BTEC Inc.

BF-401 Induced Draft Fan Emissions Test Report

Prepared for:

Occidental Chemical Corporation

Ludington, Michigan

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AIR QUALITY DIVISION

Oxychem
1600 S. Madison Street
Ludington, MI 49431

Project No. 049AS-440629
August 13, 2018

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
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EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Occidental Chemical Corporation (OxyChem) to evaluate particulate matter (PM) concentrations and emission rates from the exhaust of BF-401 Induced Draft Fan exhaust stack (stack ID# SVFLAKERDRUMS) for the Dry Calcium Chloride Flake Process, EUFLAKEDDRY at OxyChem in Ludington, MI. The emissions test program was conducted on June 18-19, 2018.

Testing of the BF-401 Induced Draft Fan consisted of triplicate 168-minute test runs. The emissions test program was required by MDEQ Air Quality Division Renewable Operating Permit (ROP) No. MI-ROP-B1846-2014. The results of the emission test program are summarized by Table I.

Table I
BF-401 Induced Draft Fan Overall Emission Summary
Test Date: June 18-19, 2018

Source	Permit Limit	Average Test Result
BF-401	0.05 lb / 1,000 lb exhaust gas[1]	0.01 lb / 1,000 lb exhaust gas[1]

[1]Exhaust gases are calculated on a dry gas basis

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1. Introduction

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Testing of the BF-401 Induced Draft Fan exhaust stack consisted of triplicate 168-minute test runs. The emissions test program was required by MDEQ Air Quality Division Renewable Operating Permit (ROP) No. MI-ROP-B1846-2014. The results of the emission test program are summarized by Table 1. All testing was performed in accordance with BTEC test plan 049AS-370896.00.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on June 18-19, 2018 at the OxyChem plant in Ludington, MI. The test program included evaluation of particulate matter emissions from the exhaust stack of the BF-401 Induced Draft Fan exhaust.

1.b Purpose of Testing

Testing was performed to demonstrate compliance with the PM emission limits as described in the AQD issued Renewable Operating Permit No. MI-ROP-B1846-2014. This ROP limits PM emissions from SVFLAKERDRUMS to not more than 0.05 pounds per 1,000 pounds of dry exhaust gas.

1.c Source Description

EUFLAKEDDRY creates flakes of calcium chloride on the flaker drums. A slight negative pressure is maintained on the flaker drum housings by an induced draft fan to collect steam and dust generated by the flaking process. The induced draft fan exhaust air is vented to the atmosphere.

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Names and affiliations for personnel who were present during the testing program are summarized by Table 1.

Table 1
Test Personnel

Name and Title	Affiliation	Telephone
Ms. Macie Sticker Process Engineer	Oxy Chemical 1600 S. Madison Street Ludington, MI 49431	(231) 845-4286
Mr. Mason Sakshaug Field Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(989) 323-0355
Mr. David Trahan Field Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Jeremy Howe Environmental Quality Analyst	MDEQ Air Quality Division	(231) 876-6687
Mr. Rob Dickman Environmental Quality Analyst	MDEQ Air Quality Division	(231) 775-4050

2. Summary of Results

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

2.a Operating Data

Process data monitored during the emissions test program included the BF-401 fan amps and the calcium chloride liquor flow to the flakers.

2.b Applicable Permit

The applicable permit for this emissions test program is Renewable Operating Permit (ROP) No. MI-ROP-B1846-2014.

2.c Results

The overall results of the emission test program are summarized by Table 2 (see Section 5.a).

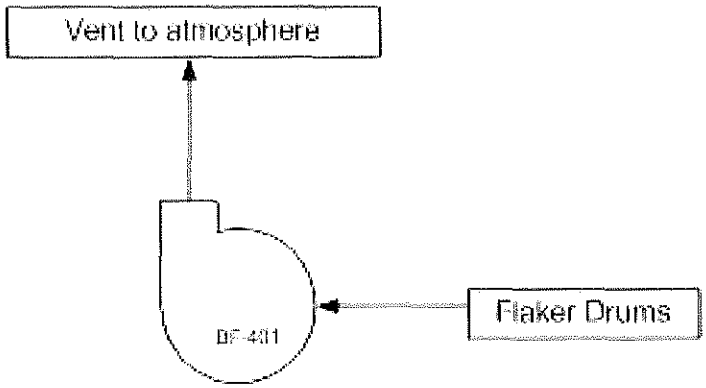
3. Source Description

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

3.a Process Description

EUFLAKEDDRY creates flakes of calcium chloride on the flaker drums. A slight negative pressure is maintained on the flaker drum housings by an induced draft fan to collect steam and dust generated by the flaking process. The induced draft fan exhaust air is vented to the atmosphere.

3.b Process Flow Diagram



3.c Raw and Finished Materials

The raw material used is calcium chloride.

3.d Process Capacity

The PM testing was performed during maximum normal operating conditions of the flaking process.

3.e Process Instrumentation

Process data monitored during the emissions test program included the BF-401 fan amps and the calcium chloride liquor flow to the flakers.

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

The emissions test program utilized the following 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 Molecular Weight of Dry Stack Gas"(Fyrite)
- Method 4 - "Determination of Moisture Content in Stack Gases"
- Method 5 - "Determination of Particulate Matter Emissions from stationary sources"

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2. S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2, were used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions outlined in Sections 2-6 through 2-8 are within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) is assigned. A diagram of the sample points is provided in Figure 2.

Cyclonic flow checks were performed at each 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 angles is greater than 20 degrees, cyclonic flow exists. Oxygen and carbon dioxide concentrations were determined using fyrite.

Exhaust gas was extracted as part of the Method 5 sampling train. Exhaust gas moisture content was determined gravimetrically.

40 CFR 60, Appendix A, Method 5, *"Determination of 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).

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consists of (1) a steel nozzle, (2) a glass probe, (3) a heated filter holder containing a pre weighed glass fiber filter (4) a Teflon connecting line to the impingers, (5) a set of four Greenburg-Smith (GS) impingers with the first two with 100 ml of deionized water (ii) an empty impinger, (iii) and an impinger filled with approximately 300 grams of silica gel. (6) a length of sample line, and (7) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

Upon completion of the final leak test for each test run, the filter was recovered, and the nozzle, probe, and the front half of the filter holder assembly were brushed and triple rinsed with acetone which was collected in a pre-cleaned sample container.

BTEC labeled each container with the test number, test location, and test date, then marked the level of liquid on the outside of the container. Blank samples of the filter and acetone were collected. BTEC personnel hand delivered all samples to the OxyChem lab for sample analysis. The chain of custody form is on page 57.

4.b Recovery and Analytical Procedures

See section 4.a.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figure 2.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 2.

5. Test Results and Discussion

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

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 2. Detailed results for the emissions test program are summarized by Table 3.

Table 2
BF-401 Induced Draft Fan Overall Emission Summary
Test Date: May 3-4, 2018

Source	Permit Limit	Average Test Result
BF-401	0.05 lb / 1,000 lb exhaust gas[1]	0.01 lb / 1,000 lb exhaust gas[1]

[1]Exhaust gases are measure on a dry gas basis.

5.b Discussion of Results

The overall results of the emission test program are summarized by Table 2 (see Section 5.a). PM emissions from the BF-401 Induced Draft Fan exhaust stack were 0.01 lb / 1,000 lb dry exhaust gas, which is less than the permit limit of 0.05 lb / 1,000 lb exhaust gas.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program.

5.d Process or Control Device Upsets

No upset conditions occurred during testing.

5.e Control Device Maintenance

There was no control equipment maintenance performed during the emissions test program.

5.f Testing Interruption

The BF-401 Induced Draft Fan exhaust particulate matter emissions test program conducted on June 18 – 19, 2018 was preceded by an interrupted emissions test series on May 10, 2018. The May 10, 2018 test series was interrupted due to plugged sampling equipment during the second run. Upon investigation, it was suspected that the distance between the test ports and fan discharge did not provide adequate droplet disengagement resulting in intermittent salt entrainment into the emission sampling equipment. The field and computer generated raw data and field notes, as well as the process data and laboratory analytical results collected during this test series are attached in Appendix F.

During the May 10, 2018 test series, the test ports were located 2 duct diameters downstream of the last disturbance and 6.4 duct diameters upstream of the stack outlet, Figure 3. This configuration was selected to position the test ports under the building roof but did not meet the EPA Method 1 recommended criteria of 8 duct diameters downstream and 2 duct diameters upstream.

Following the May 10, 2018 test series and preceding the June 18 – 19, 2018 emission test series, BF-401 exhaust stack test ports were relocated above the roof level. In the new location, the test ports were placed 7.4 duct diameters after the last disturbance and 1 duct diameter upstream of the exhaust stack outlet, Figure 2.

Intermittent droplet entrainment as the cause of the interrupted May 10, 2018 test series is supported by the change in cyclonic flow field data between May 10, 2018 test series, page 74, and the June 18 - 29, 2018 test series, page 24. Reduced localized velocity due to improved air flow uniformity avoids intermittent droplet entrainment. No changes were made to the flaker drumming operation between the aborted May 10, 2018 tests and the successful June 18 – 19, 2018 emission tests.

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 are available in Appendix D.

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MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose Air Quality Services, LLC, (MAQS) personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, MAQS personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

Limitations

All testing performed was done in conformance to the ASTM D7036-04 standard. The information and opinions rendered in this report are exclusively for use by Oxychem. BTEC will not distribute or publish this report without Oxychem's consent except as required by law or court order. BTEC accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by: _____
Mason Sakshaug
Field Technician

This report was reviewed by: _____
Brandon Chase
QA/QC Manager

Table 3
BF-401 Induced Draft Fan Exhaust Particulate Matter Emission Rates

Company	**OxyChem**			
Source Designation	**BF-401**			
Test Date	**6/18/2018**	**6/19/2018**	**6/19/2018**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	83.7	78.8	79.4	80.6
Meter Pressure - Pm (in. Hg)	29.4	29.5	29.5	29.5
Measured Sample Volume (Vm)	144.8	144.1	141.6	143.5
Sample Volume (Vm-Std ft3)	139.7	140.8	138.1	139.5
Sample Volume (Vm-Std m3)	3.96	3.99	3.91	3.95
Condensate Volume (Vw-std)	19.011	17.912	17.917	18.280
Gas Density (Ps(std) lbs/ft3) (wet)	0.0712	0.0714	0.0713	0.0713
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	11.30	11.33	11.13	11.25
Total weight of sampled gas (m g lbs) (dry)	10.41	10.49	10.29	10.40
Nozzle Size - An (sq. ft.)	0.000428	0.000428	0.000428	0.000428
Isokinetic Variation - I	103.2	102.4	99.7	101.8
Stack Data				
Average Stack Temperature - Ts (F)	148.4	143.6	146.9	146.3
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	27.5	27.6	27.6	27.6
Stack Gas Specific Gravity (Gs)	0.951	0.953	0.953	0.952
Percent Moisture (Bws)	11.98	11.29	11.48	11.58
Water Vapor Volume (fraction)	0.1198	0.1129	0.1148	0.1158
Pressure - Ps ("Hg)	29.2	29.3	29.3	29.3
Average Stack Velocity -Vs (ft/sec)	42.1	42.0	42.6	42.2
Area of Stack (ft2)	3.1	3.1	3.1	3.1
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	7,926	7,905	8,024	7,951
Flowrate ft^3 (Standard Wet)	6,721	6,776	6,842	6,780
Flowrate ft^3 (Standard Dry)	5,916	6,011	6,056	5,995
Flowrate m^3 (standard dry)	168	170	171	170
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	34.9	41.6	48.7	41.7
Total Particulate Concentration				
lb/1000 lb (wet)	0.007	0.008	0.010	0.008
lb/1000 lb (dry)	0.007	0.009	0.010	0.009
mg/dscm (dry)	8.8	10.4	12.5	10.6
gr/dscf	0.0039	0.0046	0.0054	0.0046
Total Particulate Emission Rate				
lb/ hr	0.20	0.24	0.28	0.24

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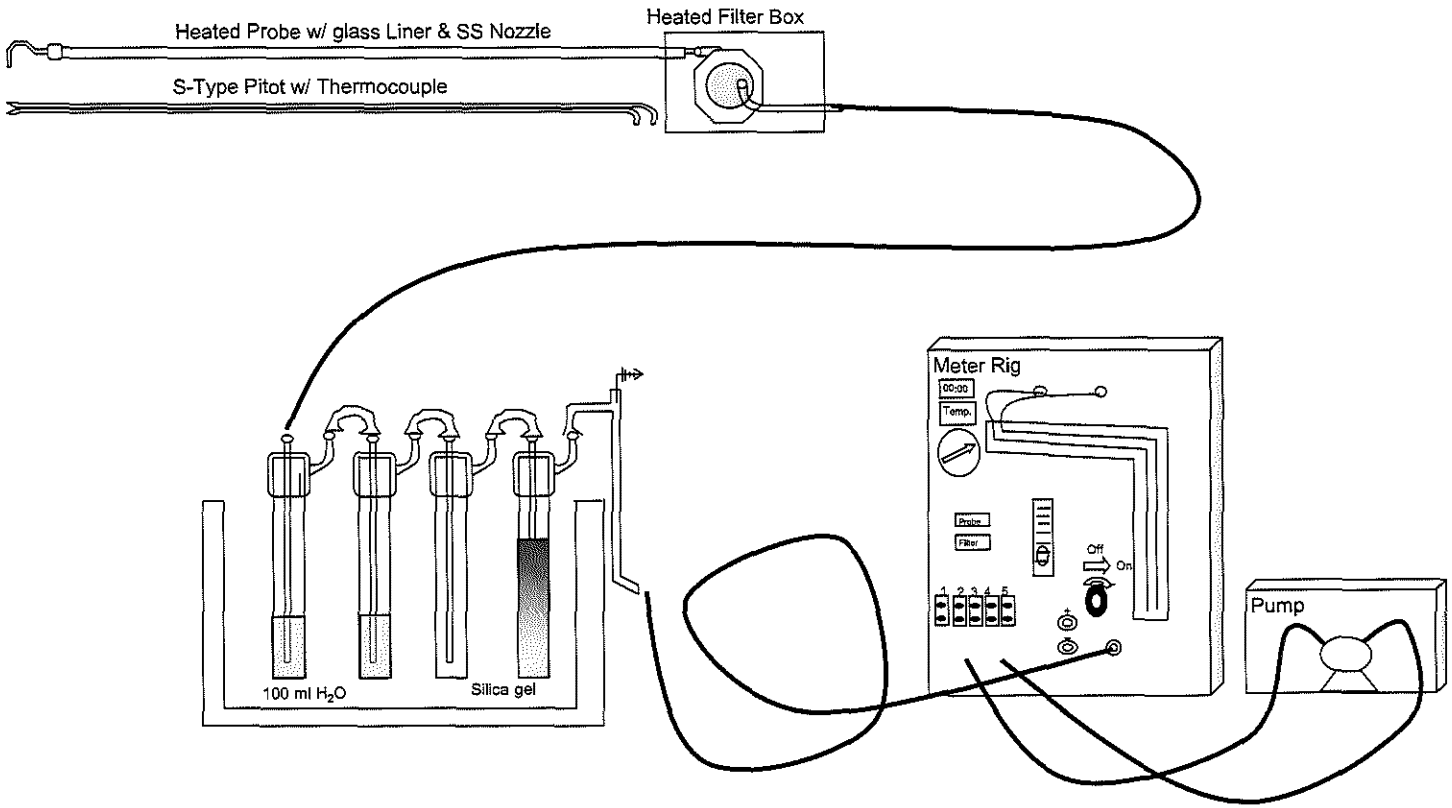

Site:	Sampling Date:	
USEPA Method 5 independent OxyChem Ludington, MI	June 18-19, 2018	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

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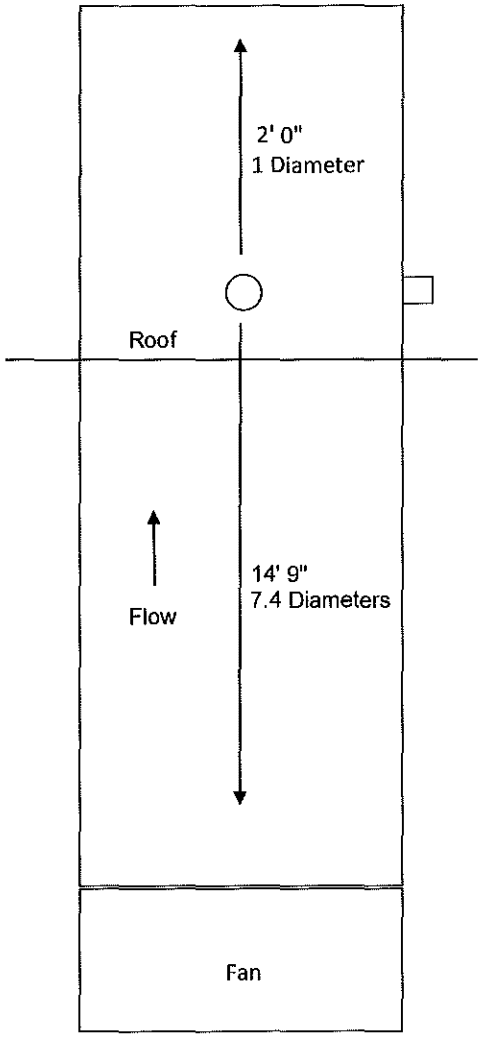
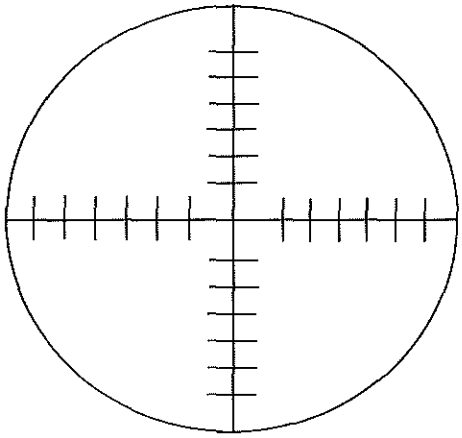
diameter = 24 inches





Not to Scale

Points	Distance "
1	0.5
2	1.6
3	2.8
4	4.2
5	6.0
6	8.5
7	15.5
8	18.0
9	19.8
10	21.2
11	22.4
12	23.5

Figure 2

Site: **BF-401** **OxyChem** **Ludington, Michigan**	**Sampling Date:** **June 18-19, 2018**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**