HORIZON
AIR MEASUREMENT SERVICES, INC.

Horizon Test No.: A79-001-FR
Date Tested: May 23 and 24, 2018
Report Date: July 11, 2018
Revision Number: 0

COMPLIANCE DEMONSTRATION EMISSIONS TEST ON A COVERED AERATED STATIC PIPE

Facility ID: [redacted]
Permit to Construct / Operate

Facility:

[redacted]

Prepared for:

[redacted]

Prepared by:

Horizon Air Measurement Services, Inc.
310 Cortez Circle
Camarillo, California 93012

Regulatory Agency:

South Coast Air Quality Management District
21865 East Copley Drive
Diamond Bar, California 91765

Scott H. Bunch
Scott H. Bunch
Sr. Project Manager

for R.V.
Richard J. Vacherot
Technical Director

HORIZON
AIR MEASUREMENT SERVICES, INC.

July 11, 2018

<u>Via Email & UPS</u>

[redacted]

Dear Mr. [redacted]

Please find attached one (1) pdf copy of the Final Report entitled “Compliance Demonstration Emissions Test on A Covered Aerated Static Pipe.” Please note that one (1) copy has been sent directly to Angela Hahn of SCAQMD via UPS.

If you have any questions, please call me at (805) 482-8753.

Sincerely,

HORIZON AIR MEASUREMENT SERVICES, INC.

Scott H. Bunch

Scott H. Bunch
Sr. Project Manager

ec/cc: Angela Hahn, SCAQMD

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1. INTRODUCTION

In accordance with South Coast Air Quality Management District (SCAQMD) Permit to Construct / Operate (PTC/O) No. [redacted] Material Compost [redacted] is required to conduct an initial compliance testing program to quantify emissions from one compost pipe located at their facility located in [redacted] California. Horizon Air Measurement Services, Inc. (Horizon) was retained to conduct the required emissions compliance test program.

Samples were collected at the biofilter outlet, under normal operating conditions, to determine the mass emission rate of ammonia, total non methane hydrocarbons and speciated organics. One (1), one-hour test run was conducted at each sample location with the exception of the ammonia testing in which two (2), one-hour test runs were conducted.

The test program was completed on May 23, and 24, 2018 by Mr. Scott H. Bunch and Mr. Daniel P. McQuillan of Horizon. [redacted] coordinated the testing with the process operation and provided general oversight. Although notified in advance, no representative of SCAQMD was present during testing. All testing was conducted in accordance with the SCAQMD approved Test Plan (Horizon No. A79-001-TP) and subsequent correspondences.

A summary of the results is provided in Section 2. The process description is provided in Section 3. The sampling/analytical procedures are provided in Section 4. A quality assurance and quality control summary is provided in Section 5.

2. SUMMARY OF RESULTS

The results of the ammonia (NH_3) and total non methane hydrocarbon (TNMHC) testing are summarized in Table 2-1.

The speciated organic compounds collected at the exhaust gas stream that resulted in values above the detection limit of EPA TO-15 are reported in Table 2-2. The complete list of results for all speciated organic compounds are provided in Appendix E.

Test Critique

Since the use of a 20.05% helium tracer gas was introduced into the flux chamber as a sweep gas, the helium concentration sampled during each test run was analyzed for and reported as a dilutant gas. The resulting helium dilution ratio was determined and factored into the final reported biofilter emissions rates per Rule 1133.3, as seen in Table 2-1 and Table 2-2.

Table 2-1
Summary of Results
[redacted]
Biofilter
May 24, 2018

Run	1	2
Ammonia,		
Outlet		
ppm	0.75	0.74
lb/hr	0.0021	0.0025
Total Non-Methane/Non-Ethane Hydrocarbons, as CH_4		
Outlet		
ppm	2.35	-
lb/hr	0.00621	-
		-
Process Data		
tons of material per batch*	125	
composting material	60% green waste and 40% food waste	
pH of compost piles		
Batch 2	6.85 (5/2/18)	
Batch 3	6.55 (4/19/18)	
Batch 4	6.62 (5/1/18)	

* During testing, seven (7) batches were in the CASP.

Table 2- 2
Summary of Results
Speciated Organic Compounds
[redacted]
Biofilter
May 24, 2018

Species	Run 1 Concentration (ppb)	Run 1 Emission Rate* (lb/hr)	Run 2 Concentration (ppb)	Run 2 Emission Rate* (lb/hr)	Run 3 Concentration (ppb)	Run 3 Emission Rate* (lb/hr)
Freon-114	1.54	6.13E-05	< 1	< 3.14E-05	< 1	< 3.09E-05
Acetone	292	3.94E-03	50.1	5.33E-04	47.9	5.02E-04
2-Propanol (IPA)	7.68	1.09E-04	< 3.5	< 3.92E-05	< 3.5	< 3.86E-05
Vinyl Acetate	13.6	2.73E-04	2.08	3.29E-05	2.33	3.62E-05
2-Butanone (MEK)	115	1.93E-03	17.7	2.34E-04	39.8	5.17E-04
Ethyl Acetate	6.92	1.60E-04	< 1.4	< 2.54E-05	< 1.4	< 2.50E-05
Tetrahydrofuran	112	1.88E-03	51.1	6.76E-04	73.4	9.56E-04
2-Hexanone (MBK)	3.78	8.82E-05	< 1.4	< 2.57E-05	< 1.4	< 2.53E-05

Note: All values preceded by "<" are below the detection limit - reported values are detection limit values.
Note: Flow Rates are based on Run No. 2 of NH_3 testing.
Note: The EPA TO-15 full list of compounds were analyzed. Only the detectable compounds were reported.
* Outlet mass emission rates include dilution correction.

3. PROCESS DESCRIPTION

3.1 Covered Aerated Static Pipe

The [redacted] CASP system is designed to treat two composting areas separated by a common biofilter in the middle. Each of the two composting areas consist of five (5), 20 feet wide by 70 feet long by 9.5 ft in height, composting zones (a total of ten composting zones). Each zone contains approximately 465 cubic yards of material. Only green waste up to 60% by volume, food waste up to 40% by volume and biochar up to 5% in volume shall be processed by this system.

An air pump located between the biofilter and the CASP draws air at approximately 7,500 cubic feet per minute (cfm) through the 10 composting zones in each area of the biofilter at temperature of approximately 113 degrees Fahrenheit (F). A schematic of the covered aerated static pipe system is provided in Appendix C. Each composting zones is equipped with a moisture system that provides water to each zone to maintain a moisture content of 40-60 volume percent.

The biofilter consists of a rectangular 61 foot by 65 foot containment, with a total surface area of 3,965 square feet. The containment contains approximately four feet of biofilter media layer consisting of 95% wood chips an 5% finished green waste compost.

3.2 Operating Conditions During Testing

During testing, the CASP system was operating under normal conditions with material in seven of the ten composting zones. All seven zones were in the active composting phase. Batches six and seven were on day 4 (composting began on May 20, 2018). All pile compositions were 60% green waste and 40% food waste. All pertinent process data records for the seven zones are provided in Appendix F.

3.3 Flame Iodization Detector (FID) Pre-Screening

Prior to the source test, a pre-screening test using an FID was conducted to verify the no hydrocarbon emissions were escaping from the compost piles or along the pushwall. The FID was positioned at various points across each compost pile and along the entire pushwall. No points of elevated concentrations were observed across the ten compost piles.

Each of the forty-eight (48) points on top of the biofilter were also sampled using the FID prior to the test program. As per the Source Test Protocol Evaluation, the five highest points determined by the FID were sampled during source testing, in addition to five points chosen at random.

4. SAMPLING AND ANALYSIS

One (1), one-hour test run was conducted for each parameter of interest with the exception of the ammonia testing in which two (2), one-hour test runs were conducted. Samples were collected at the biofilter surface exhaust using the following test methods:

Parameter	**Method**	**Run No.:**
Flow Rate	Calculated (SCAQMD Rule 1133.3)	1 and 2
Ammonia/Moisture	SCAQMD Method 207.1 (Modified for surface emissions)	1 and 2
Fixed Gases	SCAQMD Method 10.1	1
Methane/TNMHC	SCAQMD Method 25.3	1
Speciated Organic Compounds	EPA TO-15	2

Details of each sampling/analytical method utilized for the test program are provided in subsequent portions of this document.

4.1 Sampling Locations

Since the biofilter is not exhausted through an exhaust ducting system or a stack, but through a large surface area (3,965 square feet in area), as described in Section 3, the exhaust outlet emissions was quantified using a flux chamber.

The flux chamber design is provided in Appendix A. It is comprised of a 16 inch diameter stainless steel hood with a surface area under the hood of 1.4 ft^2. The chamber is equipped with four ports (sweep gas /air, sample line, excess vent and thermocouple probe). The volume of the chamber is approximately 25 liters. The inside of the flux chamber is lined with Teflon and was equipped with 1/4 inch diameter Teflon probe into the flux chamber (downstream of the introduction of the sweep air).

Ten sample points were utilized for sample collection. Five of the sample points were chosen at random and five of the sample points were chosen from the highest points found during the pretest using the portable FID. The flux chamber was placed in one sampling location with the base of the chamber 2-3 centimeters below the surface. The sweep gas (approximately 20% helium in air) was initiated in the flux chamber at 5 liters per minute (lpm) as measured using a calibrated rotometer. Sampling began after the chamber has been in place with the sweep air running at least for 2 residence times (10 minutes). The total sampling time was for six minutes per sampling point. The flux chamber was then moved to the next point repeating the procedure previously described for a total of 10 sampling points and 60 minutes of sampling. The following parameters were recorded at each sample point:

- start/end times
- sweep air rate
- chamber temperature
- ambient air temperature

In addition to the samples to be collected for the target compounds, an integrated sample was collected in a SUMMA canister (in conjunction with SCAQMD Method 25.3 and EPA TO-15 where applicable) for each test duration. This sample was analyzed for helium to determine the surface flow rate correction factor as follows:

Surface Flow Rate Correction Factor = C_t/C_s

Where:

C_t = Concentration of Tracer in Sweep Gas
C_s = Concentration of Sweep Gas in Flux Chamber Sample

The subsequent results for each target compound were calculated as follows:

Corrected Flux Chamber Results (lb/hr - ft^2) = UFC x SFCF

Where:

UFC = Uncorrected Flux Chamber Results (lb/hr - ft^2)
SFCF = Surface Flow Correction Factor

Mass emissions were calculated as follows:

lb/hr = lb/hr - ft^2 x Total Biofilter Surface Area (ft^2)

Two (2) test runs were completed on the surface area of the biofilter. Each test run was comprised of six minutes of testing at each of ten locations on the surface of the biofilter for a total of 60 minutes of testing. The first test run included testing for ammonia and total non-methane hydrocarbons. The samples collected were a composite sample of each of the ten sample locations. The exhaust helium concentration was determined from the duplicate SCAQMD Method 25.3

samples. The second test run included the second ammonia test run and three speciated organic compound test runs (20 minutes test runs). The samples collected were a composite sample of each of the ten sample locations with the exception of the speciated organic compound testing in which three samples were collected over the ten sampling locations. The first speciated organic compound test was collected over sampling location 1, 2 and 3. The second speciated organic compound test was collected over sampling location 4, 5 and 6 and the third test run was collected over sample location 7, 8, 9 and 10. The exhaust helium concentration was determined from the speciated organic compound samples.

4.2 Flow Rate

The exhaust flow rate in terms of lb/hr-ft^2 at the biofilter surface area were determined using the procedures identified in Rule 1133.3, Item 8 "Procedure for Measuring Surface Emissions." A description of this Rule is provided in Appendix A.

4.3 Fixed Gases (CO_2, O_2, N_2)

Oxygen, carbon dioxide and nitrogen concentrations at the exhaust of the biofilter were determined in accordance with SCAQMD Method 10.1 as described in Appendix A.

4.4 Ammonia

Ammonia concentrations of the biofilter surface was determined in accordance with a modified SCAQMD Method 207.1. This modification replaces the "full sized" impinger specified in Method 207.1 with a midget impinger sampling train consisting of two midget impingers each filled with 15 ml of 0.1 N sulfuric acid, an empty bubbler and a bubbler filled with silica gel. The sample train was operated at 0.5 liters per minute (lpm). The subsequent samples were analyzed using an ion specific electrode. Two (2) test runs were conducted.

4.5 Methane and Total Non-Methane Hydrocarbons (TNMHC)

Total non-methane hydrocarbon concentration was determined at the surface of the biofilter exhaust using SCAQMD 25.3, as described in Appendix A.

4.6 Speciated Organics

Three samples were collected from the exhaust of the biofilter under normal operating conditions using the evacuated cannister collection system depicted under in Appendix A and analyzed in accordance with EPA Method TO-15 (full list). All system components coming in contact with the digester gas were Teflon or stainless steel. Speciated organic compounds were identified and quantified using GC/MS analytical procedures.

5. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES

A strict quality assurance program was adhered throughout the field testing and analytical phases of the test program. Below is a summary of the QA/QC procedures.

5.1 Field Sampling

5.1.1 SCAQMD Method 25.3

The SCAQMD Method 25.3 field sampling QC requirements are as follows:

- SUMMA canisters verified to be of sufficient cleanliness
- sample apparatus verified to be of sufficient cleanliness
- successful pre and post-test leak checks
- sample collection integrated over sample period
- sample impingers stored on ice
- final container pressure within Method guidelines

All Method QC requirements were successfully fulfilled.

5.1.2 EPA Method TO-15

The EPA Method TO-15 field sampling QC requirements are as follows:

- sample containers verified to be of sufficient cleanliness
- sample apparatus verified to be of sufficient cleanliness
- successful system pre and post-leak check
- sample collection integrated over sample period (±10%)
- sample stored properly pending analyses (tedlar bags protected from sunlight)
- data sheets completed
- final container pressure within Method guidelines (if applicable)
- recovery study completed (if required)

All Method QC requirements were successfully fulfilled.

5.1.3 SCAQMD Method 207.1

The SCAQMD Method 207.1 field sampling QC requirements are as follows:

- properly calibrated equipment within the required time interval
- successful pre and post-test leak checks
- minimum sample volume obtained
- proper chain of custody maintained

- field data sheets properly completed
- sample trains components maintained within Method temperature requirements
- field blank sample obtained
- pH verified at the conclusion of test run to be less than 2

All Method QC requirements were successfully fulfilled.

5.2 Laboratory Analyses

5.2.1 SCAQMD Method 25.3

The SCAQMD Method 25.3 analytical QC requirements are as follows:

- proper chain of custody maintained
- samples analyzed within holding time
- duplicate analyses within limits (< 20%)
- calibration verification standard withing limits (85-115%)
- method blank within acceptable limits
- matrix spike within acceptable limits (75-125%)

All Method analytical QC requirements were successfully fulfilled.

5.2.2 EPA TO-15

The EPA Method TO-15 analytical QC requirements are as follows:

- proper chain of custody maintained
- samples analyzed within holding time
- duplicate analyses within limits
- pre and post calibration verification standard within limits (70% - 130%)
- method blank within acceptable limits
- laboratory control spikes within recovery limits (70% - 130%)

All Method analytical QC requirements were successfully fulfilled.

5.2.3 SCAQMD Method 207.1

The SCAQMD Method 207.1 analytical QC requirements are as follows:

- proper chain of custody maintained
- use of approved procedures
- samples properly stored pending transport to lab
- reagents used are of required quality
- field and laboratory blanks analyzed and found to be acceptable

- all calculations checked
- calibrations curve within acceptable limits for slope (-54 to -60) and correlation coefficient (>0.997)
- matrix spike recoveries within acceptable limits
- calibration verification standard within acceptable limits (± 10%)
- duplicate analyses within acceptable limits (< 5%)

All Method analytical QC requirements were successfully fulfilled.

APPENDIX A - Methods Description

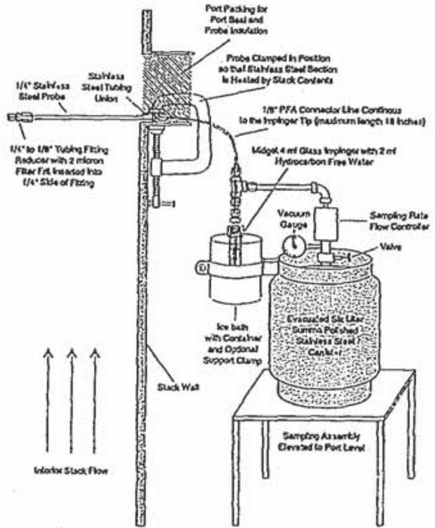
Method: **Determination of Total Gaseous Non-Methane Organic Emissions as Carbon**

Reference: SCAQMD Method 25.3

Principle: A sample of flue gas is drawn through a condensate trap (mini-impinger) and into an evacuated six liter SUMMA canister. Volatile organic compounds (VOC), as total gaseous non-methane organics (TGNMO), are determined by combining results from independent analysis of condensate in the traps and gases in the SUMMA canisters.

Sampling Procedure: Duplicate gas samples are withdrawn from a source at a constant rate through condensate traps immersed in an ice bath followed by evacuated six liter (nominal) SUMMA canisters. Heavy organic components condense as liquids and solids in the condensate traps. Lighter components pass as gases through the traps into the canisters. The combined results from canisters and mini-impinger analyses are used to determine a qualitative and quantitative expression of the effluent gas stream. Duplicate sampling is designed into the system to demonstrate precision.

The sampling apparatus is checked for leaks prior to the sampling program by capping the end of the sample probe. The sample flow valve is then opened and then closed to introduce vacuum to the system. The vacuum drop should then cease numerically above 10 in. Hg. A cease in movement of the vacuum gauge for a period of ten minutes indicates an acceptable leak check. When sampling is initiated, the vacuum gauge must indicate a canister vacuum of greater than 28 in. Hg. Immediately after sampling a post-test leak check is performed, followed by a rinse of the PFA line into the condensate trap with 0.5 to 1.0 ml of hydrocarbon free water.



Analytical Procedure: Condensate traps are analyzed for total organic carbon by liquid injection into an infrared total organic carbon analyzer.

The organic content of the sample fraction collected in each canister is measured by injecting a portion into the FID/TCA analysis system which uses a two phase gas chromatography (GC) column to separate carbon monoxide (CO), methane (CH_4) and carbon dioxide (CO_2) from each other and from the total gaseous non-methane organics (TGNMO) which are eluted as backflush. All eluted components are first oxidized to CO_2 by a hopcalite catalyst and then reduced to methane by a nickel catalyst. The resulting methane is detected using the flame ionization detector. A gas standard containing CO, CH_4, CO_2 and propane, traceable to NBS, is used to calibrated the FID/TCA analysis system.

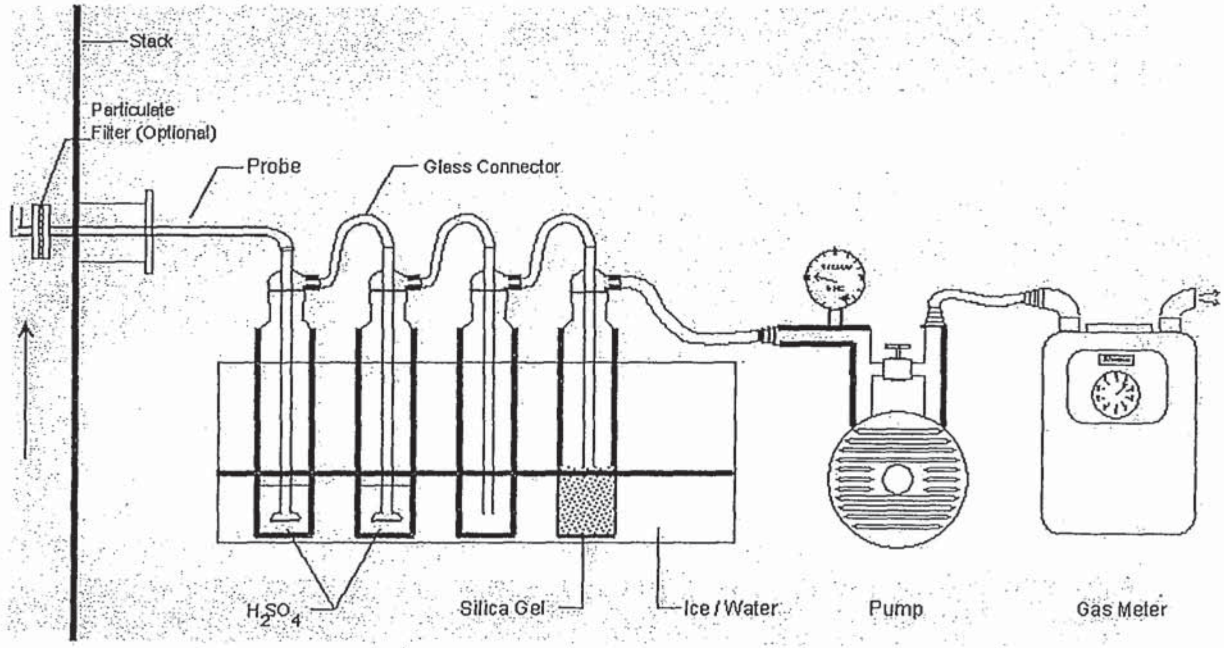
Method:	Carbon Monoxide and Carbon Dioxide by Gas Chromatograph/Non-Dispersive Infrared Detector (GC/NDIR) - Oxygen by Gas Chromatography-Thermal Conductivity (GC/TCD)
Reference:	SCAQMD Method 10.1 (From Evacuated Canisters)
Principle:	An evacuated canister is filled with sample gas according to SCAQMD Method 25.1 or 25.3. The canister contents are analyzed by total combustion analyses/flame ionization detection for carbon monoxide and carbon dioxide. Oxygen is measured by a gas chromatograph using a thermal conductivity detector.
Sampling Procedure:	Refer to SCAQMD Method 25.1 or 25.3.
Analytical Procedure:	Carbon monoxide and carbon dioxide - gas chromatography/non dispersive infrared detector (GC/NDIR). Oxygen - gas chromatography/thermal conductivity detector (GC/TCD).

Method: **Procedure for Collection and Analysis of Ammonia in Stationary Sources**

Reference: SCAQMD Method 207.1

Principle: Sample is withdrawn nonisokinetically from the source through a sample train consisting of a probe, glass impingers, a calibrated meter and a pump. Gaseous ammonia is collected in a series of impingers containing 0.1N sulfuric acid. Samples are then analyzed for ammonia by ion selective electrode (ISE). Two test runs are conducted per source.

Sampling Procedure: The sampling train is shown in the figure. The sample is drawn nonisokinetically through a nozzle and glass lined probe followed by an impinger train. The train consists of two standard Greenberg-Smith impingers (1st and 2nd) each containing 100 ml each of 0.1N H_2SO_4 and one empty Greenburgh-Smith impinger (3rd) empty and one modified impinger with silica gel.



Sample Recovery: Following testing, moisture content is determined gravimetrically or volumetrically from initial and final impinger weights or volume. Samples are recovered as follows:

Container #1 - The filter (optional) is placed in its original petri dish

Container #2 - The nozzle, probe, all connective tubing (filter holder/optional) and the impingers are rinsed three times with 0.1N H_2SO_4 and combined with the impinger contents.

Sample Analyses: Container #2 - The sample volume is brought to 1 liter and analyzed for the ammonium ion using ion selective electrode (ISE).

Method: **Speciated VOC's by GC/MS Analyses or GC Analyses**

Reference: EPA TO-15 (Canister Method)

Principle: A sample is collected using stainless steel canisters and analyzed using the appropriate GC or GC/MS techniques to quantify speciated volatile organic compounds.

Sampling Procedure: Sample are collected using stainless steel canisters which are evacuated to less than 10 mm Hg absolute. The tanks are pressurized and evacuated three times with ultrapure nitrogen and leak checked prior to use. Representative, integrated samples are collected through a heat conditioned stainless steel probe followed by a 1/4" O.D. Teflon sample line. The gas samples are metered into the canisters through the rotometer maintaining a constant flow rate throughout each sampling period.