

**To:** Aaron Manley, Olympic Region Clean Air Agency  
**cc:** Michael Nolan and Christine Yanik, Weyerhaeuser NR Company  
**From:** Beth Ryder and Maddie Coates, Trinity Consultants  
**Date:** February 14, 2024  
**RE:** Weyerhaeuser Raymond NOC Application Addendum (23NOC1614) – Arsenic Emission Factor

Weyerhaeuser NR Company (Weyerhaeuser) is requesting an update to the proposed emission factor associated with arsenic emissions from the Notice of Construction (NOC) application #23NOC1614 associated with the direct-fired continuous dry kiln (CDK) at the Raymond facility (the "Facility").

Arsenic emissions are dependent on (1) the fuel used to create the heat for the kiln, and (2) the process of producing the heat. Metals, including arsenic, are not destroyed, or created in a combustion or gasification process. The originally submitted emission factor for arsenic was determined by National Council for Air and Stream Improvement (NCASI) Technical Bulletin 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions (March 2023). There is no known dataset of arsenic emissions associated with a gasification process or CDK. The combustion process occurring in a wood fired boiler and the gasification process occurring in the proposed CDK burner have some important differences that may lead to these values being overly conservative.

The gasification burner system generates combustible gases from cooking the green sawdust in a low oxygen environment. In stage one, the sawdust is delivered to the top of a sloped grate in a chamber and heated as it travels down the grate. This stage is completed in a low oxygen environment, and no combustion occurs on the grate. The green sawdust can reach temperatures between 300 – 1,000°F with higher temperature expected toward the grate and lower temperature on the outlet side of the pile. Temperatures over 800°F are not as energy efficient and are expected to be adjusted using burner operator controls. A byproduct of the process is leftover char, which is collected in a water basin and removed from the gasifier. The char contains additional heat content that is un-combusted. The wood gas that is produced travels up to a separate chamber for stage two. Oxygen is added to the combustible gases created from the green sawdust and combusted to create the heat necessary for the CDK drying process.

Arsenic is inherent in the green sawdust used in the gasifier; high heat and oxygen cause the arsenic to volatilize and/or oxidize and escape from the wood. Higher heat causes increased volatilization.<sup>1</sup> Because this process includes the gasification of wood which brings wood to a lower internal temperature compared to wood combustion and in a reduced oxygen environment, emission factors for wood-fired boilers are conservative for estimating emissions from the CDK.

Weyerhaeuser completed stack testing on the existing hog fuel boiler (EU1) in 2009. The CDK is expected to use a similar fuel type as the existing hog fuel boiler. Therefore, emissions from this boiler are representative of relative emissions associated with the specific fuel type. As such, Weyerhaeuser would like to propose the use of this stack test data to create a linear relationship between particulate matter less than 10 micron (PM<sub>10</sub>) and arsenic emissions. Based on data from a study published in The Journal of

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<sup>1</sup> This is further demonstrated by the fact that arsenic emissions are not listed for indirect fired kilns.

Environmental Sciences in 2018<sup>2</sup>, there is a direct correlation between arsenic and PM emissions. Air samples near industrial activity in several cities in China were taken and the samples were analyzed for heavy metal concentrations. Approximately 73% of the measured arsenic was in the “fine mode” (1.1-2.1 micron) while the remaining 27% was in the “coarse mode” (9-10 micron). While the majority of arsenic was found in the mode that would classify as PM<sub>2.5</sub>, the proposed method applies a linear ratio of arsenic to PM<sub>10</sub>; this ratio is calculated using the 2009 stack test on the hog fuel boiler at the Raymond Mill. The stack test can be found in Attachment A and the ratio calculation can be found in Attachment B.

To account for the differences in a combustion process verses the CDK gasification burner, the arsenic to PM<sub>10</sub> ratio is applied to the CDK PM<sub>10</sub> emission factor from the “EPD Recommended Emission Factors for Lumber Kiln Permitting in Georgia.” This factor uses total annual throughput in million board feet (MMBF) to determine emissions from both combustion and drying but does not include emissions from startup and idling. A combustion emission factor for wood-fired boilers with wet scrubber control technology from NCASI Technical Bulletin 1013<sup>3</sup> will still be used for the expected startup and idling emissions. Updated emission calculations can be found in Attachment C.

**Table 1. Arsenic Emissions**

Normal Operation			Startup/Idling			Total CDK
lb/MMBF	lb/hr	tpy	lb/MMBtu	lb/hr	tpy	tpy
5.34E-03	1.97E-04	8.27E-04	1.01E-05	5.05E-04	9.09E-05	9.18E-04

The update to the emission calculations did not change the facility wide total reported hazardous air pollutant (HAP) emission rate of 21.68 tpy. The updated emission calculations, along with the project-netting from the removal of the hog fuel boiler and batch kilns, emissions from arsenic for the project are above the small quantity emission rate (SQER) but modeled concentrations are below the acceptable source impact level (ASIL) as shown in Table 1 below. Updated arsenic models can be found in Attachment D.

**Table 2. Arsenic Modeling Results**

Averaging Period	ASIL (µg/m <sup>3</sup> )	Modeled Concentration	Exceeds ASIL?
Annual	0.0003	0.00022	No

Impacts from these updated arsenic emission calculations will also carry over into the Tier II Health Impact Assessment (HIA). Therefore, an updated Tier II HIA will be submitted under separate cover.

<sup>2</sup> “Size Distribution and Source of Heavy Metals in Particulate Matter on the Lead and Zinc Smelting Affected Area” published in the Journal of Environmental Sciences, April 2018.

<sup>3</sup> NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions, Table 4.3: Summary of Trace Metal Emissions from Wood-Fired Boilers

## **Attachment A**

### **2009 Raymond Mill Hog Fuel Boiler Stack Test**



# **The Avogadro Group, LLC**

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## **SOURCE TEST REPORT 2009 TOXICS AIR CONTAMINANTS TESTS WEYERHAEUSER NR RAYMOND MILL RAYMOND, WASHINGTON**

Prepared For:

**Weyerhaeuser NR**  
Federal Way, Washington

For Submittal To:

**Olympic Region Clean Air Agency**  
Olympia, Washington

and

**United States Environmental Protection Agency**  
Region 10: Seattle, Washington

Prepared By:

Shawn Nelezen

**The Avogadro Group, LLC**

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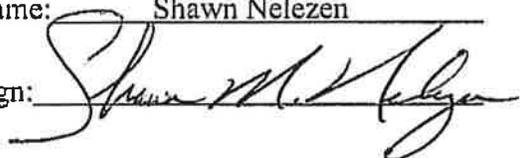
3003 SW 153<sup>rd</sup> Dr., Ste. 215  
Beaverton, Oregon 97006  
(503) 658-2091

October 14, 2009

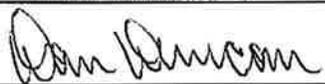


## REVIEW AND CERTIFICATION

All work, calculations, and other activities and tasks performed and documented in this report were carried out by me or under my direction and supervision.

Name: Shawn Nelezen Title: Client Account Manager  
Sign:  Date: October 14, 2009

I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. The presented material is authentic and accurate to the best of my knowledge.

Name: Dan Duncan Title: Operations and IT Director  
Sign:  Date: 10/15/09

Initials \_\_\_\_\_

Initials \_\_\_\_\_



## SUMMARY INFORMATION

### Source and Contact Information

Source Location: Weyerhaeuser NR Raymond Sawmill  
51 Ellis Street  
Raymond, Washington 98577

Plant Contact: Sylvia Markham Lois Nadolny  
Title: Environmental Coordinator Mill Manager  
Telephone: (360) 942-6305 (360) 942-6301

Regulatory Agency: Olympic Region Clean Air Agency (ORCCA)  
Contacts: Gordon Lance Mike Shults  
Addresses: 2940-B Limited Lane NW 301 Ocean Avenue  
Olympia, Washington 98502 Raymond, Washington 98577  
Telephone: (800) 422-5623 (360) 789-3652

Sampling Location: 115 MMBtu/hr Hog Fueled Boiler (EU1) exhaust stack

Purpose: The purpose of this test program was to determine emissions of Hazardous Air pollutants (HAPs) as required by an EPA Information Collection Request (ICR). Some test results were used to determine compliance with the mill's Title V Permit No. 04AOP387 issued by ORCAA.

Test Methods: EPA 1, 2, 3A, 4, 6C, 7E, 10, 19, 23, 25A/18, 26, 29, OTM-027, OTM-028 and CARB 430

Test Dates: August 11-13, 2009

### Testing Company Information

Testing Firm: The Avogadro Group, LLC  
2825 Verne Roberts Circle  
Antioch, California 94509

Contact: Mr. Shawn Nelezen Mr. Kevin Donahoe  
Client Account Manager Portland District Manager

Telephone: (925) 680-4397 (503) 658-2091  
Facsimile: (925) 429-9052 (503) 427-1153



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## SECTION 1.0

### INTRODUCTION

The Avogadro Group, LLC (Avogadro) was contracted by Weyerhaeuser NR (Weyerhaeuser) to perform a series of emission tests at the Raymond Saw Mill in Raymond, Washington. The purpose of the test program was to determine emissions of hazardous air pollutants (HAPs) as required by an Environmental Protection Agency (EPA) Information Collection Request (ICR). Some test results are intended to determine compliance with the mill's Title V Permit No. 04AOP387 issued by the Olympic Region Clean Air Agency (ORCAA).

Avogadro provided the personnel and the necessary test equipment, and subcontracted the laboratory analyses of the samples. The tests were performed during the week of August 10, 2009 by Kevin Donahoe, David Ramirez, and Jacob Byrne of Avogadro. Sylvia Markham and Ken Nichols of Weyerhaeuser coordinated the testing program. Mr. Gordon Lance of ORCAA was present to observe portions of the test program. All of the emissions tests were conducted during normal operating conditions and were performed to determine the following parameters:

- Oxides of nitrogen (NO<sub>x</sub>), carbon monoxide (CO) and sulfur dioxide (SO<sub>2</sub>)
- Dioxins and furans (PCDD/PCDF)
- Total hydrocarbons (THC) and methane (CH<sub>4</sub>)
- Formaldehyde
- Particulate matter:
  - Total particulate matter (TPM)
  - Condensable particulate matter (CPM)
  - Filterable particulate matter:
    - Particulate matter >10µm in diameter
    - Particulate matter <10µm in diameter (PM<sub>10</sub>)
    - Particulate matter <2.5µm in diameter (PM<sub>2.5</sub>)
- Trace select metals (TSM)
- Hydrogen chloride and hydrogen fluoride (HCl/HF)
- Stack gas volumetric flow rate and moisture content
- Oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>)

The final results of the testing program are presented in this report. Supporting data includes descriptions of the scope of work, the sampling and traverse point locations, the testing and analytical procedures, the laboratory reports, the field data sheets, calculations, and quality assurance procedures.



## 1.1 TEST RESULT SUMMARIES

The results of the testing program are summarized in Tables 1-1 through 1-4. Section 6.0 presents detailed results for individual test runs. All supporting data is included in the appendices.

**TABLE 1-1  
 SUMMARY OF AVERAGE TEST RESULTS  
 HOG FUEL BOILER EXHAUST STACK  
 WEYERHAEUSER RAYMOND SAW MILL  
 AUGUST 11-13, 2009**

Test Parameter	Average
<b>Filterable Particulate Matter (F<sub>1/2</sub> PM):</b>	
gr/dscf @ 7% O <sub>2</sub>	0.00062
lb/hr	0.079
<b>Particulate Matter &gt;10 µm (&gt;PM<sub>10</sub>):</b>	
gr/dscf @ 7% O <sub>2</sub>	0.00044
lb/hr	0.059
<b>Particulate Matter &gt;2.5 and &lt;10 µm:</b>	
gr/dscf @ 7% O <sub>2</sub>	0.00021
lb/hr	0.028
<b>Total Particulate Matter &lt;2.5 µm (PM<sub>2.5</sub>):</b>	
gr/dscf @ 7% O <sub>2</sub>	0.00028
lb/hr	0.038
<b>Condensable Particulate Matter (CPM):</b>	
gr/dscf @ 7% O <sub>2</sub>	0.00097
lb/hr	0.132
<b>Hydrogen Chloride (HCl):</b>	
ppm @ 7% O <sub>2</sub> as HCl	< 0.062
g/s	< 1.7E-03
lb/hr	< 5.4E-03
<b>Hydrogen Fluoride (HF):</b>	
ppm @ 7% O <sub>2</sub> as HF	< 0.116
g/s	< 1.7E-03
lb/hr	< 5.6E-03

- (1) The non-detection (ND<) notation indicates the species was not detected in any sample or sample fraction.
- (2) The less than (<) notation indicates a species was detected in at least one (but not all) samples or fractions.
- (3) The PM results presented above are blank-corrected in accordance with CARB Method 5.
- (4) HCl and HF results are not blank-corrected in accordance with EPA Method 26.



**TABLE 1-2**  
**SUMMARY OF AVERAGE TEST RESULTS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAW MILL**  
**AUGUST 11-13, 2009**

Test Parameter	Average
<b>Arsenic</b>	
μg/dscm @ 7% O <sub>2</sub>	ND< 0.203
lb/MMBtu	ND< 1.76E-07
<b>Beryllium</b>	
μg/dscm @ 7% O <sub>2</sub>	ND< 0.101
lb/MMBtu	ND< 8.76E-08
<b>Cadmium</b>	
μg/dscm @ 7% O <sub>2</sub>	< 0.139
lb/MMBtu	< 1.21E-07
<b>Cobalt</b>	
μg/dscm @ 7% O <sub>2</sub>	0.119
lb/MMBtu	1.03E-07
<b>Chromium</b>	
μg/dscm @ 7% O <sub>2</sub>	0.774
lb/MMBtu	6.71E-07
<b>Manganese</b>	
μg/dscm @ 7% O <sub>2</sub>	15.24
lb/MMBtu	1.32E-05
<b>Nickel</b>	
μg/dscm @ 7% O <sub>2</sub>	0.815
lb/MMBtu	7.06E-07
<b>Mercury</b>	
μg/dscm @ 7% O <sub>2</sub>	< 2.063
lb/MMBtu	< 1.32E-08
<b>Lead</b>	
μg/dscm @ 7% O <sub>2</sub>	0.234
lb/MMBtu	2.03E-07
<b>Phosphorus</b>	
μg/dscm @ 7% O <sub>2</sub>	26.79
lb/MMBtu	2.32E-05
<b>Antimony</b>	
μg/dscm @ 7% O <sub>2</sub>	ND< 0.203
lb/MMBtu	ND< 1.76E-07
<b>Selenium</b>	
μg/dscm @ 7% O <sub>2</sub>	0.425
lb/MMBtu	3.68E-07



**TABLE 1-3**  
**SUMMARY OF AVERAGE TEST RESULTS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAW MILL**  
**AUGUST 11-13, 2009**

<b>Test Parameter</b>	<b>Average</b>
<b>Sulfur Dioxide (SO<sub>2</sub>)</b>	
ppm volume dry	0.33
ppm @ 7% O <sub>2</sub>	0.44
lb/hr	0.07
<b>Oxides of Nitrogen (NO<sub>x</sub>)</b>	
ppm volume dry	97.18
ppm @ 7% O <sub>2</sub>	128.34
lb/hr as NO <sub>2</sub>	15.67
<b>Carbon Monoxide (CO)</b>	
ppm volume dry	148.82
ppm @ 7% O <sub>2</sub>	200.20
lb/hr	14.73
<b>Total Hydrocarbons (THC)</b>	
ppm volume dry as C <sub>3</sub> H <sub>8</sub>	< 1.39
ppm @ 7% O <sub>2</sub> as C <sub>3</sub> H <sub>8</sub>	< 1.84
lb/hr as C <sub>3</sub> H <sub>8</sub>	< 1.65
<b>Methane (CH<sub>4</sub>)</b>	
ppm volume dry	2.08
ppm @ 7% O <sub>2</sub>	2.70
lb/hr	0.116



**TABLE 1-4**  
**SUMMARY OF AVERAGE TEST RESULTS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAW MILL**  
**AUGUST 11-13, 2009**

<b>Test Parameter</b>	<b>Average</b>
<b>Total Dioxins / Furans</b>	
ng/dscm @ 7% O <sub>2</sub>	0.032
ng/dscm @ 12% CO <sub>2</sub>	0.029
lb/hr	2.07E-09
<b>Dioxins / Furans –EPA Toxic Equivalent</b>	
ng/second	1.98E-03
<b>Formaldehyde</b>	
ppm volume dry	0.055
ppm @ 7% O <sub>2</sub>	0.072
lb/hr	5.76E-03

## 1.2 TESTING CONTRACTOR

Avogadro is a source testing and consulting firm specializing in combustion-generated air pollution emissions, emission measurement, emission control devices, continuous emission monitoring systems and regulatory affairs. Avogadro possesses technical expertise for a variety of stationary combustion and industrial process device types. These include utility and industrial boilers, simple and combined-cycle turbines, asphalt plants, cement kilns, flares, incinerators, oxidizers, drying ovens, and a variety of other specialized process equipment. Avogadro is certified by the California Air Resources Board (CARB) under their Independent Contractor program to conduct emission testing pursuant to Section 91200-21220, Title 17, California Code of Regulations.

Avogadro provided a professional source test team to conduct the testing as described in this report. The test team members assigned to this project have performed hundreds of similar tests in the past and are familiar with the specific testing methods and laboratory procedures used in this program. The Avogadro personnel who participated in this project are listed in Table 1-5.



**TABLE 1-5  
AVOGADRO TEST PROGRAM PERSONNEL  
WEYERHAEUSER RAYMOND SAW MILL**

<b>PERSONNEL</b>	<b>TITLE</b>	<b>ASSIGNMENT</b>	<b>EXPERIENCE</b>
Kevin Crosby	Scientist IV	QA Officer	32 years
Dan Duncan	Engineer IV	Chemical Engineer	22 years
Shawn Nelezen	Scientist III	Principal in Charge	11 years
Kevin Donahoe	Scientist II	Project Manager	6 years
Robert Odell	Technician III	Field Support	4 years

Mr. Shawn Nelezen was Principal in Charge for the test program at Weyerhaeuser. Shawn's responsibilities included overseeing the execution and planning of all air sampling efforts including reporting and project coordination. Shawn's primary objective was to ensure that the results generated by this test program met the expectations and requirements of Weyerhaeuser and the regulatory agencies.

Mr. Kevin Crosby was the Quality Assurance Officer for the project. He reviewed and validated all test results, lab analyses, and the final report. Kevin has managed or conducted hundreds of toxics tests over his career. A summary of our standard QA / QC program is presented Section 6.0 and in Appendix B.

Mr. Dan Duncan was the Chemical Engineer for this project. Dan's responsibilities included glassware cleaning and preparation, laboratory supply ordering and coordination with the subcontract laboratories. He assumed sample custody and ensured that the proper paperwork and samples reached the subcontract laboratories, ensured that the samples were analyzed according to the test report, and ensured that both the field and laboratory efforts comply with EPA approved procedures.

### **1.3 PROGRAM CONTACTS**

The contact persons for the various entities involved in the testing project are:

- Avogadro Group, LLC: Shawn Nelezen Principal in Charge (925) 680-4397 Kevin Donahoe Project Manager (503) 658-2091
- Weyerhaeuser: Ms. Sylvia Markham Environmental Coordinator (360) 942-6305
- ORCAA / EPA: Gordon Lance Engineer II (800) 422-5623 James Eddinger Engineer (919) 541-5426



## SECTION 2.0

### FACILITY INFORMATION

#### 2.1 PROCESS DESCRIPTION

Weyerhaeuser maintains offices or operations in 13 countries and manages 22 million acres of timberland. The Weyerhaeuser Raymond sawmill is located at 51 Ellis St. in Raymond, Washington. At the site, Weyerhaeuser operates a high-speed planer mill and dries and finishes softwood for use in home and commercial construction in the Midwest and Puget Sound. Much of the residuals from the debarking process and sawmill are conveyed to a Wellons boiler for fuel.

#### 2.2 SAMPLING LOCATION

The Hog Fuel Boiler emissions exhaust through a vertical duct 64 inches in diameter. The stack has two 4-inch diameter sampling ports located on the same horizontal plane. A third sampling port is located about two feet below and between the test ports. The ports are located approximately 2 stack diameters upstream and 2.5 stack diameters downstream from the nearest flow disturbances. A total of twenty-four traverse points were used during each isokinetic test run. All tests were performed downstream of the control equipment, an electrostatic precipitator (ESP). The test ports were accessible from a platform reached by stairs.

Avogadro personnel measured the dimensions of the stack prior to testing. A diagram of the sampling ports is included in the appendix of this report along with the traverse point locations.



## SECTION 3.0

### TEST PROGRAM DESCRIPTION

#### 3.1 PROGRAM OBJECTIVES

On September 13, 2004, the United States Environmental Protection Agency (EPA) promulgated the National Emission Standards for Hazardous Air Pollutants (NESHAPS) for Industrial, Commercial and Institutional Boilers also called the "Boiler MACT." These rules, which are referred to as the Maximum Achievable Control Technology Standards, established emission limits and monitoring requirements for sources considered major under the NESHAP regulations. Major sources are those that emit or have the potential to emit at least 10 tons per year of any single hazardous air pollutant (HAP) or 25 tons per year of any combination of HAPs. Also included are standards for plants that are classified as area sources. Area sources are stationary sources of HAPs that are not major. The Boiler MACT was vacated by the courts on June 8, 2007.

To address the vacated Boiler MACT, EPA made an Information Collection Request (ICR) to the Office of Management and Budget. The objective was to collect available data on boiler process and heater design, operations, fuels, control devices and emissions data. EPA found that fuel and material type, combustor design, and emission control device impact hazardous air pollutants (HAP) emissions.

The purpose of this test program was to assist EPA in completing data gaps in fuel type and combustor design regarding the ICR study. This test program included measurements of the emissions of toxic air contaminants as outlined in this protocol. Some of the tests were performed to determine compliance with Weyerhaeuser Raymond's Title V Permit No. 04AOP387 issued by the ORCAA.

#### 3.2 TEST CONDITIONS

The tests were conducted while the boiler was operating under normal conditions, as required by the EPA. The emission limitations are referenced in Table 3-1.



**TABLE 3-1  
 PERMITTED EMISSION LIMITATIONS  
 2009 EMISSIONS TEST PROGRAM  
 WEYERHAEUSER RAYMOND MILL**

Pollutants	Permit Reference	Emission Limits
<b>Oxides of Nitrogen (NO<sub>x</sub>)</b> concentration, ppm @ 7% O <sub>2</sub>	Table 5-1, Condition 5.1K	175
<b>Carbon Monoxide (CO)</b> concentration, ppm @ 7% O <sub>2</sub>	Table 5-1, Condition 5.1L	300
<b>Sulfur Dioxide (SO<sub>2</sub>)</b> concentration, ppm @ 7% O <sub>2</sub>	Table 5-1, Condition 5.1A	1,000
<b>Visible Emissions</b> percent, 3-min. aggregate in 60 min.	Testing conditions 19, 20	20
<b>Particulate Matter (PM)</b> concentration, gr/dscf @ 7% O <sub>2</sub>	Table 5-1, Conditions 5.C-D	0.20
mass emissions, lb/MMBtu	Table 5-1, Condition 5.1H	0.10

### 3.3 TEST CALCULATIONS

The test run durations for the toxic air contaminants were selected based on the requirements of a test notification letter and attachments dated June 1, 2009 from Peter Tsirigotis, Director of EPA Sector Policies and Programs Division. General calculations are included in Appendix F.

### 3.4 LABORATORY ANALYSIS

Avogadro's in-house laboratory conducted the front and back-half gravimetric analysis on the PM samples and methane analysis. Three professional analytical laboratories provided services for this project. The laboratories chosen are established leaders in development and performance of the reference methods for which they performed analyses. These laboratories are listed below along with the species they analyzed:

- Vista Analytical Laboratory                      PCDD/PCDF
- Test America    Trace metals, HCl/HF
- Atmospheric Analysis & Consulting              Formaldehyde



### 3.5 TEST PROGRAM SCHEDULE

The testing program was completed in four days. The first day consisted of travel and equipment set-up. Emission tests were conducted on the subsequent three days. The test program schedule is presented in Table 3-2.

**TABLE 3-2  
 TEST PROGRAM SCHEDULE  
 WEYERHAEUSER RAYMOND SAWMILL**

DATE	ACTIVITY	SAMPLE RUNS	SAMPLING DURATION
Monday August 10, 2009	Travel	--	--
	Set-up equipment	--	--
<u>Emissions Tests</u>			
Tuesday August 11, 2009	O <sub>2</sub> , CO <sub>2</sub>	1, 2 of 3	240 minutes
	Trace metals w/filterable PM	1, 2 of 3	240 minutes
	HCl and HF	1, 2 of 3	240 minutes
	PM	1, 2 of 3	240 minutes
<u>Emissions Tests</u>			
Wednesday August 12, 2009	O <sub>2</sub> , CO <sub>2</sub>	3 of 3	240 minutes
	Trace metals w/filterable PM	3 of 3	240 minutes
	HCl and HF	3 of 3	240 minutes
	PM	3 of 3	240 minutes
	O <sub>2</sub> , CO <sub>2</sub> , CO, NO <sub>x</sub> , SO <sub>2</sub>	1 of 3	240 minutes
	THC, CH <sub>4</sub>	1 of 3	240 minutes
	Formaldehyde	1 of 3	240 minutes
	PCDD/PCDF	1 of 3	240 minutes
<u>Emissions Tests</u>			
Thursday August 13, 2009	O <sub>2</sub> , CO <sub>2</sub> , CO, NO <sub>x</sub> , SO <sub>2</sub>	2, 3 of 3	240 minutes
	THC, CH <sub>4</sub>	2, 3 of 3	240 minutes
	Formaldehyde	2, 3 of 3	240 minutes
	PCDD/PCDF	2, 3 of 3	240 minutes



## **SECTION 4.0**

### **TEST PROCEDURES**

Avogadro used a mobile laboratory on site for the purposes of this testing program. The mobile lab was equipped with a flammable liquid storage cabinet and a sample storage refrigerator, as well as the CEM system. There was sufficient room to work in the mobile lab with spacious counter tops for sample recovery, calculation of results and completion of the sample chain of custody forms. Samples were stored and refrigerated in a designated locked area under strict chain of custody guidelines.

#### **4.1 PRIMARY EMISSIONS TESTS**

The test procedures used by Avogadro in this testing program are summarized in Table 4-1 on the following page. Descriptions of standard procedures are included in Appendix A. Additional information on specific applications or modifications to standard procedures is presented in the following sub-sections. Where any conflicts exist in the descriptions, the specific descriptions here in Section 4.1 will take precedence.



**TABLE 4-1  
 TEST METHODS AND PROCEDURES  
 2009 EMISSIONS TEST PROGRAM  
 WEYERHAEUSER RAYMOND SAW MILL**

TEST PARAMETER	REFERENCE METHOD	ANALYTICAL APPROACH	DETECTION LIMIT
O <sub>2</sub>	EPA 3A	Paramagnetism	<2% of full scale
CO <sub>2</sub>	EPA 3A	Non-dispersive infrared	<2% of full scale
NO <sub>x</sub>	EPA 7E	Chemiluminescence	<2% of full scale
SO <sub>2</sub>	EPA 6C	Ultraviolet absorption	<2% of full scale
CO	EPA 10	Gas filter correlation	<2% of full scale
Volumetric flow rate	EPA 1, 2	Pitot traverse	--
	EPA 19	Stoichiometric calculation	--
Moisture content	EPA 4	Impinger weight gain	--
THC	EPA 25A	Flame ionization detection	<2% of full scale
CH <sub>4</sub>	EPA 18	Gas chromatograph	0.1 ppm
Formaldehyde	CARB 430	HPLC	~0.5 ug/ m <sup>3</sup>
PCDD/PCDF <sup>1</sup>	EPA 23	HRGC/HRMS	.05-3.0 pg/m <sup>3</sup>
Visible emissions	EPA 9	Visual observation	5%
Filterable PM	EPA 29	Gravimetry	0.0002 gr/dscf
PM <sub>10</sub> , PM <sub>2.5</sub>	EPA OTM-27	Cyclone separation	0.0002 gr/dscf
Condensable PM	EPA OTM-28	Gravimetry	0.0002 gr/dscf
Mercury	EPA 29	CVAA	0.5-1.0 ug/ m <sup>3</sup>
Trace metals <sup>2</sup>	EPA 29	ICP/MS	0.1-1.0 ug/m <sup>3</sup>
HCl, HF	EPA 26A	Ion chromatography	0.5 ppm

<sup>1</sup> Tetra - through octa - chlorinated dibenzodioxin and dibenzofuran homologue totals and individual 2,3,7,8-chlorinated dibenzodioxin and dibenzofuran congeners.

<sup>2</sup> Metals samples were analyzed for antimony (Sb), arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), lead (Pb), manganese (Mn), nickel (Ni), phosphorous (P), selenium (Se) and mercury (Hg).

**4.1.1 Gaseous Emissions**

**Method:** EPA 6C, 7E and 10, Amended August 2006

**Deviations:** None



Triplicate 240-minute gaseous emission (CO, NO<sub>x</sub> and SO<sub>2</sub>) test runs were performed at the hog fuel boiler exhaust stack. Concentrations were measured using Avogadro's dry extractive continuous emissions monitor system (CEMS) described in Appendix A. This system meets the requirements of EPA methods for gaseous species. A heated Teflon line and chilled knockout system were used to prevent loss of SO<sub>2</sub> and/or NO<sub>2</sub> in the sampling system. The NO<sub>x</sub> analyzer was operated in the NO<sub>x</sub> mode to measure NO plus NO<sub>2</sub>. A molybdenum catalyst converter was used to convert NO<sub>2</sub> to NO for measurement of total NO<sub>x</sub>.

The sample conditioning and delivery system includes components to extract a representative sample from the source, remove the moisture and particulate matter from the sample stream, and transport the sample to the analyzers. The primary components of this subsystem are:

- 1) A quartz, titanium, stainless steel or glass probe - heated or insulated as necessary to avoid condensation,
- 2) Sample filtration – filters located on the probe, pump, and prior to all of the analyzers for removal of particulate matter,
- 3) Teflon tubing - connecting the probe to the sample conditioner and the sample conditioner to the analyzer manifold - heated or insulated as necessary to avoid condensation,
- 4) Sample conditioner - glass or stainless steel flasks immersed in an ice bath to remove the moisture from the sample gas stream,
- 5) Vacuum pump - a leak-free pump with Teflon diaphragm to transport the sample gas through the system,
- 6) Sample manifold - a distribution system, constructed of stainless steel and Teflon tubing, to direct sample gas to the analyzers, and
- 7) Sample flow rate control - a series of rotameters, vacuum gauges and pressure gauges connected to the manifold used to maintain the appropriate sample flow rates.

The calibration gas system utilizes only EPA Protocol gases to verify the operation, linearity, and range settings of the electronic analyzers. The sample gas system allows for the introduction of the protocol gases to the analyzers either directly through the manifold (calibration error check - performed once daily) or through the sampling system (system bias check - performed with each run).

The electronic analyzers are rack mounted and are maintained in the mobile lab. The data recording and acquisition system is based on a digital system known as STRATA. It includes software for controlling the collection of calibration and emission monitoring data, and hardware for connection of the analyzer outputs to the recording system. Test results can be provided in three forms: on-site printouts of the digitized data, diskette recordings of the digitized data, and if printouts of strip charts from the monitoring data.



For this program, on-site print outs of the one-minute average monitoring data are included.

#### 4.1.2 Dioxins and Furans

**Method:** EPA 23  
**Deviations:** None

Tester: The Avogadro Group, LLC  
Contact: Shawn Nelezen (925) 680-4397, fax (925) 680-4416  
Lab: Vista Analytical Laboratory, El Dorado Hills, California  
Contact: Martha Maier (916) 933-1640, fax (916) 933-0940  
Analysis: High-resolution capillary column gas chromatography with high-resolution mass spectrometry (HRGC/HRMS).

*Test Description:* Measurements of the emissions of polychlorinated dibenzo-dioxins (PCDD) and furans (PCDF) were performed according to the procedures of EPA Method 23. The target analytes for PCDD/PCDF were tetra- through octa-chlorinated dibenzo-dioxin and dibenzo-furan homologue totals and individual 2, 3, 7, 8-chlorinated dibenzo-dioxin and dibenzo-furan isomers.

The tests were performed from the stack serving the hog fuel boiler. Triplicate test runs were 240 minutes in duration and the sampling were performed isokinetically with a multi-point traverse of the sampling plane. The total sample volume for each run was approximately 133 dscf.

One field blank was prepared, recovered and analyzed according to the method. Reagent blanks were also collected and retained at the Avogadro laboratory.

*Pre-test Cleaning Procedure:* All glassware and Teflon sampling apparatus exposed to the sample (this includes the probe nozzle, probe liner, filter assembly, Teflon connecting tube, condenser, resin cartridge and impingers) were cleaned prior to use per the following procedures:

- a. Soak in a hot solution of Liquinox detergent and water;
- b. Following soaking, rinse six times with hot tap water;
- c. Next, soak in chromic acid cleaning solution for at least four hours;
- d. Next, rinse with deionized water;
- e. Next, rinse with acetone, methylene chloride and toluene;
- f. Next, dry in a 200 °F oven;
- g. Last, seal with hexane rinsed foil.

All the cleaned glassware and Teflon parts were sealed in hexane-rinsed aluminum foil. Sampling reagents included pre-cleaned glass fiber filters and resin cartridges charged



with pre-cleaned Amberlite XAD-2 resin. The filters and resin cartridges were pre-cleaned and screened for contamination by Vista Analytical Laboratory. Pesticide-grade (Fisher Scientific *Optima* grade or equivalent) acetone, methylene chloride and toluene reagents were used as sample recovery solvents.

Sample Train Operation: Pretest preparations, preliminary determinations, and leak check procedures are those outlined in EPA Method 5 and 23. Borosilicate glass probe liners and nozzles were used to avoid possible contamination and sealing greases were not used on the sample train.

This train was operated in the same manner as a regular EPA Method 5 sampling train. The sampling apparatus included a heated glass probe equipped with an S-type pitot tube and thermocouple. The probe was attached to an oven containing a heated filter holder, Teflon frit and toluene-rinsed glass-fiber filter. Both the probe exit temperature and oven were maintained at  $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$  during sampling. The filter holder was connected by a length of new heated Teflon tubing to a condenser coil and XAD-2 sorbent trap. The temperature of the gas entering the sorbent trap was maintained below  $68^{\circ}\text{F}$  at all times. The trap was connected directly to the impinger train containing five chilled impingers in series. The impinger train was connected to the control box containing the sampling pump and calibrated dry gas meter.

The first impinger, of the short stem design, was empty. The second and third impingers contained 100 ml of organic free water each, the fourth was empty, and the fifth impinger contained silica gel.

The entire sample train was leak tested once prior to sampling and once following testing. The pre-test leak check was performed at a nominal vacuum to ensure that leakage did not exceed 0.02 cfm. The post-test leak check were performed at a vacuum greater than the highest vacuum recorded during the test to ensure that leakage did not exceed the lesser of a) 4 percent of the average sampling rate, or b) 0.02 cfm. The sampling rate and nozzle size were chosen to allow isokinetic sampling at  $100\% \pm 10\%$ .

Sample Recovery: Avogadro collected and recovered the samples, protected them from contamination, and delivered them to the laboratory for analysis within the method's hold time. All exposed glassware openings in the sampling train were covered with hexane-rinsed foil, to avoid possible contamination, immediately following the final leak check. All QA/QC and chain of custody procedures were followed in strict accordance with the test method.

All sample fractions, except the resin cartridges, were collected in solvent-rinsed amber glass jars with Teflon-lined lids. The liquid levels (when applicable) were marked on each sample container. The contents of the impingers were weighed and recorded prior to recovery



The filter was collected into Container 1a. The XAD sorbent trap was capped off and sealed in a plastic baggie labeled Container 1b. The nozzle, probe and front-half of the filter holder, back half of the filter holder, connecting Teflon line and condenser were rinsed into Container 2 using measured volumes of acetone and methylene chloride (three times each for five minutes in that order). Then the equipment was rinsed with toluene three times (five minutes each) into Container 3 using the same procedure. The silica gel impinger contents were weighed for moisture catch determination only.

All of the samples were protected from light and kept below 4 °C at all times. The samples were delivered in ice chests packed with blue ice to the lab for analysis. The chain of custody and sample login were documented on suitable forms.

*Sample Analysis:* Analyses for dioxin and furans was performed by Vista Analytical Laboratory. The XAD resin trap, filter and rinses were analyzed according to EPA Method 23. The analytical method includes the addition of internal standards in known quantities, matrix-specific extraction of the sample, preliminary fractionating and cleanup of extracts (if necessary) and analysis of the processed extract. The analyses were conducted using high-resolution capillary column gas chromatography coupled with high-resolution mass spectrometry (HRGC/HRMS).

*Reporting:* The results were presented in terms of non-blank-corrected concentrations and mass emission rates. The non-detected species were calculated using either zero as stipulated in the method. Results were reported in units of concentration (pg/dscm or ng/dscm and ng/dscm @ 7% O<sub>2</sub>) and mass emissions (lb/hr).

#### **4.1.3 Total Hydrocarbons and Methane**

**Method:** EPA 25A and 18

**Deviations:** No pre-survey Method 18 samples were collected

Concentrations of total hydrocarbons (THC) were measured using EPA Method 25A. The test runs were 240 minutes in duration and were performed concurrently with the CO, NO<sub>x</sub> SO<sub>2</sub>, PCDD/PCDF and formaldehyde test runs. A flame ionization detector (FID) analyzer was used for measurement of the concentrations as described in the method. The sampling apparatus included a stainless steel probe, filter and heated Teflon line connected to the inlet port of the analyzer. The analyzer uses an internal sampling pump and a heated oven/analysis section that keeps the sample gas at a minimum of 180 degrees Celsius (356 °F). The heated line was maintained at a minimum of 135 degrees Celsius (275 °F) during the test program.

The FID analyzer was calibrated with three different concentrations of EPA Protocol gases that contained mixtures of propane in air. Results were calculated and presented as propane.



Concentrations of methane (CH<sub>4</sub>) were measured using EPA Method 18. Methane concentrations were measured by gas chromatographic analysis of sample gas collected into Tedlar bags. The method is a modification of EPA Method 18, as no pre-survey samples were collected. Three Tedlar bags were filled with sample gas using a quartz probe, new Teflon tubing, and a rigid displacement container. The samples were collected over the course of the test run from a single average traverse point. The bags were shipped to the Avogadro laboratory in Antioch, California for GC / FID analysis of C<sub>1</sub>.

#### 4.1.4 Formaldehyde

**Method:** CARB 430, Second Edition, Proposed December 13, 1991

**Deviations:** Toluene was added to the impingers prior to sampling

Tester: The Avogadro Group, LLC  
Contact: Shawn Nelezen (925) 680-4397, fax (925) 680-4416  
Lab: Atmospheric Analysis & Consulting, Inc.  
Analysis: High-pressure liquid chromatography (HPLC).  
Contact: Dr. Sucha Parmar, (805) 650-1642, fax (805) 650-1644

*Test Description:* Measurements of the emissions of formaldehyde were performed according to the procedures of CARB Method 430. The target analyte for this program was formaldehyde.

The tests were performed at the exhaust stack serving the hog fuel boiler. Triplicate test runs were 240 minutes in duration and collect approximately 90 liters of gas. The sampling was performed non-isokinetically at a single representative point on the sampling plane.

*Pre-test Cleaning Procedure:* All glassware and Teflon sampling apparatus being exposed to the sample were pre-cleaned using the following procedure according to the method:

- a Soak in a hot solution of Liquinox detergent and water;
- b Following soaking, rinse six times with hot tap water;
- c Next, rinse three times with DI water;
- d Next, rinse with methylene chloride and allow to air dry;
- e Finally, seal all pieces with parafilm.

*Sample Train Operation:* Pretest preparations, preliminary determinations, and leak check procedures were performed as outlined in CARB Method 430. Borosilicate glass and Teflon were used throughout the sampling train to avoid possible contamination and sealing greases were not used on the sample train. Testing occurred within 48 hours after the reagent blank analysis by the laboratory.



Gaseous emissions were collected through a quartz probe and a 1/8" o.d. Teflon sample line to three midget impingers in series. A pump and calibrated orifice was used to draw the sample through the impingers at a flow rate of 0.39 liters per minute. Each impinger contained 10 ml of an aqueous acidic solution of 2,4-dinitrophenyl-hydrazine (DNPH). To ensure that the organic extractions started immediately, 5 milliliters of toluene was added to the impingers prior to sampling. The entire sample train was leak tested once prior to sampling and once following testing per the method.

Sample Recovery: The sample line was rinsed into the first impinger with 2 ml of DNPH followed by 1 ml of organic free water. The impingers were recovered in the same manner. Avogadro collected and recovered the samples into their original glass vials. Field blanks were collected during every test run according to the method. A trip blank and field spike were also analyzed. Reagent blanks were collected and retained. After collection, the samples were transported to the AAC for analysis within the method's hold-time. The samples were protected from light and kept below 4 °C at all times. All QA/QC and chain of custody procedures were followed in strict accordance with the test method.

Sample Analysis: The DNPH sampling solution were prepared and analyzed by Atmospheric Analysis & Consulting, Inc. Sample analysis included high-performance liquid chromatography (HPLC) in strict accordance with the method. The analysis occurred within the method hold time. The laboratory QA/QC procedures outlined in the method were adhered to.

Reporting: The results are presented in terms of non-corrected concentrations as required by the EPA ICR. The reporting method is a modification of the test method. Results are also reported in comparison to the reporting limit as calculated using CARB Method 430. Results are reported in units of concentration (ug/dscm, ppm and ppm @ 7% O<sub>2</sub>) and mass emissions (lb/hr). Complete documentation of the calculations are provided in this report.

#### **4.1.5 Particulate Matter**

**Methods:** EPA Methods OTM-027 and OTM-028, both of April 15, 2009

**Deviations:** None

Tester: The Avogadro Group, LLC  
Contact: Shawn Nelezen (925) 680-4397, fax (925) 680-4416  
Lab: Avogadro analytical laboratory, Antioch, California  
Analysis: Gravimetry  
Contact: Mr. Dan Duncan, (925) 680-4300, fax (925) 680-4416



The emissions of particulate matter less than 2.5 microns in diameter ( $PM_{2.5}$ ), particulate matter greater than 2.5 microns and less than 10.0 microns in diameter ( $PM_{2.5-10}$ ), particulate matter greater than 10.0 microns in diameter ( $PM_{10}$ ) and condensable particulate matter (CPM) were measured using the procedures and equipment specified in EPA Other Test Methods 027 and 028. The methods consist of the sampling and analytical methodology necessary to quantify  $PM_{2.5}$ ,  $PM_{2.5-10}$ ,  $PM_{10}$  and CPM from stationary sources. All quality assurance procedures detailed in the methods were followed. Triplicate test runs were 240 minutes in duration and the sampling was performed isokinetically with a multi-point traverse of the sampling plane.

The sampling apparatus included two in stack cyclone assemblies attached to a probe equipped with an S-type pitot tube and thermocouple. The probe was attached to a length of new Teflon tubing to the OTM-028 impinger train (see below). The impinger train was connected to the control box that houses the sampling pump and calibrated dry gas meter.

The OTM-028 test train consisted of four impingers connected in series. The first and second impingers were empty, a Teflon filter was placed between the second and third impingers and maintained below 85° F. The third impinger contained 100 ml of deionized (DI) water, and the fourth contained silica gel. All of the impinger tare weights were recorded prior to sampling. All glassware and other components coming in contact with the sample were pre-cleaned using hot water and detergent, tap water, methylene chloride and DI water, in that order. The glassware was also placed in an oven set to 300 °C for at least 6 hours.

The entire sample train was leak tested once prior to sampling and once following testing. Note: the post test leak check was performed just downstream of the cyclone assemblages. The pre-test leak check was performed at a vacuum of at least 15" to ensure that leakage does not exceed 0.02 cfm. The post-test leak checks were performed at a vacuum greater than the highest vacuum recorded during the test to ensure that leakage does not exceed the lesser of a) 4 percent of the average sampling rate, or b) 0.02 cfm. The constant sampling rate and nozzle size were chosen to allow isokinetic sampling at 100% ±20%.

The  $PM_{2.5}$ ,  $PM_{2.5-10}$  and  $PM_{2.10}$  were recovered from the cyclone assemblies as described in OTM-027. The sample fractions include a filter and multiple acetone rinses of the cyclone assemblages. All acetone fractions were stored in glass sample containers and the liquid level were marked. The filter was placed back into its original petri dish and sealed.

The "back-half" condensable contents were also recovered and analyzed according to OTM-028. The entire sampling system was purged with nitrogen at 20 liters per minute for one hour immediately at the end of each test run. The contents of the impingers were weighed, recorded and placed into a separate glass sample container which included the water rinses of the impingers, sample line, probe and the back-half filter holder.



Additional methylene chloride rinses were collected. The liquid level was marked on the sample containers. The silica gel was also weighed and recorded.

Analyses were performed by Avogadro. The OTM-027 samples were analyzed gravimetrically to determine the concentration of PM<sub>2.5</sub>, PM<sub>2.5-10</sub>, PM<sub>10</sub> and particulate matter in both cyclone rinses. Each back-half sample was extracted with dichloromethane in a separatory funnel. The analysis includes gravimetric measurement of the residue from the aqueous and organic fractions. The corrected results were used to determine the concentration of condensable particulate matter.

**Filterable Particulate Matter by EPA Method 29** - The emissions of filterable "front half" particulate matter (F<sup>1/2</sup> PM) were measured using the procedures and equipment specified in EPA Method 29, Sections 8.3.1.1 and 8.3.2. Please see the sample recovery procedure of Section 4.1.7 below for more information.

#### 4.1.6 Selected Trace Metals

**Method:** EPA 29

**Deviations:** None

Tester: The Avogadro Group, LLC  
Contact: Shawn Nelezen (925) 680-4397, fax (925) 680-4416  
Lab: Test America, West Sacramento, California  
Contact: Robert Weidenfeld (800) 753-4225, fax (510) 486-0532  
Analysis: Inductively coupled plasma mass spectrometry (ICP-MS) & Cold vapor atomic absorption spectroscopy (CVAAS)

Test Description: Select trace metals were measured at hog fuel boiler exhaust stack using EPA Method 29. Triplicate test runs were 240 minutes in duration and the sampling was performed isokinetically with a multi-point traverse of the sampling plane. The total sample volume for each run were approximately 132 dscf. The samples were analyzed for 11 different metals including: arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, selenium, phosphorus.

One field blank was prepared, recovered and analyzed according to the method. Reagent blanks were also collected; however, the samples were not analyzed because no field blank anomalies were reported.

Pre-test Cleaning Procedure: All glassware and Teflon sampling apparatus exposed to the sample were pre-cleaned using the following procedure according to the method:

- a. Soak in a hot solution of Liquinox detergent and water;
- b. Following soaking, rinse six times with hot tap water;
- c. Next, soak in 10% nitric acid for at least four hours;



- d. Next, rinse three times with Type II DI water;
- e. Next, rinse with acetone and allow to air dry;
- f. Finally, seal all pieces with parafilm.

Sample Train Operation: Pretest preparations, preliminary determinations, and leak check procedures were those outlined in EPA Method 5 and EPA 29. Borosilicate glass probe liners and nozzles were used to avoid possible contamination and sealing greases were not used on the sample train.

The sampling train was operated in the same manner as a regular EPA Method 5 sampling train. The sampling apparatus included a heated glass probe equipped with an S-type pitot tube and thermocouple. The probe was attached to an oven containing a heated filter holder, Teflon frit and Pallflex 2500QAT-UP quartz-fiber filter. Both the probe exit temperature and oven were maintained at  $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$  during sampling. The filter holder was connected by a length of new Teflon tubing to the impinger train containing seven chilled impingers in series. The impinger train was connected to the control box containing the sampling pump and calibrated dry gas meter.

The reagents used in the impinger trains were prepared fresh daily. The optional empty first impinger was used to prevent dilution of the impinger reagents. The second and third impingers each contained 100 ml of 5%  $\text{HNO}_3$ /10%  $\text{H}_2\text{O}_2$ , the fourth was empty, the fifth and sixth impingers contained 100 ml of 4%  $\text{KMnO}_4$ /10%  $\text{H}_2\text{SO}_4$  and the seventh impinger contained silica gel. All of the impinger tare weights were recorded prior to sampling.

The entire sample train was leak tested once prior to sampling and once following testing. The pre-test leak check was performed at a nominal vacuum to ensure that leakage did not exceed 0.02 cfm. The post-test leak check was performed at a vacuum greater than the highest vacuum recorded during the test to ensure that leakage did not exceed the lesser of a) 4 percent of the average sampling rate, or b) 0.02 cfm. The sampling rate and nozzle size were chosen to allow isokinetic sampling at  $100\% \pm 10\%$ .

Sample Recovery: Avogadro collected and recovered the samples, protected them from contamination, and delivered them to the laboratory for analysis. All sample containers were of the amber glass variety incorporating Teflon leak-proof caps and were pre-cleaned with 5% nitric acid. All containers were then rinsed three times with 0.1  $\text{HNO}_3$ . The contents of the impingers were weighed and recorded prior to recovery. The liquid level was marked on each sample container. All exposed glassware openings in the sampling train were covered with parafilm to avoid possible contamination.

The filter was collected into Container 1. The nozzle, probe and front-half of the filter holder were rinsed into Container 2 using a measured volume of acetone. The nozzle, probe and front-half of the filter holder were then be rinsed into Container 3 with a measured volume of 0.1N  $\text{HNO}_3$ . The contents of the first three impingers were poured into Container 4 along with measured rinse volumes of 0.1N  $\text{HNO}_3$  from the impingers,



sample line and back half of the filter holder. The pH of the solution was checked. The contents of the fourth (empty) impinger was poured into Container 5A. The impinger was rinsed with a measured volume of 0.1 HNO<sub>3</sub> and poured into the same container. The pH of the solution was again verified to be less than 2. The contents of the fifth and sixth impingers were poured into Container 5B followed by measured volumes of rinses with both 4% KMnO<sub>4</sub>/10% H<sub>2</sub>SO<sub>4</sub> and DI water in that order. Finally, these impingers were rinsed into Container 5C using exactly 25 ml of 8N HCl. The silica gel impinger contents were weighed for moisture catch determination only.

After collection, the samples were transported to the laboratory for analysis within the method's hold-time. The samples were protected from light and kept below 4 °C at all times. All QA/QC and chain of custody procedures were followed in strict accordance with the test method.

Sample Analysis: The analyses were performed by Test America in West Sacramento, California. Sample analysis procedures were performed in strict accordance with the method including the use of microwave digestion and proportional compositing of the front half, filter, and back half sample fractions (impingers 1-3) for a single analysis of trace metals. The potassium permanganate impinger fraction and the hydrochloric acid rinse fractions were analyzed separately for mercury. Analysis techniques include the use of inductively coupled plasma mass spectroscopy (ICP-MS) and cold vapor atomic absorption spectroscopy (CVAAS). Spiked quality control samples, matrix spikes, serial dilution, and duplicate analyses will all be used to establish the quality of the data. Duplicate analyses were performed on 10% of all samples.

Reporting: The results were presented in terms of non-blank-corrected concentrations and emission rates. Results were reported in units of concentration (ug/dscm) and mass emissions (lb/hr and lb/MMBtu). Complete documentation of the calculations are provided in this report.

#### **4.1.7 Hydrogen Chloride and Hydrogen Fluoride**

**Method:** EPA 26

**Deviations:** Substitute large impingers for mini-impingers

Tester: The Avogadro Group, LLC  
Contact: Shawn Nelezen (925) 680-4397, fax (925) 680-4416  
Lab: Test America, West Sacramento, California  
Contact: Robert Weidenfeld (800) 753-4225, fax (510) 486-0532  
Analysis: Ion chromatography with conductivity detection

Test Description: Hydrogen chloride (HCl) and hydrogen fluoride (HF) were measured from the hog fuel boiler exhaust stack using EPA Method 26 modified. Triplicate test runs were 240 minutes in duration and the sampling were performed non-isokinetically



with a multi-point traverse of the sampling plane. The total sample volume for each run was greater than 100 dscf.

One field blank were prepared, recovered and analyzed according to the method. Reagent blanks were also collected and retained.

Pre-test Cleaning Procedure: All glassware and Teflon sampling apparatus exposed to the sample were pre-cleaned using the following procedure per the method:

- a. Soak in a hot solution of Liquinox detergent and water;
- b. Following soaking, rinse six times with hot tap water;
- c. Next, rinse three times with Type II DI water;
- d. Next, allow to air dry;
- e. Finally, seal all pieces with parafilm.

Sample Train Operation: Pretest preparations, preliminary determinations, and leak check procedures were those outlined in EPA Methods 5 and 26. Borosilicate glass probe liners were used to avoid possible contamination and sealing greases were not used on the sample train.

This train was operated in the same manner as a regular EPA Method 5 sampling train. The sampling apparatus will include a heated glass probe equipped with an S-type pitot tube and thermocouple. The probe was attached to an oven containing a heated filter holder, Teflon frit and Pallflex 2500QAT-UP quartz-fiber filter. Both the probe exit temperature and oven were maintained at  $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$  during sampling. The filter holder was connected by a length of Teflon tubing to the impinger train containing four chilled impingers in series. The impinger train was connected to the control box containing the sampling pump and calibrated dry gas meter.

The reagents used in the impinger train were prepared at the Avogadro laboratory. The first and second impingers each contained 100 ml of 0.1N  $\text{H}_2\text{SO}_4$  solution. The third was empty and the fourth impinger contained silica gel. All of the impinger tare weights were recorded prior to sampling.

The entire sample train was leak tested once prior to sampling and once following testing. The pre-test leak check was performed at a nominal vacuum to ensure that leakage did not exceed 0.02 cfm. The post-test leak check was performed at a vacuum greater than the highest vacuum recorded during the test to ensure that leakage did not exceed the lesser of a) 4 percent of the average sampling rate, or b) 0.02 cfm.

Sample Recovery: Avogadro collected and recovered the samples, protected them from contamination, and delivered them to the laboratory for analysis. All sample containers were of the amber glass variety incorporating Teflon leak-proof caps and were pre-cleaned with DI water. The contents of the impingers were weighed and recorded prior



to recovery. The liquid level was marked on each sample container. All exposed glassware openings in the sampling train were covered with parafilm to avoid possible contamination.

The filter and front half rinses and filter were discarded. The contents of the first two impingers were poured into Container 1. The impingers and crossovers were then rinsed three times with measured volumes of 0.1N H<sub>2</sub>SO<sub>4</sub> solution. The rinses were also poured into Container 1. The silica gel impinger contents were weighed for moisture catch determination only.

After collection, the samples were transported to the laboratory for analysis within the method's hold-time. The samples were protected from light and kept below 4 °C at all times. All QA/QC and chain of custody procedures were followed in strict accordance with the test method.

Sample Analysis: Sample analyses were performed by Test America using ion chromatography with conductivity detection. The laboratory QA/QC procedures outlined in the method were followed. The chloride and fluoride peaks were identified by characteristic retention times and quantified by reference to external standards.

Reporting: The results were presented in terms of non-blank-corrected concentrations and emission rates, as described in the method. The non-detected species were calculated using the full reporting limit. Results were reported in units of concentration (mg/dscm) and mass emissions (lb/hr and lb/MMBtu). Complete documentation of the calculations are provided in the final report.

## 4.2. ANCILLARY TEST PROCEDURES

The testing program will include measurements that provide data to be used in calculation of pollutant emission rates. These ancillary or supplementary tests are either included in the reference methods, or were run concurrently with the reference methods.

### 4.2.1 Diluent Gases

**Method:** EPA 3A, Amended August 2006

**Deviations:** None

Concentrations of the gaseous constituents of stack gas (O<sub>2</sub> and CO<sub>2</sub>) were measured using Avogadro's dry extractive continuous emissions monitor system (CEMS) described in Section 4.1.1 and Appendix A. The results were used for the molecular weight and dilution calculations necessary for reporting mass emission rates.



Run durations varied, but each test run were performed concurrently with an isokinetic test run. In this way, mass emissions were calculated using the volumetric flow rates measured during the aligned wet chemical tests.

#### **4.2.2 Volumetric Flow Rate and Moisture Content**

**Methods: EPA Methods 1, 2, 4, 19 Amended February 2000**

**Deviations: None**

Volumetric flow rates were measured using EPA Methods 1 and 2. Moisture contents were measured according to EPA Method 4. These methods are integral to all of the isokinetic tests. Emission rates were calculated in units of lb/hr or other mass flow units from the measured concentrations and volumetric flow rates. Emission rates for non-isokinetic test runs were calculated using flow rate measured during concurrent isokinetic test runs. Separate flow traverses were performed as necessary.

Stack gas volumetric flow rates were also be determined by stoichiometric calculations based on fuel flow rates, fuel composition (from fuel analysis data), and excess O<sub>2</sub> (%) measured from the flue gas. Calculations were performed using an "F" factor and higher heating value for natural gas as outlined in EPA Method 19. The results, presented in dry standard cubic feet per minute (dscfm), were used with the measured gaseous emission concentrations to calculate mass emission rates in lb/hr and lb/MMBtu.

#### **4.2.3 Fuel Analysis**

**Method: ASTM Methods**

Integrated fuel samples were collected by Weyerhaeuser personnel during every test day that sampling was performed. The EPA boiler and process heater test program requires fuel variability sampling for fuel based HAPs in addition to the emission testing. The fuel analyses include: chlorine, fluorine and metals for any boiler or process heater firing solid or liquid fuels that is selected to conduct an emission test program. At least ten samples were collected over a period of 30 days in accordance with Sections 2.1 through 2.4 of the Summary of Test Procedures, Methods, and Reporting Requirements issued by EPA.



## SECTION 5.0

### QUALITY ASSURANCE AND REPORTING

#### 5.1 SAMPLING AND ANALYTICAL QA/QC

Avogadro follows a rigorous QA/QC program for all of its air pollution testing. The program ensures that the emission data reported are accurate and the procedures included in the cited reference methods were followed for all steps of preparation, sampling, calibration, and analysis. Avogadro was responsible for preparation, calibration and cleaning of the sampling apparatus and conducted the sampling, recovery, storage and shipping.

The contract laboratories we selected conducted the majority of the preparation and sample analyses. The laboratories are established leaders in development and performance of the reference methods for which they have been selected. Their credentials for adherence to the required quality assurance procedures are well documented.

#### 5.2 QUALITY CONTROL REQUIREMENTS

Our Quality Assurance Program Summary, located in Appendix A, provides our equipment maintenance and calibration schedule, quality control acceptance limits, and any corrective action that may be needed. For additional quality control, Avogadro followed the procedures outlined below:

- Preliminary stack flow and temperature measurements were taken every day to assure correct isokinetic sampling.
- The acidified permanganate-filled impingers were carefully monitored throughout the test for bleaching via reduction reactions. The intent was to prevent “breakthrough” of mercury species.
- All field equipment had undergone a visual inspection prior to testing and included pre-test calibration checks.
- In addition to the normal cleaning methods, all metals sample train glassware was cleaned in Citranox<sup>®</sup> acidic cleaning solution.
- Glassware was visually inspected prior to testing.
- All reagents were made fresh daily. A new reagent blank was retained for every new stock of reagent.



### 5.3 QUALITY ASSURANCE AUDITS

Quality assurance audits were conducted as part of the toxics program to ensure that the final results were calculated from the highest quality data. The individual audits are listed below:

- The dry gas meters used during the test program were calibrated using a critical orifice (with a known calibration factor) prior to mobilization. The meters were then checked following the program. The meter values agreed within  $\pm 5$  percent of the orifice value.
- All S-type pitot tubes used during the test program were calibrated using a wind tunnel and standard pitot tube.
- All thermocouples (TCs) used during the test program were calibrated using three standards (ice water, boiling water, and boiling oil).

### 5.4 DATA REDUCTION PROCEDURES

The raw data collected during the sampling and analysis procedures were used to calculate the results of the testing program. The analysis and reduction of the data to the final results followed these steps where appropriate to the test method:

- The field-sampling data and the calculations of data averages were double-checked for accuracy (e.g., temperatures, pressures, volumes, etc.).
- The in-house and contract laboratory reports were reviewed to ensure that appropriate and/or required QA/QC steps were followed.
- The field and laboratory data inputs to computer spreadsheets were verified for calculation of volumetric flow rates, mass emission rates, etc.
- The calculated results were verified by conducting example calculations by hand on a single test run for each emission result reported.
- The report's summary tables of results were reviewed for accuracy.

### 5.5 REPORTING

This report includes copies of spreadsheet printouts (data input and results output) and example calculation checks. The field data sheets with average data calculations are also included. All values found to be below the detection limit of the analytical method were reported as either "non-detect" (ND<) or "less than" (<) the laboratory reporting limit value. Standard conditions used for data reduction were 29.92 inches of mercury and 68 °F, as defined by the EPA.



## SECTION 6.0

### DISCUSSION OF RESULTS

The results of the air source emission tests are presented in tables throughout this section and are summarized in the subsections that follow. The supporting data is contained in the appendices and includes the information listed below:

- 1) Appendix A presents generic descriptions of the standard test methods.
- 2) Appendix B contains Avogadro quality assurance information, California ARB certification, and calibration data.
- 3) Appendix C contains supporting data including an image of the sampling location, the plant process data, and the Avogadro CEMS data.
- 4) Appendix D contains the field data sheets for all the sampling activities.
- 5) Appendix E contains the abbreviated laboratory reports for all of the tests.
- 6) Appendix F presents the general emission calculations, emission calculation spreadsheets and hand-written examples.
- 7) Appendix G contains a copy of the operating permit.
- 8) Appendix H contains the full supporting chromatograph lab packages from Vista Analytical and Test America Laboratories.

#### 6.1 PARTICULATE MATTER

The results of the particulate matter emissions tests are summarized in Table 6-1. Detailed laboratory results are included in Appendix E.1. The results are presented in units of gr/dscf, gr/dscf @ 7% O<sub>2</sub>, lb/hr and lb/MMBtu. Results are blank corrected in accordance with EPA Method 5. Particulate matter was detected in every sample but not all sample fractions. Fractions for which the laboratory result was zero were assigned the analytical detection limit of 0.1 mg as the result used for all subsequent calculations, and any results using that limit are denoted with a "<" symbol. Tests 1-MM, 2-MM and 3-MM correspond to 1-PM, 2-PM and 3-PM respectively. No analytical problems were encountered.



**TABLE 6-1**  
**SUMMARY OF RESULTS**  
**PARTICULATE MATTER EMISSIONS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAWMILL**

Test No.:	1-MM 2-PM	2-MM 3-PM	3-MM 4-PM	Average
<b>Date:</b>	8/11/09	8/11/09	8/12/09	--
<b>Time:</b>	0957-1400	1500-1902	0819-1221	--
<b>Process Data:</b>				
Steam output, lb/hr	39,480	37,020	42,900	39,800
<b>Flue Gas:</b>				
O <sub>2</sub> , % volume dry	11.850	11.208	10.215	11.091
CO <sub>2</sub> , % volume dry	8.79	9.37	10.32	9.49
Stack temperature, °F	319.5	318.6	315.4	317.8
Moisture content, % vol.	12.45	14.38	14.34	13.73
Stack flow rate, dscfm	22,246	21,485	21,252	21,661
<b>F<sup>1</sup>/<sub>2</sub> Particulate Matter:</b>				
gr/dscf	< 0.00047	0.00059	< 0.00021	0.00042
gr/dscf @ 7% O <sub>2</sub>	< 0.00073	0.00085	< 0.00027	0.00062
lb/hr	< 0.090	0.109	< 0.037	0.079
lb/MMBtu	< 0.0015	0.0018	< 0.0006	0.0013
<b>PM &gt;10 µm (&gt;PM<sub>10</sub>):</b>				
gr/dscf	0.00051	0.00025	0.00022	0.00033
gr/dscf @ 7% O <sub>2</sub>	0.00078	0.00026	0.00029	0.00044
lb/hr	0.099	0.039	0.039	0.059
<b>PM &gt;2.5 and &lt;10 µm:</b>				
gr/dscf	0.00003	< 0.00002	0.00043	0.00016
gr/dscf @ 7% O <sub>2</sub>	0.00004	< 0.00002	0.00056	0.00021
lb/hr	0.005	< 0.003	0.076	0.028
<b>PM &lt;2.5 µm (PM<sub>2.5</sub>):</b>				
gr/dscf	0.00027	0.00018	0.00019	0.00021
gr/dscf @ 7% O <sub>2</sub>	0.00041	0.00019	0.00024	0.00028
lb/hr	0.052	0.028	0.033	0.038
lb/MMBtu	0.0009	0.0004	0.0005	0.0006
<b>Condensable PM:</b>				
gr/dscf	0.00055	0.00060	0.00110	0.00075
gr/dscf @ 7% O <sub>2</sub>	0.00084	0.00064	0.00143	0.00097
lb/hr	0.107	0.097	0.192	0.132
lb/MMBtu	0.0017	0.0013	0.0029	0.0020

(1) The results presented above are blank-corrected in accordance with EPA Method 5.



## 6.2 HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE

The results of the gaseous hydrogen chloride (HCl) and hydrogen fluoride (HF) tests are summarized in Table 6-2. Detailed laboratory results are included in Appendices E.2 and H.2. The results are presented in units of ppm volume dry, ppm @ 7% O<sub>2</sub>, lb/hr and lb/MMBtu. There were no testing or analytical problems encountered.

HCl and HF were not detected in the samples or field blanks. Field blanks are reported at the laboratory reporting limit. No sampling problems were encountered. The test results are not blank-corrected in accordance with EPA 26.

All QA/QC matrix tests were performed according to the procedures in the test method. The procedures included field and laboratory blanks, matrix and blank spikes, and spike duplicates. All results were within the 75-125 percent acceptance limits. The results varied from 100%-101%.



**TABLE 6-2**  
**SUMMARY OF RESULTS**  
**HCL AND HF EMISSIONS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAWMILL**

Test No.:	1-HCl	2-HCl	3-HCl	Average	FB-HCl
<b>Date:</b>	8/11/09	8/11/09	8/12/09	--	--
<b>Time:</b>	0957-1357	1500-1900	0819-1219	--	--
<b>Process Data:</b>					
Steam output, lb/hr	39,480	37,020	42,900	39,800	--
<b>Flue Gas:</b>					
O <sub>2</sub> , % volume dry	11.850	11.208	10.215	11.091	11.091
CO <sub>2</sub> , % volume dry	8.79	9.37	10.32	9.49	9.49
Flue gas temperature °F	319.5	318.6	314.8	317.6	317.6
Moisture content, % vol.	12.45	14.25	14.28	13.66	13.66
Stack flow rate, dscfm	22,662	21,862	20,999	21,841	21,841
<b>Hydrogen Chloride</b>					
mg/sample as HCl	< 0.607	< 0.658	< 0.658	< 0.641	< 0.206
mg/dscm as HCl	< 0.196	< 0.213	< 0.212	< 0.207	< 0.066
ppm volume dry as HCl	< 0.129	< 0.140	< 0.140	< 0.137	< 0.044
ppm @ 7% O <sub>2</sub> as HCl	< 0.198	< 0.201	< 0.182	< 0.194	< 0.062
lb/hr as HCl	< 0.017	< 0.017	< 0.017	< 0.017	< 5.4E-03
lb/MMBtu as HCl	< 2.7E-04	< 2.8E-04	< 2.5E-04	< 2.6E-04	< 8.5E-05
<b>Hydrogen Fluoride</b>					
mg/sample as HF	< 0.632	< 0.684	< 0.684	< 0.667	< 0.211
mg/dscm as HF	< 0.204	< 0.222	< 0.221	< 0.215	< 0.068
ppm volume dry as HF	< 0.245	< 0.266	< 0.265	< 0.259	< 0.082
ppm @ 7% O <sub>2</sub> as HF	< 0.376	< 0.382	< 0.345	< 0.368	< 0.116
lb/hr as HF	< 0.017	< 0.018	< 0.017	< 0.018	< 5.6E-03
lb/MMBtu as HF	< 2.8E-04	< 2.9E-04	< 2.6E-04	< 2.8E-04	< 8.7E-05

- (1) The less than (<) notation indicates a species was not detected in the sample fraction. HCl and HF were not detected in any samples or field blanks.
- (2) The field blank values presented were calculated using the average sample volume and volumetric flow rate from the three test runs.
- (3) The results presented above are not blank-corrected in accordance with EPA Method 26.
- (4) Non-detected elements were calculated at the laboratory reporting limit.
- (5) The volumetric flow rate data was collected with the concurrent metals test runs.



### 6.3 SELECTED TRACE METALS

The results of the metals emission tests are summarized in Table 6-3. Detailed laboratory results are included in Appendices E.3 and H.2. The results were not blank-corrected in accordance with the EPA ICR. This is a modification of EPA Method 29, which allows for blank correction. The results are presented in units of micrograms per dry standard cubic meter (*ug/dscm*) for each test run, lb/hr and lb/MMbtu for the average of the three test runs. Results for the non-detected elements were calculated using the laboratory reporting limit. All QA/QC matrix tests were performed according to the procedures in the test method.

When analyzing trace metals, detection limits can vary from run to run, as the amount of analytical interferences (“matrix” interference) also varies from run to run. In some cases, the method of standard additions (dilution) is used to reduce those interferences to acceptable levels.

Antimony, arsenic, and beryllium were not detected in any sample fraction including the field blanks. Cadmium was detected in sample 2 only. Mercury was detected in the samples for each test run, but not all fractions. Elements that were detected under the reporting limit are reported at their respective reporting limits. All other metals were detected in the samples. The field blank contained detectable quantities of chromium, manganese, nickel, phosphorus and selenium. The method blank did not contain detectable quantities of any of the metals.

All duplicate sample recoveries were within 3.7% repeatability for all the trace metals, well within the acceptable limit of 15% for each species. Spike recoveries for the trace metals ranged between 81% and 109%, each was within the upper and lower specification limit.



**TABLE 6-3**  
**SUMMARY OF RESULTS**  
**TRACE METALS EMISSIONS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAWMILL**

Test No.	1-MM	2-MM	3-MM	AVERAGE			FB-MM
Date	8/11/09	8/11/09	8/12/09				8/4/09
Time	0957-1400	1500-1902	0819-1221				--
Steam output, lb/hr	39,480	37,020	42,900				39,800
Flow Rate, dscfm	22,246	21,485	21,260				21,664
Sample vol., dscf	154.10	162.62	161.92				159.54
O <sub>2</sub> , % vol. dry	11.85	11.21	10.22				11.09
CO <sub>2</sub> , % vol. dry	8.788	9.370	10.32				9.493
Moisture, %	12.45	14.38	14.34				13.73
	ug/m <sup>3</sup>	ug/m <sup>3</sup>	ug/m <sup>3</sup>	ug/m <sup>3</sup>	ug/m <sup>3</sup> @ 7% O <sub>2</sub>	lb/MMBtu	ug/m <sup>3</sup>
Antimony	ND<0.149	ND<0.139	ND<0.140	ND<0.142	ND<0.203	ND<1.76E-07	ND<0.168
Arsenic	ND<0.149	ND<0.139	ND<0.140	ND<0.142	ND<0.203	ND<1.76E-07	ND<0.168
Beryllium	ND<0.073	ND<0.069	ND<0.070	ND<0.071	ND<0.101	ND<8.76E-08	ND<0.084
Cadmium	ND<0.073	0.150	ND<0.070	<0.098	<0.139	<1.21E-07	ND<0.084
Chromium	0.894	0.326	0.371	0.530	0.774	6.71E-07	0.509
Cobalt	0.103	0.069	0.076	0.083	0.119	1.03E-07	ND<0.084
Lead	0.197	0.165	0.124	0.162	0.234	2.03E-07	ND<0.084
Manganese	14.94	9.815	6.695	10.48	15.24	1.32E-05	0.819
Nickel	0.939	0.282	0.458	0.560	0.815	7.06E-07	0.332
Phosphorus	19.50	22.37	14.11	18.66	26.79	2.32E-05	10.91
Selenium	0.367	0.239	0.283	0.296	0.425	3.68E-07	0.642
Mercury	<1.533	<1.414	<1.389	<1.445	<2.063	<1.32E-05	ND<0.394

- (1) The non-detection (ND<) notation indicates the species was not detected in any sample or sample fraction.
- (2) The less than (<) notation indicates a species was detected in at least one (but not all) samples or fractions.
- (3) The field blank values presented were calculated using the average sample volume from the three test runs.
- (4) The results presented above are not blank-corrected in accordance with the EPA ICR. This is a modification of EPA Method 29, which allows for blank corrections.
- (5) Non-detected elements were calculated using the laboratory reporting limit.
- (6) Chromium is presented as the measured total chromium.
- (7) Concentrations are presented in units of microgram per dry standard cubic meter.



#### 6.4 DIOXINS AND FURANS

The results of the polychlorinated dibenzo-dioxins (PCDD), dibenzo-furans (PCDF) emission tests are summarized in Tables 6-4 and 6-5. Detailed laboratory results are included in Appendices E.4. and H.1. The results are presented in units of nanograms per sample, nanograms per dry standard cubic meter (ng/dscm), ng/dscm @ 7% O<sub>2</sub>, ng/dscm @ 12% CO<sub>2</sub>, picograms per dry standard cubic meter (pg/dscm), pg/dscm @ 7% O<sub>2</sub> and lb/hr for each congener for each test run. The results are summarized for each species (i.e. 2378-TCDD, 12378 PeCDD, etc.), and as "Total PCDD", "Total PCDF", and "Total PCDD/PCDF" by simple addition of the individual congeners.

The results for non-detected congeners were calculated using zero for all tests as required by EPA Method 23. Results were not blank-corrected. The field and method blanks contained no significant quantities of any PCDD or PCDF congeners compared to the measured results.

All quality assurance and quality control (QA/QC) matrix tests were performed according to the procedures in the test method. The QA/QC standards for the sampling and analysis procedures were met for each test run and no sampling or analytical problems were encountered.



**TABLE 6-4  
 SUMMARY OF RESULTS  
 DIOXIN AND FURAN EMISSION TESTS  
 HOG FUEL BOILER EXHAUST STACK  
 WEYERHAEUSER RAYMOND SAWMILL**

<b>Test No.:</b>	<b>1-PCDD</b>	<b>2-PCDD</b>	<b>3-PCDD</b>	<b>Average<sup>4</sup></b>
<b>Date:</b>	8/12/09	8/13/09	8/13/09	--
<b>Time:</b>	1357-1800	0757-1159	1248-1650	--
<b>Process Data:</b>				
Steam output, lb/hr	48,100	42,250	40,960	43,770
<b>Flue Gas:</b>				
O <sub>2</sub> , % volume dry	8.950	10.736	11.207	10.298
CO <sub>2</sub> , % volume dry	11.51	9.83	9.38	10.24
Gas temperature °F	322.8	329.1	314.9	322.3
H <sub>2</sub> O content, % volume	14.91	13.76	13.17	13.94
Flow rate, dscfm	21,242	23,203	23,075	22,506
<b>Total PCDD</b>				
ng/sample	0.015	0.010	0.003	0.009
ng/dscm	0.004	0.002	0.001	0.002
ng/dscm @ 7% O <sub>2</sub>	0.004	0.003	0.001	0.003
ng/dscm @ 12% CO <sub>2</sub>	0.004	0.003	0.001	0.002
lb/hr	2.88E-10	1.90E-10	5.78E-11	1.79E-10
<b>Total PCDF</b>				
ng/sample	0.120	0.114	0.056	0.097
ng/dscm	0.029	0.025	0.013	0.02
ng/dscm @ 7% O <sub>2</sub>	0.034	0.035	0.018	0.029
ng/dscm @ 12% CO <sub>2</sub>	0.031	0.031	0.016	0.026
lb/hr	2.34E-09	2.21E-09	1.11E-09	1.89E-09
<b>Total PCDD/PCDF</b>				
ng/sample	0.135	0.124	0.059	0.106
ng/dscm	0.033	0.028	0.014	0.02
ng/dscm @ 7% O <sub>2</sub>	0.038	0.038	0.019	0.032
ng/dscm @ 12% CO <sub>2</sub>	0.034	0.034	0.017	0.029
lb/hr	2.63E-09	2.40E-09	1.17E-09	2.07E-09

- (1) The less than (<) notation indicates a species was detected in at least one (but not all) samples or fractions.
- (2) The field blank values presented were calculated using the average sample volume from the three test runs.
- (3) The results presented above are not blank-corrected in accordance with EPA Method 23.
- (4) Non-detected isomers were calculated using zero as the analytical result according to EPA Method 23.
- (5) Concentrations are presented in units of nanograms per dry standard cubic meter.



**TABLE 6-5  
 SUMMARY OF RESULTS  
 DIOXIN/FURAN EMISSION TESTS  
 HOG FUEL BOILER EXHAUST STACK  
 WEYERHAEUSER RAYMOND SAWMILL**

<b>Species</b>	<b>1-PCDD</b> pg/m <sup>3</sup> @ 7% O <sub>2</sub>	<b>2-PCDD</b> pg/m <sup>3</sup> @ 7% O <sub>2</sub>	<b>3-PCDD</b> pg/m <sup>3</sup> @ 7% O <sub>2</sub>	<b>Average</b> pg/m <sup>3</sup> @ 7% O <sub>2</sub>
2378-TCDD	0.000	0.000	0.000	0.000
Other TCDD	1.745	0.834	0.958	1.214
12378 PeCDD	0.000	0.000	0.000	0.000
Other PeCDD	0.000	0.000	0.000	0.000
123478 HxCDD	0.000	0.000	0.000	0.000
123678 HxCDD	0.000	0.000	0.000	0.000
123789 HxCDD	0.000	0.000	0.000	0.000
Other HxCDD	0.000	0.000	0.000	0.000
1234678 HpCDD	0.000	0.000	0.000	0.000
Other HpCDD	0.000	0.000	0.000	0.000
OCDD	2.470	2.156	0.000	1.617
2378 TCDF	2.390	2.642	2.094	2.380
Other TCDF	30.69	29.73	16.35	26.02
12378 PeCDF	0.000	0.000	0.000	0.000
23478 PeCDF	0.000	0.000	0.000	0.000
Other PeCDF	0.610	0.953	0.000	0.534
123478 HxCDF	0.000	0.000	0.000	0.000
123678 HxCDF	0.000	0.000	0.000	0.000
234678 HxCDF	0.000	0.000	0.000	0.000
123789 HxCDF	0.000	0.000	0.000	0.000
Other HxCDF	0.000	0.764	0.000	0.244
1234678 HpCDF	0.582	0.672	0.000	0.433
1234789 HpCDF	0.000	0.000	0.000	0.000
Other HpCDF	0.000	0.000	0.000	0.000
OCDF	0.000	0.000	0.000	0.000

## 6.5 GASEOUS EMISSIONS

The results of the gaseous emissions tests conducted at the stack location are summarized in Tables 6-6 on the next page. Detailed results are included in Appendices C.2 and F.2.6. Triplicate 240-minute test runs were performed in accordance with EPA Methods 6C, 7E and 10.



**TABLE 6-6**  
**SUMMARY OF RESULTS**  
**GASEOUS EMISSIONS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAWMILL**

Parameter	Run 1	Run 2	Run 3	Averages
<b>Date:</b>	8/12/09	08/13/09	8/13/09	--
<b>Time:</b>	1357-1800	0757-1159	1248-1650	--
<b>Process Data:</b>				
Steam output, lb/hr	48,100	42,250	40,960	43,770
<b>Stack Gas:</b>				
O <sub>2</sub> , % volume dry	8.950	10.736	11.207	10.298
CO <sub>2</sub> , % volume dry	11.51	9.83	9.38	10.24
Moisture content, % volume	14.91	13.76	13.17	13.94
Gas temperature, °F	322.8	329.1	314.9	322.3
Flow rate, dscfm	21,242	23,203	23,075	22,506
<b>CO Emissions:</b>				
ppm volume dry	103.25	176.01	167.21	148.82
ppm volume dry @ 7% O <sub>2</sub>	120.10	240.71	239.78	200.20
lb/hr	9.57	17.81	16.83	14.73
tons/year	41.90	78.01	73.71	64.54
lb/1,000 lb of steam	0.199	0.422	0.411	0.344
<b>NO<sub>x</sub> Emissions:</b>				
ppm volume dry	97.72	99.28	94.55	97.18
ppm volume dry @ 7% O <sub>2</sub>	113.67	135.77	135.59	128.34
lb/hr as NO <sub>2</sub>	14.87	16.50	15.63	15.67
tons/year as NO <sub>2</sub>	65.13	72.28	68.46	68.63
lb/1,000 lb of steam	0.309	0.391	0.382	0.360
<b>SO<sub>2</sub> Emissions:</b>				
ppm volume dry	0.39	0.15	0.46	0.33
ppm volume dry @ 7% O <sub>2</sub>	0.45	0.21	0.66	0.44
lb/hr	0.08	0.03	0.11	0.07
tons/year	0.36	0.15	0.46	0.33
lb/1,000 lb of steam	0.002	0.001	0.003	0.002

Notes: The volumetric flow rates were measured with the concurrent PCDD/PCDF test runs.  
 The ton/year emission rates are calculated based on 8,760 operation hours per year and the measured emission rates.



## 6.6 FORMALDEHYDE EMISSIONS

The results of the emission tests for formaldehyde are summarized in Table 6-7. Detailed laboratory results are included in Appendix E.6. Results have been calculated as described in CARB Method 430. The results are presented in units of milligrams per dry standard cubic meter (mg/dscm), ppb volume dry, ppm @ 7% O<sub>2</sub> and lb/hr for each test run.

CARB Method 430 prescribes correction of the results for the field blanks in those cases where the sample concentrations are at least 5 times the “background” concentrations in the field blanks. If the sample-to-blank ratio is less than 5, then the emissions are best represented by the non-blank-corrected results, which are an upper bound for the measured concentrations. If the ratio is greater than 5, then the emissions are best represented by the blank-corrected results. For these test runs, all results are presented as non-blank corrected.

The results have also been calculated in terms of the CARB reporting limit for each test run. Since the measured concentrations were above the reporting limits, the average result is presented in the tables. The CARB reporting limit results can be found in Appendix F.2.5.

Some sample fractions may have included aldehyde concentrations below the detection limit of the laboratory analysis. Those cases are noted with the symbol “<” and the results calculated at the detection limit for that sample fraction. If no formaldehyde was detected in all the fractions, then the symbol “ND<” was used to flag the entire sample as below the detection limit; the results were calculated at the detection limit.



**TABLE 6-7**  
**SUMMARY OF RESULTS**  
**ALDEHYDE EMISSIONS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAWMILL**

Parameter	1-Form	2-Form	3-Form	Average
<b>Date:</b>	08/12/2009	8/13/2009	08/13/2009	--
<b>Time:</b>	1503-1903	0757-1157	1301-1701	--
<b>Process Data:</b>				
Steam output, lb/hr	48,100	42,250	40,960	43,770
<b>Stack Gas Data:</b>				
O <sub>2</sub> , % volume dry	8.950	10.736	11.207	--
Flow rate, dscfm	21,242	23,203	23,075	--
<b>Formaldehyde:</b>				
mg/dscm	0.094	0.055	0.058	0.069
ppb volume dry	75.2	44.3	46.7	55.4
ppm volume dry	0.075	0.044	0.047	0.055
ppm @ 7% O <sub>2</sub>	0.088	0.061	0.067	0.072
gram/hr	3.39	2.18	2.284	2.616
lb/hr	7.46E-03	4.79E-03	5.03E-03	5.76E-03
lb/MMBtu	9.84E-05	5.79E-05	6.11E-05	7.24E-05

Notes: 1) The results for tests 1-FORM, 2-FORM and 3-FORM presented above are not blank-corrected in accordance with the EPA ICR.  
 2) The volumetric flow rate information is from the PCDD/PCDF sampling train performed concurrently with the formaldehyde tests.

## 6.7 VOLATILE ORGANIC COMPOUNDS

The results of the volatile organic compounds (VOC) tests conducted at the stack location are summarized in Table 6-8. Emission rates in terms of lb/hr were calculated for each compound using the measured concentration and the corresponding stack flow rate for the test run. Detailed laboratory results are included in Appendix E.5. Triplicate 240-minute test runs were performed in accordance with EPA Methods 18 and 25A.



**TABLE 6-8**  
**SUMMARY OF RESULTS**  
**VOLATILE ORGANIC COMPOUND EMISSIONS**  
**HOG FUEL BOILER EXHAUST STACK**  
**WEYERHAEUSER RAYMOND SAWMILL**

Parameter	Run 1	Run 2	Run 3	Averages
<b>Date:</b>	8/12/09	08/13/09	8/13/09	--
<b>Time:</b>	1357-1800	0757-1159	1248-1650	--
<b>Process Data:</b>				
Steam output, lb/hr	48,100	42,250	40,960	43,770
<b>Stack Gas:</b>				
O <sub>2</sub> , % volume dry	8.950	10.736	11.207	10.298
CO <sub>2</sub> , % volume dry	11.51	9.83	9.38	10.24
Moisture content, % volume	14.91	13.76	13.17	13.94
Gas temperature, °F	322.8	329.1	314.9	322.3
Stack flow rate, dscfm	21,242	23,203	23,075	22,506
<b>THC Emissions:</b>				
ppm volume dry as C <sub>3</sub> H <sub>8</sub>	< 1.41	< 1.39	< 1.38	< 1.39
ppmvd @ 7% O <sub>2</sub> as C <sub>3</sub> H <sub>8</sub>	< 1.64	< 1.90	< 1.98	< 1.84
lb/hr as C <sub>3</sub> H <sub>8</sub>	< 1.47	< 1.70	< 1.77	< 1.65
lb/hr as C	0.056	0.060	0.060	< 0.059
lb/day as C	1.34	1.45	1.43	< 1.41
lb/MMBtu as C	0.001	0.001	0.001	< 0.001
lb/hr as CH <sub>4</sub>	< 0.224	< 0.242	< 0.239	< 0.235
lb/day as CH <sub>4</sub>	< 5.39	< 5.81	< 5.73	< 5.64
lb/MMBtu as CH <sub>4</sub>	< 0.001	< 0.001	< 0.001	< 0.001
<b>Methane Emissions:</b>				
ppm volume dry	2.96	1.03	2.26	2.08
ppmvd @ 7% O <sub>2</sub>	3.44	1.41	3.24	2.70
lb/hr	0.157	0.060	0.130	0.116
<b>VOC Emissions (NMOC):</b>				
lb/hr as CH <sub>4</sub>	< 0.067	< 0.182	< 0.109	< 0.119
lb/day as CH <sub>4</sub>	< 1.62	< 4.37	< 2.61	< 2.87
lb as CH <sub>4</sub> /1,000 lb of steam	< 0.001	< 0.004	< 0.003	< 0.003

Notes: 1) The less than (<) notation indicates one or more compounds were not detected in the sample.  
 2) Non-detected species were calculated using the full reporting limit.  
 3) Emission results for VOC include all 62 compounds that the samples were analyzed for. Not all compounds were detected. Please refer to Appendix F.2.7 for details on the individual compounds.



## **Attachment B**

### **Arsenic to PM<sub>10</sub> Ratio Calculation**

Submitted Electronically

## Attachment C

### Updated Emission Calculations

Submitted Electronically

## **Attachment D**

### **Updated Arsenic Models**

Submitted Electronically