RECEIVED
JUL 06 2019
AIR QUALITY DIVISION

Treva A. Formby
Environmental Professional
Detroit Refinery
Marathon Petroleum Company LP
tformby@marathonpetroleum.com

DRIFT EMISSIONS TEST REPORT FOR MARATHON COOLING TOWER F

Performed for:

MARATHON DETROIT REFINERY

CTI Report No. CA19-06D
Client Reference No: 4101815380
CleanAir Project No: 13788
June 18, 2019

This confidential report was generated by CleanAir Engineering - a Licensed CTI Testing Agency. CTI Registration Number CA19-06D.

Submitted by,

Jacob W. Bentley

Reviewed by,

Steven C. Gray

REVISION HISTORY

DRIFT EMISSIONS TEST REPORT FOR MARATHON COOLING TOWER F

Revision History

Revision No:	Date	Pages	Comments
0	6/18/19	All	Original version of document.

CONTENTS

EXECUTIVE SUMMARY

Marathon Detroit Refinery (MPC) contracted Clean Air Engineering (CleanAir) to test the drift emissions of Cooling Tower F. Two drift test runs were completed on a single cell of the tower. The test result will be used to demonstrate that the tower emissions are in compliance with regulatory requirements.

CleanAir is licensed by the Cooling Technology Institute (CTI) for the conduct of cooling tower thermal performance, drift emissions and sound emissions tests. This report deals with the drift emissions testing that took place on May 16, 2019.

The testing was governed by the site specific drift test plan written by CleanAir under the guidelines of the ATC-140 Drift Test Code (1994). The execution of the test runs were in compliance with the requirements of the governing test plan and the tower was configured in normal summertime operation. All data is included in the attached appendices. The tracer elements utilized for test analyses were magnesium and calcium.

The drift emission rate for the tested cell was 0.0014% of the circulating water flow rate based on magnesium and calcium as the chosen tracers.

1.0 PROJECT OVERVIEW

1.1 SCOPE OF WORK

MPC contracted CleanAir to test the drift emissions of Cooling Tower F. This work was governed by the site specific drift test plan written by CleanAir which was written under the framework of the ATC-140 Drift Test Code (1994). Two drift test runs were completed on a single cell of the cooling tower which was used to characterize the emissions from the tower as a whole.

1.2 COOLING TOWER DESCRIPTION

Cooling Tower F consists of two counterflow cells with three circulating water pumps available to circulate the water to the plant process equipment. Each cell of the tower is equipped with a single fan. The tower was configured in normal summertime operation during testing.

All of the cooling tower cells contain the same components and cool the same water. Thus, for cells with consistent components and in the same state of repair, it is reasonable to test one cell and consider it representative of the entire tower.

1.3 TEST SCHEDULE

The schedule of events for the testing is shown in Table 1-1.

Table 1-1: Test Schedule

Date	Description
May 16, 2019	Installed test equipment and completed the two drift test runs. Removed drift equipment from the tower.

A list of personnel participating on site during the test is presented in Table 1-2.

Table 1-2: Test Personnel Participants

Name	Company	Role
Steven Gray	CleanAir Engineering	Test Engineer
Jacob Bentley	CleanAir Engineering	Test Engineer
Jacob Ortman	CleanAir Engineering	Test Engineer
Hayden Ottinger	CleanAir Engineering	Engineering Technician
Mohammad Khatib	CleanAir Engineering	Engineering Technician
Adam Dalton	CleanAir Engineering	Engineering Technician
Treva Formby	MPC	Witness
Paul Bortolussi	MPC	Witness

2.0 METHODOLOGY

2.1 TEST INSTRUMENTS AND EXECUTION

CleanAir performed two drift emissions tests on the 2-cell Cooling Tower F. The performance instruments used for the testing were supplied and calibrated by CleanAir at the CleanAir calibration facility in Powell, TN. The instruments used for the testing met the requirements set forth in the governing test plan and ATC-140.

The circulating water flow rate to the tower was provided by the plant.

Barometric pressure was taken with a Testo hand held barometer.

An ambient air sample was collected with a high volume air sampler. The sampler was placed upwind of the cooling tower near the air inlet to the test cell. One filter was exposed during the duration of the test runs. The objective of this sampling was to provide guidance as to the selection of tracer elements.

During the execution of the drift tests, the airflow speed and direction were measured at each of the sampling stations in order to set the "target" sampling velocity at the inlet to the glass bead pack. The air speed and direction measurements were made with an S-type "double" pitot consisting of two pitots positioned at 90 degrees to each other and mounted on the end of the sampling boom near the sampling nozzle. The differential pressure of the angle sensing pitot was measured locally with a Magnahelic gauge. The velocity pressure of the flow measuring pitot was measured with an inclined manometer. The angle of rotation of the sample train was directly measured with a protractor after the sample train was aligned with the flow.

The flow rate through the sampling train was measured with a certified orifice in a dimensional flow section. Differential pressure across the orifice was also measured with an inclined manometer or digital pressure sensor. Barometric pressure, inlet temperature (stack temperature) and flow section temperature were measured to correct for the density difference between the air at the sampling probe inlet and the air flowing through the orifice. After assembly in the field, the sampling train was leak checked under a strong vacuum to ensure the integrity of the sampling train.

Six locations on each of four radii were sampled for each test run. Table 2-1 contains the radial sampling stations at the stack exit plane.

Table 2-1: Radial Sampling Positions

Sampling Position	Inches
1	5.5
2	17.3
3	30.5
4	45.7
5	64.2
6	90.2

2.2 COMPARISON WITH TEST CODE REQUIREMENTS

The governing test plan states that the tower is to be configured in normal summertime operation with respect to the circulating water flow rate, fan speed and tower bypass. Relevant test data is included in Appendix B.

A summary of the target conditions as well as the corresponding test condition are presented in Table 2-2.

Table 2-2: Drift Test Measurements Summary

Measured Parameter	Target Range	Test Condition
Waterflow Rate	Normal Summer Operation	5,002 gpm
Circulating Water Chemistry	>100 mg/L Mg >200 mg/L Ca	64.2 mg/L Mg 225.0 mg/L Ca
Fan Motor Power	Normal Summer Operation	Normal Summer Operation

Because the objective of this testing is to quantify the tower emissions during normal summer operation, current "normal" operation may be different than the original thermal design specifications. The drift testing was conducted in accordance with the site test plan and the tower was operated in a manner consistent with normal operation during the summer.

3.0 DATA SUMMARY

3.1 PERFORMANCE CONDITIONS

A summary of the selection criteria and target values for the candidate tracers are presented in Table 3-1. Target values were assigned by CleanAir in the drift emissions test plan.

Table 3-1: Elemental Tracer Selection Criteria

May 16, 2019 Test Run 1	Target	Ca	Mg
Ratio of bead pack concentration to RDL	>5	35.40	11.10
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	0.56	0.53
May 16, 2019 Test Run 2	Target		
Ratio of bead pack concentration to RDL	>5	34.30	10.60
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	0.60	.061

The results listed as "NA" in Table 3-1 are due to the fact that analyses of the procedural blank returned a non-detect for the tracer element. Non-detect means the concentration was below the detection limit of the analysis technique. In this case, "NA" indicates that these criteria are acceptable.

CTI ATC-140 dictates that an ambient air sample be collected during each drift test run to evaluate the amount of the tracer element in the air in the vicinity of the tower. Substantial amounts of the tracer in the ambient air may lead to a reported drift rate that is artificially high. This positive bias occurs when mineral bearing ambient air enters the tower and the minerals are not scrubbed by the falling water within the tower, but the minerals are captured by the drift sampling equipment. Since the scrubbing effect of individual cooling towers is unknown, as indicated in ATC-140, a correction for the ambient concentration cannot be applied.

3.0 DATA SUMMARY

Table 3-2 summarizes the results of the tests conducted at the Marathon Refinery on Cooling Tower F on May 16, 2019.

Table 3-2: Drift Test Results

Test ID	Drift Rate Ca	Drift Rate Mg
Test 1	0.0013%	0.0015%
Test 2	0.0013%	0.0016%
Average	**0.0014%**	

The calculated drift emission rate for Cooling Tower F at the Marathon Detroit Refinery was 0.0014% of the circulating water flow rate. Composite results were based on calculations using both magnesium and calcium as the chosen tracers.

Laboratory analyses are included in Appendix A. Drift test data and calculations are included in Appendix B.