Survey of Source Emissions for:

Weyerhaeuser

4111 West Four Mile Road
Grayling, MI 49738

Sources:
EUPRESSLINE Biofilter

40 CFR Part 63 Subpart DDDD
PCWP MACT

EGLE Renewable Operating Permit No.
MI-ROP-B7302-2016c

Test Date: November 28, 2023
Project ID: 2311520004

Environmental Services Company, Inc.

Arkansas
Little Rock & Springdale

New Mexico
Carlsbad & Albuquerque

1-888-ESC-First (3477)
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REVIEWED AND CERTIFIED BY:

Baxter Woosley

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BAXTER S. WOOSLEY, AIR PROJECTS MANAGER/QSTI

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the sources tested in the scope of this project.

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1.0 Introduction

1.1 Summary of Test Program

At the request of Mr. Tim Tadlock of Weyerhaeuser, Environmental Services Company, Inc. (ESC) performed air emissions testing at Weyerhaeuser's Grayling, Michigan facility. The scope of work consisted of testing the EUPRESSLINE Biofilter for formaldehyde (HCHO) destruction efficiency. The testing was in accordance with the United States Environmental Protection Agency (EPA) regulations, the facility's EGLE permit, 40 CFR Part 63 Subpart DDDD Plywood and Composite Wood Products (PCWP) Maximum Achievable Control Technology (MACT) standards.

1.2 Regulatory Information

Permit No.	EGLE Renewable Operating Permit No. MI-ROP-B7302-2016c
Regulatory Citation	40 CF Part 60
Regulatory Information	US EPA Region 5

1.3 Source Information

Source names:	EUPRESSLINE Biofilter
Source ID:	SVBIOFILTER
Target Parameters:	Formaldehyde

1.4 Test Location and Facility Contact

Mr. Tim Tadlcok
timothy.tadlock@weyerhaeuser.com
Weyerhaeuser
4111 West Four Mile Road
Grayling, Michigan 49378
Phone: (989) 348-3411

1.5 Regulatory Contact

Mr. Trevor Drost
drostt@michigan.gov
Michigan Department of Environment, Great Lakes & Energy (EGLE)
Phone: (517) 245-5781

1.6 Test Company and Personnel

Environmental Services Company, Inc.
13715 West Markham
Little Rock, AR 72211
Phone: (501) 221-2565

Project Manager	Field Team Leader
Steve Woosley	Baxter Woosley
stevew@esclabs.com	baxterw@esclabs.com

1.7 Site-Specific Test Plan and Testing Notes

All testing was performed in accordance with the Site-Specific Test Plan (SSTP) submitted to Michigan Department of Environment, Great Lakes and Energy dated October 26, 2023. Prior to sampling ESC Labs and Weyerhaeuser petitioned EGLE for several variances in testing that were originally planned in the SSTP. The variations included not running EPA Method 326 for MDI, the use of EPA Method 320 for determining moisture content on the EUPRESSLINE Biofilter, and utilizing section 8.6 of US EPA Method 2. This section was used to eliminate the use of US EPA Method 3A on EUPRESSLINE Biofilter. Section 8.6 of US EPA Method 2 states, " For processes emitting essentially air, an analysis need not be conducted: use a dry molecular weight of 29.0."

2.0 Summary of Results

2.1 Results Table

On November 28, 2023, ESC performed formaldehyde destruction efficiency testing on the EUPRESSLINE Biofilter at the Weyerhaeuser facility in Grayling, Michigan to determine compliance with EGLE Renewable Operating Permit No. MI-ROP-B7302-2016c, and provisions of the 40 CFR 60.

The summary of results from the testing compared to PCWP MACT limits are summarized in the table in the table below. Section 2.2 of the report contains all field data and calculated results for each run and the calculations used in this sampling program.

Results Table					
Weyerhaeuser					
Grayling, Michigan					
EUPRESSLINE Biofilter					
	Run #1	Run #2	Run #3	Average	Regulatory Limit
Sample Date	11/28/23	11/28/23	11/28/23		
Sample Time	1132-1237	1258-1358	1408-1508		
Stack Parameters - Inlet					
Flow, acfm	98,808.73	103,306.99	104,612.98	102,242.90	--
Flow, dscf/hr	5,021,744.47	5,243,249.74	5,315,147.87	5,193,380.69	--
Temperature, °F	130	129	129	129	--
Stack Parameters - Outlet					
Flow, acfm	98,893.99	102,565.09	105,868.07	102,442.38	--
Flow, dscf/hr	5,563,861.25	5,788,963.00	5,973,691.51	5,775,505.25	--
Temperature, °F	77	75	75	76	--
Formaldehyde - Inlet					
Concentration, ppmvd	10.11	12.67	11.96	11.58	--
Inlet mass, lbs/hr	3.96	5.18	4.96	4.70	--
Formaldehyde - Outlet					
Concentration, ppmvd	0.06	0.06	0.25	0.12	--
Emission rate, lbs/hr	0.03	0.03	0.12	0.06	1.0
Destruction Rate Efficiency					
Destruction rate efficiency, %	***99.34***	***99.47***	***97.62***	***98.81***	***90.0***

40 CFR part 63 subpart DDDD Table 1B allows facilities to demonstrate compliance in one of 6 ways.

(1) Reduce emissions of total HAP, measured as THC (as carbon)a, by 90 percent; or
(2) Limit emissions of total HAP, measured as THC (as carbon)a, to 20 ppmvd; or
(3) Reduce methanol emissions by 90 percent; or
(4) Limit methanol emissions to less than or equal to 1 ppmvd if uncontrolled methanol emissions entering the control device are greater than or equal to 10 ppmvd; or
(5) Reduce formaldehyde emissions by 90 percent; or
(6) Limit formaldehyde emissions to less than or equal to 1 ppmvd if uncontrolled formaldehyde emissions entering the control device are greater than or equal to 10 ppmvd.

Weyerhaeuser has elected to demonstrate compliance using option number five.

Per 63.2262 (g) all nondetect data (runs #1 and 2) must be reported as half of the method detection limit (MDL).

2.2 Data Summary

The following provides a detailed summary of the field data, calculated data, and calculations.

USEPA Method 320
Data Summary
Formaldehyde Destruction Rate Efficiency

Inlet		**Run #1**	**Run #2**	**Run #3**
	Identification:		EUPRESSLINE Biofilter Inlet	
	Date:	11/28/23	11/28/23	11/28/23
	Run Time:	1132-1237	1258-1358	1408-1508
C_{HCHO}	Formaldehyde concentration, ppmvw	9.98	12.46	11.78
B_{ws}	Water vapor in the gas stream, proportion by volume	0.0129	0.0163	0.0147
Q_{std}	Stack gas dry volumetric flow rate, dscf/hr	5,021,744.47	5,243,249.74	5,315,147.87
$C_{HCHO(dry)}$	Formaldehyde concentration, ppmvd	10.11	12.67	11.96
E_{HCHOIn}	Formaldehyde inlet mass, lbs/hr	3.96	5.18	4.96

Outlet		**Run #1**	**Run #2**	**Run #3**
	Identification:		EUPRESSLINE Biofilter Outlet	
	Date:	11/28/23	11/28/23	11/28/23
	Run Time:	1132-1237	1258-1358	1408-1508
C_{HCHO}	Formaldehyde concentration, ppmvw	0.06	0.06	0.08
B_{ws}	Water vapor in the gas stream, proportion by volume	0.0056	0.0055	0.0056
Q_{std}	Stack gas dry volumetric flow rate, dscf/hr	5,563,861.25	5,788,963.00	5,973,691.51
$C_{HCHO(dry)}$	Formaldehyde concentration, ppmvd	0.06	0.06	0.25
$E_{HCHOOut}$	Formaldehyde inlet mass, lbs/hr	0.03	0.03	0.12
DRE	***Destruction rate efficiency, %***	***99.34%***	***99.47%***	***97.62%***

USEPA Method 2
Data Summary
Volumetric Flow Rate

Inlet		**Run #1**	**Run #2**	**Run #3**
	Identification:		EUPRESSLINE Biofilter Inlet	
	Date:	11/28/23	11/28/23	11/28/23
	Start Time:	1155	1335	1425
	Stop Time:	1200	1340	1430
C_p	Pitot correction factor, dimensionless	0.840	0.840	0.840
$\sqrt{\Delta P}$	Average of the square roots of the pressure heads, in. H_2O	0.7059	0.7383	0.7477
D_s	Stack diameter, ft.	7.0000	7.0000	7.0000
T_s	Average stack temperature, °F	130	129	129
P_{bar}	Barometric pressure at sampling site, in. Hg	28.68	28.68	28.68
P_g	Stack static pressure, in. Hg	0.00	0.00	0.00
B_{ws}	Water vapor in the gas stream, proportion by volume	0.0129	0.0163	0.0147
M_d	Dry molecular weight of stack gasses, lb/lb-mole	29.0000	29.0000	29.0000
P_s	Absolute stack gas pressure, in. Hg	28.68	28.68	28.68
M_s	Wet molecular weight of stack gasses, lb/lb-mole	28.8577	28.8211	28.8383
A	Area of the stack, ft^2	38.4846	38.4846	38.4846
V_s	Velocity in the stack, ft/sec	42.7915	44.7395	45.3051
V_{acfm}	Velocity in the stack, acfm	98,808.73	103,306.99	104,612.98
Q_{std}	Stack gas dry volumetric flow rate, dscf/hr	5,021,744.47	5,243,249.74	5,315,147.87

USEPA Method 2
Data Summary
Volumetric Flow Rate

Outlet		**Run #1**	**Run #2**	**Run #3**
	Identification:		EUPRESSLINE Biofilter Outlet	
	Date:	11/28/23	11/28/23	11/28/23
	Start Time:	1145	1300	1440
	Stop Time:	1150	1305	1445
C_p	Pitot correction factor, dimensionless	0.840	0.840	0.840
$\sqrt{\Delta P}$	Average of the square roots of the pressure heads, in. H_2O	0.7416	0.7704	0.7951
D_s	Stack diameter, ft.	7.0000	7.0000	7.0000
T_s	Average stack temperature, °F	77	75	75
P_{bar}	Barometric pressure at sampling site, in. Hg	28.68	28.68	28.68
P_g	Stack static pressure, in. Hg	0.00	0.00	0.00
B_{ws}	Water vapor in the gas stream, proportion by volume	0.0056	0.0055	0.0056
M_d	Dry molecular weight of stack gasses, lb/lb-mole	29.0000	29.0000	29.0000
P_s	Absolute stack gas pressure, in. Hg	28.68	28.68	28.68
M_s	Wet molecular weight of stack gasses, lb/lb-mole	28.9388	28.9395	28.9389
A	Area of the stack, ft^2	38.4846	38.4846	38.4846
V_s	Velocity in the stack, ft/sec	42.8284	44.4182	45.8487
V_{acfm}	Velocity in the stack, acfm	98,893.99	102,565.09	105,868.07
Q_{std}	Stack gas dry volumetric flow rate, dscf/hr	5,563,861.25	5,788,963.00	5,973,691.51

2.3 Run 1 Calculations

Run 1 Calculations

Method 2

Absolute stack gas pressure (P_s), in. Hg = $P_{bar} + P_g$

where,

P_{bar} 28.68 = Barometric pressure at sampling site, in. Hg
P_g 0.00 = Stack static pressure, in. Hg
P_s 28.68 = Absolute stack gas pressure, in. Hg

Wet molecular weight of stack gasses (M_s), lb/lb-mole = $M_d(1 - B_{ws}) + 18.0B_{ws}$

where,

M_d 29.0000 = Dry molecular weight of stack gasses, lb/lb-mole
B_{ws} 0.0060 = Water vapor in the gas stream, proportion by volume
M_s 28.9340 = Wet molecular weight of stack gasses, lb/lb-mole

Area of stack (A), ft^2 = $\left(\frac{D_s}{2}\right)^2 \times 3.1416$

where,

D_s 7.0000 = Stack diameter or dimensions, ft
A 38.4846 = Area of stack, ft^2

Velocity in the stack (V_s), ft/sec =

$$85.49 C_p \sqrt{\Delta P_{avg}} \sqrt{\frac{460 + T_s}{P_s M_s}}$$

where,

C_p	0.84	= Pitot correction factor, dimensionless
$\sqrt{\Delta P}$	0.8899	= Average of the square roots of the pressure heads, in. H2O
T_s	77	= Average stack temperature, °F
P_s	28.68	= Absolute stack gas pressure, in. Hg
M_s	28.9340	= Wet molecular weight of stack gasses, lb/lb-mole
V_s	51.40	= Velocity in the stack, ft/sec

Velocity in the stack (V_{acfm}), acfm =

$$60 \times A \times V_s$$

where,

A	38.4846	= Area of stack, ft^2
V_s	51.40	= Velocity in the stack, ft/sec
V_{acfm}	118,677.55	= Velocity in the stack, acfm

Stack gas dry volumetric flow rate (Q_{std}), dscf/hr =

$$3600\left(1 - B_{ws}\right)V_s A\left[\frac{528}{460 + T_s} \times \frac{P_s}{29.92}\right]$$

where,

B_{ws}	0.0060	= Water vapor in the gas stream, proportion by volume
V_s	51.40	= Velocity in the stack, ft/sec
A	38.4846	= Area of stack, ft^2
T_s	77	= Average stack temperature, °F
P_s	28.68	= Absolute stack gas pressure, in. Hg
Q_{std}	6,673,789.01	= Stack gas dry volumetric flow rate, dscf/hr

Method 320

Inlet Formaldehyde concentration (C), ppmvd = $\left(\frac{C}{1 - B_{ws}}\right)$

where,

C_{HCHO}	9.98	= Average formaldehyde concentration indicated by the gas analyzer, ppmvw
B_{ws}	0.0129	= Water vaport in the gas stream indicated by the gas analyzer, unitless
C_{HCHOIn}	10.11	= Formaldehyde concentration, ppmvd

Inlet Formaldehyde emission rate (HCHO), lbs/hr $\frac{C_{nox}\ x\ 30.031\ x\ Q_{std}}{385.1E06}$

where,

C_{HCHO}	10.11	= Formaldehyde concentration, ppmvd
Q_{std}	5,021,744.47	= Stack gas dry volumetric flow rate, dscf/hr
E_{HCHOIn}	3.96	= Formaldehyde emission rate, lbs/hr

Outlet Formaldehyde concentration (C), ppmvd = $\left(\frac{C}{1 - B_{ws}}\right)$

where,

C_{HCHO}	0.06	= Average formaldehyde concentration indicated by the gas analyzer, ppmvw
B_{ws}	0.006	= Water vaport in the gas stream indicated by the gas analyzer, unitless
$C_{HCHOOut}$	0.06	= Formaldehyde concentration, ppmvd

Outlet Formaldehyde emission rate (HCHO), lbs/hr $\frac{C_{nox}\ x\ 30.031\ x\ Q_{std}}{385.1E06}$

where,

C_{HCHO}	0.06	= Formaldehyde concentration, ppmvd
Q_{std}	5,563,861.25	= Stack gas dry volumetric flow rate, dscf/hr
$E_{HCHOOut}$	0.03	= Formaldehyde emission rate, lbs/hr

Destruction rate efficiency (DRE), % = $1 - \frac{E_{HCHOIn}}{E_{HCHOOut}} x100$

where,

E_{HCHOIn}	3.96	= Formaldehyde emission rate as carbon, lbs/hr
$E_{HCHOOut}$	0.03	= Formaldehyde inlet mass as carbon, lbs/hr
DRE	99.34%	= Destruction rate efficiency, %

3.0 Facility and Sampling Location Descriptions

3.1 Process Description and Operation

Weyerhaeuser manufactures oriented-strand board (OSB) at its facility in Grayling, Michigan. Wood logs are sorted by species and stored in the wood yard. Logs are transferred to heated vats to clean and thaw (in winter months) the wood. The wood logs are conveyed from the vats to a debarking machine that removes the other layers of the logs. A ring-strander cuts the logs into thin wood chips (strands). The strands are conveyed to a storage bin where they are fed into four wood-fired dryers. The dryers remove moisture from the strands to product-specific content. The strands exit the dryers and are sorted according to size using shaker screens.

The fine strands are collected and used as fuel in the dryers and RTOs. The larger strands are conveyed to a blending area where wax and resins are added for adhesion purposes. The strands are then layered, at different angles for strength, onto an 8-foot-wide conveyor belt. The layered strands are cut into 8-foot-by-24-foot sections and formed into mats. The mats are stacked and the press is used to heat and compact the strands to form OSB. Depending on the thickness of the product (i.e.,7/16 or 3/8 inch) up to 16 mats can be compacted in less than 4 minutes. The OSB is cut, labeled, and prepared for shipment.

As part of the manufacturing process, emissions are generated by wood debarking and stranding, conveyance, drying, binding, pressing, milling, and painting (sides of wood). Weyerhaeuser operates pollution control equipment to control the discharge of pollutants to the atmosphere. The biofilter, wet electrostatic precipitator (WESP), and RTOs control emissions from the drying and pressing operations.

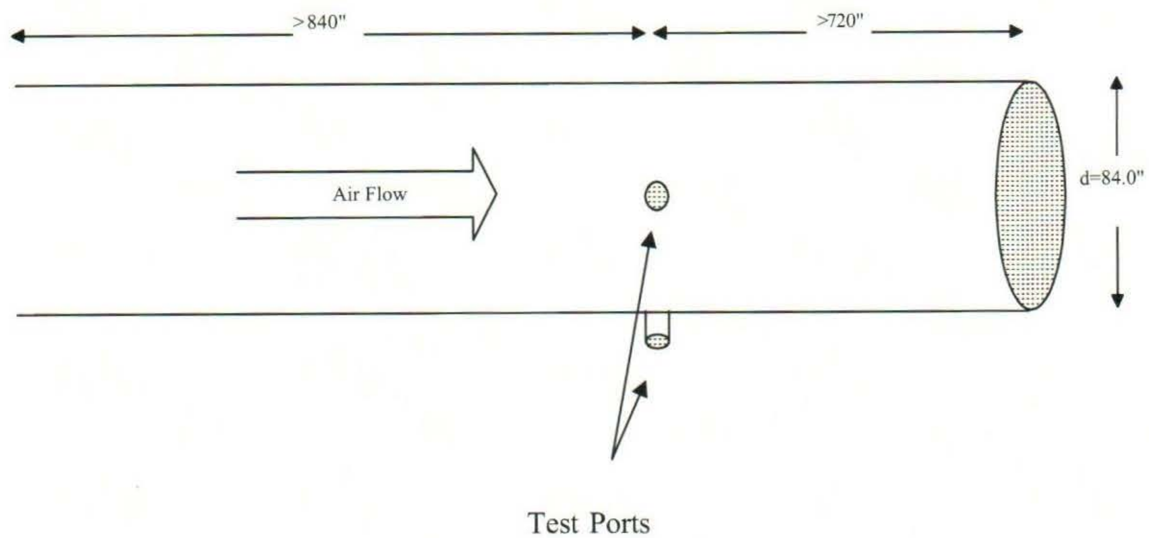
The VOC CERMS installed on the EUPRESSLINE Biofilter, and the VOC and CO CERMS and COMS on the FGDRYERS RTO exhaust stacks are used to evaluate continuous compliance with permit limits.

The pages included in Section 3.4 of this report detail the production/throughput data maintained by the facility during the testing program, which were provided to ESC after the completion of the sampling event.

3.2 Flue Gas Sampling Locations

Gas stream sampling was conducted in accordance with U.S. EPA Method 1 for the sources tested. Attached in Section 3.3 are the schematics of the sampling locations and traverse points that provide a representative sample of the sources.

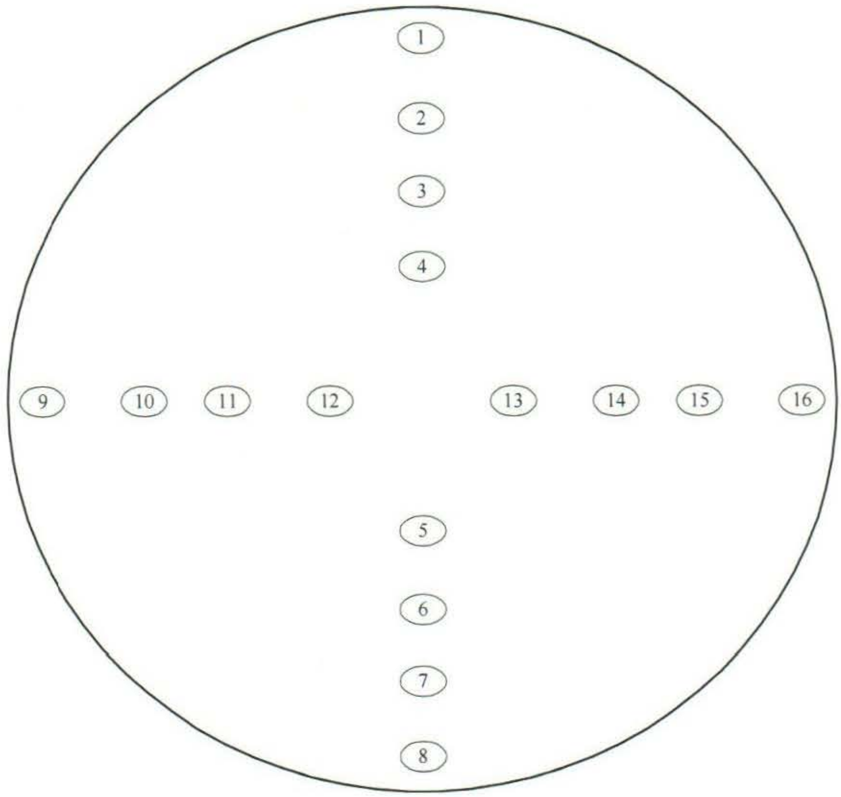
3.3 Stack Schematics



Weyerhaeuser - Grayling, MI

EUPRESSLINE Biofilter Inlet

Side View

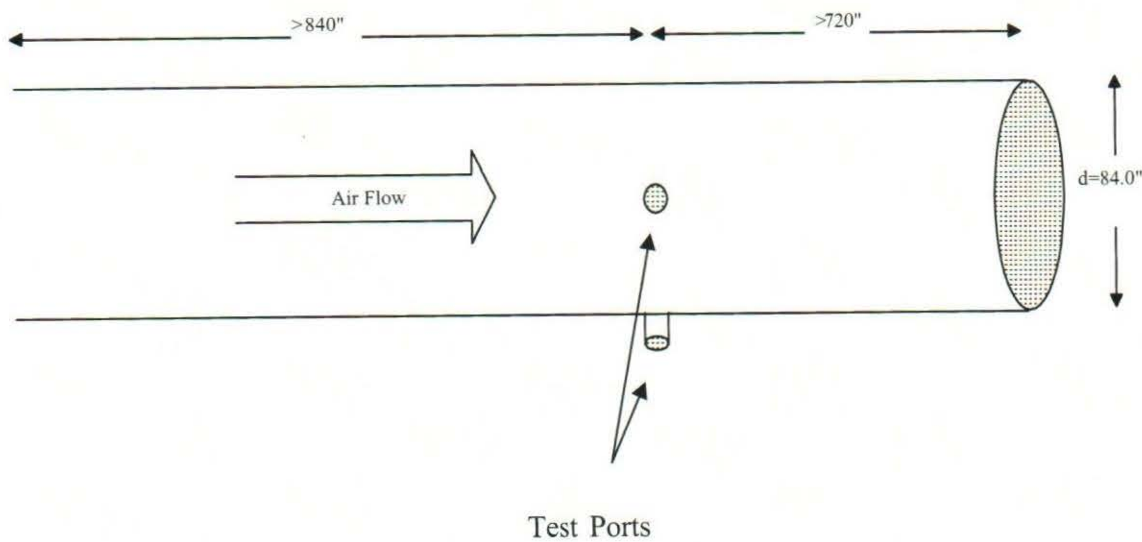


Sample Point	Location
1 and 9	5.7"
2 and 10	11.8"
3 and 11	19.3"
4 and 12	30.1"
5 and 13	59.9"
6 and 14	70.7"
7 and 15	78.2"
8 and 16	84.3"

Weyerhaeuser - Grayling, MI

EUPRESSLINE Biofilter Inlet

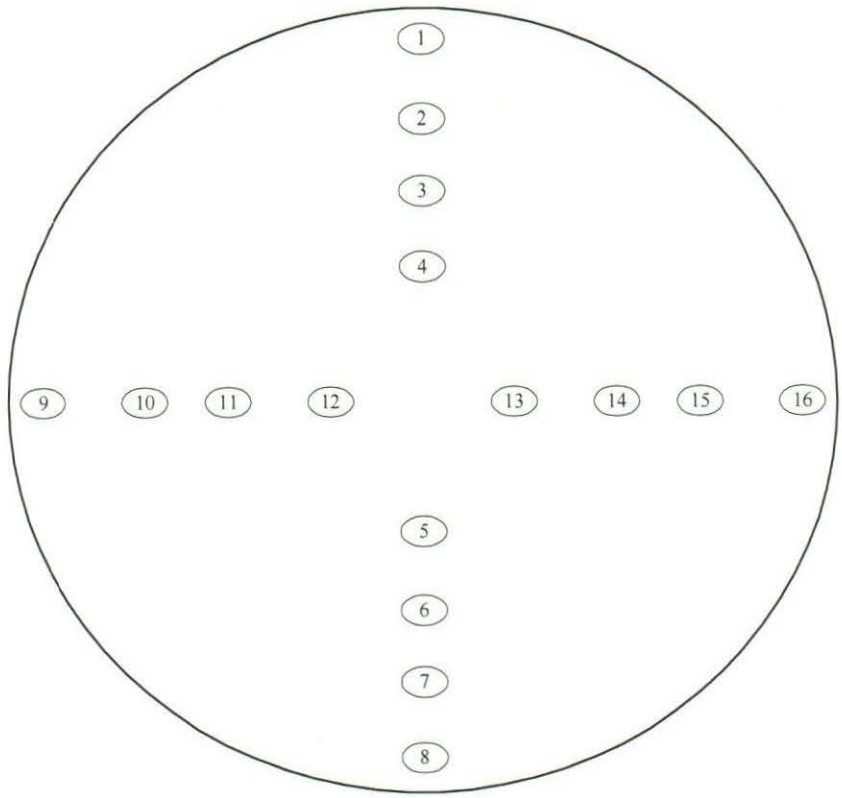
Sample Points



Weyerhaeuser - Grayling, MI

EUPRESSLINE Biofilter Outlet

Side View



Sample Point	Location
1 and 9	5.7"
2 and 10	11.8"
3 and 11	19.3"
4 and 12	30.1"
5 and 13	59.9"
6 and 14	70.7"
7 and 15	78.2"
8 and 16	84.3"

Weyerhaeuser - Grayling, MI

EUPRESSLINE Biofilter Outlet

Sample Points