97.73 %	70 %

Table 3-2. Test Run Data

P200 Engine A Test Run Data				
PARAMETER	**RUN 1**	**RUN 2**	**RUN 3**	**AVERAGE**
Sample Date	2/15/2023	2/15/2023	2/15/2023	--
Sample Times (start/end)	09:00-10:00	10:20-11:20	11:38-12:38	--
Outlet CO (ppmv @ 15% O_2)	1.56	1.43	1.42	1.47
Inlet CO (ppmv @ 15% O_2)	35.27	36.89	37.57	36.58
CO (RE %)	**95.58**	**96.13**	**96.23**	**95.99**
P200 Engine B Test Run Data				
PARAMETER	**RUN 1**	**RUN 2**	**RUN 3**	**AVERAGE**
Sample Date	2/14/2023	2/14/2023	2/14/2023	--
Sample Times (start/end)	09:10-10:10	10:30-11:30	12:00-13:00	--
Outlet CO (ppmv @ 15% O_2)	0.71	0.73	0.70	0.72
Inlet CO (ppmv @ 15% O_2)	32.02	90.94	32.05	31.67
CO (RE %)	**97.78**	**97.64**	**97.82**	**97.73**

Table 3-3. Engine A Process Data

PARAMETER	RUN 1	RUN 2	RUN 3	AVERAGE
Sample Date	02/15/2023	02/15/2023	02/15/2023	--
Sample Times (start-end)	09:00-10:00	10:20-11:20	11:38-12:38	--
Engine RPM (RPM)	1848.29	1848.94	1848.46	1848.56
Engine Load Speed	100.00	100.00	100.00	100.00
Fuel Consumed (Gallons)	46	49	38	44.33
Engine Coolant Temperature (surrogate for exit temp) (F)	132	173	168	158
Catalyst A				
Catalyst Inlet Temp (Deg F)	740.70	720.26	718.62	726.53
Differential Pressure (IWC)	21.83	21.91	21.80	21.85
Catalyst B				
Catalyst Inlet Temp (Deg F)	747.47	726.03	726.38	733.29
Differential Pressure (IWC)	22.45	22.58	22.43	22.49

***1 gallon of distillate fuel with 15 ppm of sulfur or less produces 137,381 Btu.**

Table 3-4. Engine B Process Data

PARAMETER	RUN 1	RUN 2	RUN 3	AVERAGE
Sample Date	2/14/2023	2/14/2023	2/14/2023	--
Sample Times (start-end)	09:10-10:10	10:30-11:30	12:00-13:00	--
Engine RPM (RPM)	1849.57	1849.24	1848.82	1849.21
Engine Load Speed	100.00	100.00	100.00	100.00
Fuel Consumed (Gallons)	45	45	41	43.66
Engine Coolant Temperature (surrogate for exit temp) (F)	105	138	145	129
Catalyst A				
Catalyst Inlet Temp (Deg F)	659.87	670.08	689.29	673.08
Differential Pressure (IWC)	15.89	15.78	15.49	15.72
Catalyst B				
Catalyst Inlet Temp (Deg F)	665.65	674.4	694.85	678.30
Differential Pressure (IWC)	16.12	16.08	15.73	15.98

***1 gallon of distillate fuel with 15 ppm of sulfur or less produces 137,381 Btu.**

4. Sampling and Analytical Procedures

4.1 Test Methods

All sampling and analytical procedures are EPA published methods or methods allowed by 63.6610. This compliance test utilized the following methods:

- EPA Method 3A for O_2 Concentration
- EPA Method 10 for CO Concentration

EPA Method 3A (Flue Gas Composition and Molecular Weight)
EPA Method 3A (Instrumental Method) was utilized to determine the diluent during each run on the outlet.

An analyzer measured O_2 content on the basis of the strong paramagnetic properties of O_2 relative to other compounds present in combustion gases. In the presence of a magnetic field, O_2 molecules become temporary magnets. The analyzer determines the sample gas O_2 concentration by detecting the displacement torque of the sample test body in the presence of a magnetic field.

EPA Method 10 (CO Sampling and Analysis)
EPA Method 10 was utilized to determine carbon monoxide concentrations during each run on the outlet.

An analyzer measured CO based on its absorption of infrared radiation. The infrared unit uses a single beam, single wavelength technique, with wavelength selection being achieved by a carefully specified narrow band optical filter making it highly selective for CO measurement in the presence of other infrared-absorbing gases.

4.2 Procedures

The above methods will be performed using mobile continuous emission monitors. Gases will be withdrawn from the stack and transported to monitors located at ground level. A stainless-steel probe will be inserted into the stack and used to collect sample gas. A Teflon sample line heated to 250°F will transport sample gas from the probe to the analyzers. The analyzers will be kept at a constant temperature inside the mobile laboratory.

Sample gas will be collected continuously from the stack for a period of one hour. A stratification test will be performed during run one at the three traverse points of 16.7%, 50% and 83.3% of the measurement line that passes through the centroidal area of the stack or duct cross section. At the mobile laboratory, the stack gas will be routed to a condenser and then transported to the analyzers for analysis.

The Reduction Efficiency (RE) tests will be conducted by measuring the Oxygen and Carbon Monoxide concentrations within the inlet and outlet and then corrected to 15% oxygen.

4.3 List of Sampling Equipment

Table 4-1: Sampling Equipment

Instrument	System	Range	Make	Model	Serial # or ID #
Method 3A (O_2)	Inlet O_2	20.1%	Servomex	1440	OXC-1601
Method 10 (CO)	Inlet CO	124.5 ppm	Thermo	48c	CO-A1604
Method 3A (O_2)	Outlet O_2	20.1%	Servomex	1440	OXC-1602
Method 10 (CO)	Outlet CO	29.9 ppm	Thermo	48i	CO-A1601

Figure 4-1. Sampling Train Used for CO & O2 (M10 & M3A)