JUL 18 2016

Georgia Department of Natural Resources

Environmental Protection Division · Air Protection Branch
4244 International Parkway · Suite 120 · Atlanta · Georgia 30354
Telephone: 404/363-7000 · Fax: 404/363-7100
Judson H. Turner, Director

MEMORANDUM:

TO: Michael Odom
THROUGH: Ross Winne, Marcus Cureton
FROM: Anna Gray
SUBJECT: SOURCE TEST REPORT REVIEW

The following test has been reviewed and was conducted in an acceptable fashion for the purpose intended.

COMPANY NAME	Sterigenics U.S. LLC
COMPANY LOCATION	Atlanta, GA
SOURCE TESTED	10-Sterilizer Chambers/Ceilcote Packed Tower Scrubber
POLLUTANT DETERMINED	Ethylene Oxide
REPORT REVIEWED BY	Anna Gray
TEST WITNESSED BY	Ross Winne
DATE(S) OF TEST	March 17, 2016 to March 18, 2016
DATE RECEIVED BY APB	May 24, 2016
APPLICABLE REGULATION	Permit No. 7389-067-0093-S-05-3, Condition 2.3
MEMORANDUM	The reduction efficiency test of the Ceilcote packed tower scrubber emission control system was conducted in accordance with USEPA CFR 40, Part 63.365. At least one of the test runs was performed using emissions from the new30-pallet sterilizer (Chamber#11). The other two chambers were: #3 and #8. Run #1 Inlet EtO= 44.9 lbs Outlet EtO= 0.0000065 lbs EtO Control Efficiency= 99.9999% Minutes/cycle= 24 Run #2 Inlet EtO=61.9 lbs Outlet EtO= 0.0000141 lbs EtO Control Efficiency= 99.9999% Minutes/cycle= 23 Run #3 Inlet EtO= 76.1 lbs Outlet EtO= 0.0000076 lbs EtO Control Efficiency= 99.9999% Minutes/cycle= 20 Average EtO Control Efficiency: 99.9999% Required EtO Control Efficiency: 99% The amount of ethylene oxide used during each sterilization cycle was calculated by the Gas law and the conditions at the beginning and the end of every exhaust phase. All exhaust phase testing wsa conducted during normal process load conditions, but with an empty sterilization chamber to facilitate inlet mass calculation and the performance of multiple test runs. Parameters during test: Ceilcote scrubber readings: pH= 1.2 ; Storage tank level=: 186 inches ;Glycol concentration=36.3% AAT scrubber readings: pH=0.9; Tank level= 105 inches; Glycol concentration=36.8%

REPORT OF
AIR POLLUTION SOURCE TESTING
OF AN ETHYLENE OXIDE EMISSION-CONTROL SYSTEM
OPERATED BY STERIGENICS, INC.
IN ATLANTA, GEORGIA
ON MARCH 17-18, 2016

Submitted to:

GEORGIA DEPARTMENT OF NATURAL RESOURCES
Environmental Protection Division
4244 International Parkway, Suite 120
Atlanta, Georgia 30354

Submitted by:

STERIGENICS U.S., LLC.
2971 Olympic Industrial Boulevard
Atlanta, Georgia 30339

GDNR Permit Number 7839-067-0093-S-05-3

Prepared by:

ECSI, INC.
PO Box 848
San Clemente, California 92674-0848

April 21, 2016

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TEST DATE

March 17-18, 2016

REGULATORY AGENCY

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1.0 INTRODUCTION

On Thursday and Friday, March 17-18, 2016, ECSi, Inc. performed air pollution source testing of an ethylene oxide (EtO) emission-control device operated by Sterigenics, Inc. in Atlanta, Georgia. The control device tested was a Ceilcote packed tower scrubber emission-control system, which is currently used to control emissions from ten EtO sterilizer vacuum pumps. The purpose of the testing program was to demonstrate continued compliance with the conditions established in the Air Quality Permit granted to Sterigenics by the Georgia Department of Natural Resources, Environmental Protection Division (GDNR).

2.0 EQUIPMENT

The EtO gas-sterilization system is comprised of ten commercial sterilizers, which are discharged through liquid-ring vacuum pumps to a Ceilcote packed tower scrubber emission-control system, ten sterilizer exhaust vents (backvents) and one aeration room, which are discharged to a two-stage Advanced Air Technologies (AAT) Safe Cell emission-control system. As an alternative emission-control scenario, the facility also has the capability to discharge the sterilization chamber vacuum pumps to the AAT Safe Cell system. The gas-sterilization and emission-control equipment consist of the following:

- Ten Gas Sterilizers, two 5-pallet, two 6-pallet, four 13-pallet, and two 30-pallet capacity, each comprised of a steam-heated sterilization chamber, a recirculating vacuum pump chamber evacuation system, a backvent valve, and a fugitive emissions exhaust hood;

- One aeration room (AR-1), 152,400 cubic feet capacity, comprised of a heated aeration chamber and a chamber exhaust system.

Sterilizer vacuum pump emissions are be controlled by:

- One Ceilcote packed tower chemical scrubber, equipped with: a reaction/interface column, 27' 4" high, 42" in diameter, with a 20' bed of #1 Tellerette packing; a 115 GPM scrubber fluid recirculation system; and two 28,000 gallon reaction/storage tanks.

Sterilizer backvent and aeration emissions are controlled by:

- One two-stage Advanced Air Technologies Safe Cell emission-control system, comprised of a packed-tower chemical scrubber (SC1), equipped with a packed reaction/interface column, a scrubber fluid recirculation system, and a scrubber fluid reaction/storage tank, and a dry bed reactor/scrubber (SC2), comprised of a bank of solid-bed reaction vessels, connected in parallel, installed downstream of SC1 and upstream of a dedicated blower exhaust system.

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3.0 TESTING

EtO source testing was conducted in accordance with the procedures outlined in USEPA CFR40, Part 63.365. EtO emissions monitoring was conducted simultaneously at the inlet and outlet of the packed tower scrubber during the first chamber evacuation of the sterilizer exhaust phase of one of the ten currently operating sterilizers, and at least one of the test runs was performed using emissions from the new 30-pallet sterilizer. A total of three exhaust-phase test runs were performed.

During the first chamber evacuation of the exhaust phase, EtO emissions to the inlet of the packed tower scrubber were determined using the Ideal Gas Law and the chamber conditions at the beginning and at the end of the first chamber evacuation. During the first chamber evacuation of the exhaust phase, EtO emissions from the outlet of the packed tower scrubber were determined using direct source sample injection into the GC.

All exhaust phase testing was conducted during normal process load conditions, but with an empty sterilization chamber to facilitate inlet mass calculation and the performance of multiple test runs. The testing program was conducted in accordance with the procedures outlined in the following sections.

4.0 RULE/COMPLIANCE REQUIREMENTS

The EtO gas-sterilization system at Sterigenics was tested to demonstrate compliance with the EPA requirements, as specified in the GDNR Air Quality Permit. The following requirements must be met:

- The sterilizer exhaust phase (post exposure vacuum pulses) emissions must be vented to control equipment with an EtO emission-reduction efficiency of at least 99 % by weight.

Testing is required to demonstrate compliance with these requirements. Source testing of the packed tower scrubber emission-control device is required initially, and may be required periodically thereafter.

5.0 TEST METHOD REFERENCE

5.1 INTRODUCTION

EtO source testing was conducted in accordance with the procedures outlined in USEPA CFR40, Part 63.365. EtO emissions monitoring was conducted simultaneously at the inlet and outlet of the packed tower scrubber during the first chamber evacuation of the sterilizer exhaust phase of one of the ten currently operating sterilizers, and at least one of the test runs was performed using emissions from the new 30-pallet sterilizer. A total of three exhaust-phase test runs were performed.

Exhaust phase testing with one sterilizer discharging to the scrubber at a time represents worst-case conditions for demonstration of control efficiency compliance. At this lower inlet loading, the scrubber must perform at its maximum efficiency to achieve outlet EtO concentrations low enough to demonstrate compliance. One of the larger sterilizers was tested for each of the test runs to provide a realistic operational scenario.

During the first chamber evacuation of the exhaust phase, EtO emissions to the inlet of the packed tower scrubber were determined using the Ideal Gas Law and the chamber conditions at the beginning and at the end of the first chamber evacuation. During the first chamber evacuation of the exhaust phase, EtO emissions from the outlet of the packed tower scrubber were determined using direct source sample injection into the GC.

All exhaust phase testing was conducted during normal process load conditions, but with an empty sterilization chamber to facilitate inlet mass calculation and the performance of multiple test runs. The testing program was conducted in accordance with the procedures outlined in the following sections.

Operation and documentation of process conditions was performed by personnel from Sterigenics, Inc. using existing monitoring instruments installed by the manufacturer on the equipment to be tested. In accordance with the procedures established in USEPA CFR40, Part 63, Subpart O, scrubber liquor level was recorded. This parametric monitoring data is attached as Appendix G.

5.2 VOLUMETRIC FLOW MEASUREMENT

Exhaust gas flow at the outlet of the scrubber was determined by 40 CFR 60, Appendix A, Method 2, using an s-type pitot tube and an inclined-oil manometer. Sampling ports were located in accordance with 40 CFR 60, Appendix A, Method 1. The test ports were located far enough from any flow disturbances to permit accurate flow measurement.

Temperature measurements were obtained from a type K thermocouple and thermometer attached to the sampling probe. Exhaust gas composition was assumed to be air and small amounts of water vapor. Water vapor was negligible and, based on previous test data, a value of 2 percent was used for flow calculations.

5.3 CONTROL EFFICIENCY AND MASS EMISSIONS MEASUREMENT

During the first chamber evacuation of the sterilizer exhaust phase, the mass emissions of EtO vented to the inlet of the scrubber were determined using the procedures outlined in CFR40, Part 63.365. This method allows the determination of the mass of EtO vented to the inlet of the scrubber through calculations based on the Ideal Gas Law and using the conditions (pressure, temperature, volume) of the sterilization chamber immediately after it has been charged with sterilant gas, and upon conclusion of the first chamber evacuation of the exhaust phase.

The mass of EtO vented to the inlet of the scrubber during the first chamber evacuation of the exhaust phase was determined by calculating the mass of EtO present in the chamber after the first chamber evacuation and subtracting it from the mass of EtO present in the chamber after it had been charged with sterilant gas. The mass of EtO present in the chamber was calculated using Equation 1, shown below in Section 5.9.

During the first chamber evacuation of the sterilizer exhaust phase, EtO emissions from the outlet were determined using direct source sample injection into the GC. The mass of EtO emitted from the outlet was determined using Equation 2, shown below in Section 5.9. Mass-mass control-efficiency of EtO during the sterilizer exhaust phase was calculated by comparing the mass of EtO vented to the system inlet to the mass of EtO vented from the system outlet.

During the sterilization chamber exhaust phase, vented gas was analyzed by an SRI, Model 8610, portable gas chromatograph (GC), equipped with the following: dual, heated sample loops and injectors; dual

columns; and dual detectors. A photoionization detector (PID) was used to quantify low-level EtO emissions at the packed tower scrubber outlet.

5.4 SAMPLE TRANSPORT

Source gas was pumped to the GC at approximately 500-1000 cubic centimeters per minute (cc/min) from the sampling ports through two lengths of Teflon® sample line, each with a nominal volume of approximately 75 cubic centimeters (cc) and an outer diameter of 0.25 inch. At the outlet of the scrubber the sampling ports were located in the exhaust stack.

5.5 GC INJECTION

Source-gas samples were then injected into the GC which was equipped with two heated sampling loops, each containing a volume of approximately 2cc and maintained at 100 degrees Celsius (C). Injections occurred at approximately one-minute intervals during the sterilization chamber exhaust phase. Helium was the carrier gas for the PID.

5.6 GC CONDITIONS

The packed columns for the GC were both operated at 80 degrees C. The columns were stainless steel, 6 feet long, 0.125 inch outer diameter, packed with 1 percent SP-1000 on 60/80 mesh Carbopack B.

Any unused sample gas was vented from the GC system back to the inlet of the scrubber.

5.7 CALIBRATION STANDARDS

The PID was calibrated for low-range ppmv level analyses using gas proportions similar to the following:

1) 100 ppmv EtO, balance nitrogen
2) 50 ppmv EtO, balance nitrogen (audit gas)
3) 10 ppmv EtO, balance nitrogen
4) 1 ppmv EtO, balance nitrogen

Each of these calibration standards was in a separate, certified manufacturer's cylinder. Copies of the calibration gas laboratory certificates are attached as Appendix F.

5.8 SAMPLING DURATION

Exhaust phase EtO measurements were taken for the entire duration of the first chamber evacuation, which was approximately 20-30 minutes. This encompassed a total sampling duration of approximately 20-30 minutes for each exhaust phase test run.

5.9 CONTROL-EFFICIENCY/MASS-EMISSIONS CALCULATIONS

The following equation was used to calculate mass of EtO discharged to the inlet of the emission-control system during the first chamber evacuation of the sterilizer exhaust phase:

EQUATION 1:

$W_c = W_{ci} - W_{cf}$

Where:

W_c = Weight of EtO discharged from the sterilization chamber to the emission-control system during the first chamber evacuation, pounds

W_{ci} = $(mw)(p)(P)(V)/(R)(T)$

(and W_{cf})

Where:

W_{ci} = Weight of EtO present in the sterilization chamber before the first chamber evacuation, pounds

W_{cf} = Weight of EtO present in the sterilization chamber after the first chamber evacuation, pounds

MW = Molecular weight of EtO, 44.05 lb/mol

p = Percent of EtO in chamber

= W_s/W_i

Where:

W_s = Scale-measured weight of EtO charged into sterilization chamber

W_i = Calculated weight of EtO charged into sterilization chamber (@ 100%)

P = Sterilization chamber pressure (after charging/at the end of the 1st evac), psia

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V	=	Sterilization chamber volume, ft^3
R	=	Gas constant, 10.73 $psia \cdot ft^3/mol \cdot {}^\circ R$
T	=	Sterilization chamber temperature (after charging/at the end of the 1st evac), $^\circ R$

Note: Standard conditions are 68°F and 1 atm.

Mass emissions of EtO during the exhaust phase were calculated using the following equation:

EQUATION 2:

MassRate = (VolFlow)(MolWt)(ppmv EtO/10^6)/(MolVol)

Where:

MassRate	=	EtO mass flow rate, pounds per minute
VolFlow	=	Corrected volumetric flow rate, standard cubic feet per minute at 68 degrees F
MolWt	=	44.05 pounds EtO per pound mole
ppmv EtO	=	EtO concentration, parts per million by volume
10^6	=	Conversion factor, ppmv per "cubic foot per cubic foot"
MolVol	=	385.32 cubic feet per pound mole at one atmosphere and 68 degrees F

Results of the control-efficiency testing are presented in Section 8.0 and in Table 1.

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6.0 TEST SCENARIO

During exhaust phase testing, each sterilizer was tested during normal process load conditions, but with an empty sterilization chamber to facilitate the performance of multiple test runs. A total of three exhaust-phase test runs were performed to verify the performance of the emission-control device. Testing was conducted with an effort to offer minimal disruption to the Sterigenics production schedule. The testing schedule was as follows:

1) Testing equipment was set up and calibrated.
2) An empty-chamber cycle was started in one of the larger sterilizers. This sterilizer was isolated for test use and designated as a test chamber.
3) Exhaust Phase Test Run #1 was conducted. Sampling was performed at outlet of the scrubber during the first chamber evacuation of the test chamber. During the performance of the test, only the sterilizer used for the test was allowed to discharge to the Ceilcote scrubber.
4) An empty-chamber cycle was started in another of the larger sterilizers. This sterilizer was isolated for test use and designated as a test chamber.
5) Exhaust Phase Test Run #2 was conducted. Sampling was performed at outlet of the scrubber during the first chamber evacuation of the test chamber. During the performance of the test, only the sterilizer used for the test was allowed to discharge to the Ceilcote scrubber.
6) An empty-chamber cycle was started in the new 30-pallet sterilizer. This sterilizer was isolated for test use and designated as a test chamber.
7) Exhaust Phase Test Run #3 was conducted. Sampling was performed at outlet of the scrubber during the first chamber evacuation of the test chamber. During the performance of the test, only the sterilizer used for the test was allowed to discharge to the Ceilcote scrubber.
8) Post calibration check was performed, testing equipment was packed.

7.0 QA/QC

7.1 FIELD TESTING QUALITY ASSURANCE

At the beginning of the test, the sampling system was leak checked at a vacuum of 15 inches of mercury. The sampling system was considered leak free when the flow indicated by the rotameters fell to zero.

At the beginning of the test, a system blank was analyzed to ensure that the sampling system was free of EtO. Ambient air was introduced at the end of the heated sampling line and drawn through the sampling system line to the GC for analysis. The resulting chromatogram also provided a background level for non-EtO components (i.e. ambient air, carbon dioxide, water vapor) which are present in the source gas stream due to the ambient dilution air which is drawn into the emission-control device, and due to the destruction of EtO by the emission-control device which produces carbon dioxide and water vapor. This chromatogram, designated AMB, is included with the calibration data in Appendix A.

7.2 CALIBRATION PROCEDURES

The GC system was calibrated at the beginning and conclusion of each day's testing. Using the Peaksimple II analytical software, a point-to-point calibration curve was constructed for each detector. A gas cylinder of similar composition as the calibration gases, but certified by a separate supplier, was used to verify calibration gas composition and GC performance.

All calibration gases and support gases used were of the highest purity and quality available. A copy of the laboratory certification for each calibration gas is attached as Appendix F.

8.0 TEST RESULTS

The Ceilcote scrubber demonstrated an EtO control efficiency of 99.99998 percent. In accordance with EPA requirements, as specified in the GDNR Air Quality Permit, this control equipment must have an EtO control efficiency of 99 percent or more during the sterilizer exhaust phase (vacuum pump emissions). The emission-control device met this requirement.

The test results are summarized in Table 1. These tables include results for EtO control efficiency of the emission-control device. Chromatograms and chromatographic supporting data are attached as Appendices A through D. Copies of field data and calculation worksheets are attached as Appendix E.

TABLES

TABLE 1
ETHYLENE OXIDE CONTROL EFFICIENCY
OF A CEILCOTE PACKED TOWER SCRUBBER EMISSION CONTROL DEVICE
OPERATED BY STERIGENICS, INC.
IN ATLANTA, GEORGIA
ON MARCH 17-18, 2016

Run #	Stack Flow (dscfm) (2)	Average Outlet Conc. (ppm) (1)	Outlet EtO Mass Flow (lbs/min) (3)	Minutes/ Cycle	Outlet EtO Mass Emissions (lbs)	Inlet EtO Mass Emissions (lbs)	EtO Control Efficiency (%)
#1	235	0.0100	0.0000003	24	0.0000065	44.9	99.999986
#2	262	0.0214	0.0000006	23	0.0000141	61.9	99.999977
#3	332	0.0100	0.0000004	20	0.0000076	76.1	99.999990
					Average EtO Control Efficiency:		**99.999984**
					Required EtO Control Efficiency:		**99**

Notes: (1) - PPM = parts per million by volume
(2) - DSCFM = dry standard cubic feet per minute
(3) - LBS/MIN = EtO emissions, pounds per minute

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APPENDICES

APPENDIX A

Calibration Data

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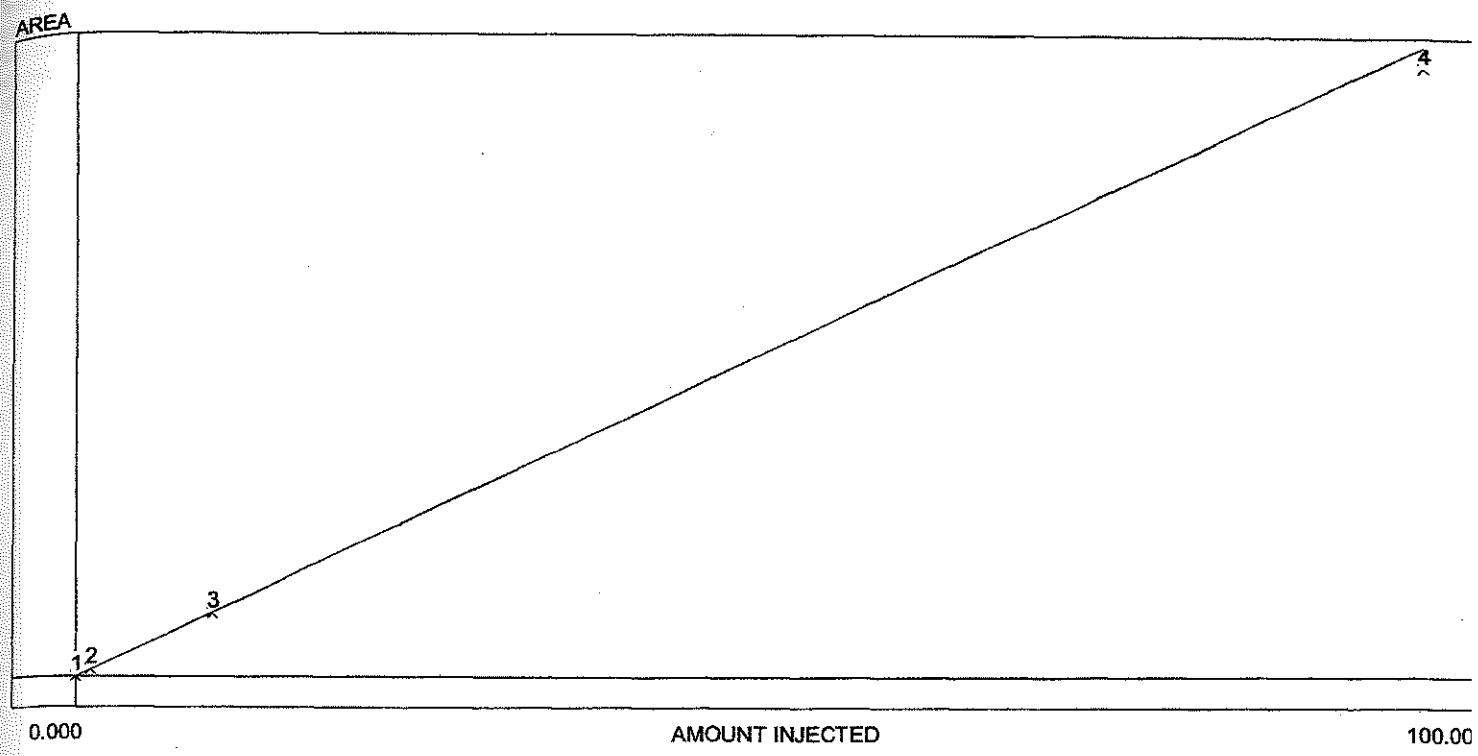
Name	Start	End	Calibration	Int.Std	Units
Dead Vol / Air	0.000	0.350		0.000	
Ambient H2O	0.350	0.500		0.000	
Ethylene Oxide	0.500	0.600	C:\peak359\1Ster	0.00016	ppm
Acetaldehyde	0.600	0.800		0.000	
CO2	0.800	1.000		0.000	

ibration file: C:\peak359\1SterAtl-2016.cal

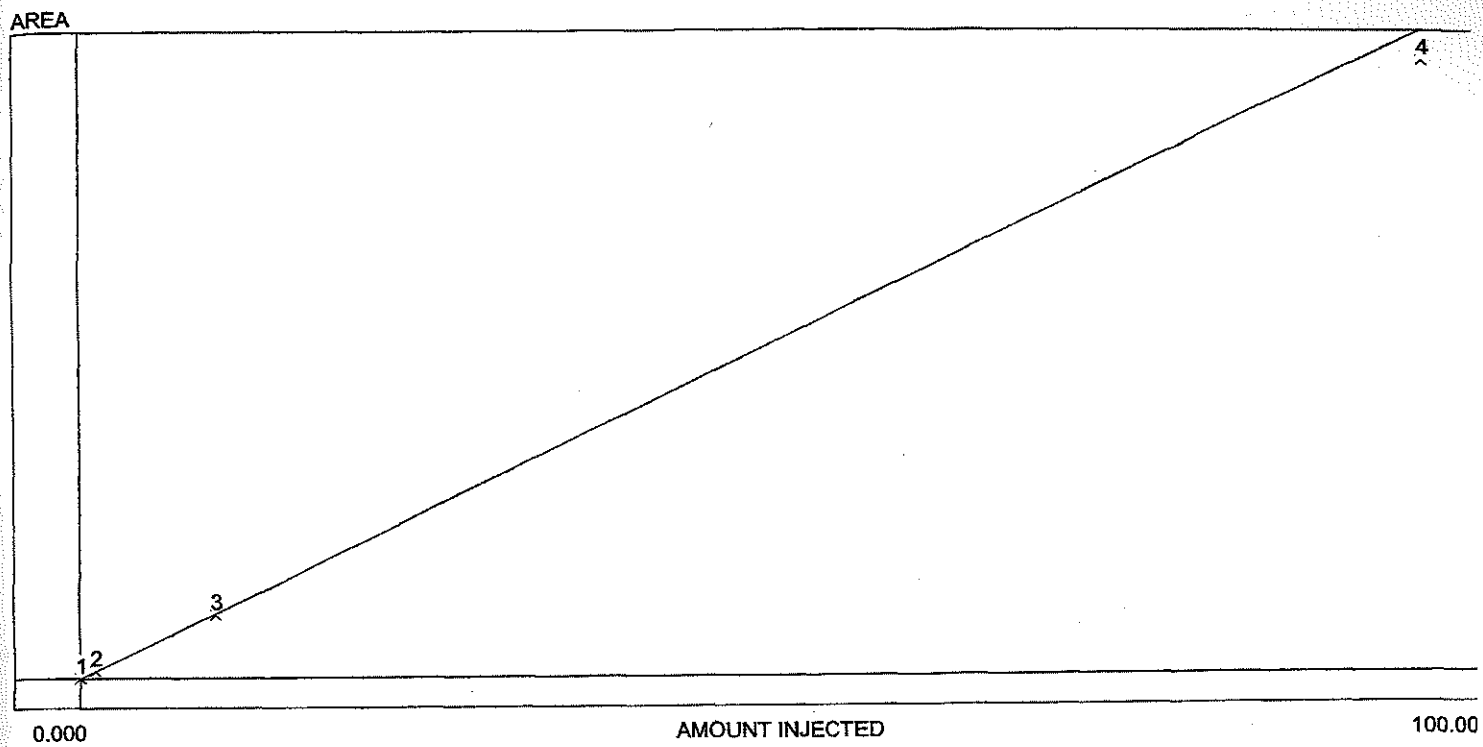


g slope of curve: 0.20
xis intercept: 0.00
earity: 1.00
mber of levels: 4
rel SD of CF's: 0.1/66.8
0.2007X
1.0000
t calibrated: Thu Mar 17 17:12:29 2016

Area/ht.	Amount	CF	Current	Previous #1	Previous #2
0.000	0.000	0.000	0.000	N/A	N/A
0.230	1.100	0.209	0.230	N/A	N/A
2.010	10.100	0.199	2.010	N/A	N/A
19.400	100.000	0.194	19.400	N/A	N/A

Name	Start	End	Calibration	Int.Std	Units
Dead Vol / Air	0.000	0.350		0.000	
Ambient H2O	0.350	0.490		0.000	
Ethylene Oxide	0.490	0.600	C:\peak359\2Ster	0.00016	ppm
Acetaldehyde	0.600	0.800		0.000	
CO2	0.800	1.000		0.000	

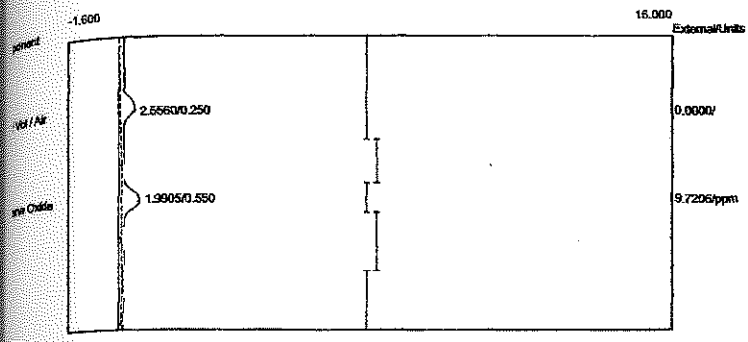
ibration file: C:\peak359\2SterAtl-2016.cal



g slope of curve: 1.34
xis intercept: 0.00
earity: 1.00
mber of levels: 4
/rel SD of CF's: 0.7/67.0
1.3350X
1.0000
t calibrated: Thu Mar 17 17:11:52 2016

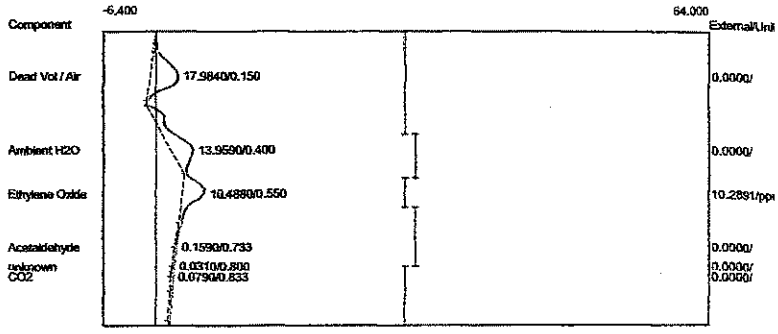
Area/ht.	Amount	CF	Current	Previous #1	Previous #2
0.000	0.000	0.000	0.000	N/A	N/A
1.560	1.100	1.418	1.560	N/A	N/A
13.300	10.100	1.317	13.300	N/A	N/A
127.000	100.000	1.270	127.000	N/A	N/A

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:29:46
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-Amb.CHR (c:\peak359)
Sample: Ambient Background
Operator: D. Kremer



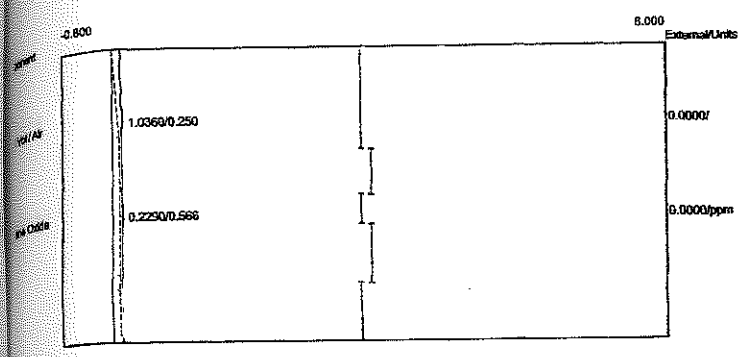
Component	Retention	Area	External	Units
ad Vol / Air	0.250	2.5560	0.0000	
ylene Oxide	0.550	1.9905	9.7206	ppm
		4.5465	9.7206	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:29:46
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-Amb.CHR (c:\peak359)
Sample: Ambient Background
Operator: D. Kremer



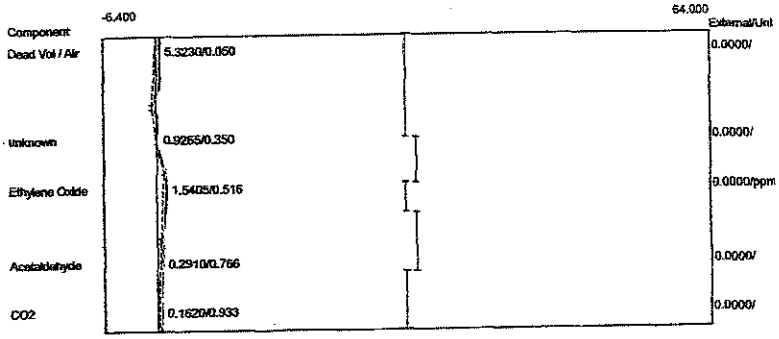
Component	Retention	Area	External	Units
Dead Vol / Air	0.150	17.9840	0.0000	
Ambient H2O	0.400	13.9590	0.0000	
Ethylene Oxide	0.550	10.4880	10.2891	ppm
Acetaldehyde	0.733	0.1590	0.0000	
CO2	0.833	0.0790	0.0000	
		42.6690	10.2891	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:36:23
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C01.CHR (c:\peak359)
Sample: 1.10 ppm EtO std
Operator: D. Kremer



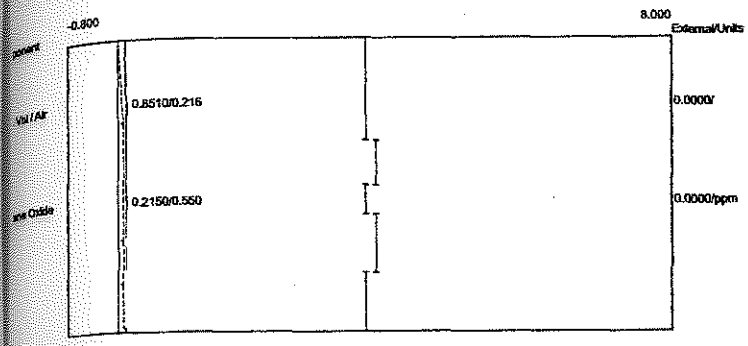
Component	Retention	Area	External	Units
ad Vol / Air	0.250	1.0360	0.0000	
ylene Oxide	0.566	0.2290	0.0000	ppm
		1.2650	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:36:23
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C01.CHR (c:\peak359)
Sample: 1.10 ppm EtO std
Operator: D. Kremer



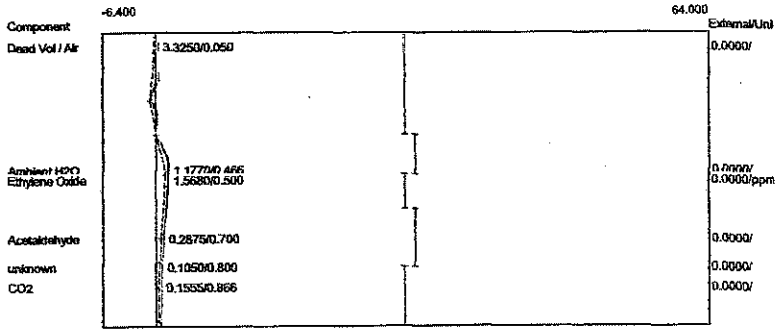
Component	Retention	Area	External	Units
Dead Vol / Air	0.050	5.3230	0.0000	
Ethylene Oxide	0.516	1.5405	0.0000	ppm
Acetaldehyde	0.766	0.2910	0.0000	
CO2	0.933	0.1620	0.0000	
		7.3165	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:42:02
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C02.CHR (c:\peak359)
Sample: 1.10 ppm EtO std
Operator: D. Kremer



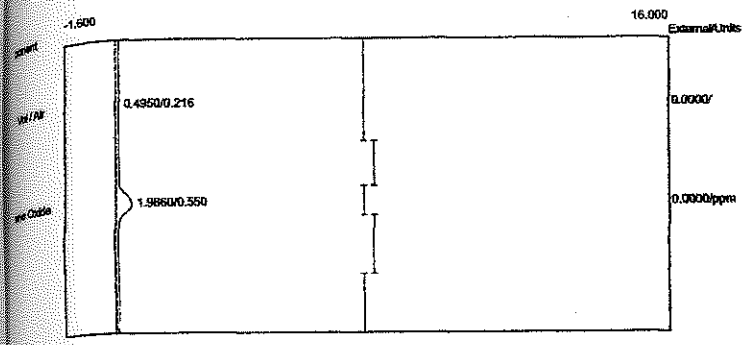
Component	Retention	Area	External	Units
ad Vol / Air	0.216	0.8510	0.0000	
lylene Oxide	0.550	0.2150	0.0000	ppm
		1.0660	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:42:02
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C02.CHR (c:\peak359)
Sample: 1.10 ppm EtO std
Operator: D. Kremer



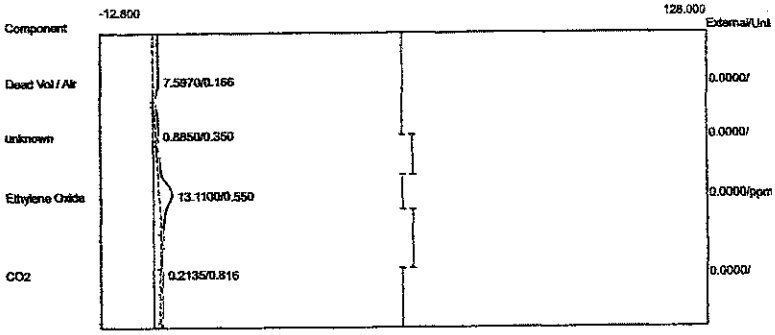
Component	Retention	Area	External	Units
Dead Vol / Air	0.050	3.3250	0.0000	
Ambient H2O	0.466	1.1770	0.0000	
Ethylene Oxide	0.500	1.5680	0.0000	ppm
Acetaldehyde	0.700	0.2875	0.0000	
CO2	0.866	0.1555	0.0000	
		6.5130	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:48:30
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C03.CHR (c:\peak359)
Sample: 10.1 ppm EtO std
Operator: D. Kremer



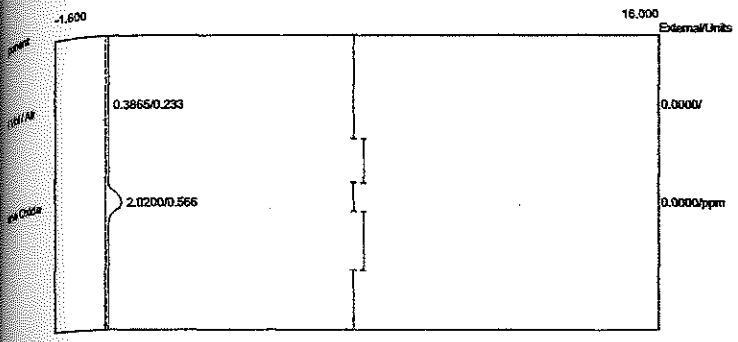
Component	Retention	Area	External	Units
ad Vol / Air	0.216	0.4950	0.0000	
ylene Oxide	0.550	1.9860	0.0000	ppm
		2.4810	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:48:30
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C03.CHR (c:\peak359)
Sample: 10.1 ppm EtO std
Operator: D. Kremer



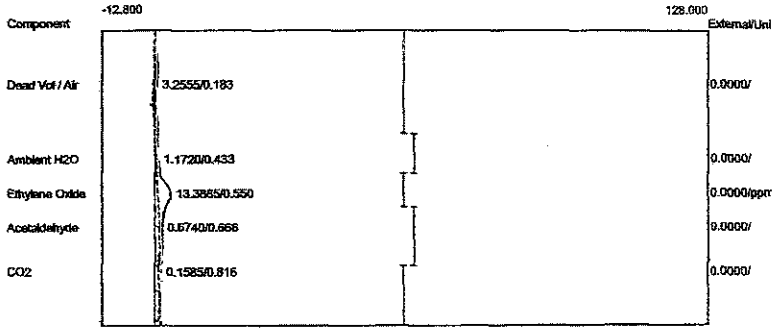
Component	Retention	Area	External	Units
Dead Vol / Air	0.166	7.5970	0.0000	
Ethylene Oxide	0.550	13.1100	0.0000	ppm
CO2	0.816	0.2135	0.0000	
		20.9205	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:50:18
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C04.CHR (c:\peak359)
Sample: 10.1 ppm EtO std
Operator: D. Kremer



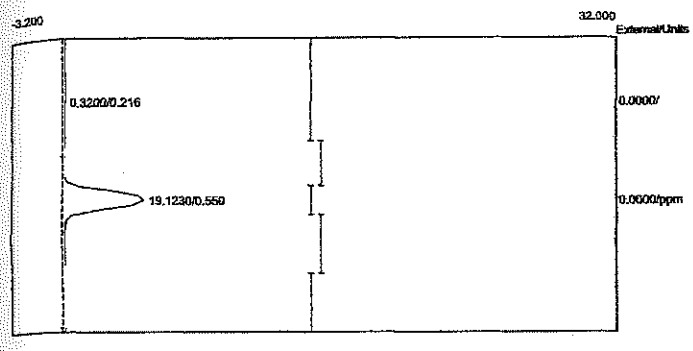
Component	Retention	Area	External	Units
ad Vol / Air	0.233	0.3865	0.0000	
ylene Oxide	0.566	2.0200	0.0000	ppm
		2.4065	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:50:18
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C04.CHR (c:\peak359)
Sample: 10.1 ppm EtO std
Operator: D. Kremer



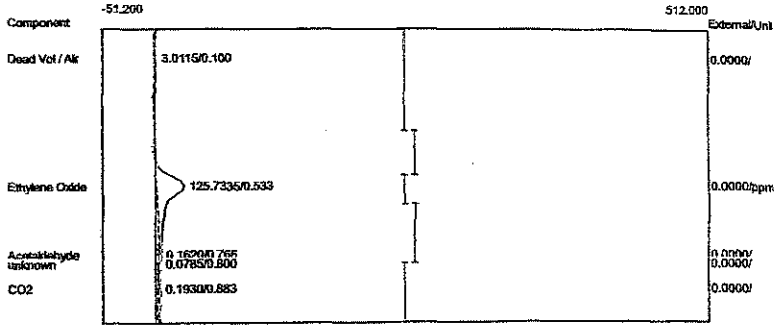
Component	Retention	Area	External	Units
Dead Vol / Air	0.183	3.2555	0.0000	
Ambient H2O	0.433	1.1720	0.0000	
Ethylene Oxide	0.550	13.3885	0.0000	ppm
Acetaldehyde	0.666	0.6740	0.0000	
CO2	0.816	0.1585	0.0000	
		18.6485	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:55:19
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C05.CHR (c:\peak359)
Sample: 100 ppm EtO std
Operator: D. Kremer



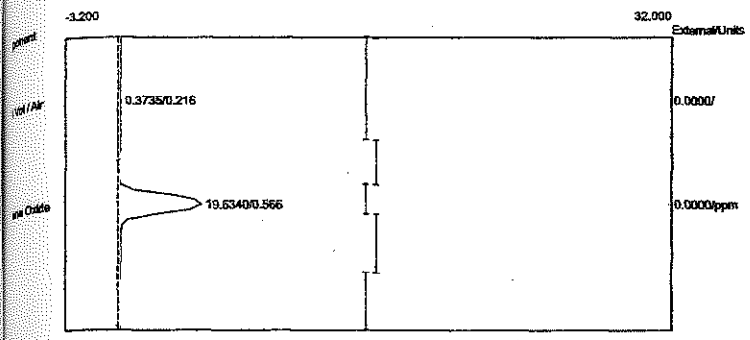
Component	Retention	Area	External	Units
Dead Vol / Air	0.216	0.3200	0.0000	
Ethylene Oxide	0.550	19.1230	0.0000	ppm
		19.4430	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:55:19
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C05.CHR (c:\peak359)
Sample: 100 ppm EtO std
Operator: D. Kremer



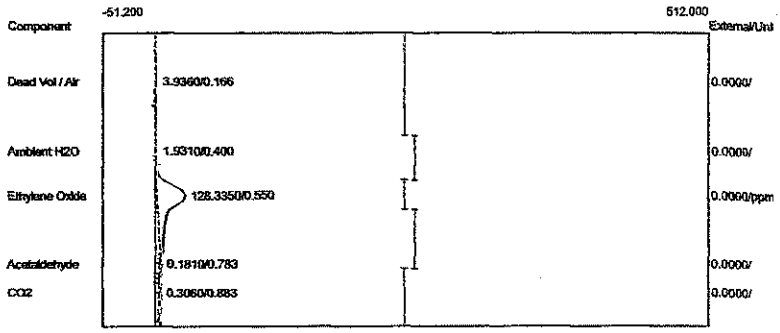
Component	Retention	Area	External	Units
Dead Vol / Air	0.100	3.0115	0.0000	
Ethylene Oxide	0.533	125.7335	0.0000	ppm
Acetaldehyde	0.766	0.1620	0.0000	
CO2	0.883	0.1930	0.0000	
		129.1000	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:57:53
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C06.CHR (c:\peak359)
Sample: 100 ppm EtO std
Operator: D. Kremer



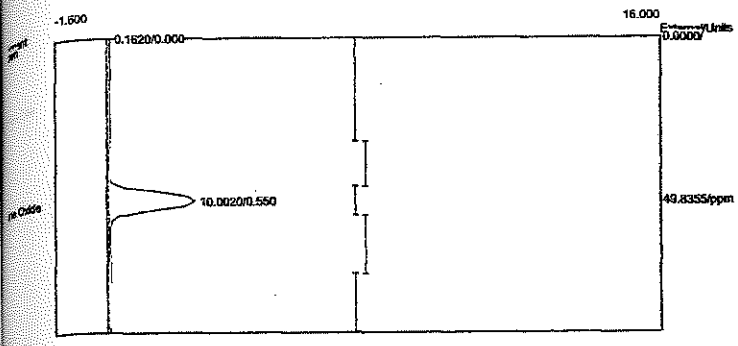
Component	Retention	Area	External	Units
ad Vol / Air	0.216	0.3735	0.0000	
ylene Oxide	0.566	19.6340	0.0000	ppm
		20.0075	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:57:53
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C06.CHR (c:\peak359)
Sample: 100 ppm EtO std
Operator: D. Kremer



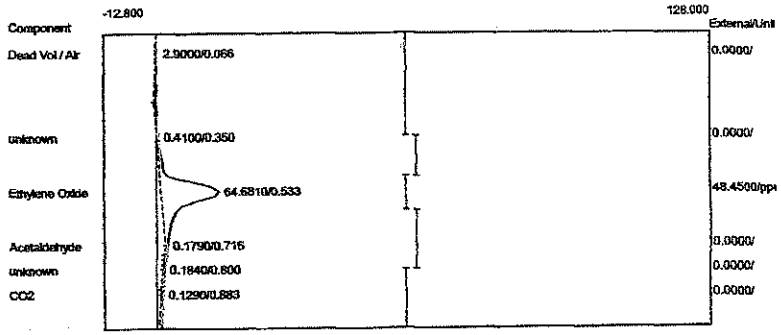
Component	Retention	Area	External	Units
Dead Vol / Air	0.166	3.9360	0.0000	
Ambient H2O	0.400	1.9310	0.0000	
Ethylene Oxide	0.550	128.3350	0.0000	ppm
Acetaldehyde	0.783	0.1810	0.0000	
CO2	0.883	0.3060	0.0000	
		134.6890	0.0000	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 17:10:35
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C07.CHR (c:\peak359)
Sample: 48.8 ppm EtO std
Operator: D. Kremer



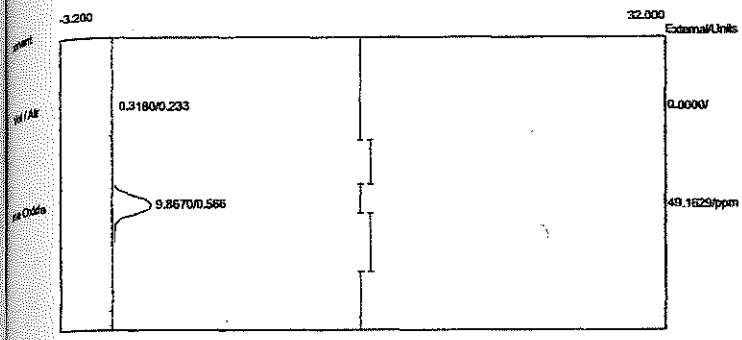
Component	Retention	Area	External	Units
ylene Oxide	0.550	10.0020	49.8355	ppm
		10.0020	49.8355	

Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 17:10:35
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C07.CHR (c:\peak359)
Sample: 48.8 ppm EtO std
Operator: D. Kremer



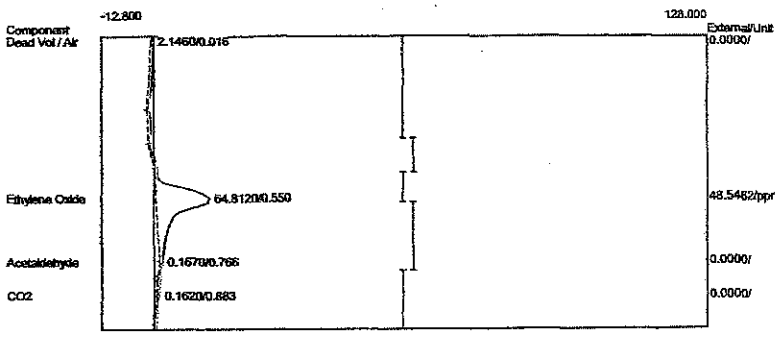
Component	Retention	Area	External	Units
Dead Vol / Air	0.066	2.9000	0.0000	
Ethylene Oxide	0.533	64.6810	48.4500	ppm
Acetaldehyde	0.716	0.1790	0.0000	
CO2	0.883	0.1290	0.0000	
		67.8890	48.4500	

Client: Sterigenics - Atlanta
Client ID: PostCal
Analysis date: 03/18/2016 12:36:57
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C08.CHR (c:\peak359)
Sample: 48.8 ppm EtO std
Operator: D. Kremer



Component	Retention	Area	External	Units
ad Vol / Air	0.233	0.3180	0.0000	
ylene Oxide	0.566	9.8670	49.1629	ppm
		10.1850	49.1629	

Client: Sterigenics - Atlanta
Client ID: PostCal
Analysis date: 03/18/2016 12:36:57
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C08.CHR (c:\peak359)
Sample: 48.8 ppm EtO std
Operator: D. Kremer



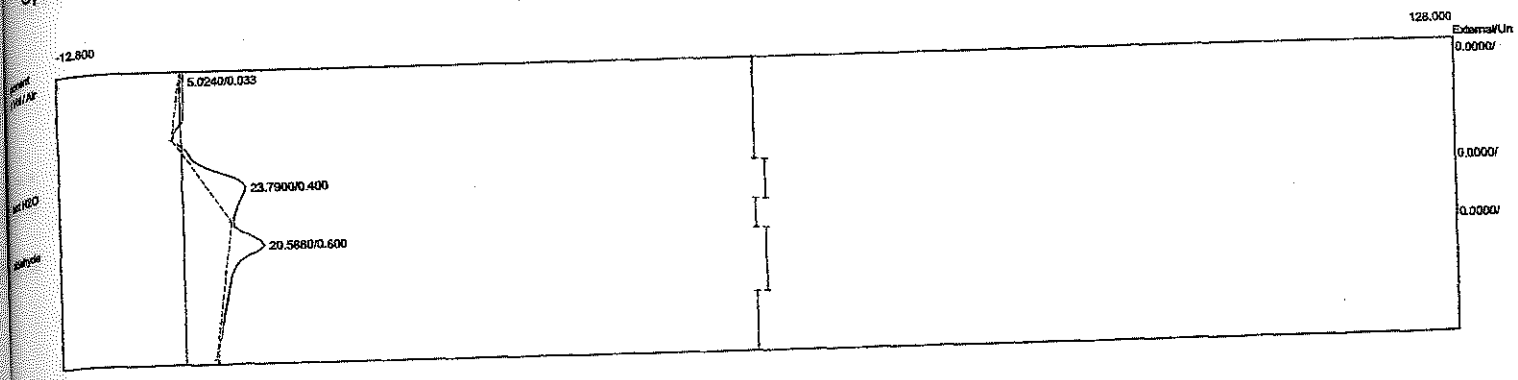
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	2.1460	0.0000	
Ethylene Oxide	0.550	64.8120	48.5482	ppm
Acetaldehyde	0.766	0.1670	0.0000	
CO2	0.883	0.1620	0.0000	
		67.2870	48.5482	

APPENDIX B

Run#1 Chromatograms

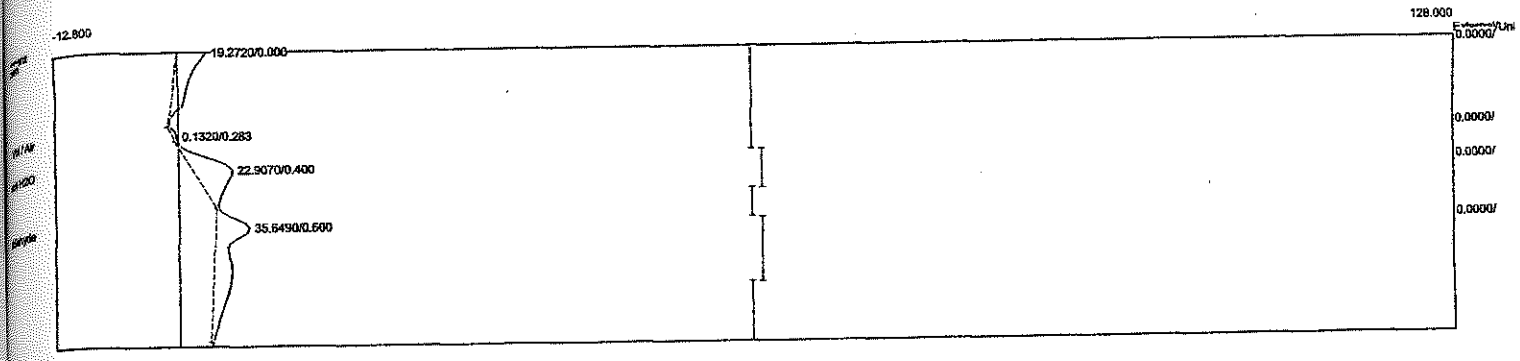
ECSi

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
Analysis date: 03/17/2016 17:40:36
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-1E01.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



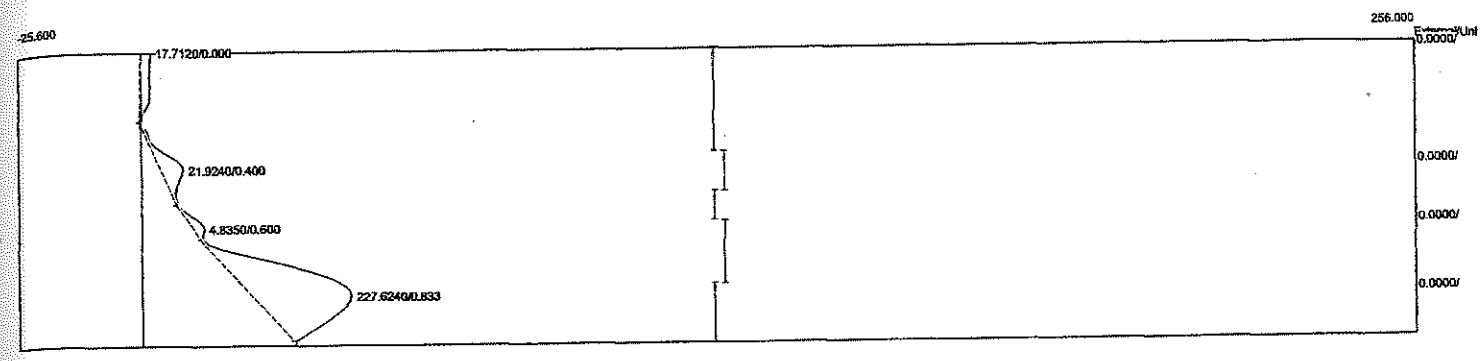
Component	Retention	Area	External	Units
ad Vol / Air	0.033	5.0240	0.0000	
bient H2O	0.400	23.7900	0.0000	
etaldehyde	0.600	20.5880	0.0000	
		49.4020	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
alysis date: 03/17/2016 17:42:26
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
omponents: eto2-100.cpt
Data file: 2SterAtl-2016-1E02.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



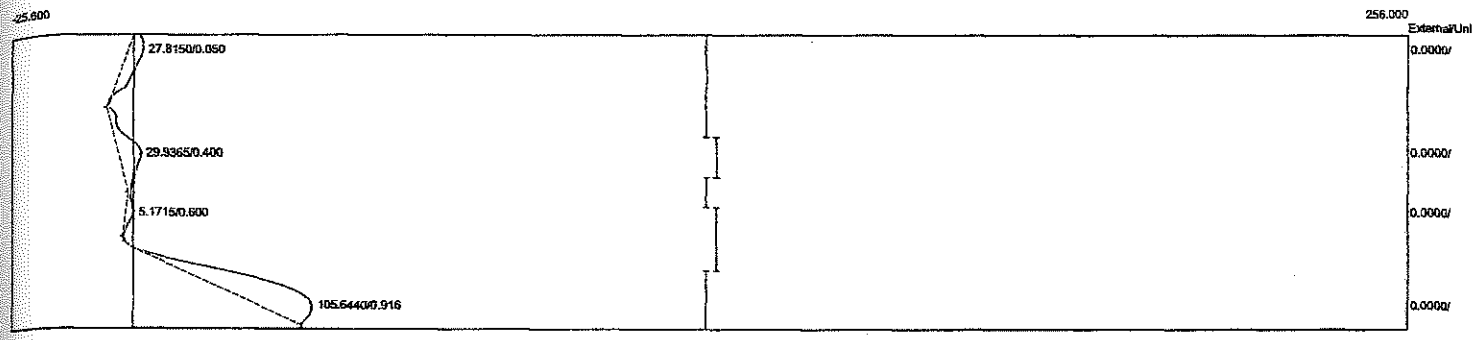
Component	Retention	Area	External	Units
ad Vol / Air	0.283	0.1320	0.0000	
tient H2O	0.400	22.9070	0.0000	
taldehyde	0.600	35.6490	0.0000	
		58.6880	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
ysis date: 03/17/2016 17:43:40
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-1E03.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



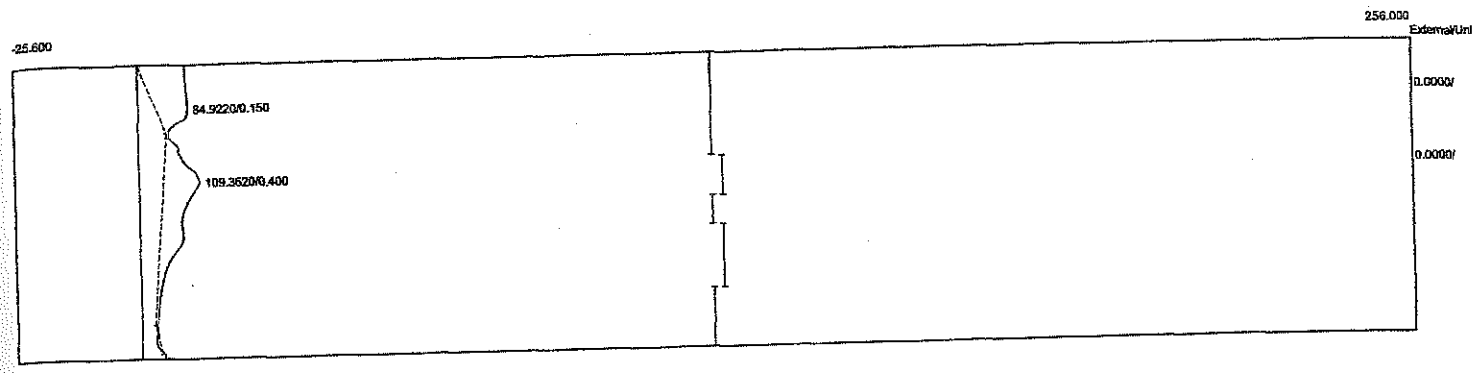
Component	Retention	Area	External	Units
bient H2O	0.400	21.9240	0.0000	
taldehyde	0.600	4.8350	0.0000	
2	0.833	227.6240	0.0000	
		254.3830	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
Data date: 03/17/2016 17:45:25
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-1E04.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



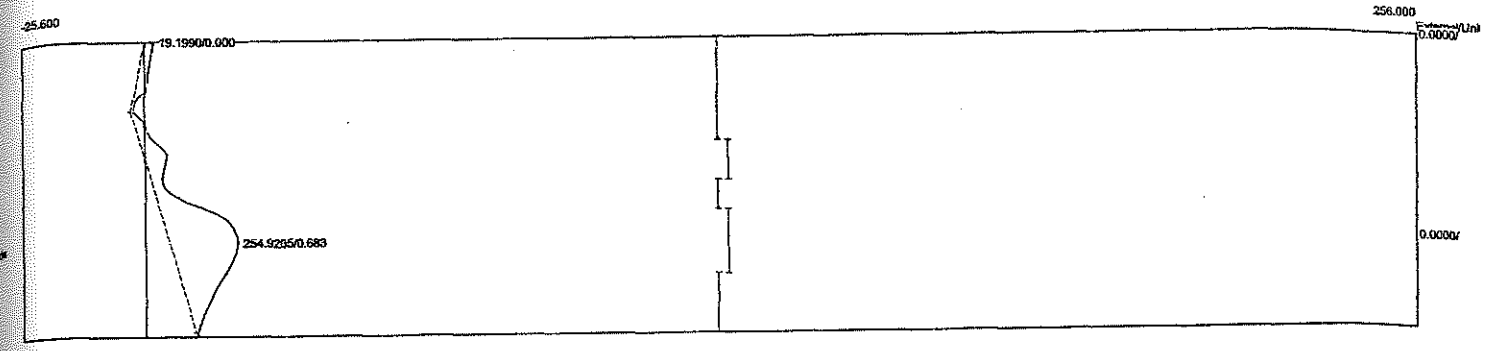
Component	Retention	Area	External	Units
Vol / Air	0.050	27.8150	0.0000	
ent H2O	0.400	29.9365	0.0000	
dehyde	0.600	5.1715	0.0000	
	0.916	105.6440	0.0000	
		168.5670	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
Analysis date: 03/17/2016 17:48:12
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-1E05.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



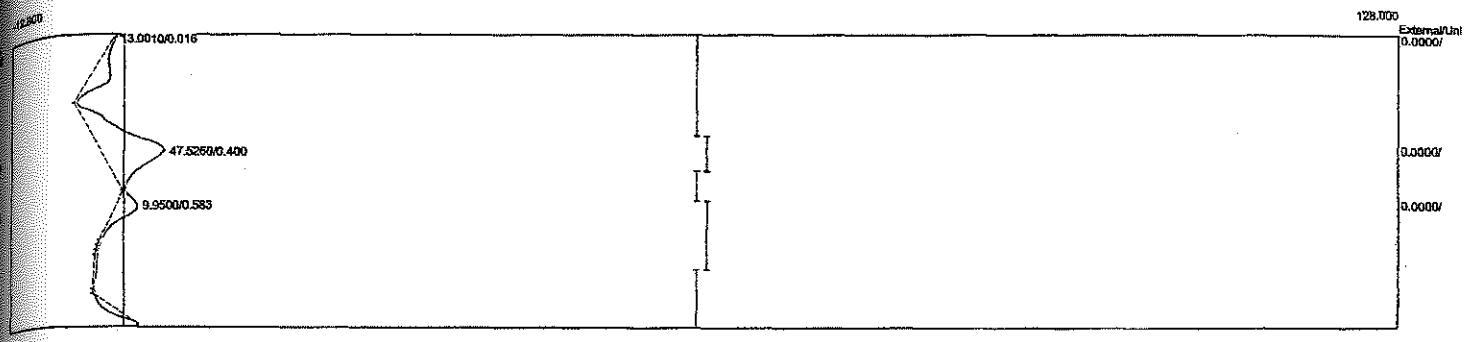
Component	Retention	Area	External	Units
ad Vol / Air	0.150	84.9220	0.0000	
bient H2O	0.400	109.3620	0.0000	
		194.2840	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
sis date: 03/17/2016 17:50:14
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAti-2016-1E06.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



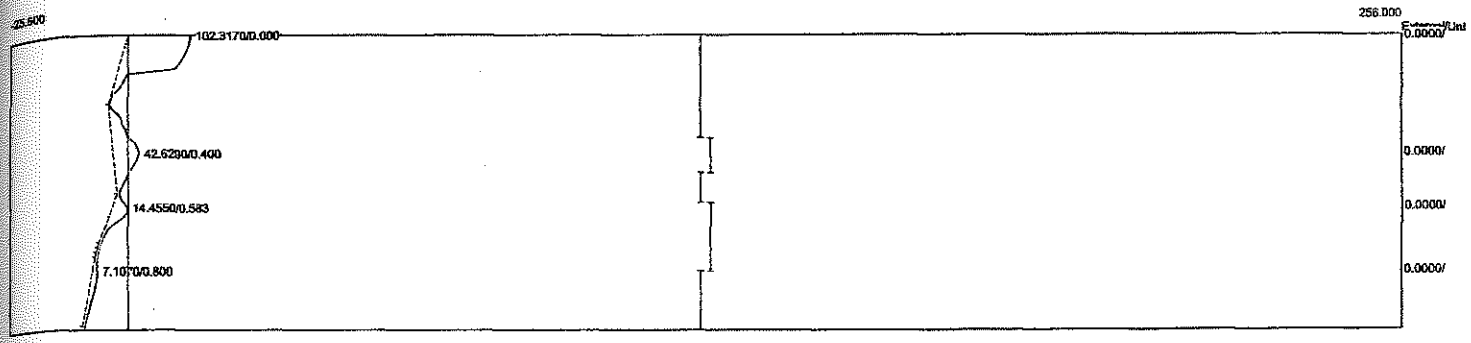
mponent	Retention	Area	External	Units
ldehyde	0.683	254.9205	0.0000	
		254.9205	0.0000	

Client: Sterigenics - Atlanta
Run ID: Run#1Exh
Date: 03/17/2016 17:53:04
Method: Direct Injection
Option: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp prog: eto-100.tem
Integrants: eto2-100.cpt
Data file: 2SterAtl-2016-1E07.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



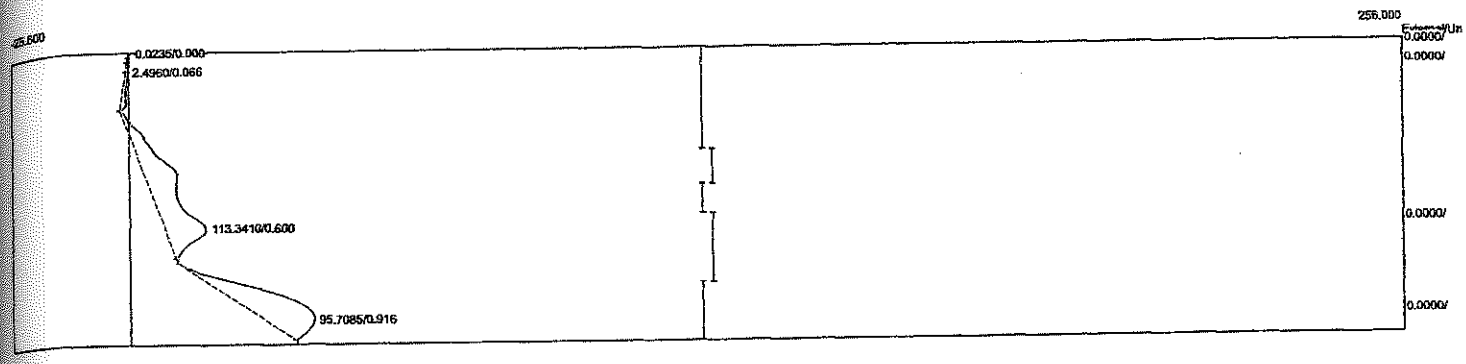
Component	Retention	Area	External	Units
Eto / Air	0.016	13.0010	0.0000	
Eto/H2O	0.400	47.5260	0.0000	
Acetaldehyde	0.583	9.9500	0.0000	
		70.4770	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
Base date: 03/17/2016 17:57:16
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-1E08.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



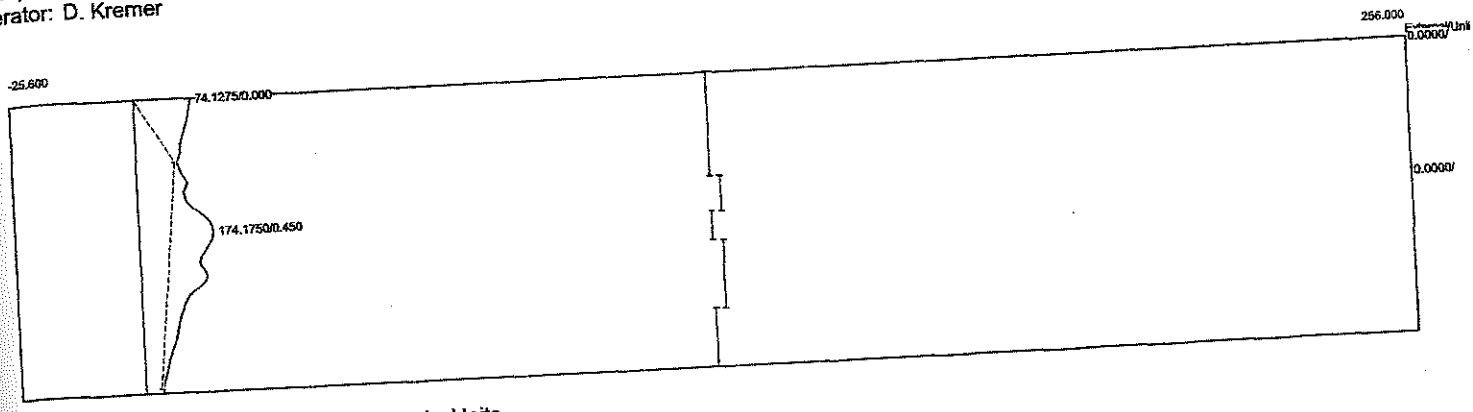
Component	Retention	Area	External	Units
Point H2O	0.400	42.6290	0.0000	
Aldehyde	0.583	14.4550	0.0000	
		57.0840	0.0000	

Client: Sterigenics - Atlanta
nt ID: Run#1Exh
a date: 03/17/2016 17:58:30
ethod: Direct Injection
cription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
d. prog: eto-100.tem
ments: eto2-100.cpt
ata file: 2SterAti-2016-1E09.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
erator: D. Kremer



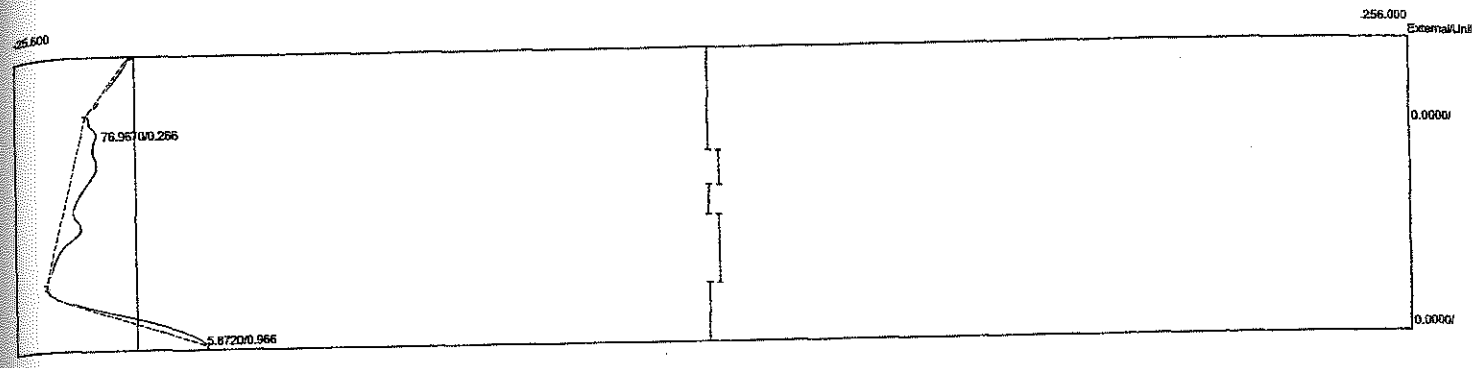
mponent	Retention	Area	External	Units
ol / Air	0.066	2.4960	0.0000	
ehyde	0.600	113.3410	0.0000	
	0.916	95.7085	0.0000	
		211.5455	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
lysis date: 03/17/2016 17:59:51
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-1E10.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



Component	Retention	Area	External	Units
ient H2O	0.450	174.1750	0.0000	
		174.1750	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#1Exh
Data date: 03/17/2016 18:01:23
Data Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-1E11.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



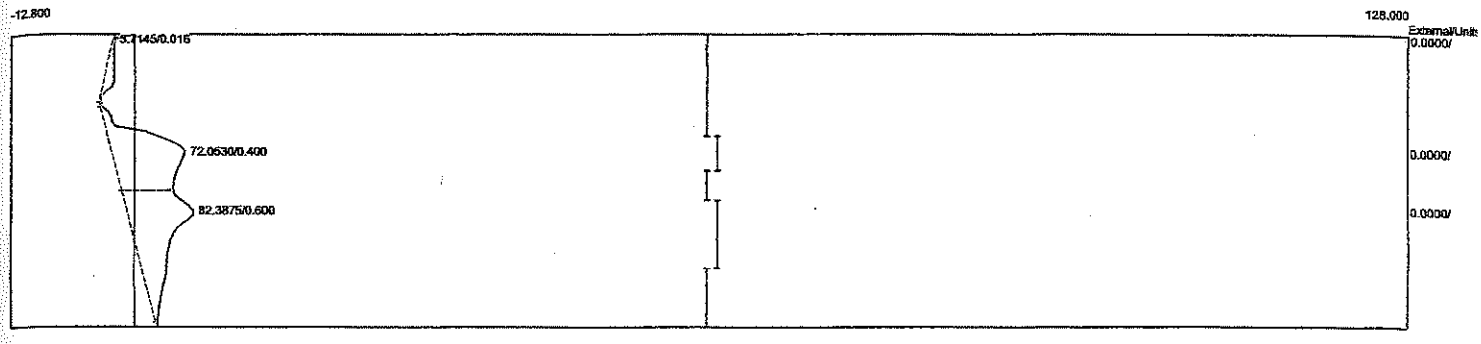
Component	Retention	Area	External	Units
Vol / Air	0.266	76.9670	0.0000	
	0.966	5.8720	0.0000	
		82.8390	0.0000	

APPENDIX C

Run#2 Chromatograms

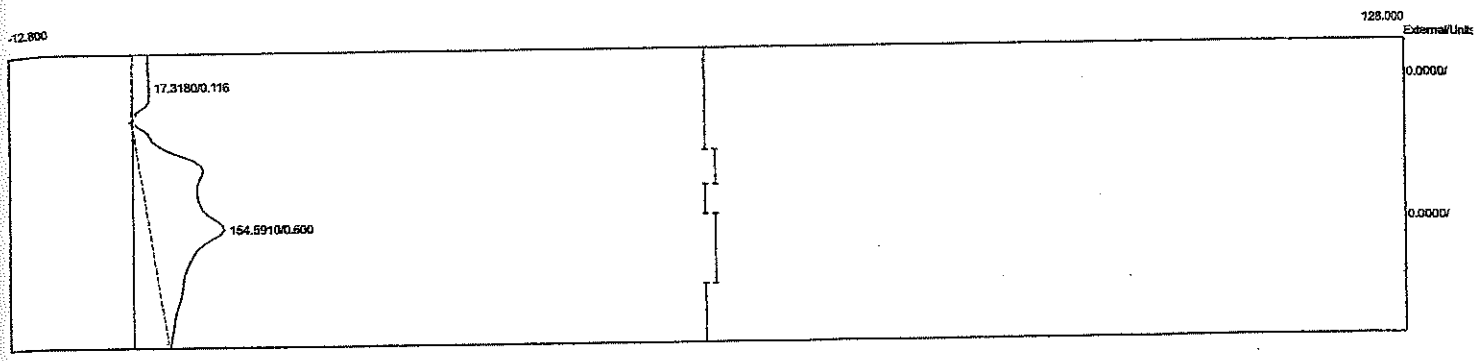
ECSi

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
ysis date: 03/18/2016 11:20:04
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-2E01.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



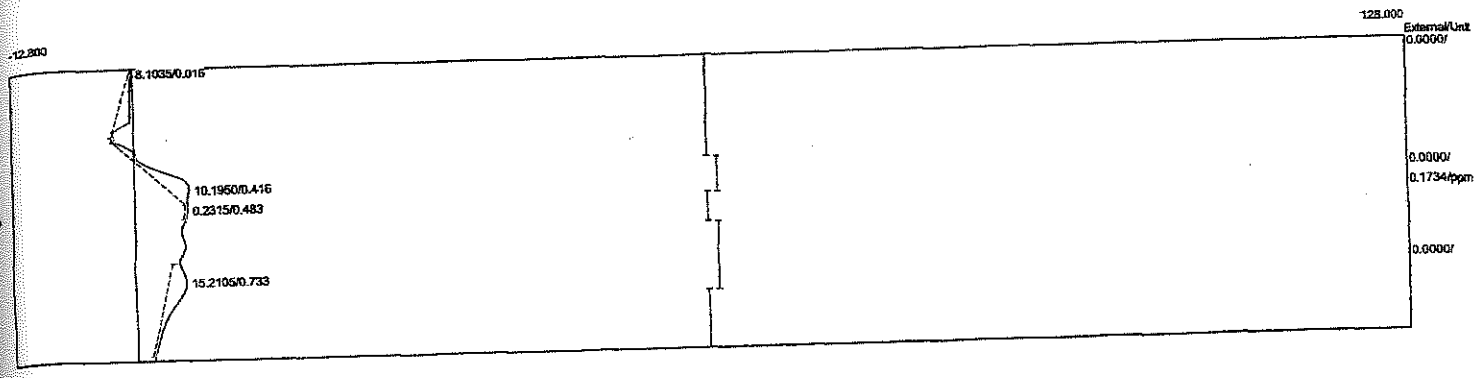
Component	Retention	Area	External	Units
d Vol / Air	0.016	5.7145	0.0000	
ient H2O	0.400	72.0530	0.0000	
aldehyde	0.600	82.3875	0.0000	
		160.1550	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
Analysis date: 03/18/2016 11:21:21
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-2E02.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



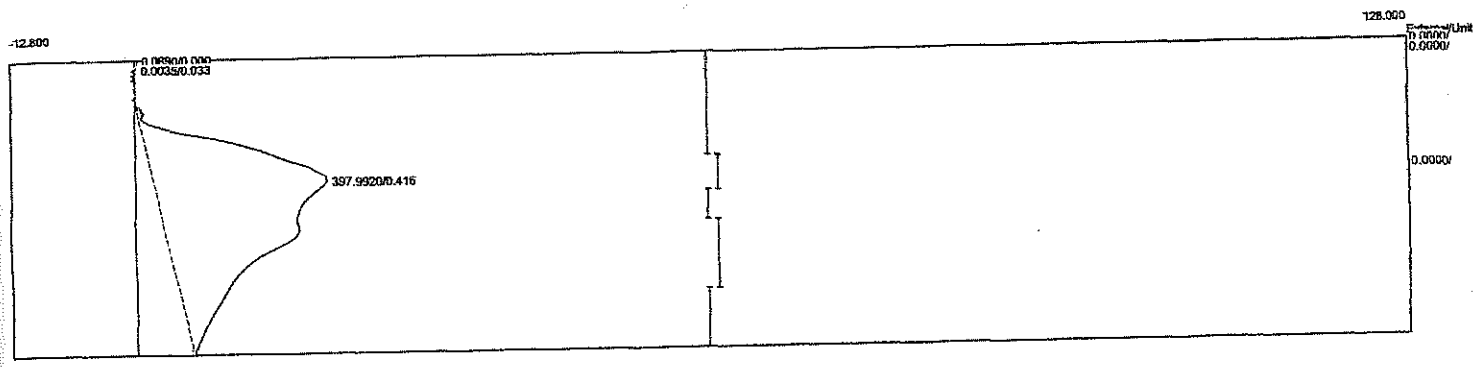
Component	Retention	Area	External	Units
Vol / Air	0.116	17.3180	0.0000	
Aldehyde	0.600	154.5910	0.0000	
		171.9090	0.0000	

Client: Sterigenics - Atlanta
lient ID: Run#2Exh
is date: 03/18/2016 11:22:28
Method: Direct Injection
cription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
p. prog: eto-100.tem
ponents: eto2-100.cpt
Data file: 2SterAtl-2016-2E03.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
perator: D. Kremer



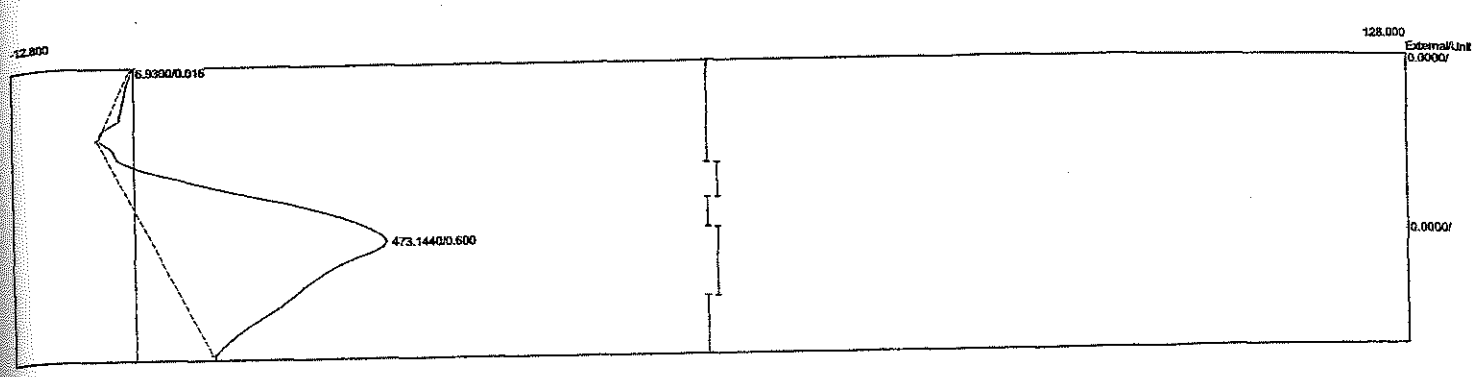
mponent	Retention	Area	External	Units
Vol / Air	0.016	8.1035	0.0000	
nt H2O	0.416	10.1950	0.0000	
ne Oxide	0.483	0.2315	0.1734	ppm
dehyde	0.733	15.2105	0.0000	
		33.7405	0.1734	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
ysis date: 03/18/2016 11:23:45
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-2E04.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



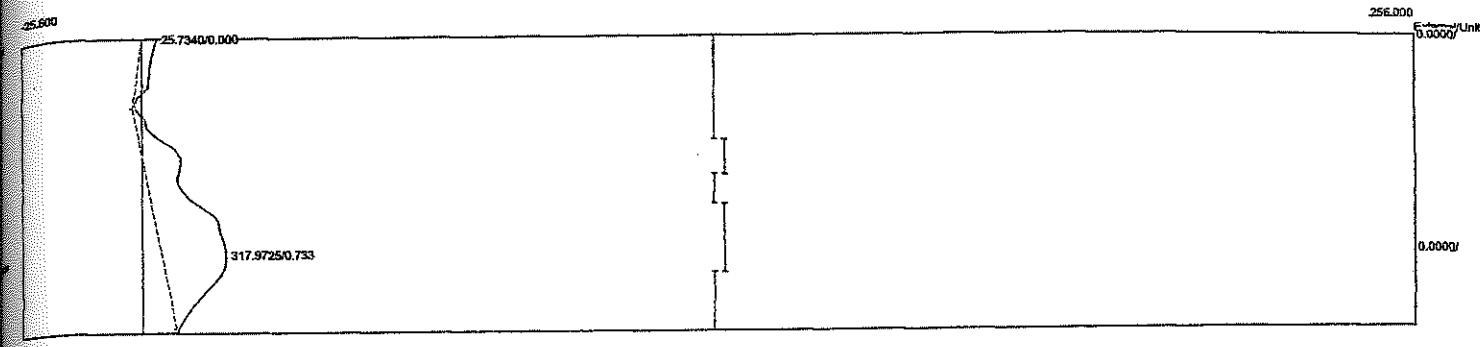
Component	Retention	Area	External	Units
Vol / Air	0.033	0.0035	0.0000	
ent H2O	0.416	397.9920	0.0000	
		397.9955	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
Inj date: 03/18/2016 11:24:48
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-2E05.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



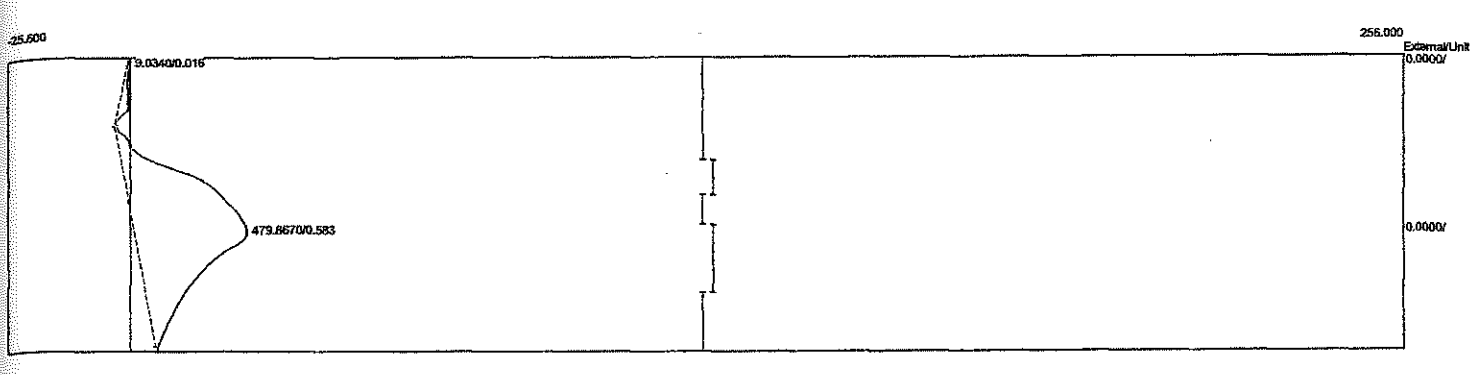
Component	Retention	Area	External	Units
Vol / Air	0.016	6.9300	0.0000	
Acetaldehyde	0.600	473.1440	0.0000	
		480.0740	0.0000	

Client: Sterigenics - Atlanta
ient ID: Run#2Exh
s date: 03/18/2016 11:27:04
Method: Direct Injection
cription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
p. prog: eto-100.tem
ponents: eto2-100.cpt
ata file: 2SterAtl-2016-2E06.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
perator: D. Kremer



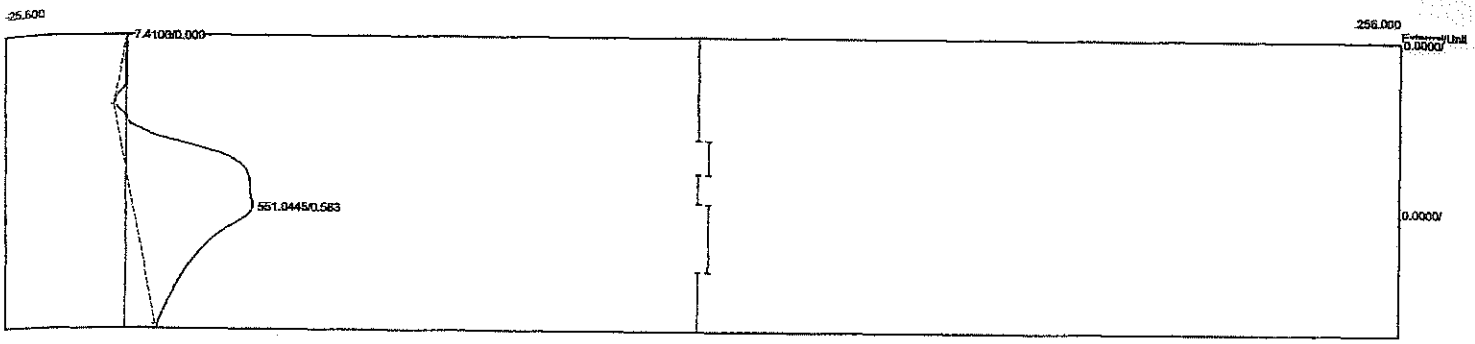
mponent	Retention	Area	External	Units
kehyde	0.733	317.9725	0.0000	
		317.9725	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
Data date: 03/18/2016 11:28:19
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAti-2016-2E07.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



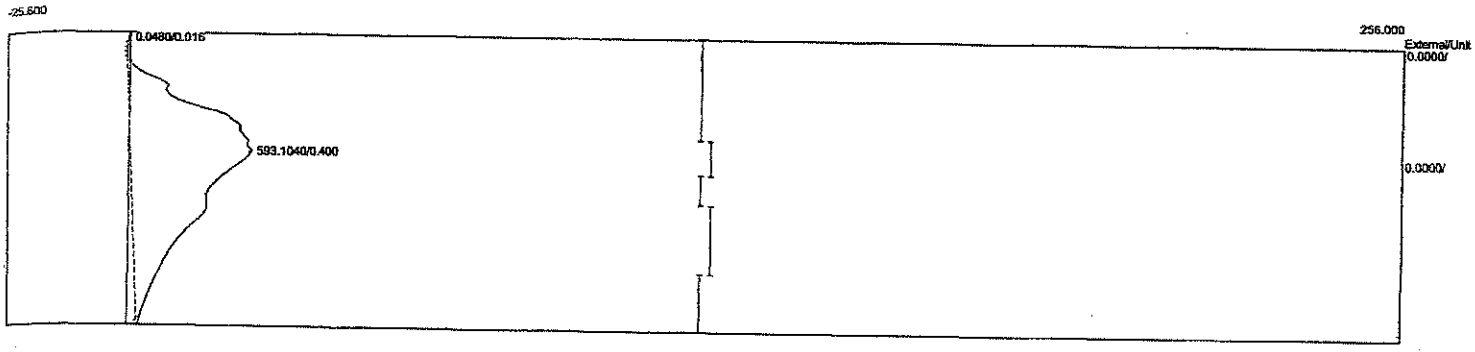
Component	Retention	Area	External	Units
Vol / Air	0.016	9.0340	0.0000	
Aldehyde	0.583	479.8670	0.0000	
		488.9010	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
is date: 03/18/2016 11:29:33
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-2E08.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



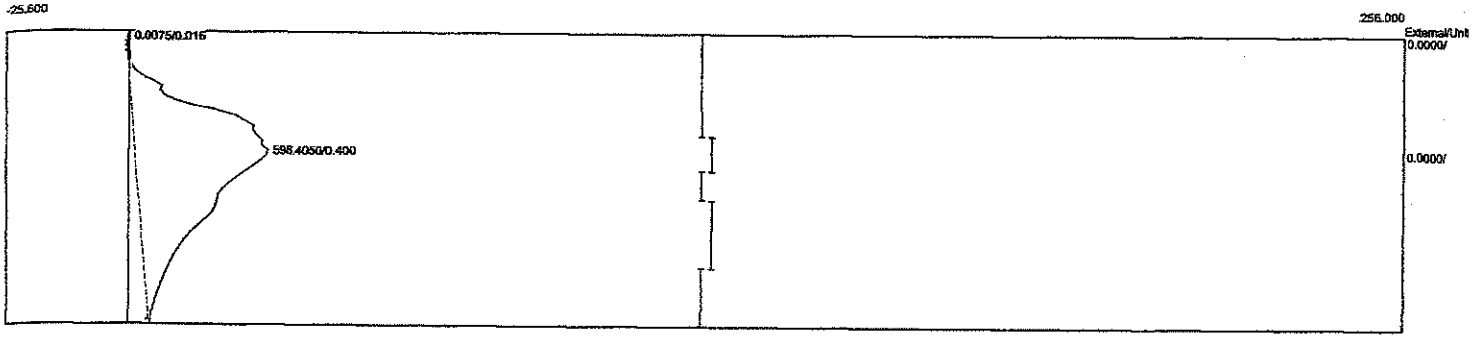
omponent	Retention	Area	External	Units
aldehyde	0.583	551.0445	0.0000	
		551.0445	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
sis date: 03/18/2016 11:30:48
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
ponents: eto2-100.cpt
Data file: 2SterAtl-2016-2E09.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



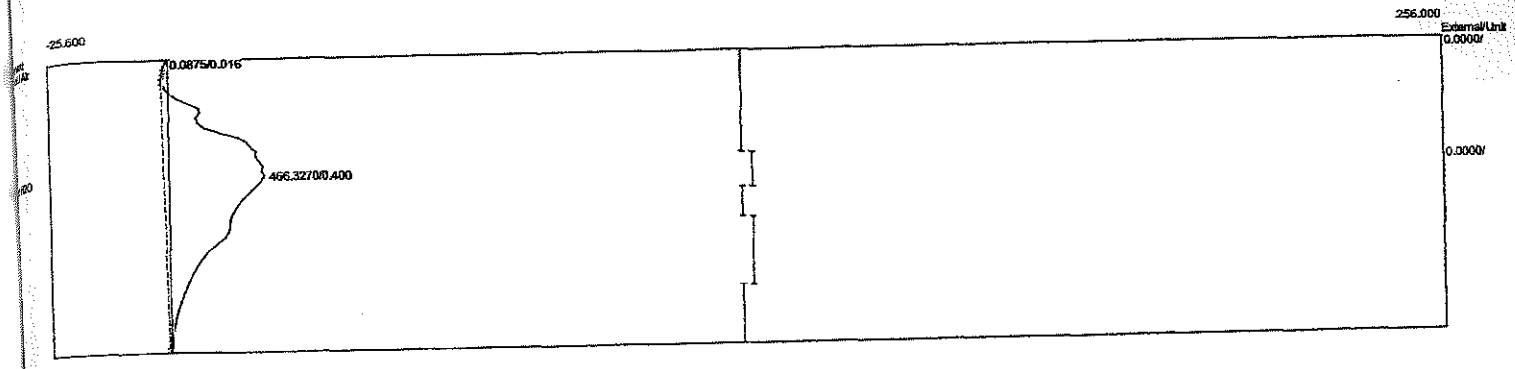
mponent	Retention	Area	External	Units
Vol / Air	0.016	0.0480	0.0000	
ent H2O	0.400	593.1040	0.0000	
		593.1520	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
ysis date: 03/18/2016 11:32:01
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-2E10.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



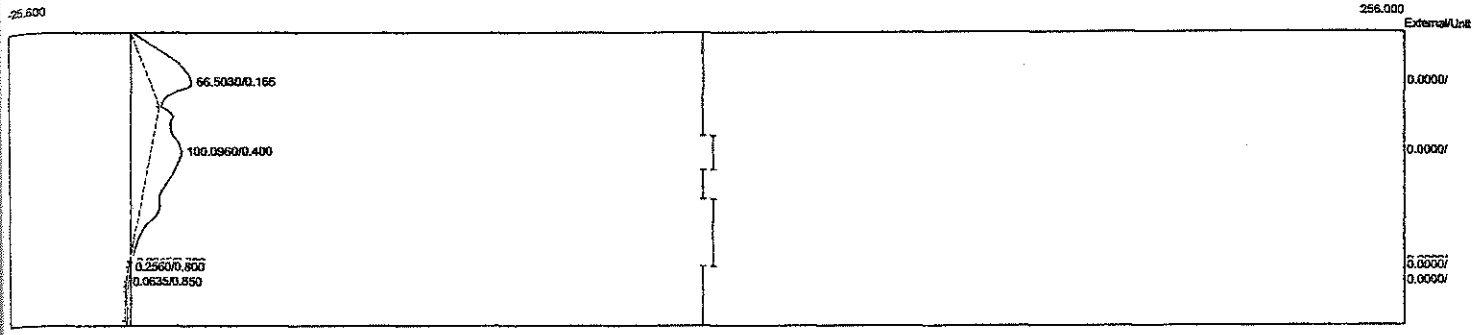
Component	Retention	Area	External	Units
Vol / Air	0.016	0.0075	0.0000	
ient H2O	0.400	598.4050	0.0000	
		598.4125	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
ysis date: 03/18/2016 11:33:17
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
emp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAti-2016-2E11.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



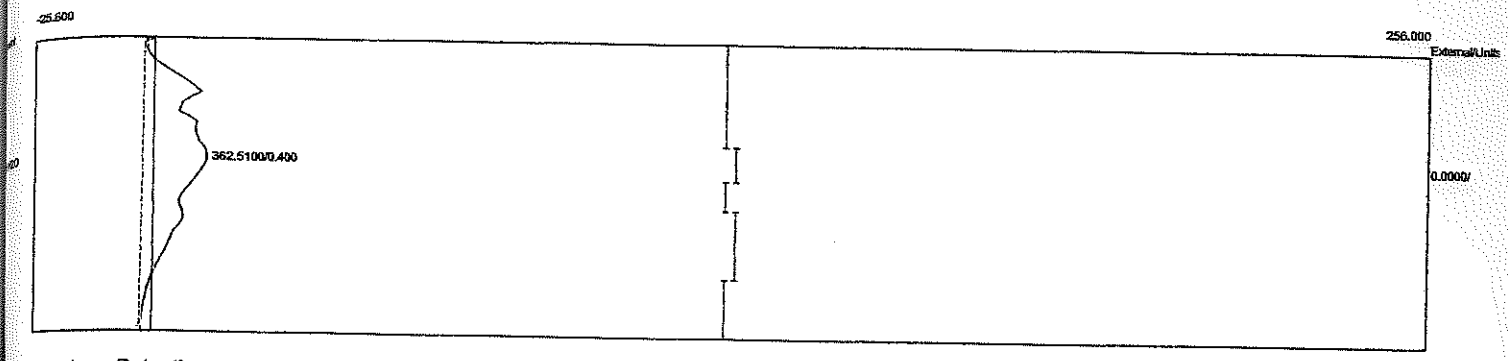
mponent	Retention	Area	External	Units
Vol / Air	0.016	0.0875	0.0000	
ent H2O	0.400	466.3270	0.0000	
		466.4145	0.0000	

Client: Sterigenics - Atlanta
ent ID: Run#2Exh
s date: 03/18/2016 11:34:40
ethod: Direct Injection
iption: CHANNEL 2 - PID
olumn: 1% SP-1000, Carbopack B
Carrier: HELIUM
. prog: eto-100.tem
nents: eto2-100.cpt
ata file: 2SterAtl-2016-2E12.CHR (c:\peak359)
ample: Ceilcote Scrubber Outlet
erator: D. Kremer



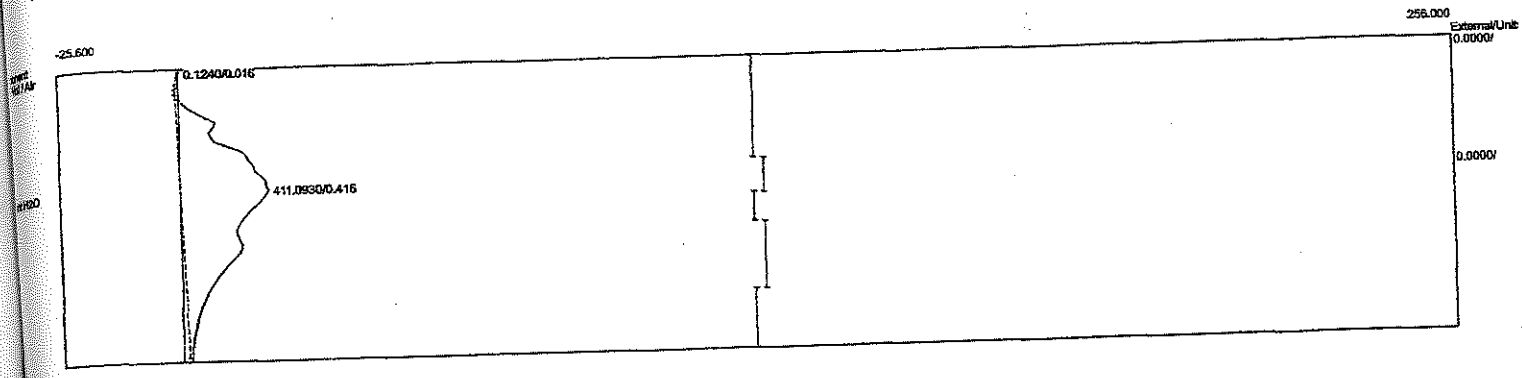
ponent	Retention	Area	External	Units
ol / Air	0.166	66.5030	0.0000	
H2O	0.400	100.0960	0.0000	
ehyde	0.783	0.0945	0.0000	
	0.850	0.0635	0.0000	
		166.7570	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
ysis date: 03/18/2016 11:35:50
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-2E13.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



mponent	Retention	Area	External	Units
ent H2O	0.400	362.5100	0.0000	
		362.5100	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#2Exh
alysis date: 03/18/2016 11:37:03
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
omponents: eto2-100.cpt
Data file: 2SterAtl-2016-2E14.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



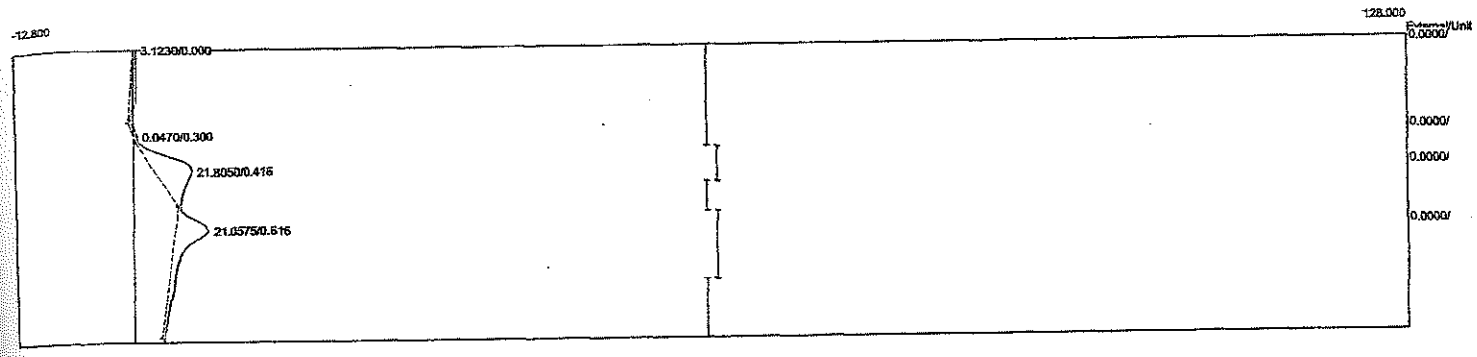
Component	Retention	Area	External	Units
id Vol / Air	0.016	0.1240	0.0000	
lient H2O	0.416	411.0930	0.0000	
		411.2170	0.0000	

APPENDIX D

Run#3 Chromatograms

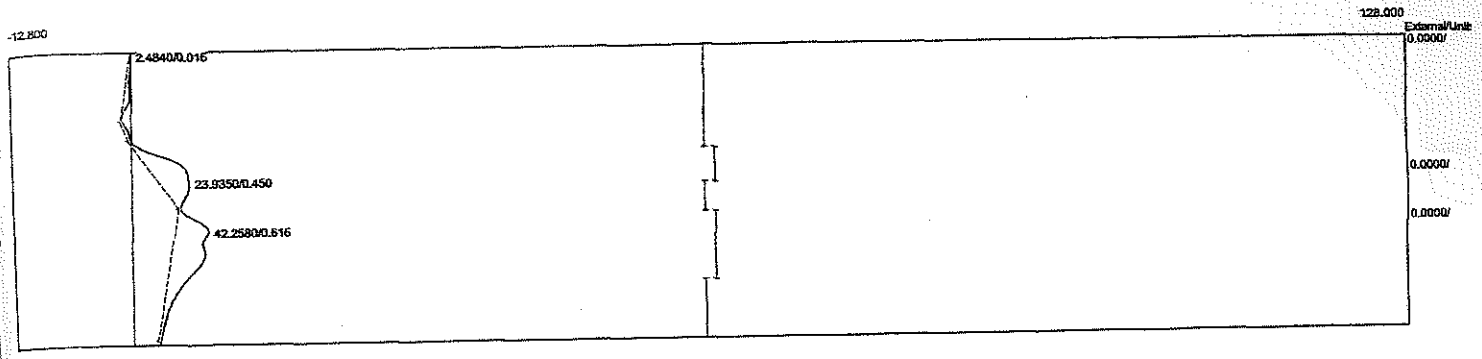
ECSi

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:04:38
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E01.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



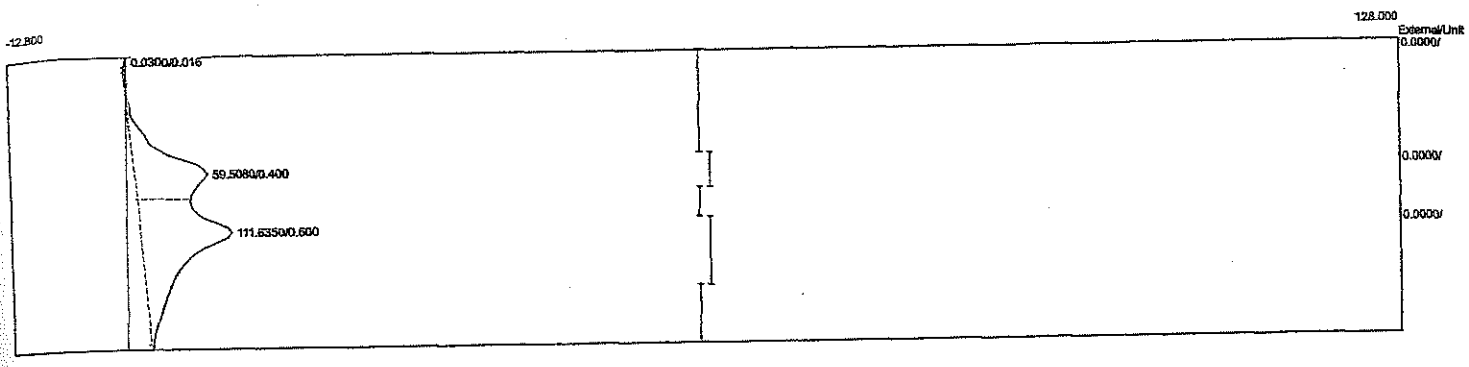
mponent	Retention	Area	External	Units
Vol / Air	0.300	0.0470	0.0000	
ent H2O	0.416	21.8050	0.0000	
ldehyde	0.616	21.0575	0.0000	
		42.9095	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
sis date: 03/18/2016 12:05:47
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
ponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E02.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
perator: D. Kremer



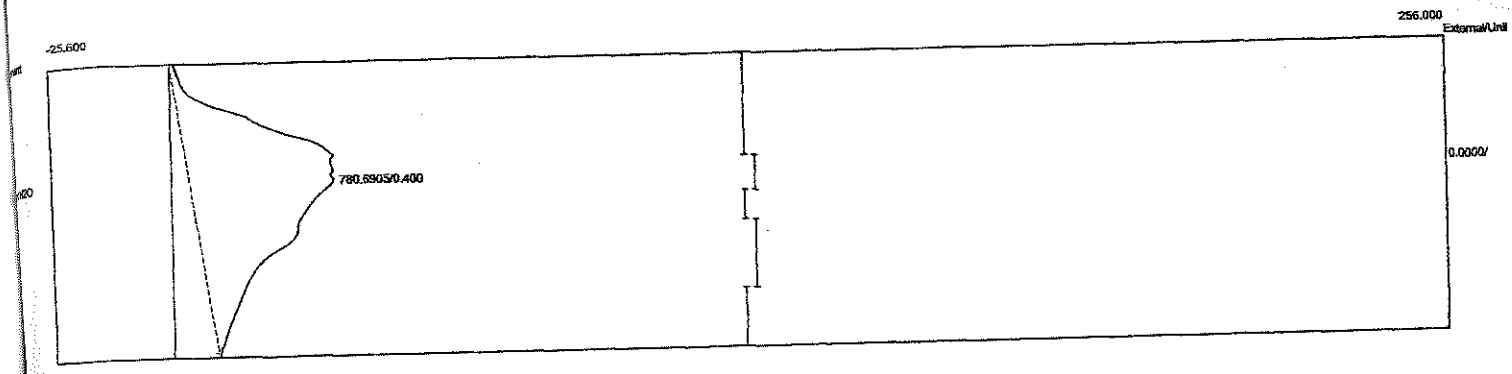
ponent	Retention	Area	External	Units
ol / Air	0.016	2.4840	0.0000	
H2O	0.450	23.9350	0.0000	
ehyde	0.616	42.2580	0.0000	
		68.6770	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:07:02
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E03.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



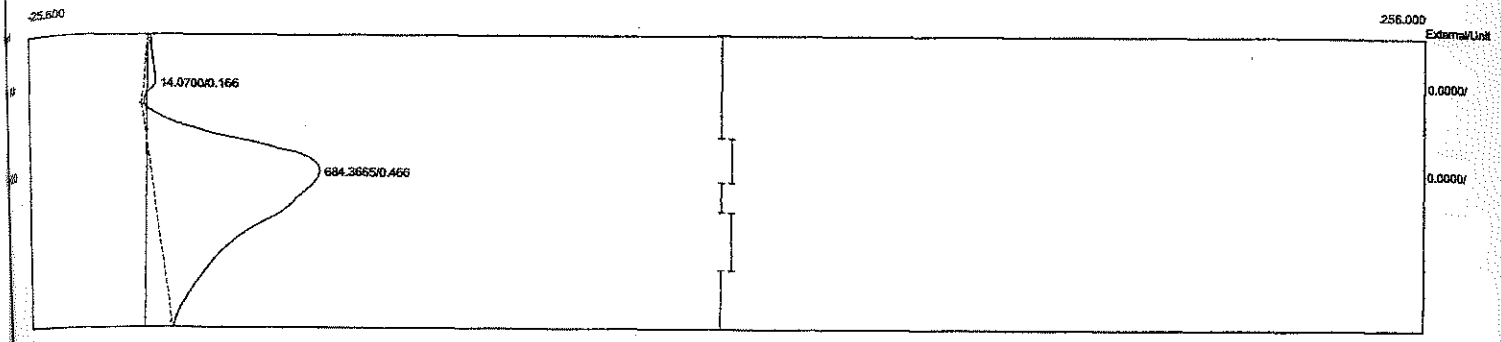
mponent	Retention	Area	External	Units
Vol / Air	0.016	0.0300	0.0000	
nt H2O	0.400	59.5080	0.0000	
ldehyde	0.600	111.6350	0.0000	
		171.1730	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
lysis date: 03/18/2016 12:08:21
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
emp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E04.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



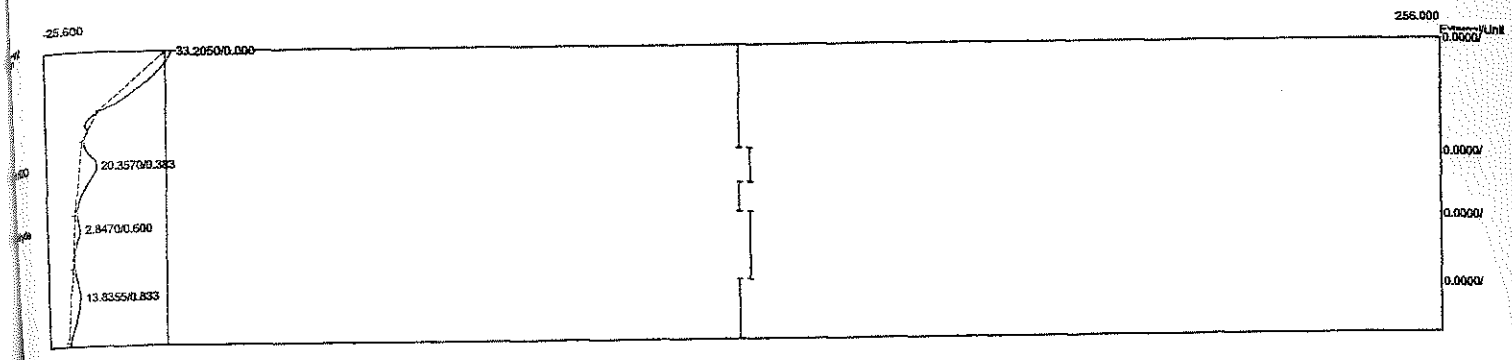
mponent	Retention	Area	External	Units
ent H2O	0.400	780.6905	0.0000	
		780.6905	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
sis date: 03/18/2016 12:10:33
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
pp. prog: eto-100.tem
ponents: eto2-100.cpt
Data file: 2SterAti-2016-3E05.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



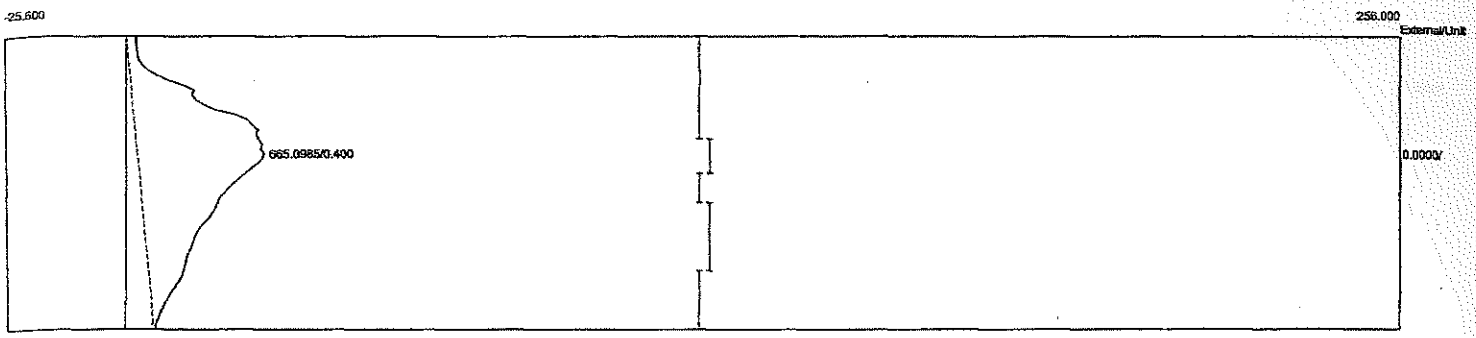
mponent	Retention	Area	External	Units
Vol / Air	0.166	14.0700	0.0000	
nt H2O	0.466	684.3665	0.0000	
		698.4365	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:12:21
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E06.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



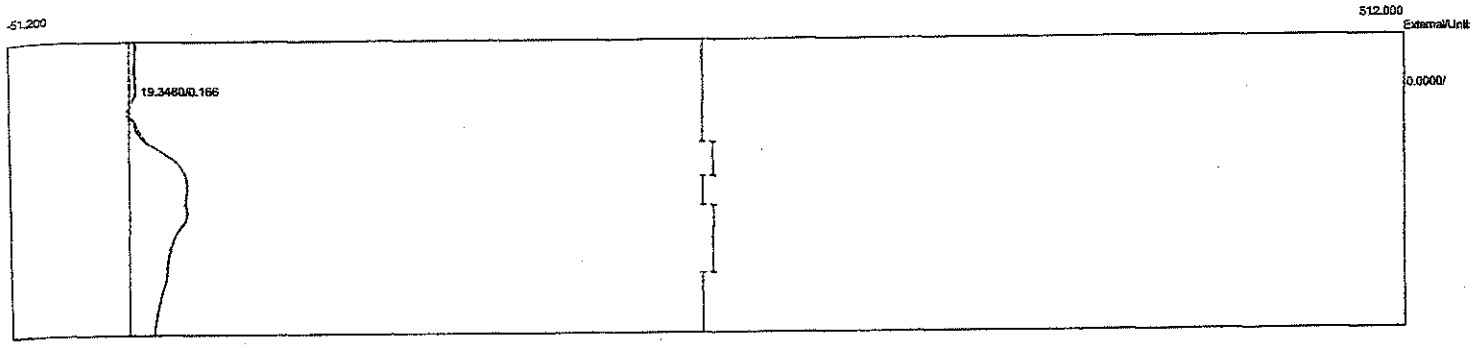
mponent	Retention	Area	External	Units
nt H2O	0.383	20.3570	0.0000	
ldehyde	0.600	2.8470	0.0000	
	0.833	13.8355	0.0000	
		37.0395	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:14:17
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E07.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



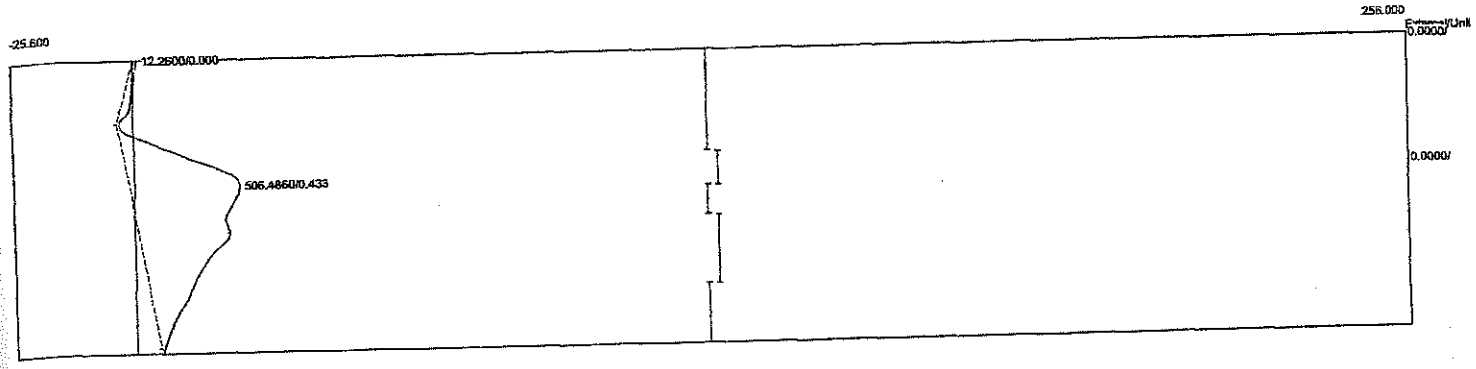
mponent	Retention	Area	External	Units
ent H2O	0.400	665.0985	0.0000	
		665.0985	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:15:53
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E08.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



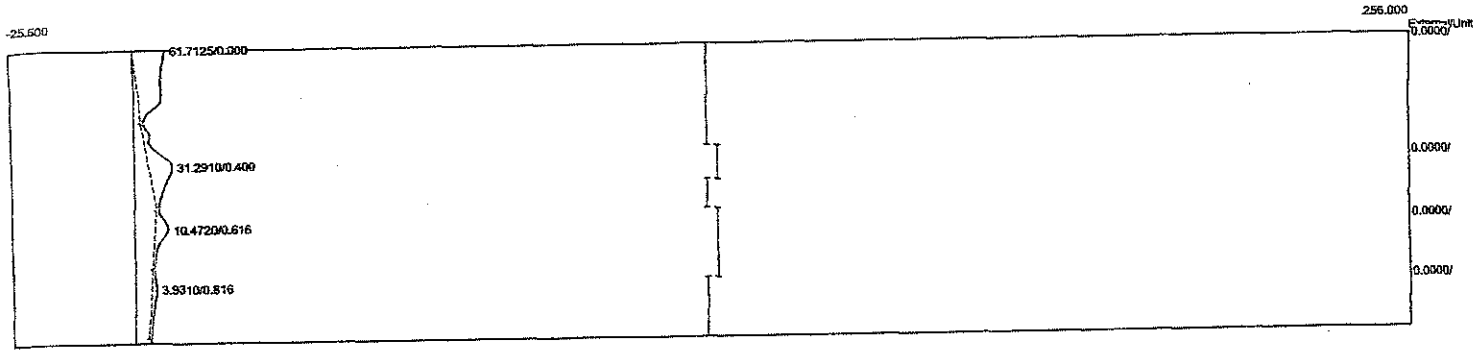
mponent	Retention	Area	External	Units
Vol / Air	0.166	19.3480	0.0000	
		19.3480	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:17:52
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E09.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



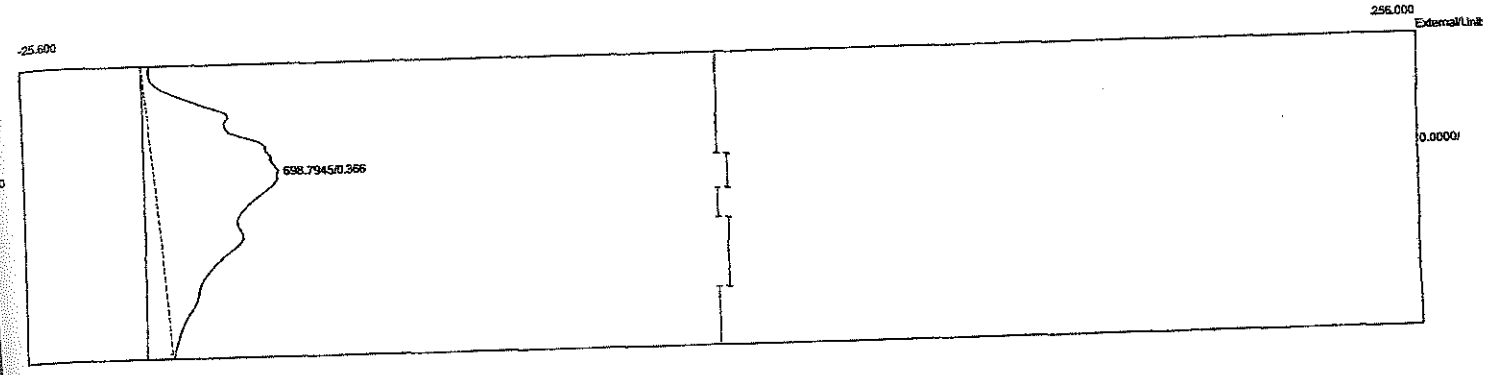
mponent	Retention	Area	External	Units
ent H2O	0.433	506.4860	0.0000	
		506.4860	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:20:21
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
ponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E10.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



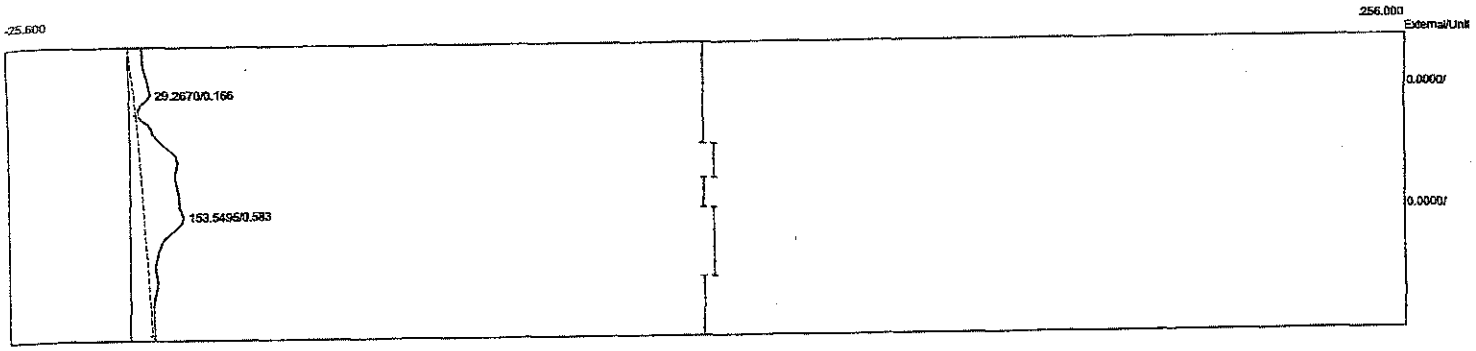
mponent	Retention	Area	External	Units
nt H2O	0.400	31.2910	0.0000	
ldehyde	0.616	10.4720	0.0000	
	0.816	3.9310	0.0000	
		45.6940	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:21:34
Method: Direct Injection
escription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
mponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E11.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



mponent	Retention	Area	External	Units
nt H2O	0.366	698.7945	0.0000	
		698.7945	0.0000	

Client: Sterigenics - Atlanta
Client ID: Run#3Exh
ysis date: 03/18/2016 12:22:52
Method: Direct Injection
scription: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
mp. prog: eto-100.tem
ponents: eto2-100.cpt
Data file: 2SterAtl-2016-3E12.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



mponent	Retention	Area	External	Units
Vol / Air	0.166	29.2670	0.0000	
dehyde	0.583	153.5495	0.0000	
		182.8165	0.0000	

APPENDIX E

Field Data and Calculation Worksheets

ECSi

ECSi, Inc.

Ethylene Oxide Mass Emissions Data and Calculations

Run #1 (Ceilcote Scrubber Outlet) - Chamber #3
Sterigenics, Inc. - Atlanta, GA
March 17, 2016

DeltaP	SqRtDeltaP	Temp (F)	ppm EtO
0.0075	0.0866	96	0.01
0.015	0.1225	95	0.01
0.01	0.1000	93	0.01
0.0075	0.0866	90	0.01
0.0075	0.0866	89	0.01
0.005	0.0707	90	0.01
0.005	0.0707	91	0.01
0.005	0.0707	94	0.01
0.005	0.0707	96	0.01
0.005	0.0707	96	0.01
0.0025	0.0500	96	0.01
0.0025	0.0500	95	0.01
Average =			
0.0065	0.0804	93.4	**0.010**
		= 553	degR

1-%H2O =	0.97	
mw =	28.54	
stack area =	0.785	
press =	29.05	
Tstd =	528	
Pstd =	29.92	
Cp =	0.99	
Kp =	85.49	
Velocity =	5.6	ft/sec
Flow =	**235**	**dscfm**
MWeto =	44.05	
MolVol =	385.32	
ppmv/ft3 =	1000000	
EtO Mass Flow =	**0.0000003**	**lbs/min**
evac start =	1335	
evac stop =	1357	
min/cycle =	24	
EtO Emissions =	**0.0000065**	**lbs/cycle**

INLET CALCULATION:

Pre-Evac:			
	V =	974	ft3
	P =	17.2	in Hg Abs
	T =	130	degF
	R =	10.73	
	mw =	44.05	
	lbs EtO @ 100% =	57.14	lbs

Post-Evac:			
	V =	974	ft3
	P =	2.0	in Hg Abs
	T =	130	degF
	R =	10.73	
	mw =	44.05	
	lbs EtO @ 100% =	6.64	lbs

Initial EtO = Scale Wt. =	50.8	lbs
% EtO @ Chamber = Scale Wt. / lbs EtO @ 100% (Pre) =	88.9	%
Final EtO = % EtO @ Chamber X lbs EtO @ 100% (Post) =	5.9	lbs
INLET ETO = Initial EtO - Final EtO =	**44.9**	**lbs**
CONTROL EFFICIENCY =	**99.999986**	**%**

ECSi, Inc.

Ethylene Oxide Mass Emissions Data and Calculations

Run #2 (Ceilcote Scrubber Outlet) - Chamber #8
Sterigenics, Inc. - Atlanta, GA
March 18, 2016

DeltaP	SqRtDeltaP	Temp (F)	ppm EtO
0.01	0.1000	98	0.01
0.015	0.1225	88	0.01
0.02	0.1414	88	0.17
0.015	0.1225	90	0.01
0.01	0.1000	97	0.01
0.0075	0.0866	99	0.01
0.005	0.0707	94	0.01
0.005	0.0707	92	0.01
0.005	0.0707	91	0.01
0.005	0.0707	92	0.01
0.005	0.0707	94	0.01
0.005	0.0707	99	0.01
0.0025	0.0500	96	0.01
0.0025	0.0500	95	0.01
Average =			
0.0080	0.0896	93.8	**0.0214**
		= 554	degR

1-%H2O =	0.97	
mw =	28.54	
stack area =	0.785	
press =	29.05	
Tstd =	528	
Pstd =	29.92	
Cp =	0.99	
Kp =	85.49	
Velocity =	6.2	ft/sec
Flow =	**262**	**dscfm**
MWeto =	44.05	
MolVol =	385.32	
ppmv/ft3 =	1000000	
EtO Mass Flow =	**0.0000006**	**lbs/min**
evac start =	1118	
evac stop =	1140	
min/cycle =	22	
EtO Emissions =	**0.0000141**	**lbs/cycle**

INLET CALCULATION:

Pre-Evac:	V =	1469	ft3	Post-Evac:	V =	1469	ft3
	P =	17.3	in Hg Abs		P =	2.0	in Hg Abs
	T =	129	degF		T =	129	degF
	R =	10.73			R =	10.73	
	mw =	44.05			mw =	44.05	
	lbs EtO @ 100% =	86.83	lbs		lbs EtO @ 100% =	10.04	lbs

Initial EtO = Scale Wt. =	70.0	lbs
% EtO @ Chamber = Scale Wt. / lbs EtO @ 100% (Pre) =	80.6	%
Final EtO = % EtO @ Chamber X lbs EtO @ 100% (Post) =	8.1	lbs
INLET ETO = Initial EtO - Final EtO =	**61.9**	**lbs**

CONTROL EFFICIENCY = 99.999977 %

ECSi, Inc.

Ethylene Oxide Mass Emissions Data and Calculations

Run #3 (Ceilcote Scrubber Outlet) - Chamber #11
Sterigenics, Inc. - Atlanta, GA
March 18, 2016

DeltaP	SqRtDeltaP	Temp (F)	ppm EtO
0.015	0.1225	100	0.01
0.025	0.1581	100	0.01
0.025	0.1581	100	0.01
0.02	0.1414	96	0.01
0.0175	0.1323	91	0.01
0.015	0.1225	89	0.01
0.01	0.1000	92	0.01
0.0075	0.0866	94	0.01
0.0075	0.0866	97	0.01
0.005	0.0707	94	0.01
0.005	0.0707	95	0.01
0.0025	0.0500	92	0.01
Average =			
0.0129	0.1137	95.0	**0.0100**
		= 555	degR

1-%H2O =	0.97	
mw =	28.54	
stack area =	0.785	
press =	29.05	
Tstd =	528	
Pstd =	29.92	
Cp =	0.99	
Kp =	85.49	
Velocity =	7.9	ft/sec
Flow =	**332**	**dscfm**
MWeto =	44.05	
MolVol =	385.32	
ppmv/ft3 =	1000000	
EtO Mass Flow =	**0.0000004**	**lbs/min**
evac start =	1203	
evac stop =	1223	
min/cycle =	20	
EtO Emissions =	**0.0000076**	**lbs/cycle**

INLET CALCULATION:

Pre-Evac:	V =	5174	ft3	Post-Evac:	V =	5174	ft3
	P =	13.0	in Hg Abs		P =	3.0	in Hg Abs
	T =	132	degF		T =	131	degF
	R =	10.73			R =	10.73	
	mw =	44.05			mw =	44.05	
	lbs EtO @ 100% =	228.65	lbs		lbs EtO @ 100% =	52.85	lbs

Initial EtO = Scale Wt. =	99.0	lbs
% EtO @ Chamber = Scale Wt. / lbs EtO @ 100% (Pre) =	43.3	%
Final EtO = % EtO @ Chamber X lbs EtO @ 100% (Post) =	22.9	lbs
INLET ETO = Initial EtO - Final EtO =	**76.1**	**lbs**
CONTROL EFFICIENCY =	**99.999990**	**%**

ECSi - VELOCITY TRAVERSE DATA

Client: Sterigenics, Inc. Run #: 1 Date: 3/17/2016 Port Sketch:

Location: Atlanta, Georgia Probe Type: Std. Baro Press: 29.05

Source: Ceilcote Packed Tower Scrubber Outlet Stack I.D.: 12 in. Static Press: -0.01

	Port 1							Port 2						
Inches From Port	Point#	Delta P Low	Delta P High	Delta P Average	Delta P Sq Root	Stack Temp (F)	Cyclonic Angle	Point#	Delta P Low	Delta P High	Delta P Average	Delta P Sq Root	Stack Temp (F)	Cyclonic Angle
0.4	1	0.0025	0.0025	0.0025	0.0500	79	0	1	0.0025	0.0025	0.0025	0.0500	79	0
1.25	2	0.0025	0.005	0.00375	0.0612	79	0	2	0.005	0.005	0.005	0.0707	79	0
2.3	3	0.005	0.0075	0.00625	0.0791	79	0	3	0.005	0.0075	0.00625	0.0791	79	0
3.9	4	0.0075	0.0075	0.0075	0.0866	79	0	4	0.0075	0.01	0.00875	0.0935	80	0
8.1	5	0.0075	0.01	0.00875	0.0935	79	0	5	0.0075	0.0075	0.0075	0.0866	80	0
9.7	6	0.005	0.0075	0.00625	0.0791	79	0	6	0.005	0.0075	0.00625	0.0791	80	0
10.75	7	0.005	0.005	0.005	0.0707	80	0	7	0.0025	0.005	0.00375	0.0612	80	0
11.6	8	0.0025	0.0025	0.0025	0.0500	80	0	8	0.0025	0.0025	0.0025	0.0500	80	0
	9							9						
	10							10						
	11							11						
	12							12						
	13							13						
	14							14						
	15							15						
	16							16						
	17							17						
	18							18						
	19							19						
	20							20						
	21							21						
	22							22						
	23							23						
	24							24						
								Average Values:			0.0053	0.0713	79.4	0.0

ETHYLENE OXIDE SOURCE TEST/CALIBRATION DATA

Client: Sterigenics - Atlanta

Source Tested: Ceilcote Scrubber / AAT Safe Cell System Date: 3/17/16 3/18/16

PRE CALIBRATION

Inlet (FID)	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO	1000 ppm EtO	10080 ppm EtO			
	Area Counts #1	.23	1.99	19.1					
	Area Counts #2	.22	2.02	19.6					
	Average Area	.23	2.01	19.4					
	Audit Standard (48.8 ppmv) Result					49.8 ✓			
Outlet (PID)	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO					
	Area Counts #1	1.54	13.1	126					
	Area Counts #2	1.57	13.4	128					
	Average Area	1.56	13.3	127					
	Audit Standard (48.8 ppmv) Result					48.6 ✓			

	Run #1 (Ch.3)	Run #2 (Ch.8)	Run #3 (Ch.11)
Exhaust Start/Stop:	1739/1803	1118/1140	1203/1223
Backvent Start/Stop:	2229/2335	2253/2308	2310/2325
	Ch.11	Ch.10	Ch.7

P_{bar}: 29.05

$\%H_2O$: 3

EtO Usage (lbs/yr): —

Cycles Per Week: —

POST CALIBRATION

Inlet (FID)	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO	1000 ppm EtO	10080 ppm EtO			
	Area Counts #1								
	Area Counts #2								
	Average Area								
	Audit Standard (48.8 ppmv) Result								
Outlet (PID)	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO					
	Area Counts #1								
	Area Counts #2								
	Average Area								
	Audit Standard (48.8 ppmv) Result								

ECSi

APPENDIX F

Gas Certifications

ECSi

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Scott Specialty Gases

2600 CAJON BLVD., SAN BERNARDINO, CA 92411 Phone: 909-887-2571 Fax: 909-887 0549

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information
Project No.: 02-57184-001
Item No.: 02020001310TCL
P.O. No.: VBL – 2 KREMER

Cylinder Number: CAL4448
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC.
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name	Concentration (Moles)		Accuracy (+/-%)
ETHYLENE OXIDE	1.10	PPM	5
NITROGEN		BALANCE	

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY: _____ DATE: 4-14-14
TIME

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Scott Specialty Gases
4630 CAJON BLVD., SAN BERNARDINO, CA 92411 Phone: 909-887-2571 Fax: 909-887-0549

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information
Project No.: 02-57164-003
Item No.: 020200013201TCL
P.O. No.: VSL - D KREMER

Cylinder Number: CLM002232
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name	Concentration (Moles)		Accuracy (+/-%)
ETHYLENE OXIDE	10.1	PPM	5
NITROGEN		BALANCE	

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY _____ DATE: 4/16/14

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Scott Specialty Gases

2600 CAJON BLVD., SAN BERNARDINO, CA 92411 Phone: 909-887-2571 Fax: 909 887 0849

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information
Project No.: 02-57164-004
Item No.: 02020001330TCL
P.O. No.: VEL - D. KREMER

Cylinder Number: CLM011335
Cylinder Size: CL
Certification Date: 14Abr2014

Customer

ECSI, INC
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name	Concentration (Moles)		Accuracy (+/-%)
ETHYLENE OXIDE	100	PPM	5
NITROGEN		BALANCE	

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY: [signature] DATE 4-14-14

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Scott Specialty Gases

2600 CAJON BLVD., SAN BERNARDINO, CA 92411 Phone: 909 887 2571 Fax: 909-887-3649

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information
Project No.: 02-57184-005
Item No.: 020200013407CL
P.O. No.: VEL - D KREMEN

Cylinder Number: CLM002810
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name	Concentration (Moles)		Accuracy (+/-%)
ETHYLENE OXIDE	1.030	PPM	5
NITROGEN		BALANCE	

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY: [signature] DATE: 4-18-14

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Scott Specialty Gases
2600 CAJON BLVD., SAN BERNARDINO, CA 92411 Phone: 909-887-2571 Fax: 909-887-0548

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information
Project No.: 02-57184-008
Item No.: 020200013407CL
P.O. No.: V6L-0 KREMER

Cylinder Number: CLM005787
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC
PO BOX 916
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name	Concentration (Moles)		Accuracy (+/-%)
ETHYLENE OXIDE	10.080	PPM	5
NITROGEN		BALANCE	

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY: [signature] DATE: 4-14-14

CERTIFICATE OF ANALYSIS

Customer Name:	ECSI, Inc.	**Cylinder Number:**	SA29925
Stock or Analyzer Tag Number:	N/A	**Product Class:**	Certified Standard
Customer Reference:	[illegible]	**Cylinder - Contents[1]:**	28 CF @ 2000 PSI
MESA Reference:	[illegible]	**Cylinder-CGA:**	[illegible]
Date of Certification:	2/18/2014	**Analysis Method:**	[illegible]
Recommended Shelf Life:	[illegible]	**Preparation Method:**	[illegible]

Component	Requested Concentration[2]	Reported Concentration[2,3]
[illegible]	50 ppm	48.8 ppm
Nitrogen	Balance	Balance

Authorized Signature: [signature]

[illegible]

2. [illegible]
3. [illegible]

[illegible]

MESA Specialty Gases & Equipment
[illegible]

APPENDIX G

Process/Parametric Monitoring Data

ECSi

ANTARES KUNSLP V3U-4 03/17/16 Thu 20:14 CYCLE 986 CHECK VALUE 34152
STEM RUN # 1695412

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP GAS	ALARMS & MESSAGES	ACTION TAKEN
:14	13.6	131		153		
:16	15.7	131		155		
:17	17.2	131		157		
					PHASE 0:13 PHASE ELAPSED 0:13	
					CYCLE 1:11	
MAX:	17.2	131		167		
MIN:	3.5	130		143		
:18	OPERATOR SENSOR CHECK --				PR 58.2, RH 0, JWT 130, VLT 103, VGX 158	
	CT1 131, CT2 131, CT3 130, P01 130, P02 FAIL, P03 FAIL, P04 81					
	P05 81, P06 81, P07 81, P08 81, P09 81, P10 81, P11 81					
	P12 81, P13 81, P14 81, P15 81, P16 81, P17 81, P18 81					
	P19 81, P20 81, ETO 0, H2O 0.1, WT 453.4					

STERILANT USED THIS PHASE: 50.8, CYCLE TOTAL: 50.8

GAS DWELL (ED) PHASE

:18	17.2	131		158		
:20	17.1	130		157		
:22	17.1	130		156		
:24	17.1	130		154		
:26	17.1	130		153		
:28	OPERATOR SENSOR CHECK --				PR 58.0, RH 0, JWT 130, VLT 101, VGX 152	
	CT1 130, CT2 130, CT3 130, P01 130, P02 FAIL, P03 FAIL, P04 81					
	P05 81, P06 81, P07 81, P08 81, P09 81, P10 81, P11 81					
	P12 81, P13 81, P14 81, P15 81, P16 81, P17 81, P18 81					
	P19 81, P20 81, ETO 0, H2O 0.1, WT 453.4					
:28	17.1	130		151		
:30	17.1	130		150		
:32	17.1	130		149		
:34	17.1	130		147		
:36	17.1	130		146		
:38	OPERATOR SENSOR CHECK --				PR 58.0, RH 0, JWT 130, VLT 100, VGX 145	
	CT1 130, CT2 130, CT3 130, P01 130, P02 FAIL, P03 FAIL, P04 81					
	P05 81, P06 81, P07 81, P08 81, P09 81, P10 81, P11 81					
	P12 81, P13 81, P14 81, P15 81, P16 81, P17 81, P18 81					
	P19 81, P20 81, ETO 0, H2O 0.1, WT 453.5					
:38	17.1	130		145		
:40	17.1	130		144		
:41	17.1	130		143		OPERATOR CYCLE STOP
:41	OPERATOR SENSOR CHECK --				PR 58.0, RH 0, JWT 130, VLT 100, VGX 143	
	CT1 130, CT2 130, CT3 130, P01 130, P02 FAIL, P03 FAIL, P04 81					
	P05 81, P06 81, P07 81, P08 81, P09 81, P10 81, P11 81					
	P12 81, P13 81, P14 81, P15 81, P16 81, P17 81, P18 81					
	P19 81, P20 81, ETO 0, H2O 0.1, WT 453.5					
:41	'KLS					
:42	17.1	130		143		
:44	17.1	130		141		
:46	17.1	130		140		
:48	17.1	130		139		

STEM RUN # 1695412

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP GAS	ALARMS & MESSAGES	ACTION TAKEN
1:26	17.2	130		123		
1:28	17.2	130		123		
1:30	17.2	130		122		
1:31	17.2	130		122		CYCLE CONTINUED
1:31	OPERATOR SENSOR CHECK --		PR	58.1,	RH 0, JWT 130, VLT 98, VGX 122	
	CT1 130, CT2 130, CT3 130, P01 130, P02 FAIL, P03 FAIL, P04 81					
	P05 81, P06 81, P07 81, P08 81, P09 81, P10 81, P11 81					
	P12 81, P13 81, P14 81, P15 81, P16 81, P17 81, P18 81					
	P19 81, P20 81, ETO 0, H2O 0.1, WT 453.5					
1:31	*KLS					
1:32	17.2	130		122		
1:34	17.2	130		121		
1:36	17.2	130		121		
1:38	17.2	130		120		
1:39	17.2	130		120		
MAX:	17.2	131		158	PHASE 0:30	PHASE ELAPSED 1:20
MIN:	17.1	130		120		CYCLE 2:32

AFTER VACUUM PHASE

1:39	17.2	130	120		
1:41	12.1	130	117		
1:43	8.5	129	120		
1:45	8.7	129	119		
1:47	8.7	130	119		
1:49	8.7	130	118		
1:51	8.7	130	117		
1:53	8.7	130	117		
1:55	7.2	130	116		
1:57	4.9	130	116		
1:59	3.5	130	115		
2:01	2.6	130	115		
2:03	2.0	130	115	EVACUATION PRESSURE	
2:03	2.0	130	115		
MAX:	17.2	130	120	PHASE 0:23	PHASE ELAPSED 0:23
MIN:	2.0	129	115		CYCLE 2:56

GAS WASH A PHASE

2:03	2.0	130	115	========== RELEASE 1 ==========	
2:05	6.4	130	120		
2:07	11.0	131	125		
2:08	15.0	132	131	========== EVACUATION 1 ==========	
2:09	14.9	132	131		
2:11	9.0	131	134		
2:13	5.8	130	132		
2:15	3.8	130	131		
2:17	2.6	130	130		
2:18	2.0	130	129	EVACUATION PRESSURE	
2:18	2.0	130	129	========== RELEASE 2 ==========	

STEM RUN # 1695889

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP GAS	ALARMS & MESSAGES	ACTION TAKEN
					HUMIDIFICATION (PRESSURE) PHASE	
4:15	2.0	131		112		
4:16	3.5	131		112		
MAX:	3.5	131		112	PHASE 0:00	PHASE ELAPSED 0:00
MIN:	2.0	131		112		CYCLE 0:37
					HUMIDITY DWELL (PRESS) PHASE	
4:16	3.6	131		112		
4:18	3.8	131		112		
4:20	3.8	130		111		
4:22	3.8	129		110		
4:24	3.8	128		109		
4:26	3.8	128		108		
4:26	3.5	128		108		
MAX:	3.8	131		112	PHASE 0:10	PHASE ELAPSED 0:10
MIN:	3.5	128		108		CYCLE 0:47
					GAS A (EO) PHASE	
4:26	3.5	128		108	======== STERILANT 1 ==========	
4:28	5.5	128		107		
4:30	OPERATOR SENSOR CHECK -- PR 25.6, RH 0, JWT 134, VLT 83, VGX 107					
	CT1 128, CT2 128, CT3 129, P01 127, P02 FAIL, P03 FAIL, P04 83					
	P05 83, P06 83, P07 83, P08 83, P09 83, P10 83, P11 83					
	P12 83, P13 83, P14 83, P15 83, P16 83, P17 83, P18 83					
	P19 83, P20 83, ETO 0, H2O 0.1, WT 482.0					
4:30	'KLS					
4:30	7.5	128		107		
4:32	9.5	129		107		
4:34	11.5	129		106		
4:36	13.6	130		106		
4:38	15.5	130		106		
4:39	17.2	129		106		
MAX:	17.2	130		108	PHASE 0:13	PHASE ELAPSED 0:13
MIN:	3.5	128		106		CYCLE 1:00

STERILANT USED THIS PHASE: 70.0, CYCLE TOTAL: 70.0

GAS DWELL (EO) PHASE

4:40	17.1	129		106
4:42	17.1	128		107
4:44	17.2	128		108
4:46	17.2	128		108

STEM RUN # 1695889

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP GAS	ALARMS & MESSAGES	ACTION TAKEN
4:48	OPERATOR SENSOR CHECK — PR 58.2, RH 0, JWT 144, VLT 83, VGX 109					
	CT1 128, CT2 130, CT3 128, P01 129, P02 FAIL, P03 FAIL, P04 83					
	P05 83, P06 83, P07 83, P08 83, P09 83, P10 83, P11 83					
	P12 83, P13 83, P14 83, P15 83, P16 83, P17 83, P18 83					
	P19 83, P20 83, ETO 0, H2O 0.1, WT 433.0					
4:48	'WJ					
4:48	17.2	129		109		
4:50	17.2	129		110		
4:52	17.2	130		111		
4:54	17.2	130		112		
4:56	17.2	130		113		
4:58	17.2	130		114		
5:00	17.2	130		114		
5:02	17.3	130		115		
5:04	17.3	129		115		
5:06	17.3	129		116		
5:08	17.3	129		116		OPERATOR CYCLE STOP
5:08	17.3	129		116		
5:08	OPERATOR SENSOR CHECK — PR 58.5, RH 0, JWT 133, VLT 83, VGX 116					
	CT1 128, CT2 130, CT3 129, P01 129, P02 FAIL, P03 FAIL, P04 83					
	P05 83, P06 83, P07 83, P08 83, P09 83, P10 83, P11 83					
	P12 83, P13 83, P14 83, P15 83, P16 83, P17 83, P18 83					
	P19 83, P20 83, ETO 0, H2O 0.1, WT 433.0					
5:09	'KLS					
5:10	17.3	129		116		
5:12	17.3	129		117		
5:14	17.3	129		117		
5:15	17.3	129		117	LONG EXPOSURE	
5:15	OPERATOR SENSOR CHECK — PR 58.5, RH 0, JWT 143, VLT 83, VGX 117					
	CT1 128, CT2 130, CT3 129, P01 129, P02 FAIL, P03 FAIL, P04 83					
	P05 83, P06 83, P07 83, P08 83, P09 83, P10 83, P11 83					
	P12 83, P13 83, P14 83, P15 83, P16 83, P17 83, P18 83					
	P19 83, P20 83, ETO 0, H2O 0.1, WT 433.1					
5:16	'KLS					CYCLE CONTINUED
5:16	17.3	129		117		
5:16	OPERATOR SENSOR CHECK — PR 58.5, RH 0, JWT 140, VLT 83, VGX 117					
	CT1 128, CT2 130, CT3 129, P01 129, P02 FAIL, P03 FAIL, P04 83					
	P05 83, P06 83, P07 83, P08 83, P09 83, P10 83, P11 83					
	P12 83, P13 83, P14 83, P15 83, P16 83, P17 83, P18 83					
	P19 83, P20 83, ETO 0, H2O 0.1, WT 433.1					
5:16	'KLS					
5:16	17.3	129		117		
5:18	17.3	129		117		
	MAX: 17.3	130		117	PHASE 0:30	PHASE ELAPSED 0:37
	MIN: 17.1	128		106		CYCLE 1:39
					AFTER VACUUM PHASE	
5:18	17.3	129		117		
5:20	10.2	128		117		

STEM RUN # 1695889

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP GAS	ALARMS & MESSAGES	ACTION TAKEN
5:22	8.9	128		117		
5:24	8.9	128		117		
5:26	8.9	129		117		
5:28	9.0	130		117		
5:30	9.0	130		117		
5:32	9.0	130		117		
5:34	7.1	130		117		
5:36	4.4	129		116		
5:38	2.8	129		116		
5:40	2.0	129		116		
5:40	2.0	129		116	EVACUATION PRESSURE	
5:40	2.0	129		116		
MAX:	17.3	130		117	PHASE 0:22	PHASE ELAPSED 0:22
MIN:	2.0	128		116		CYCLE 2:01

GAS WASH A PHASE

5:40	2.0	129		116	======== RELEASE 1 ========	
5:42	8.8	130		116		
5:43	15.0	132		116	======== EVACUATION 1 ========	
5:44	14.9	132		116		
5:46	7.9	130		116		
5:48	4.6	129		116		
5:50	2.8	129		116		
5:51	2.0	129		116	EVACUATION PRESSURE	
5:51	2.0	129		116	======== RELEASE 2 ========	
5:52	3.7	129		116		
5:54	10.7	131		115		
5:55	15.0	132		116	======== EVACUATION 2 ========	
5:56	11.9	132		116		
5:58	6.6	130		116		
6:00	3.9	130		116		
6:02	2.4	129		116		
6:02	2.0	129		116	EVACUATION PRESSURE	
6:02	2.0	129		116		
MAX:	15.0	132		116	PHASE 0:22	PHASE ELAPSED 0:22
MIN:	2.0	129		115		CYCLE 2:24

RELEASE PHASE

6:02	2.0	129		116
6:04	9.3	130		115
6:06	16.5	132		115
6:08	22.6	132		115

11. Phase » EO Inject by Pressure

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure	[mg/l] AT-EO	[lbs] EO Weight Used
3/18/2016				
13:59:04	132.2	6.4	173.0	70
14:00:04	132.3	7.3	224.8	86
14:00:53	132.4	8.0	263.8	98
14:00:57	132.4	8.1	267.1	99

Step Gas Usage

ID	Gas	Drum S/N	Lot Number	Usage Value
56	EO	E000086	UTLX902056B16	99lbs

Device	Summary	Summary Value		Specified Range
Current Phase Time	Final	00:05:54		00:01:00 - 00:30:00
Elapsed Phase Time	Final	00:05:54		n/a - N/A
TempAve	Min	131.6	°F	120.0 - 140.0 °F
TempAve	Max	132.4	°F	120.0 - 140.0 °F
PCurr	Final	8.1	inHg	7.0 - 9.5 inHg
PCurr	Final	8.1	inHg	n/a - 9.0 inHg
AT-EO	Final	267.1	mg/l	N/A - N/A mg/l
EO Weight Used	Final	99	lbs	N/A - N/A lbs

12. Phase » Static Dwell

(Phase No.11)

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure
3/18/2016		
14:00:58	132.4	8.1
14:01:58	132.4	8.0
14:02:58	132.4	8.0
14:03:58	132.2	8.0
14:04:58	132.1	8.0
14:05:57	132.1	8.0
14:05:58	132.1	8.0
14:05:58	132.1	8.0

Device	Summary	Summary Value		Specified Range
Current Phase Time	Final	00:05:01		00:04:00 - 00:06:00
Elapsed Phase Time	Final	00:05:01		n/a - N/A
TempAve	Min	132.1	°F	120.0 - 140.0 °F
TempAve	Max	132.4	°F	120.0 - 140.0 °F
PCurr	Min	8.0	inHg	7.0 - 9.0 inHg
PCurr	Min	8.0	inHg	n/a - N/A inHg
PCurr	Max	8.1	inHg	7.0 - 9.0 inHg
PCurr	Max	8.1	inHg	n/a - N/A inHg

13. Phase » EO Inject by Pressure

(Phase No.12)

14. Phase » EO Dwell with Nitrogen Makeup

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure	[mg/l] AT-EO	[mg/l] AT-AH	[%] RH Sensor
3/18/2016					
16:01:40	132.0	13.0	578.4	34.5	N/A
16:02:40	132.1	13.0	578.4	34.5	N/A
16:03:26	132.1	13.0	578.4	34.5	N/A
OPR Operator has requested abort					
16:03:26	132.1	13.0	578.4	34.5	N/A

Device	Summary	Summary Value		Specified Range
Current Phase Time	Final	01:51:46		01:59:00 - 02:15:00
Elapsed Phase Time	Final	01:51:46		n/a - N/A
TempAve	Min	131.8	°F	125.0 - 135.0 °F
TempAve	Max	132.8	°F	125.0 - 135.0 °F
PCurr	Min	13.0	inHg	12.0 - 14.5 inHg
PCurr	Min	13.0	inHg	n/a - 14.0 inHg
PCurr	Max	13.1	inHg	12.0 - 14.5 inHg
PCurr	Max	13.1	inHg	n/a - 14.0 inHg
RH from AH Calc	Min	N/A	%	N/A - N/A %
RH from AH Calc	Max	N/A	%	N/A - N/A %
AT-AH	Min	33.6	mg/l	N/A - N/A mg/l
AT-AH	Max	35.4	mg/l	N/A - N/A mg/l
AT-EO	Min	545.5	mg/l	N/A - N/A mg/l
AT-EO	Max	578.4	mg/l	N/A - N/A mg/l

DVN Current Phase Time has a measurement value of 01:51:46. The min specified value is 01:59:00

15. Phase » Vacuum

(Phase No.14)

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure
3/18/2016		
16:03:26	132.1	13.0
SYS Cycle has entered EO Abort sequence while running Run ID 301852 at phase no. 14 - 0		
16:04:26	132.0	12.5
16:05:26	131.9	11.5
16:06:26	131.7	10.7
16:07:26	131.6	9.9
16:08:11	131.5	9.0
OPR Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0		
16:08:26	131.5	8.9
16:09:02	131.5	8.9
ALM Recirculation blower is enabled but not operational		
16:09:07	131.5	8.9
ALM Recirculation blower is enabled but not operational		
16:09:19	131.5	8.9
OPR Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0		
OPR Operator has requested run mode		
16:09:26	131.5	8.9

15. Phase » Vacuum

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure	
3/18/2016			
16:09:29	131.5	9.0	
OPR			Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0
16:10:12	131.5	9.0	
OPR			Operator has requested run mode
16:10:12	131.5	9.0	
OPR			Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0
16:10:22	131.6	9.0	
OPR			Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0
16:10:26	131.5	9.0	
16:11:14	131.6	8.9	
ALM			Recirculation blower is enabled but not operational
16:11:18	131.6	8.9	
ALM			Recirculation blower is enabled but not operational
16:11:26	131.6	8.9	
16:11:51	131.6	8.9	
OPR			Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0
OPR			Operator has requested run mode
16:12:01	131.6	8.9	
OPR			Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0
16:12:26	131.7	8.9	
16:12:52	131.7	8.9	
ALM			Recirculation blower is enabled but not operational
16:12:57	131.7	8.9	
ALM			Recirculation blower is enabled but not operational
16:13:23	131.7	8.9	
OPR			Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0
OPR			Operator has requested run mode
16:13:26	131.7	8.9	
16:13:34	131.7	8.9	
OPR			Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0
16:13:55	131.7	8.9	
OPR			Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0
OPR			Operator has requested run mode
16:14:26	131.7	8.8	
16:15:26	131.7	7.7	
16:16:26	131.5	6.8	
16:17:26	131.5	5.9	
16:18:26	131.4	5.2	
16:19:26	131.4	4.6	
16:20:26	131.4	4.0	
16:21:26	131.3	3.6	
16:22:26	131.3	3.1	
16:22:46	131.4	3.0	
16:22:48	131.3	3.0	

Sterigenics

Ceilcote Readings:

T2 = 186 – Inches
PH = 1.2
Glycol = 36.3%

AAT Readings:

T2 = 105 – Inches
PH= 0.9
Glycol = 36.8%

Recorded By: _____ Date: 18-MAR-16