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The Dow Chemical Company, Michigan Operations

MACT Performance Testing 858 Building Thermal Treatment Unit, FG858TOX-S1

MI-ROP-A4033

October 26, 2018

1. Introduction

1.1 Summary of Test Program

AECOM Technical Services Inc. (AECOM) was contracted by The Dow Chemical Company (Dow) in Midland Michigan, to conduct Performance testing on the Thermal Treatment Unit (TTU) at 858 Building on August 29, 2018. The performance testing consisted of measurements for chloroform in the TTU inlet vents, and hydrogen chloride (HCl), chlorine (Cl_2), and chlorobenzene in the final vent stack out the TTU scrubber. The following sections present the regulatory background, objectives, description, and schedule of the testing program.

Dow submitted a test plan for performance testing on the 858 TTU system, which is a shared control device. The 858 TTU system is used for control of organic HAP emissions, halogenated emissions, and HCl and chlorine emissions from Group 1 process vents from 1028 building. 1028 building is campaign operated and can either run the Penoxsulam process (subject to the PAIP MACT) or the DHEP/DCEP process (subject to the MON MACT). This test was used to demonstrate compliance with the existing source requirements for control for both 40 CFR 63 Subpart MMM (Pesticide MACT) and 40 CFR 63 Subpart FFFF (MON MACT).

Table 1-1 presents a summary of the emission testing program.

Table 1-1 858 TTU Emission Testing Results – 8/29/2018

Sample Type	Test Method	Sampling Time (min/run)	Emission Standard	Test Results
VOC (DRE)	SW-846 Method 0030	120 min	>98% DRE	99.4
HCl	EPA Method 26A	60 min	<20 ppmv @ 7% O_2	10.0
HCl (DRE)	EPA Method 26A	60 min	>99% DRE	99.3

1.2 Regulatory Background

When implementing the MON for the 1028 DHEP/DCEP process, EPA approval was granted to use prior 858 TTU performance test data. The parameter limits in Table 1 had therefore been used for MON compliance.

Table 1-2 858 TTU/Scrubber Operating Parameters (based on 2004 & 2007 Performance Tests)

858 TTU/Scrubber Operating Parameter	Standard	Operating Limit
Minimum Firebox gas temperature	98% DRE & < 20 ppmv HAP	982.1°C (1800°F)
Minimum scrubber flow rate	> 99% HCl removal	26.5 gpm
Minimum scrubber pH		5.3

On March 15, 2018, a DHEP/DCEP process change was made where several new vents were tied into the 858 control system (notification occurred in the revised MON NOCS submitted on March 15, 2018). This process change represents a change in worst-case conditions for batch process vents under MON; therefore, a performance test was completed to comply with §63.2460(c)(2)(vi) which says a facility 'must conduct a subsequent performance test or compliance demonstration equivalent to an initial compliance demonstration within 180 days of a change in the worst-case conditions'.

1028 building is campaign operated and can either run the Penoxsulam process (subject to the PAIP MACT) or the DHEP/DCEP process (subject to the MON MACT). These two processes cannot be run at the same time. When running the DHEP/DCEP campaign, the DHEP portion is run independently of the DCEP portion and these two processes may or may not be operated simultaneously. Therefore, a spike test (hypothetical worst-case conditions) was completed for the 1028 vent header to ensure that worst case conditions for the control device are considered for both MON [§63.2460(c)(2)(ii) & §63.1257(b)(8)] and PAIP MACT [§63.1365(b)(11)(ii), (iii)]. An emission profile by equipment will be used to describe the 1028 vent stream characteristics [§63.1257(b)(8)(i)(B), §63.1365(b)(11)(ii)].

The testing demonstrates compliance with the following MACT emission control standards.

MON MACT:

- Reduce collective uncontrolled OHAP emissions from the sum of all batch process vents within the process by >=98 percent by weight by venting emissions from a sufficient number of vents through one or more CVS to any combination of non-flare control devices [§63.2450(e), Table 2 to Subpart FFFF],
- Use a halogen reduction device after the combustion control device to reduce overall emissions of hydrogen halide and halogen HAP within a process by > 99% by weight or to an outlet concentration ≤20 ppmv. [§63.2450(e)(3), Table 2, condition 2.a.]

PAIP MACT:

- Reduce uncontrolled organic HAP emissions from a process vent by $\geq$ 98 wt % [§63.1362(b), Table 2 to Subpart MMM],
    - *This test did not analyze the outlet for THC concentration due to the low spike feed rate during testing. The 2004 858 TTU PAI performance test demonstrated compliance with the following requirement: Reduce uncontrolled organic HAP emissions from any process vent to an outlet concentration $\leq$ 20 ppmv [§63.1362(b)(2)]. The TTU operating temperature was the same for both tests.*
- Reduce HCl and Cl_2 emissions, including HCl generated from combustion of halogenated process vent emissions, from the sum of all process vents within a process by $\geq$ 94% or to an outlet concentration $\leq$ 20 ppmv. [§63.1362(b)(3)]

Summary of MACT Emission Control Standards

MACT	Control device	Pollutant	Emission Control Standard to be Demonstrated
MON	858 TTU	Organic HAP	> 98% removal
	858 TTU Scrubber	HCl/Cl_2	$\leq$20 ppm HCl/Cl_2 or 99% removal
PAIP	858 TTU	Organic HAP	> 98% removal
	858 TTU Scrubber	HCl/Cl_2	$\leq$20 ppm HCl/Cl_2 or 94% removal

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

Responsible Groups	• The Dow Chemical Company • Michigan Department of Environmental Quality (MDEQ) • Environmental Protection Agency (EPA)
Applicable Regulations	• MI-ROP-A4033-2017 • 40 CFR Part 63 PAI MACT (Subpart MMM) • 40 CFR Part 63 MON MACT (Subpart FFFF)
Industry/Plant	• 858 Building TTU system
Plant Location	• The Dow Chemical Company Midland, Michigan 48667
Unit Initial Start-up	• 1990
Air Pollution Control Equipment	• 858 Building TTU system (which includes a quench and scrubber)
Emission Points	• 858 TTU system vent stack
Pollutants/Diluent Measure	• Hydrogen Chloride (HCl) • Chlorine (Cl2) • Chlorobenzene (surrogate) • TOC (as THC)
Test Date	• August 29, 2018

1.3 Key Personnel

The key personnel coordinating this test program were:

- Dave Bosco provided support as the Process Focal Point. The Process Focal Point is responsible for coordinating the plant operation during the test and ensuring the unit is operating at the agreed upon conditions in the test plan. He also served as the key contact for collecting any process data required and providing all technical support related to process operation.

- Patty Worden provided support as the Environmental Focal Point for this test. The Environmental Focal Point is responsible for ensuring that all regulatory requirements and citations are reviewed and considered for the testing. All agency communication will be completed through this role. Contact information is 989-638-7632.

- Daniel J Nuñez served as the Test Plan Coordinator. The Test Plan Coordinator is responsible for the overall leadership of the sampling program. They also develop the overall testing plan and determine the correct sample methods.

- Eugene Youngerman provided support as a technical review of the test data.

- Daniel J Nuñez also served as the Sample Team Leader. The sample Team Leader is responsible for ensuring the data generated meets the quality assurance objectives of the plan. Kyle Kennedy, James Edmister, Matthew Newland and Eugene Youngerman also assisted as sampling technicians.

2. Plant and Sampling Locations

2.1 Facility and Control Device Description

The 858 TTU system is a shared device which controls vents from the following process units:

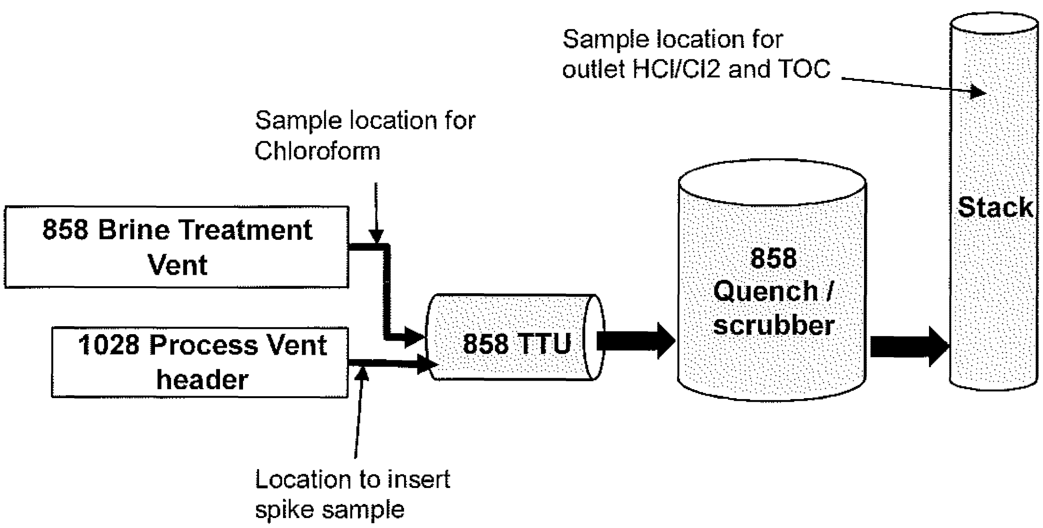
Facility	Title V emission unit	Applicable MACT	Description / Comments
858 Dursban®	EU15-S1	PAIP MACT	This facility produces an insecticide. The process has no Group 1 MACT vents but the associated brine water treatment system generates chloroform which is sent to the TTU. The chloroform emission scenario is generally continuous, year round and represents the highest overall HAP loading to the TTU.
1028 Penoxsulam	FGRule290-S1	PAIP MACT	The Penoxsulam process produces a technical herbicide and runs for 4-8 months per year. 1028 can either run the Penoxsulam campaign or the DHEP/DCEP campaign. HAP emissions only occur during the solvent addition and exchange steps which last nominally 12 hours per day. HAPs emitted: toluene, acetonitrile
1028 DHEP/DCEP	EUDCEP-S1	MON MACT	This DHEP/DCEP process produces a herbicide intermediate and runs for 4-8 months per year. 1028 can either run the DHEP/DCEP campaign or the Penoxsulam campaign. HAP emissions only occur during the solvent addition, solvent exchange and distillation steps which last nominally 12 hours per day. HAPs emitted: methanol, triethylamine, methyl chloride, ethyl chloride, chloroform
969 DEDS	FGRule290-S1	MON MACT	This DEDS process produces a herbicide intermediate. It only sends thermal expansion related emissions from a Group 1 acetonitrile storage tank to the 858 TTU. HAP emissions are negligible compared to the 858 brine treatment and 1028 process.
934 Insecticide Formulations	FGRule290-S1	MON MACT	This facility produces insecticide formulations. All process vents are MON exempt.

The 858 TTU system is represented by FG858TOX-S1 in the Title V permit and it does not have a finished product associated with it. The 858 TTU system includes a firebox followed by a water quench and caustic scrubber system. The formation of HCl and Chlorine result from combusting halogenated HAPs. See the Table 1 on next page for a description of this equipment. This system is shown schematically in Figure 1. There has been no maintenance performed on the 858 TTU system in the past 3 months.

Table 1 Description of Control Equipment

Control Device	Description
858 ME-921 TTU Burner	Manufacturer: John Zink Minimum Firebox temperature: 1800 F Minimum residence time: 1 second Capacity: 5 MM BTU/hr >99.9% destruction efficiency of organics
858 T-924 Scrubber	Packed column scrubber (24" diameter; 10.5' of packing) Scrubbing fluid: caustic/water solution Design liquid rate: minimum 22 gpm Design vapor rate: 2500 cfm > 99% HCl/Cl_2 removal
858 V-922 Quench	Manufacturer: Schuette and Koertig, Model 7110 Two venturi type scrubbers in series Recirculating fluid: water Design vapor rate: 200 cfm

Figure 1 858 TTU Process Schematic and Sampling Locations



2.2 Performance Test Operations

The Performance Test was conducted under hypothetical worst case conditions adequate for both PAIP and MON compliance. The emission profile by equipment consisted of the following two primary HAP vent streams to the 858 TTU:

- **858 Brine Treatment vent**: The chlorpyrifos manufacturing process (858 Building) does not generate organic HAP emissions. The process does generate water that is discharged from the process unit. Because this water does not contain any organic HAPs it is not considered wastewater according to Subpart MMM. After exiting the process unit, this water stream is treated to destroy any residual chlorpyrifos before discharge to the sewer system leading to the on-site waste water treatment plant. This treatment process uses bleach. Chloroform is formed as a byproduct of the bleaching process. The vent from the treatment process is routed to the 858 TOX.

  The vent from the bleach treatment process unit is continuous. Dow considers this a conservative measure because the vent comes from a source not subject to the rule. However, since the chloroform is a significant contributor to the control device HAP loading (~ 23 lb/hour) Dow included this source in the performance test. During the performance test, the water treatment operations were operating at normal rates.

- **1028 Process vent**: The 1028 facility can produce either Penoxsulam (PAIP MACT) or DHEP/DCEP (MON MACT). At the time of the test, the facility was in turnaround to switch from DHEP/DCEP to Penoxsulam and the generation of vents was primarily from cleanouts. Therefore, to simulate the hypothetical worst case emission profile of this vent, a spike test was conducted on the 1028 vent. The spike test (discussed in more detail in Section 3.3) provided more challenging test conditions to demonstrate DRE than the 1028 vent HAP loading.

In summary, as a conservative measure, the most challenging condition for the TTU control device includes both the 858 brine treatment vent and the 1028 process vent when describing the maximum HAP load.

During each test run, CMS parameters were monitored and stack gas emissions measured. The following sections briefly summarize these activities associated with the Performance test.

2.3 Unit Process Data

Process monitoring information pertinent to establishing that the unit is operating at normal conditions was recorded during the test by the TTU data acquisition system. One-minute average data was obtained from the process control system for each operating parameter specified in the test plan for each test run. For each operating parameter, an average value was calculated for each test run. Table 2-1 shows the process data collected during the test program.

Table 2-1 Process Data Collected During Testing

Parameter	Units	Value
TTU Firebox Temperature	°C	982.1
TTU Scrubber Liquid Flow rate (influent)	gpm	26.0
TTU Scrubber liquid pH (effluent)	N/A	6.1
TTU Quench liquid flow	gpm	12.1
Scrubber blower RPM	RPM	1985.6
Scrubber blower pressure	Inches water	-10.3
Brine flow to Chlorinator	gpm	40.9
Chlorinator Temperature	°C	98.1
Chlorine Flow to chlorinator	Lb/hr	343.8
Caustic flow to chlorinator	gpm	0.7

Scrubber L/G: The MON MACT requires that a facility determine the scrubber gas inlet flow and average L/G over the performance test period. Per the rule, an acceptable determination method is using the design blower capacity, with appropriate adjustments for pressure drop. The T-924 scrubber blower has a variable speed motor. The plant measured RPMs and inlet pressure. Using these parameters along with the blower curve (see Section 10), the gas flow rate was established. Below is the average L/G value for the test period.

L: Scrubber Liquid flow (cfm)	3.5 (26.0 gpm)
G: Scrubber gas flow (cfm)	1750
L/G (unitless)	0.002

3. Summary and Discussion of Test Plan

3.1 Objectives and Test Matrix

The primary objective of this testing is to demonstrate compliance with the requirements of 40 CFR 63 Subpart MMM (PAIP MACT) and 40 CFR 63 Subpart FFFF (MON MACT). This test report describes the instrumental and manual procedures performed on the 858-Bldg TTU inlet vents and 858-Bldg TTU scrubber stack.

3.2 Process Operating Rates

Testing was conducted at hypothetical worst case conditions for the 1028 process vent via spike testing (see section 3.3 for details). In addition to the 1028 vent spiking, the 858 brine treatment process was operating at normal capacity to ensure chloroform loading during testing is representative of standard operation.

The table below outlines the proposed minimum operating rates of the TTU system and the actual values during the test.

Table 3-1 858 TTU Operating Parameters

Parameter	Target Operating Rate	Average Operating Rate During Test
TTU Exit Gas Temperature (°C)	> 982.1	982.1
TTU Residence Time (sec)	> 1	> 1
Scrubber liquid flow rate (gpm)	> 26.5	26.0
Scrubber Liquid pH	> 5.3	6.1

Table 3-2 Testing Run Data (HCl/Cl_2)

	Run 2	Run 3	Run 4	Average
Run Date	8/29/2018	8/29/2018	8/29/2018	-----
Run Times	11:23-12:29	13:10-14:17	15:20-16:28	-----
Stack Gas Wet Flow (cf/hr)	45,917	46,473	45,856	46,082
Stack Gas Wet Flow Std. Cond. (scf/hr)	38,592	39,076	38,646	38,771
Stack Gas Dry Flow Std. Cond. (dscf/hr)	27,445	27,931	27,613	27,663
Volume Gas Collected (dscf)	35.777	37.414	37.232	-----
Stack Gas O_2 (%)	9.5	9.8	9.5	-----
HCl/Cl_2				
Mass Found (µg)	16,941	16,778	3,597	12,438
Concentration (mg/dscf)	0.473	0.448	0.096	0.339
Concentration (ppmdv)	11.3	10.7	2.31	8.13
Concentration (ppmdv @ 7%O2)	13.8	13.5	2.82	10
Emission Rate (lb/hr)	0.029	0.028	0.006	0.021
Chlorine Feed Rate (lb/hr)	2.99	2.99	2.20	2.73
Chlorine DRE (%)	99.0	99.1	99.7	99.3

Table 3-3 Testing Run Data (VOC DRE)

	Run 2	Run 3	Run 4	Average
Run Date	8/29/2018	8/29/2018	8/29/2018	-----
Run Times	10:55-12:55	13:05-15:00	15:10-17:05	-----
Stack Gas Wet Flow (cf/hr)	45,917	46,473	45,856	46,082
Stack Gas Wet Flow Std. Cond. (scf/hr)	38,592	39,076	38,646	38,771
Stack Gas Dry Flow Std. Cond. (dscf/hr)	27,445	27,931	27,613	27,663
Volume Gas Collected (dscf)	35.777	37.414	37.232	-----
Stack Gas O_2 (%)	9.5	9.8	9.5	-----
VOC				
Mass Found – Tenax 1 (µg)	<0.01	<0.01	<0.01	<0.01
Mass Found – Tenax/Charcoal 1 (µg)	<0.01	<0.01	<0.01	<0.01
Mass Found – Tenax 2 (µg)	<0.01	<0.01	<0.01	<0.01
Mass Found – Tenax/Charcoal 2 (µg)	<0.01	<0.01	<0.01	<0.01
Mass Found – Tenax 3 (µg)	<0.01	<0.01	<0.01	<0.01
Mass Found – Tenax/Charcoal 3 (µg)	<0.01	<0.01	<0.01	<0.01
Mass Found – Tenax 4 (µg)	<0.01	<0.01	<0.01	<0.01
Mass Found – Tenax/Charcoal 4 (µg)	<0.01	<0.01	<0.01	<0.01
Mass Found – Condensate (µg)	<0.0428	<0.0424	<0.0414	<0.0422
Concentration (µg/dscf)	<0.00016	<0.00013	<0.00013	<0.00014
Emission Rate (lb/hr)	<0.0000027	<0.0000022	<0.0000022	<0.0000024
Spiking Feed Rate (lb/hr)	0.00035	0.00040	0.00040	0.00038
VOC DRE (%)	99.2	99.4	99.4	99.3

"<" indicates that results were below the method detection limit

3.3 Surrogate Spiking

Due to regulatory testing requirements and operational scheduling, the 1028 process vent worst-case HAP operational scenario source was not in service at the time of the required test. As a result, Dow used surrogate spiking to simulate worst case conditions as the best approach to demonstrate compliance with the applicable standards. After review of the potentially present compounds, Dow utilized chlorobenzene (an EPA Class 1 POHC) as a surrogate spiking compound. Using chlorobenzene as the spiking compound presents a number of benefits, including:

- Thermal stability ranking of Class 1, which puts it in line with the worst of the potentially present compounds,
- Chlorobenzene behaves well in multiple sampling and analytical methods,
- Chlorobenzene is readily available, and
- The testing contractor, AECOM, has successfully utilized this compound for surrogate spiking and demonstration for over fifteen years.

Dow introduced the spiking solution into the inlet to the TTU at a rate of nominally 0.0004 lb/hr. The spike rate was determined by evaluating the detection and collection limits of the suggested test method and was measured and controlled with a mass flow meter.

Dow optioned to demonstrate DRE using only Chlorobenzene at a mass loading rate less than typical operation. This approach allowed Dow to demonstrate the control device's ability to achieve the required DRE with a high degree of confidence.

A certified gas standard of known concentration of chlorobenzene was used as the spiking material. The volume fed was monitored to determine the spiking rate, and support DRE calculations. The spiking material was shipped in sealed containers.

Table 3-4 presents the surrogate spiking rates for the test program.

Table 3-4 Surrogate Spiking Rates

Parameter	Run 2	Run 3	Run 4	Average
Run Duration (hr)	2.0	1.9	1.9	1.9
Total Chlorobenzene Fed (lbs)	0.00069	0.00077	0.00078	0.00074
Spike Rate (lb/hr)	0.00035	0.00040	0.00040	0.00038

4. Sampling and Analytical Procedures

INLET ANALYSIS

858 Brine treatment vent inlet - Parameters measured during the performance test were:

- Chloroform, using modified EPA Method 18.

1028 process vent inlet - Parameters measured during the performance test were:

- Chlorobenzene (spike material), using a mass flow controller

The scrubber inlet chloride mass rates were determined from the inlet chloroform and chlorobenzene mass flow rates.

OUTLET ANALYSIS

858-Bldg TTU scrubber outlet - Parameters measured during the performance test were:

- HCl and Cl_2, using EPA Method 26A: Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources
- O_2/CO_2 using EPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources.";
- Chlorobenzene, using SW-846 Method 0030, "*Volatile Organic Sampling Train"*

The compliance test was conducted on August 29, 2018. The emission testing of the 858-Bldg TTU inlet vents and scrubber stack consisted of three (3) test runs. Each test run was a minimum of 1 hour. Sampling specifications are presented in Table 5 and Table 6.

Table 5 Test Matrix

Source	Parameter	Test Method	Sampling Details
858 Brine treatment vent inlet	Chloroform	Modified EPA Method 18	≥60 min, ~0.5 lpm
1028 process vent	Chlorobenzene	Mass Flow Controller	Continuous during testing
858 TTU Scrubber Stack	HCl/Cl_2	EPA Method 26A	≥60 min, ≥30 cf
	Velocity, Volumetric Flow Rate	EPA Method 2	Concurrent with Method 26A
	O_2, CO_2, dry molecular weight	EPA Method 3A	Concurrent with Method 26A
	Moisture, wet molecular weight	EPA Method 4	Concurrent with Method 26A
	Chlorobenzene	SW-846 Method 0030	4 tube pairs, 30 minutes per pair, ≤7liter per minute sample rate, condensate collected after 4th pair

Table 6 Sampling Matrix

Sampling Location	Sample/Type Pollutant	Sampling Method	Sampling Organization	Sampling Details		Analytical Method	Analytical Lab
				Duration	Rate		
TTU inlet – chlorinator vent	Chloroform	Mod. M18	AECOM	≥60 min	N/A	M18	Enthalpy
TTU inlet – 1028 spike	Chlorobenzene	N/A	AECOM	continuous	N/A	N/A	N/A
Scrubber Exit	Mol. Wt. (O_2/CO_2)	M3A	AECOM	Concurrent with M26A	N/A	Paramagnetic, Infrared	AECOM
	Moisture	M4	AECOM		N/A	Gravimetric/ Calculation	AECOM
	Flow	M2	AECOM		N/A	N/A	AECOM
	HCl/Cl_2	M26A	AECOM	≥60 min	~0.5 cfm	Ion Chromatography	Test America
	Chlorobenzene (HAP surrogate)	M0030	AECOM	≥120 min	~0.7 l/min 4 30-min tube pairs per run, Condensate collected after run	GCMS	Test America

4.1 Sample Port Location

TTU Inlet – 858 Brine Treatment Vent

The 858 Brine Treatment vent is approximately 6 feet high with an inside diameter of 2 inches at the elevation of the sampling point. The sampling port is approximately 20 inches downstream from the closest disturbance and 20 inches upstream from the next nearest disturbance.

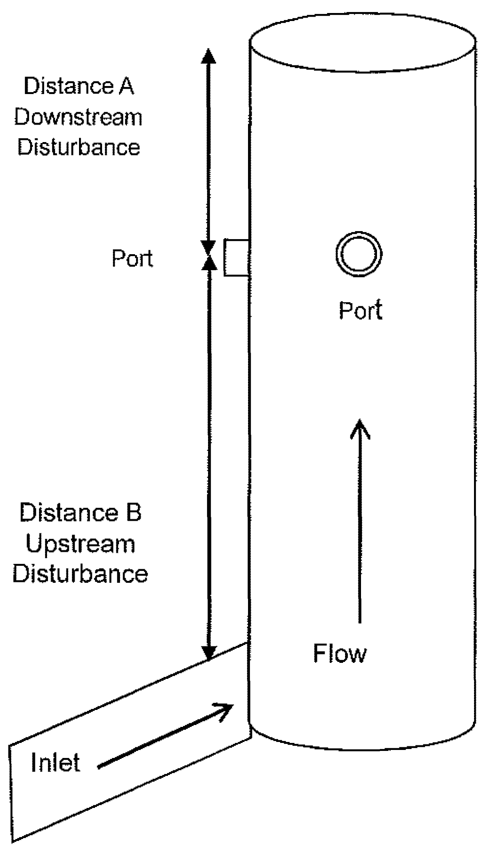
TTU Inlet – 1028 Process Vent (Spike location)

The 1028 process vent is approximately 6 feet high with an inside diameter of 2 inches at the elevation of the spiking point. No sampling was conducted at this location; therefore it is not required to meet specifications for EPA Method 1.

Scrubber Exit

The scrubber exit is approximately 40 feet high with an inside diameter of 12 inches at the elevation of the sampling points. The sampling ports are approximately 27 inches downstream from the closest disturbance and 108 inches upstream from the next nearest disturbance.

Sample Location	Distance A Downstream disturbance	Distance B Upstream disturbance
858 Brine Treatment Vent	20"	20"
Vent Stack	27"	108"



4.2 Sampling Methods

4.2.1 EPA Methods 2, 3A and 4 (Flow Rate, Gas Composition, and Moisture) Scrubber Exit Only

Concurrent with the performance of Method 26A, measurements were made to determine stack gas flow rate by EPA Method 2, gas composition by EPA Method 3A, and moisture by EPA Method 4.

4.2.2 Modified EPA Method 18 (Chloroform)

The 858 Brine Treatment Vent gas was be sampled for determination of chloroform using a sampling train meeting the requirements of EPA Method 18. Gas was withdrawn from the duct, utilizing sample line of proper size to allow sufficient sample collection. The chloroform was collected in a solution of Methanol. An S-type pitot was used to determine differential pressure for the purpose calculating gas flow rate. Measurements taken at this location were used to determine chlorine loading rate for the purpose of calculating DRE across the scrubber.

4.2.3 EPA Method 26A (Hydrogen Chloride and Chlorine)

The scrubber stack gas was sampled for determination of hydrogen chloride and chlorine using a sampling train meeting the requirements of EPA Method 26A. Gas was withdrawn from the duct, utilizing a gooseneck nozzle of proper size to allow isokinetic sample collection. An S-type pitot was monitored to determine the isokinetic sampling rate. The particulate matter is filtered from the gas sample.

From the heated filter, sample gas entered a series of impingers which are charged with absorbing solutions in accordance with EPA Method 26. The first two impingers contained a solution of 0.1N H_2SO_4. The third and fourth impingers contained a solution of 0.1N NaOH. The fifth and final impinger contained a desiccant to dry the sample gas before metering. A pump and dry gas meter were used to control and monitor the sample gas flow rate. The impingers were recovered and rinsed in to separate containers and analyzed in accordance with the requirements of Method 26A.

An example of the sampling train is shown in Figure 2.

4.2.4 EPA Method SW86-0030 (Chlorobenzene)

The stack gas was sampled for determination of HAP (Chlorobenzene) using a sampling train meeting the requirements of EPA Method SW86-0030. Gas was withdrawn from the duct at a constant rate. The method is adapted for this measurement effort by sampling rate at approximately 0.7 liters per minute for 30 minutes. The total volume of the sample shall be 20 Liters. 4 sets of traps will be collected for each run.

At the conclusion of the 30-minute sample time, the traps were replaced with a new set of traps. Depending on the volume, condensate recovery was performed at the end of each run (nominally 2 hours), or more often if necessary.

A schematic drawing of the sampling "train" is shown in Figure 3

4.3 Chlorine Inlet Feed Rate

In addition to the Chloroform measurements at the 858 Brine Vent, the Chlorobenzene spiking rate was recorded at the 1028 Vent Header. These two measurements were used to calculate inlet Chlorine loading. The data and calculations are shown in Section 6.

Figure 2 EPA Method 26A Sampling Train

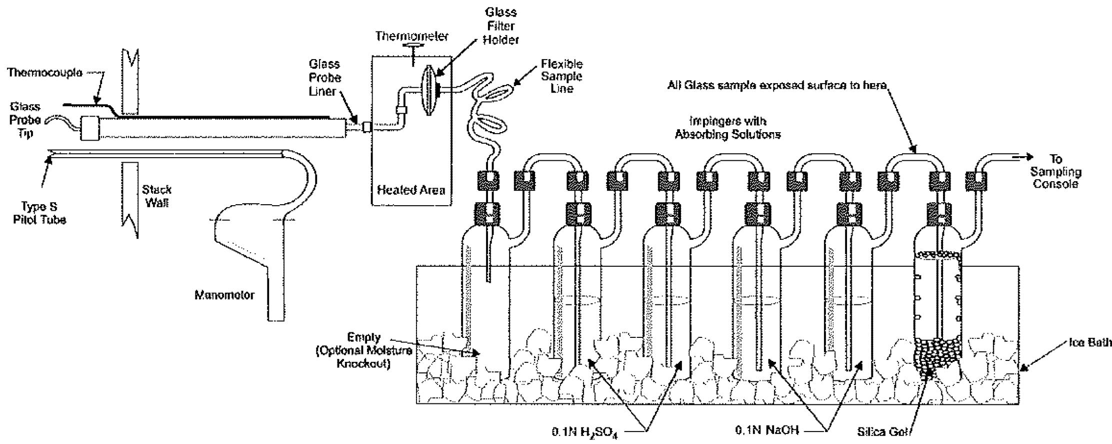
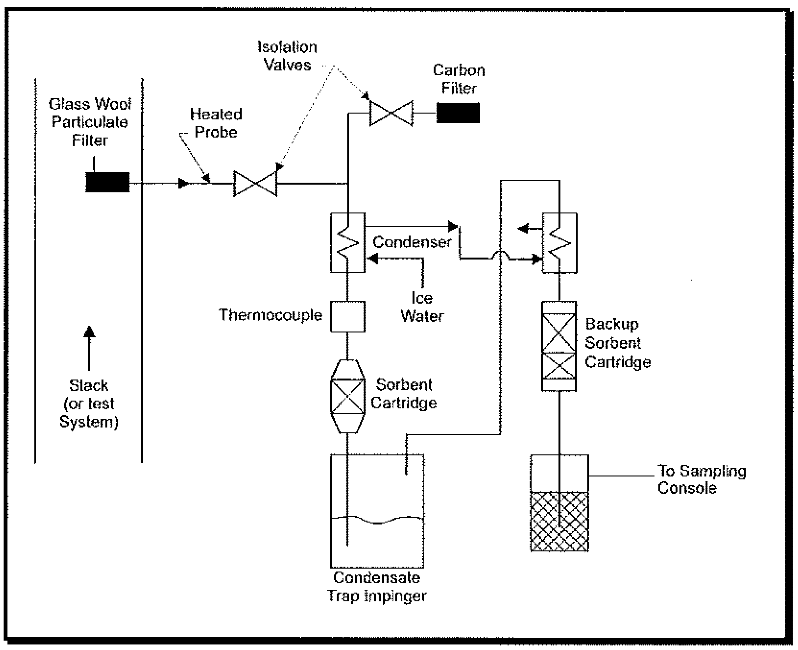


Figure 3 SW846 Method 0030 Sampling Train (VOST)



4.3.1 Instrumental Sampling Methods

Emission gas was withdrawn from the scrubber stack and transported to the AECOM CEMS located at ground level. A stainless-steel sampling probe was inserted into the source and used to collect sample gas. A heated Teflon sample line transported the sample gas from the sampling probe to the CEMS. The CEMS analyzers were kept at a stable temperature inside the AECOM mobile laboratory. At the mobile laboratory, sample gas was routed to a condenser and then transported to the analyzers for analysis of O_2/CO_2 on a dry basis. AECOM utilized a Teledyne model 376 to measure O_2 concentration and model 344 to measure CO_2 concentration, on a dry basis, according to EPA Method 3A.

The analyzers' electronic output signals were converted to a digital format and stored by AECOM's computerized data acquisition system. The system translated this digital signal into the proper units of measurement (e.g. percent CO_2, dry basis) and stored them on a hard drive. The system stores the data as fifteen-second averages.

The CEMS analyzers were calibrated prior to initiating testing using appropriately certified standards as specified by EPA Method 3A. Only EPA Protocol gases or certified pure zero nitrogen and air gases were used for calibration.

A three-point calibration error check was performed on the CEMS analyzer prior to testing. Zero, span, and mid-range calibration gases were introduced directly to the instruments to establish calibration error. The instrument system response for each of these gases was no more than ±2% of span from the calibration gas value.

An example of the instrumental sampling system is shown in Figure 4.

Figure 4 Schematic of AECOM CEM System