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DEPARTMENT OF ENVIRONMENTAL QUALITY
STATE A Q PROGRAM

February 14, 2012

Bill Rogers, P.E.
Idaho Department of Environmental Quality
Air Quality Division
1410 N. Hilton
Boise, ID 83706
Tel: (208) 373 – 0502

Re: Idaho Forest Group – Moyie Springs, Facility ID No. 021-00001

Dear Bill:

Idaho Forest Group (IFG) owns and operates a lumber facility at Moyie Springs, Idaho. The Moyie Springs facility is regulated under Tier I Operating Permit No. T1-2007.0072. The Tier I permit incorporates, but does not supersede, PTC/Tier II No. T2-050113. IFG is submitting the enclosed Permit to Construct (PTC) application to modify PTC/Tier II No. T2-050113 by adding plant-wide limitations on Hazardous Air Pollutants (HAP) emissions. This application package includes a check for $1,000 to cover the Permit to Construct Application Fee, as required under IDAPA 58.01.01.224.

Permitting History and Actual Emissions

The requested permit conditions would to limit HAPs emissions to less than 10 tons per year (tpy) of a single HAP and 25 tpy of total HAPs. These permit changes will make the Moyie Springs facility a minor (area) source of HAPs. IFG has been considering this permit change since Permit No. T2-050113 was issued in August 2009. IFG submitted a similar permit application on August 31, 2010, which was deemed incomplete because it did not use the most recent dry kiln HAP emission factors. IFG withdrew the PTC application on October 15, 2010 due to uncertainty about how much the new HAP emission factors, published in 2008, would limit allowable kiln production.

The August 2009 Tier II/PTC permit includes steam production limits on the boiler and lumber production limits on the kilns. IFG has operated under this permit for two and a half years, and has found that the steam production limit is the limiting factor for kiln production. IFG cannot produce the permitted kiln lumber throughput using the permitted amount of steam allowed. In essence, the Moyie Springs mill has not been a major source of HAPs since Tier II/PTC No. T2-050113 went into effect in August 2009.

IFG has been tracking the actual rolling 12-month HAP emissions from the facility from December 2009 through December 2011, using the 2008 dry kiln emission factors. The highest total HAP emission during a consecutive 12-month period was 15 tpy and the highest single HAP emissions during a consecutive 12-month period was 6.1 tpy. IFG is confident that the HAP emissions from the mill will not exceed the proposed minor source HAP limits.

Potential to Emit

The Moyie Springs TIER II/PTC permit limits lumber throughput to the dry kilns to 199 million board feet per any consecutive 12-calendar month period (MMBF/yr). IFG is proposing to modify Permit Condition 4.5 to limit dry kiln lumber throughput to 160 MMBF/yr. IFG has determined that the mill cannot exceed this kiln production capacity with the permitted steam supply.

The PTE HAP emissions from the facility, including the boiler and dry kilns, have been calculated using the HAP emissions tracking spreadsheet in Attachment A. Using a representative wood-species mix, the PTE spreadsheet shows that IFG can comply with the proposed HAP emission limits. IFG will continue to use the HAP emissions tracking spreadsheet to verify compliance with the HAP emission limits.

Boiler MACT Applicability

By reclassifying the mill as a minor HAP source, IFG will avoid becoming subject to EPA's Boiler Maximum Achievable Control Technology (Boiler MACT) rules. The Boiler MACT rules became final in 2004, and were then vacated. EPA proposed the Boiler MACT regulations again on June 4, 2010 and they became final on March 21, 2011. On May 18, 2011, EPA issued a rule to delay the effective date of the Boiler MACT regulations. On December 23, 2011 EPA proposed revised Boiler MACT rules. On January 9, 2012, the DC Circuit Court of Appeals overturned the May 18, 2011 delay of the Boiler MACT rules. For now, IFG is assuming that the March 21, 2011 Boiler MACT rules will become the final rules.

On May 16, 1995, John Seitz, Director of the Office of Air Quality Planning and Standards of EPA, issued a memo titled "Potential to Emit for MACT Standards – Guidance on Timing Issues." The conditions established in this memo have become known as the "once-in-always-in" provision of the MACT standards. The memo states:

> *The purpose of this memo is to clarify* when *a major source of hazardous air pollutants can become an area source – by obtaining federally enforceable limits on its potential to emit – rather than comply with major source requirements.*

The memo goes on to state the following, as relates to existing sources:

> *Today's guidance clarifies that facilities may switch to area source status at any time until the "first compliance date" of the standard. The "first compliance date" is defined as the first date a source must comply with an emission limitation or other substantive regulatory requirement (i.e., leak detection and repair programs, work practice measures, housekeeping measures, etc..., but not a*

notice requirement) in the applicable MACT standard. By that date, to avoid being in violation, a major source must either comply with the standard, or obtain and comply with federally enforceable limits ensuring that actual and potential emissions are below major source thresholds.

The March 21, 2011 Boiler MACT rules were published in the Federal Register (FR), Vol. 76, No. 54. FR Section §63.7495(b) describes when existing sources have to comply with the subpart. It states "If you have an existing boiler or process heater, you must comply with this subpart no later than March 21, 2014."

If the March 21, 2011 Boiler MACT rules become the final version, the first compliance date for IFG would have been March 21, 2014. Therefore IFG is eligible to take federally enforceable limits at this time to become a minor source and avoid Boiler MACT applicability.

Plywood (PCWP) MACT Applicability

Riley Creek Lumber, former owners of the Moyie Springs facility, submitted notification in 2005 stating that the Plywood and Composite Wood Product (PCWP) MACT (NESHAP Subpart DDDD) applied to the Moyie Springs mill. This notification was based on the fact that the mill had not been shown to be a minor source of HAPs at that time.

Upon review, IFG has determined that the facility will no longer be subject to the PCWP MACT after the HAP emission limits are in effect. The PCWP MACT regulations contain no requirements for lumber dry kilns other than notification requirements. Since no substantive requirements for lumber dry kilns gone into effect, IFG is eligible to take federally enforceable limits at this time to become a minor source and avoid PCWP MACT applicability

Permit Application Package

This application package includes the following information:

- Cover Sheet, Form CSPTC.
- General Information, Form GI. Please note that the Plant Manager has changed.
- Idaho Form FRA, NSPS/NESHAP Regulations Review and Applicability Form.
- HAP emission inventory description, contained in Attachment A.
- HAP emissions calculation spreadsheets (also submitted electronically).
- HAP emission factor reference documentation, contained in Attachment B.
- Check for $1,000 to cover the application fee

Please call me at the phone number listed on the general information sheet if you have any questions. You can also contact Diane Lorenzen at (406) 549-0210 with technical questions about the application materials.

Sincerely,

Bob Blanford

Bob Blanford
Plant Manager

Enclosure

✓# 048038 $1000.00

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DEQ AIR QUALITY PROGRAM
1410 N. Hilton, Boise, ID 83706
For assistance, call the
Air Permit Hotline – 1-877-5PERMIT

Cover Sheet for Air Permit Application – Permit to Construct **Form CSPTC**

Please see instructions on page 2 before filling out the form.

COMPANY NAME, FACILITY NAME, AND FACILITY ID NUMBER			
1. Company Name	Idaho Forest Group		
2. Facility Name	Moyie Springs	3. Facility ID No.	021-00001
4. Brief Project Description - One sentence or less	Modify PTC to limit HAP emissions to 10 tpy of a single HAP and 25 tpy of total HAPs.		

PERMIT APPLICATION TYPE

5. ☐ New Source ☐ New Source at Existing Facility ☐ PTC for a Tier I Source Processed Pursuant to IDAPA 58.01.01.209.05.c
☐ Unpermitted Existing Source ☒ Facility Emissions Cap ☐ Modify Existing Source: Permit No.:_____ Date Issued:_____
☐ Required by Enforcement Action: Case No.:_____

6. ☒ Minor PTC ☐ Major PTC

FORMS INCLUDED

Included	N/A	Forms	DEQ Verify
☒	☐	Form CSPTC – Cover Sheet	☐
☒	☐	Form GI – Facility Information	☐
☐	☐	Form EU0 – Emissions Units General	☐
☐	☐	Form EU1– Industrial Engine Information Please specify number of EU1s attached: _____	☐
☐	☐	Form EU2– Nonmetallic Mineral Processing Plants Please specify number of EU2s attached: _____	☐
☐	☐	Form EU3– Spray Paint Booth Information Please specify number of EU3s attached: _____	☐
☐	☐	Form EU4– Cooling Tower Information Please specify number of EU3s attached: _____	☐
☐	☐	Form EU5 – Boiler Information Please specify number of EU4s attached: _____	☐
☐	☐	Form CBP– Concrete Batch Plant Please specify number of CBPs attached: _____	☐
☐	☐	Form HMAP – Hot Mix Asphalt Plant Please specify number of HMAPs attached: _____	☐
☐	☐	PERF – Portable Equipment Relocation Form	☐
☐	☐	Form AO – Afterburner/Oxidizer	☐
☐	☐	Form CA – Carbon Adsorber	☐
☐	☐	Form CYS – Cyclone Separator	☐
☐	☐	Form ESP – Electrostatic Precipitator	☐
☐	☐	Form BCE– Baghouses Control Equipment	☐
☐	☐	Form SCE– Scrubbers Control Equipment	☐
☐	☐	Form VSCE – Venturi Scrubber Control Equipment	☐
☐	☐	Form CAM – Compliance Assurance Monitoring	☐
☐	☐	Forms EI-CP1 - EI-CP4– Emissions Inventory– criteria pollutants (Excel workbook, all 4 worksheets)	☐
☐	☐	PP – Plot Plan	☐
☐	☐	Forms MI1 – MI4 – Modeling (Excel workbook, all 4 worksheets)	☐
☒	☐	Form FRA – Federal Regulation Applicability	☐

DEQ AIR QUALITY PROGRAM
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Air Permit Hotline – 1-877-5PERMIT

General Information **Form GI**
Revision 7
2/18/10

Please see instructions on page 2 before filling out the form.

All information is required. If information is missing, the application will not be processed.

IDENTIFICATION

1. Company Name	2. Facility Name:
Idaho Forest Group	Moyie Springs

3. Brief Project Description:	Request emissions limits of 10 tpy of a single HAP and 25 tpy of total HAPs, so the facility is defined as a Minor Source for HAPs.

FACILITY INFORMATION

4. Primary Facility Permit Contact Person/Title	Bob Blanford		Plant Manager	
5. Telephone Number and Email Address	(208) 255-3271		bblanford@idahoforestgroup.com	
6. Alternate Facility Contact Person/Title	Chris Pease		Environmental Contact	
7. Telephone Number and Email Address	(208) 255-3252		cjensen@idahoforestgroup.com	
8. Address to Which the Permit Should be Sent	P.O. Box 108			
9. City/County/State/Zip Code	Moyie Springs	Boundary	Idaho	83845
10. Equipment Location Address (if different than the mailing address above)	1 mile off Old Highway 2			
11. City/County/State/Zip Code	Moyie Springs	Boundary	Idaho	83845
12. Is the Equipment Portable?	☐ Yes ☒ No			
13. SIC Code(s) and NAICS Code	Primary SIC: 2421	Secondary SIC:	NAICS: 321113	
14. Brief Business Description and Principal Product	Sawmill, dry kilns and planer mill that produce finished lumber			
15. Indentify any adjacent or contiguous facility that this company owns and/or operates	None			
16. Specify the reason for the application	☒ Permit to Construct (PTC) For Tier I permitted facilities only: If you are applying for a PTC then you must also specify how the PTC will be incorporated into the Tier I permit. ☒ Incorporate the PTC at the time of the Tier I renewal ☐ Co-process the Tier I modification and PTC ☐ Administratively amend the Tier I permit to incorporate the PTC upon your request (IDAPA 58.01.01.209.05.a, b, or c) ☐ Tier I Permit ☐ Tier II Permit ☐ Tier II/Permit to Construct			

CERTIFICATION

In accordance with **IDAPA 58.01.01.123 (Rules for the Control of Air Pollution in Idaho), I** certify based on information and belief formed after reasonable inquiry, the statements and information in the document(s) are true, accurate, and complete.

17. Responsible Official's Name/Title	Scott Atkison	President	
18. Responsible Official's Signature	[signature]	Date:	6/8/12

19. ☒ Check here to indicate that you would like to review the draft permit prior to final issuance.

DEQ AIR QUALITY PROGRAM
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Air Permit Hotline – 1-877-5PERMIT

AIR PERMIT APPLICATION

Revision 6
10/7/09

For each box in the table below, CTRL+click on the blue underlined text for instructions and information.

IDENTIFICATION	
1. Company Name: Idaho Forest Group	2. Facility Name: Moyie Springs
3. Brief Project Description:	Request emissions limits of 10 tpy of a single HAP and 25 tpy of total HAPs, so the facility is defined as a Minor Source for HAPs.
APPLICABILITY DETERMINATION	
4. List applicable subparts of the New Source Performance Standards (NSPS) (40 CFR part 60). Examples of NSPS affected emissions units include internal combustion engines, boilers, turbines, etc. The applicant must thoroughly review the list of affected emissions units.	List of applicable subpart(s): **Not Applicable**
5. List applicable subpart(s) of the National Emission Standards for Hazardous Air Pollutants (NESHAP) found in 40 CFR part 61 and 40 CFR part 63. Examples of affected emission units include solvent cleaning operations, industrial cooling towers, paint stripping and miscellaneous surface coating. EPA has a web page dedicated to NESHAP that should be useful to applicants.	List of applicable subpart(s): No current or proposed NESHAP will apply because the mill is no longer a major HAPs source. NESHAP Subpart DDDD previously applied, but did not have substantive requirements for lumber dry kilns so it no longer applies. The facility does not have any emergency or non-emergency SI or CI RICE units.
6. For each subpart identified above, conduct a complete a regulatory analysis using the instructions and referencing the example provided on the following pages. **Note** - Regulatory reviews must be submitted with sufficient detail so that DEQ can verify applicability and document in legal terms why the regulation applies. Regulatory reviews that are submitted with insufficient detail will be determined incomplete.	☐ A detailed regulatory review is provided (Follow instructions and example). ☐ DEQ has already been provided a detailed regulatory review. Give a reference to the document including the date.

Attachment A

Idaho Forest Group – Moyie Springs
Facility Wide Hazardous Air Pollutant Potential to Emit

HAP Potential to Emit (PTE) emissions have been calculated for the hog fuel boiler, dry kilns and fugitive sources at the Moyie Springs lumber mill. The only source of fugitive HAP emissions is diesel fuel combustion in vehicles, and the PTE total is very small.

Hog fuel boiler HAP emission calculations are based primarily on AP-42 emission factors from AP-42 Section 1.6. In 2003, the former owner of the Moyie Springs lumber mill commissioned HAP tests on the hog fuel boiler. Emission factors based on the on-site test results were used for the pollutants included in the test. The summary page from the 2003 Moyie Springs source test is included in Attachment B.

The HAP emissions inventory has been updated using the information contained in the attached article titled "Emissions of hazardous air pollutants from lumber drying" published in the July/August 2008 issue of the Forest Products Journal. A search of the internet has not shown any more recent dry kiln HAP research. The kiln HAP reference is included in Attachment B.

The kiln PTE HAP emissions are based on a typical species mix of 56% Douglas fir/larch (DF), 25% western hemlock or hem fir (HF), 12% Engelmann spruce and lodgepole pine (ESLP), 6% alpine fir and other white wood (AF/WW), and 1% Ponderosa Pine (P. Pine). White wood emission factors have been used for the ESLP and AF/WW lumber groups, while accounting for differences of drying temperature.

Facility-wide HAP emissions are summarized in Table 1. A print-out of the spreadsheet used to calculate HAP PTE emissions from the kilns and boiler is attached. The spreadsheet has been proved to Idaho DEQ in electronic format. A printout of the PTE HAP emissions from vehicles is also attached. Units for the HAP emissions are in tons per year (T/yr).

Table 1: HAP POTENTIAL TO EMIT EMISSIONS SUMMARY

HAP Pollutants	PTE (T/yr)
Acetaldehyde	6.8
Methanol*	9.9*
Formaldehyde	1.8
Acrolein	1.4
Benzene	1.3
Other Individual Haps	<1
Total HAPs	23

* Maximum Individual HAP

Moyie Springs Kiln Production
Actually Monthly Production is Entered into Yellow Cells

Permit Limit, Proposed
160,000 mbdft/yr

Month	Monthly Production – board feet (bdft): Total	DF	HF	ESLP	AF/WW	P. Pine	Running 12-month Production – thousand board feet (mbdft): Total	DF	HF	ESLP	AF/WW	P. Pine
Jan-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Feb-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Mar-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Apr-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
May-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Jun-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Jul-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Aug-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Sep-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Oct-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Nov-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Dec-11	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Jan-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Feb-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Mar-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Apr-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
May-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Jun-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Jul-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Aug-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Sep-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Oct-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Nov-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
Dec-12	13,333,333	7,500,000	3,300,000	1,600,000	800,000	133,333	160,000	90,000	39,600	19,200	9,600	1,600
etc.												
							Prod. % Used	56%	25%	12%	6%	1%

Running 12-month HAP Calculation
Moyie Springs Boiler
Enter monthly steam usage in yellow cells.

Month	Steam 1000 pounds	Running 12-month Steam (k lb) (Permit Limit 391,000 klb/yr)	Running 12-month MMBtu	Total HAPs 1.83E-02	Acetald 8.30E-04	Acrolein 4.00E-03	Benzene 4.20E-03	Formad 4.40E-03	HCl 3.00E-04
				Pollutant (emission factors units lb/MMBtu)					
Jan-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Feb-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Mar-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Apr-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
May-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Jun-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Jul-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Aug-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Sep-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Oct-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Nov-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Dec-11	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Jan-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Feb-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Mar-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Apr-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
May-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Jun-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Jul-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Aug-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Sep-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Oct-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Nov-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09
Dec-12	32,583	390,996	620,902	5.68	0.26	1.24	1.30	1.37	0.09

IFG -- Moyie Springs
HAP Compliance Determination

Month	Total HAPs	Acetald	Acrolein	Propanal	Formad	Methanol	HCl	Major?
	(tons per year)							
Jan-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Feb-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Mar-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Apr-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
May-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Jun-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Jul-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Aug-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Sep-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Oct-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Nov-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Dec-11	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Jan-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Feb-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Mar-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Apr-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
May-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Jun-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Jul-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Aug-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Sep-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Oct-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Nov-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Dec-12	22.93	6.80	1.41	1.57	1.73	9.91	0.09	FALSE
Proposed HAP Limit	25	10	10	10	10	10	10	

Running 12-month HAP Calculation
Moyie Springs Kilns

Emission Factors based on 2008 research, highest temperature emission factor usec

EMISSION FACTORS:	lb Pollutant / MBF for Lumber Dry Kilns Temperatures as shown on Page 5					
Pollutant	Total HAP	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
Ponderosa Pine	0.1483	0.1021	0.0067	0.0334	0.0027	0.0034
ESLP	0.2431	0.1247	0.0070	0.1018	0.0044	0.0054
Douglas Fir	0.1903	0.1170	0.0043	0.0670	0.0008	0.0012
AF/WW	0.2431	0.1247	0.0070	0.1018	0.0044	0.0054
Hem Fir	0.2559	0.1399	0.0032	0.1029	0.0084	0.0016

Running 12-month (reads from kiln page) — HAP Calculations

Month	Total	DF	HF	ESLPAF	AF/WW	P.Pine	Total HAPs	Acetald	Acrolein	Propional	Formad	Methanol
	thousand board feet (mbdft)						(tons per year)					
Dec-10	160,000											
Jan-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Feb-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Mar-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Apr-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
May-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Jun-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Jul-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Aug-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Sep-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Oct-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Nov-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Dec-11	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Jan-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Feb-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Mar-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Apr-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
May-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Jun-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Jul-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Aug-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Sep-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Oct-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Nov-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91
Dec-12	160,000	90,000	39,600	19,200	9,600	1,600	17.25	6.54	0.16	0.27	0.36	9.91

Kiln HAP Emission Factors are based on 2008 Milota Research (Attached) According to this reference, Kiln HAP emissions are temperature dependent. The testing spanded ranges from 170F to 235 F. This page allows the kiln temps to be entered so an appropriate emission factor for each HAP and Wood Species can be determined. Kiln temperatures are exiting air temperatures.

	P Pine		Actual Temp
Temperature (F)	**170**	**235**	**210**
Methanol	0.035	0.144	0.1021
Formaldehyde	0.0027	0.0092	0.0067
Acetaldehyde	0.042	0.028	0.0334
Propioandehyde	0.0019	0.0032	0.0027
Acrolein	0.0017	0.0045	0.0034

	Doug-Fir		
Temperature (F)	**200**	**235**	**235**
Methanol	0.069	0.117	0.1170
Formaldehyde	0.0019	0.0043	0.0043
Acetaldehyde	0.071	0.067	0.0670
Propioandehyde	0.0006	0.0008	0.0008
Acrolein	0.0004	0.0012	0.0012

	Hem-Fir		
Temperature (F)	**200**	**235**	**220**
Methanol	0.077	0.187	0.1399
Formaldehyde	0.0014	0.0045	0.0032
Acetaldehyde	0.128	0.084	0.1029
Propioandehyde	0.001	0.014	0.0084
Acrolein	0.0011	0.0019	0.0016

	ESLP		
Temperature (F)	**190**	**235**	**210**
Methanol	0.074	0.188	0.1247
Formaldehyde	0.0045	0.0101	0.0070
Acetaldehyde	0.144	0.049	0.1018
Propioandehyde	0.0044	0.0043	0.0044
Acrolein	0.005	0.0058	0.0054

	AF/WW		
Temperature (F)	**190**	**235**	**240**
Methanol	0.074	0.188	0.2007
Formaldehyde	0.0045	0.0101	0.0107
Acetaldehyde	0.144	0.049	0.0384
Propioandehyde	0.0044	0.0043	0.0043
Acrolein	0.005	0.0058	0.0059

IDAHO FOREST GROUP - MOYIE BOILER
HAZARDOUS AIR POLLUTANTS (HAPS)

Operating Parameters:

Potential Hours of Operation	8,760	hours/yr
Annual Steam Production	273,275	k lbs/yr
Annual Boiler Heat Input, max	433,961	mmBtu /yr

Emission Factors:

AP-42 Ch.1.6, Tables 1.6-3 and 1.6-4 (9/03), * indicates emission from Riley Creek tests	Emission Factor (lb/mmBtu)	Total Annual Emissions (tons/yr)
Acetaldehyde	8.30E-04	1.80E-01
Acetophenone	3.20E-09	6.94E-07
Acrolein	4.00E-03	8.68E-01
Benzene	4.20E-03	9.11E-01
Benzo(a)pyrene	2.60E-06	5.64E-04
bis(2-ethylhexyl)phthalate	4.70E-08	1.02E-05
Bromomethane (methyl bromide)	1.50E-05	3.25E-03
2-Butanone (MEK)	5.40E-06	1.17E-03
Carbon tetrachloride	4.50E-05	9.76E-03
Chlorine	7.90E-04	1.71E-01
Chlorobenzene	3.30E-05	7.16E-03
Chloroform	2.80E-05	6.08E-03
Chloromethane (Methyl Chloride)	2.30E-05	4.99E-03
1,2-Dichloroethane	2.90E-05	6.29E-03
Dichloromethane (Methylenechloride)	2.90E-04	6.29E-02
1,2-Dichloropropane (Propolyene dichloride)	3.30E-05	7.16E-03
Ethylbenzene	3.10E-05	6.73E-03
Formadehyde	4.40E-03	9.55E-01
Hydrogen chloride*	3.00E-04	6.51E-02
Naphthalene	9.70E-05	2.10E-02
4-Nitrophenol	1.10E-07	2.39E-05
Pentachlorophenol	5.10E-08	1.11E-05
Phenol	5.10E-05	1.11E-02
Polycyclic Organic Matter (POM)	2.89E-06	6.27E-04
Benzo(a)anthracene	6.50E-08	
Benzo(a)pyrene	2.60E-06	
Benzo(b)fluoranthene	1.00E-07	
Benzo(k)fluoranthene	3.60E-08	
Indeno(1,2,3,cd)pyrene	8.70E-08	
Styrene	1.90E-03	4.12E-01
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.60E-12	1.87E-09
Toluene	9.20E-04	2.00E-01
1,1,1-Trichloroethane (Methyl Chloroform)	3.10E-05	6.73E-03
2,4,6-Trichlorophenol	2.20E-08	4.77E-06
Vinyl Chloride	1.80E-05	3.91E-03
o-Xylene	2.50E-05	5.42E-03
Antimony	7.90E-06	1.71E-03
Arsenic*	2.00E-06	4.34E-04
Berylium	1.10E-06	2.39E-04
Cadmium*	3.00E-06	6.51E-04
Chromium, total*	1.00E-06	2.17E-04
Chromium, hexavalent*	1.00E-06	2.17E-04
Cobalt	6.50E-06	1.41E-03
Lead*	1.00E-05	2.17E-03
Manganese*	1.20E-04	2.60E-02
Mercury*	1.56E-06	3.38E-04
Nickel	3.30E-05	7.16E-03
Selenium	2.80E-06	6.08E-04
TOTAL HAPS	**1.83E-02**	**3.97**

IDAHO FOREST GROUP - MOYIE FUGITIVE
HAZARDOUS AIR POLLUTANTS (HAPS)

The primary source of fugitive HAPs is diesel combustion in equipment engines including fork lifts etc.

Annual Fuel Usage, PTE	223,400	gallons/year
Fuel Heat Content	137,000	Btu/gallon
Annual Fuel Usage, PTE	30,606	mmBtu /yr

Emission Factors:		
AP-42 Ch.1.6, Tables 1.6-3 and 1.6-4 (9/03). *Indicates emission from Moyie Springs test. **Indicates factor from NCASI TB 858.	Emission Factor (lb/mmBtu)	Total Annual Emissions (tons/yr)
Acetaldehyde	7.67E-04	1.17E-02
Acrolein	9.25E-05	1.42E-03
Benzene	9.33E-04	1.43E-02
Propylene	2.58E-03	3.95E-02
1,3-Butadiene	3.91E-05	5.98E-04
Formadehyde	1.18E-03	1.81E-02
Polycyclic aromatic hydrocarbons(PAH)	1.68E-04	2.57E-03
Naphthalene	8.48E-05	1.30E-03
Acenaphthylene	5.06E-06	7.74E-05
Acenaphthene	1.42E-06	2.17E-05
Fluorene	2.92E-05	4.47E-04
Phenanthrene	2.94E-05	4.50E-04
Anthracene	1.87E-06	2.86E-05
Fluoranthene	7.61E-06	1.16E-04
Pyrene	4.78E-06	7.31E-05
Benzo(a)anthracene	1.68E-06	
Chrysene	3.53E-07	
Benzo(a)pyrene	1.88E-07	
Benzo(b)fluoranthene	9.91E-08	
Benzo(k)fluoranthene	1.55E-07	
Indeno(1,2,3,cd)pyrene	3.75E-07	
Dibenz(a,h)anthracene	5.83E-07	
Benzo(g,h,l)perlyene	4.89E-07	
Toluene	4.09E-04	6.26E-03
Xylenes	2.85E-04	4.36E-03
	TOTAL HAPS	**0.10**

Moyie Springs Kiln Production

Permit Limit
199,000 mbdft/yr

Month	Monthly Production						Running 12-month Production					
	Total	DF	HF	ESLP	AF/WW	P. Pine	Total	DF	HF	ESLP	AF/WW	P. Pine
	board feet (bdft)						thousand board feet (mbdft)					
Jan-09	9,307,716	5,328,541	1,336,627	1,761,699	880,849	0						
Feb-09	8,641,023	3,839,554	1,322,402	2,319,378	1,159,689	0						
Mar-09	9,752,977	4,707,521	1,870,102	2,116,903	1,058,451	0						
Apr-09	9,932,708	6,508,017	2,158,081	844,407	422,203	0						
May-09	7,270,096	3,546,053	956,786	1,844,838	922,419	0						
Jun-09	8,191,712	5,768,101	1,503,460	613,434	306,717	0						
Jul-09	8,273,257	5,963,640	462,374	1,231,495	615,748	0						
Aug-09	8,624,529	6,481,617	959,280	789,088	394,544	0						
Sep-09	8,355,168	4,944,123	1,947,013	976,021	488,011	0						
Oct-09	8,077,265	3,418,957	2,470,018	1,458,860	729,430	0						
Nov-09	8,837,005	5,189,460	1,845,524	1,201,347	600,674	0						
Dec-09	8,766,598	4,234,604	1,704,030	1,885,309	942,655	0	104,030	59,930	18,536	17,043	8,521	0
Jan-10	9,807,323	5,813,435	1,988,130	1,319,045	686,713	0	104,530	60,415	19,187	16,600	8,327	0
Feb-10	8,630,875	5,321,664	2,256,575	701,757	350,879	0	104,520	61,897	20,121	14,983	7,518	0
Mar-10	9,733,040	6,994,508	1,839,376	599,437	299,719	0	104,500	64,184	20,091	13,465	6,760	0
Apr-10	8,793,729	5,898,120	2,056,337	559,515	279,757	0	103,361	63,574	19,989	13,180	6,617	0
May-10	8,302,080	5,533,172	1,506,927	841,321	420,660	0	104,393	65,561	20,539	12,177	6,116	0
Jun-10	8,753,679	4,689,135	1,883,851	1,149,520	1,031,173	0	104,955	64,482	20,919	12,713	6,840	0
Jul-10	8,359,178	6,391,039	1,256,604	474,357	237,178	0	105,040	64,910	21,714	11,956	6,461	0
Aug-10	8,323,905	5,627,743	1,800,552	597,073	298,537	0	104,740	64,056	22,555	11,764	6,365	0
Sep-10	9,116,771	6,530,612	1,699,620	591,026	295,513	0	105,501	65,642	22,308	11,379	6,173	0
Oct-10	8,171,207	5,480,158	1,795,221	597,219	298,609	0	105,595	67,704	21,633	10,517	5,742	0
Nov-10	7,851,764	5,450,865	1,170,255	820,429	410,215	0	104,610	67,965	20,957	10,136	5,552	0
Dec-10	9,306,651	5,627,550	1,876,098	768,434	384,217	650,352	105,150	69,358	21,130	9,019	4,993	650
Jan-11	9,083,361	4,888,641	2,977,861	811,239	405,620	0	104,426	68,433	22,119	8,511	4,712	650
Feb-11	8,075,168	3,857,979	2,702,769	1,009,613	504,807	0	103,871	66,970	22,565	8,819	4,866	650
Mar-11	9,246,512	5,804,527	2,126,519	876,977	438,489	0	103,384	65,780	22,853	9,097	5,005	650
Apr-11	9,063,976	4,495,557	1,936,362	1,754,705	877,352	0	103,654	64,377	22,733	10,292	5,602	650
May-11	8,758,581	3,622,851	2,553,649	1,721,387	860,694	0	104,111	62,467	23,779	11,172	6,042	650
Jun-11	8,870,999	4,765,240	1,844,968	1,206,925	603,463	450,403	104,228	62,543	23,740	11,229	5,615	1,101
Jul-11	8,751,717	4,273,881	2,785,459	1,128,251	564,126	0	104,621	60,426	25,269	11,883	5,942	1,101
Aug-11	9,164,437	5,546,652	2,732,815	589,980	294,990	0	105,461	60,345	26,202	11,876	5,938	1,101
Sep-11	8,724,207	4,675,280	2,364,666	1,122,841	561,420	0	105,069	58,489	26,867	12,408	6,204	1,101
Oct-11	8,843,333	3,324,813	3,709,198	1,206,215	603,107	0	105,741	56,334	28,781	13,017	6,508	1,101
Nov-11	8,381,422	3,870,771	3,201,088	873,042	436,521	0	106,270	54,754	30,811	13,070	6,535	1,101
Dec-11	8,787,380	4,531,182	2,661,382	1,063,211	531,605	0	105,751	53,657	31,597	13,364	6,682	450

Running 12-month HAP Calculation
Moyie Springs Boiler

Permit Limit 391,000 klb/yr

Pollutant (emission factors units lb/MMBtu)

Month	Steam 1000 pounds	Running 12-month Steam (k lb)	Running 12-month MMBtu	Total HAPs 1.83E-02	Acetald 8.30E-04	Acrolein 4.00E-03	Benzene 4.20E-03	Formad 4.40E-03	HCl 3.00E-04
Dec-09	25,945	241,807	383,990	3.51	0.16	0.77	0.81	0.84	0.06
Jan-10	26,886	243,964	387,415	3.54	0.16	0.77	0.81	0.85	0.06
Feb-10	21,619	241,262	383,124	3.50	0.16	0.77	0.80	0.84	0.06
Mar-10	23,651	240,721	382,265	3.50	0.16	0.76	0.80	0.84	0.06
Apr-10	20,416	239,723	380,679	3.48	0.16	0.76	0.80	0.84	0.06
May-10	18,112	242,187	384,594	3.52	0.16	0.77	0.81	0.85	0.06
Jun-10	18,483	244,771	388,697	3.56	0.16	0.78	0.82	0.86	0.06
Jul-10	12,587	244,614	388,447	3.55	0.16	0.78	0.82	0.85	0.06
Aug-10	14,529	243,775	387,114	3.54	0.16	0.77	0.81	0.85	0.06
Sep-10	14,733	242,614	385,272	3.52	0.16	0.77	0.81	0.85	0.06
Oct-10	18,800	239,322	380,043	3.48	0.16	0.76	0.80	0.84	0.06
Nov-10	23,452	239,213	379,870	3.47	0.16	0.76	0.80	0.84	0.06
Dec-10	27,997	241,265	383,129	3.50	0.16	0.77	0.80	0.84	0.06
Jan-11	28,355	242,734	385,462	3.53	0.16	0.77	0.81	0.85	0.06
Feb-11	26,344	247,459	392,965	3.59	0.16	0.79	0.83	0.86	0.06
Mar-11	26,955	250,763	398,212	3.64	0.17	0.80	0.84	0.88	0.06
Apr-11	22,027	252,374	400,770	3.67	0.17	0.80	0.84	0.88	0.06
May-11	18,913	253,175	402,042	3.68	0.17	0.80	0.84	0.88	0.06
Jun-11	20,095	254,787	404,602	3.70	0.17	0.81	0.85	0.89	0.06
Jul-11	16,974	259,174	411,568	3.76	0.17	0.82	0.86	0.91	0.06
Aug-11	18,307	262,952	417,568	3.82	0.17	0.84	0.88	0.92	0.06
Sep-11	16,568	264,787	420,482	3.85	0.17	0.84	0.88	0.93	0.06
Oct-11	23,936	269,923	428,638	3.92	0.18	0.86	0.90	0.94	0.06
Nov-11	25,977	272,448	432,647	3.96	0.18	0.87	0.91	0.95	0.06
Dec-11	28,824	273,275	433,961	3.97	0.18	0.87	0.91	0.95	0.07

IFG -- Moyie Springs

Month	Total HAPs	Acetald	Acrolein	Propanal	Formad	Methanol	HCl	Major?
	(tons per year)							
Dec-09	14.09	4.47	0.88	0.96	1.06	5.78	0.06	FALSE
Jan-10	14.16	4.49	0.88	0.97	1.07	5.81	0.06	FALSE
Feb-10	14.07	4.47	0.87	0.96	1.05	5.79	0.06	FALSE
Mar-10	13.98	4.43	0.86	0.95	1.05	5.76	0.06	FALSE
Apr-10	13.85	4.38	0.86	0.95	1.04	5.70	0.06	FALSE
May-10	13.94	4.40	0.86	0.96	1.05	5.74	0.06	FALSE
Jun-10	14.09	4.45	0.87	0.97	1.06	5.79	0.06	FALSE
Jul-10	14.09	4.45	0.87	0.97	1.06	5.80	0.06	FALSE
Aug-10	14.07	4.44	0.87	0.97	1.06	5.80	0.06	FALSE
Sep-10	14.09	4.46	0.86	0.96	1.05	5.82	0.06	FALSE
Oct-10	13.97	4.42	0.85	0.95	1.04	5.79	0.06	FALSE
Nov-10	13.84	4.37	0.85	0.94	1.03	5.72	0.06	FALSE
Dec-10	13.85	4.35	0.85	0.95	1.04	5.73	0.06	FALSE
Jan-11	13.83	4.33	0.85	0.96	1.04	5.70	0.06	FALSE
Feb-11	13.89	4.33	0.87	0.97	1.06	5.69	0.06	FALSE
Mar-11	13.92	4.33	0.88	0.99	1.07	5.68	0.06	FALSE
Apr-11	14.03	4.37	0.89	1.00	1.08	5.72	0.06	FALSE
May-11	14.17	4.42	0.90	1.01	1.09	5.78	0.06	FALSE
Jun-11	14.18	4.41	0.90	1.01	1.09	5.78	0.06	FALSE
Jul-11	14.38	4.47	0.92	1.03	1.11	5.85	0.06	FALSE
Aug-11	14.55	4.52	0.93	1.05	1.12	5.91	0.06	FALSE
Sep-11	14.60	4.53	0.94	1.06	1.13	5.92	0.06	FALSE
Oct-11	14.85	4.61	0.96	1.09	1.15	6.00	0.06	FALSE
Nov-11	15.02	4.66	0.97	1.10	1.16	6.07	0.06	FALSE
Dec-11	15.04	4.68	0.97	1.11	1.16	6.07	0.07	FALSE

Running 12-month HAP Calculation
Moyie Springs Kilns

Emission Factors based on 2008 research, highest temperature emission factor usec

EMISSION FACTORS:	lb Pollutant / MBF for Lumber Dry Kilns Temperatures as shown on Page 5					
Pollutant	Total HAP	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
Ponderosa Pine	0.1483	0.1021	0.0067	0.0334	0.0027	0.0034
ESLP	0.2431	0.1247	0.0070	0.1018	0.0044	0.0054
Douglas Fir	0.1700	0.0964	0.0033	0.0687	0.0007	0.0009
AF/WW	0.2431	0.1247	0.0070	0.1018	0.0044	0.0054
Hem Fir	0.2559	0.1399	0.0032	0.1029	0.0084	0.0016

Running 12-month (reads from kiln page) — HAP Calculations

Month	Total	DF	HF	ESLP	AF/WW	P.Pine	Total HAPs	Acetald	Acrolein	Propional	Formad	Methanol
	thousand board feet (mbdft)						(tons per year)					
Dec-09	104,030	59,930	18,536	17,043	8,521	0	10.57	4.31	0.11	0.16	0.22	5.78
Jan-10	104,530	60,415	19,187	16,600	8,327	0	10.62	4.33	0.11	0.16	0.22	5.81
Feb-10	104,520	61,897	20,121	14,983	7,518	0	10.57	4.31	0.10	0.16	0.21	5.79
Mar-10	104,500	64,184	20,091	13,465	6,760	0	10.48	4.27	0.10	0.15	0.21	5.76
Apr-10	103,361	63,574	19,989	13,180	6,617	0	10.37	4.22	0.10	0.15	0.20	5.70
May-10	104,393	65,561	20,539	12,177	6,116	0	10.42	4.24	0.09	0.15	0.20	5.74
Jun-10	104,955	64,482	20,919	12,713	6,840	0	10.53	4.29	0.10	0.15	0.21	5.79
Jul-10	105,040	64,910	21,714	11,956	6,461	0	10.53	4.28	0.09	0.15	0.20	5.80
Aug-10	104,740	64,056	22,555	11,764	6,365	0	10.53	4.28	0.09	0.16	0.20	5.80
Sep-10	105,501	65,642	22,308	11,379	6,173	0	10.57	4.30	0.09	0.16	0.20	5.82
Oct-10	105,595	67,704	21,633	10,517	5,742	0	10.50	4.27	0.09	0.15	0.20	5.79
Nov-10	104,610	67,965	20,957	10,136	5,552	0	10.36	4.21	0.09	0.15	0.20	5.72
Dec-10	105,150	69,358	21,130	9,019	4,993	650	10.35	4.19	0.08	0.15	0.20	5.73
Jan-11	104,426	68,433	22,119	8,511	4,712	650	10.30	4.17	0.08	0.15	0.20	5.70
Feb-11	103,871	66,970	22,565	8,819	4,866	650	10.29	4.17	0.08	0.15	0.20	5.69
Mar-11	103,384	65,780	22,853	9,097	5,005	650	10.28	4.16	0.08	0.15	0.20	5.68
Apr-11	103,654	64,377	22,733	10,292	5,602	650	10.36	4.20	0.09	0.15	0.20	5.72
May-11	104,111	62,467	23,779	11,172	6,042	650	10.49	4.26	0.09	0.16	0.20	5.78
Jun-11	104,228	62,543	23,740	11,229	5,615	1,101	10.48	4.25	0.09	0.16	0.20	5.78
Jul-11	104,621	60,426	25,269	11,883	5,942	1,101	10.62	4.30	0.10	0.17	0.20	5.85
Aug-11	105,461	60,345	26,202	11,876	5,938	1,101	10.73	4.35	0.10	0.17	0.21	5.91
Sep-11	105,069	58,489	26,867	12,408	6,204	1,101	10.75	4.36	0.10	0.18	0.21	5.92
Oct-11	105,741	56,334	28,781	13,017	6,508	1,101	10.93	4.43	0.10	0.19	0.21	6.00
Nov-11	106,270	54,754	30,811	13,070	6,535	1,101	11.06	4.48	0.10	0.19	0.21	6.07
Dec-11	105,751	53,657	31,597	13,364	6,682	450	11.07	4.50	0.10	0.20	0.21	6.07

Kiln HAP Emission Factors are based on 2008 Milota Research (Attached) According to this reference, Kiln HAP emissions are temperature dependent. The testing spanded ranges from 170F to 235 F. This page allows the kiln temps to be entered so an appropriate emission factor for each HAP and Wood Species can be determined. Kiln temperatures are exiting air temperatures.

	P Pine		
Temperature (F)	**170**	**235**	**210**
Methanol	0.035	0.144	0.1021
Formaldehyde	0.0027	0.0092	0.0067
Acetaldehyde	0.042	0.028	0.0334
Propioandehyde	0.0019	0.0032	0.0027
Acrolein	0.0017	0.0045	0.0034

	Doug-Fir		
Temperature (F)	**200**	**235**	**220**
Methanol	0.069	0.117	0.0964
Formaldehyde	0.0019	0.0043	0.0033
Acetaldehyde	0.071	0.067	0.0687
Propioandehyde	0.0006	0.0008	0.0007
Acrolein	0.0004	0.0012	0.0009

	Hem-Fir		
Temperature (F)	**200**	**235**	**220**
Methanol	0.077	0.187	0.1399
Formaldehyde	0.0014	0.0045	0.0032
Acetaldehyde	0.128	0.084	0.1029
Propioandehyde	0.001	0.014	0.0084
Acrolein	0.0011	0.0019	0.0016

	ESLP		
Temperature (F)	**190**	**235**	**210**
Methanol	0.074	0.188	0.1247
Formaldehyde	0.0045	0.0101	0.0070
Acetaldehyde	0.144	0.049	0.1018
Propioandehyde	0.0044	0.0043	0.0044
Acrolein	0.005	0.0058	0.0054

	AF/WW		
Temperature (F)	**190**	**235**	**240**
Methanol	0.074	0.188	0.2007
Formaldehyde	0.0045	0.0101	0.0107
Acetaldehyde	0.144	0.049	0.0384
Propioandehyde	0.0044	0.0043	0.0043
Acrolein	0.005	0.0058	0.0059

IDAHO FOREST GROUP - MOYIE BOILER
HAZARDOUS AIR POLLUTANTS (HAPS)

Operating Parameters:

Potential Hours of Operation	8,760	hours/yr
Annual Steam Production	273,275	k lbs/yr
Annual Boiler Heat Input, max	433,961	mmBtu /yr

Emission Factors:		
AP-42 Ch.1.6, Tables 1.6-3 and 1.6-4 (9/03), * indicates emission from Riley Creek tests	Emission Factor (lb/mmBtu)	Total Annual Emissions (tons/yr)
Acetaldehyde	8.30E-04	1.80E-01
Acetophenone	3.20E-09	6.94E-07
Acrolein	4.00E-03	8.68E-01
Benzene	4.20E-03	9.11E-01
Benzo(a)pyrene	2.60E-06	5.64E-04
bis(2-ethylhexyl)phthalate	4.70E-08	1.02E-05
Bromomethane (methyl bromide)	1.50E-05	3.25E-03
2-Butanone (MEK)	5.40E-06	1.17E-03
Carbon tetrachloride	4.50E-05	9.76E-03
Chlorine	7.90E-04	1.71E-01
Chlorobenzene	3.30E-05	7.16E-03
Chloroform	2.80E-05	6.08E-03
Chloromethane (Methyl Chloride)	2.30E-05	4.99E-03
1,2-Dichloroethane	2.90E-05	6.29E-03
Dichloromethane (Methylenechloride)	2.90E-04	6.29E-02
1,2-Dichloropropane (Propolyene dichloride)	3.30E-05	7.16E-03
Ethylbenzene	3.10E-05	6.73E-03
Formadehyde	4.40E-03	9.55E-01
Hydrogen chloride	3.00E-04	6.51E-02
Naphthalene	9.70E-05	2.10E-02
4-Nitrophenol	1.10E-07	2.39E-05
Pentachlorophenol	5.10E-08	1.11E-05
Phenol	5.10E-05	1.11E-02
Polycyclic Organic Matter (POM)	2.89E-06	6.27E-04
Benzo(a)anthracene	6.50E-08	
Benzo(a)pyrene	2.60E-06	
Benzo(b)fluoranthene	1.00E-07	
Benzo(k)fluoranthene	3.60E-08	
Indeno(1,2,3,cd)pyrene	8.70E-08	
Styrene	1.90E-03	4.12E-01
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.60E-12	1.87E-09
Toluene	9.20E-04	2.00E-01
1,1,1-Trichloroethane (Methyl Chloroform)	3.10E-05	6.73E-03
2,4,6-Trichlorophenol	2.20E-08	4.77E-06
Vinyl Chloride	1.80E-05	3.91E-03
o-Xylene	2.50E-05	5.42E-03
Antimony	7.90E-06	1.71E-03
Arsenic*	2.00E-06	4.34E-04
Berylium	1.10E-06	2.39E-04
Cadmium*	3.00E-06	6.51E-04
Chromium, total*	1.00E-06	2.17E-04
Chromium, hexavalent*	1.00E-06	2.17E-04
Cobalt	6.50E-06	1.41E-03
Lead*	1.00E-05	2.17E-03
Manganese*	1.20E-04	2.60E-02
Mercury*	1.56E-06	3.38E-04
Nickel	3.30E-05	7.16E-03
Selenium	2.80E-06	6.08E-04
TOTAL HAPS	1.83E-02	3.97

ATTACHMENT B

IFG Moyie Springs

HAP Emission Factor Documentation

EXECUTIVE SUMMARY

The results from the Moyie Springs Hog Fuel Boiler MACT emissions testing are summarized below.

9-19-03

Hog Fuel Boiler EFB Primary Stack Gaseous Pollutant Results

Pollutant	ppm	lb/hr	lb/MM btu
VOC (as Carbon)	307.9	15.17	0.15
NO_x	95.85	18.07	0.18
CO	1,309.0	150.5	1.48
SO_2	0.0	0.0	0.0
Mercury	0.0002	0.0002	1.56**
HCl	0.1900	0.0300	0.0003
Arsenic	0.0005	0.0002	0.00000
Barium	0.0144	0.0080	0.00008
Beryllium	0.0000	0.0000	0.00000
Cadmium	0.0003	0.0003	0.00000
Chromium	0.0003	0.0001	0.00000
Cobalt	0.0000	0.0000	0.00000
Copper	0.0024	0.0006	0.00001
Lead	0.0007	0.0006	0.00001
Manganese	0.0521	0.0117	0.00012
Nickel	0.0000	0.0000	0.00000
Phosphorus	0.2950	0.0375	0.00037
Selenium	0.0000	0.0000	0.00000
Silver	0.0003	0.0001	0.00000
Thallium	0.0000	0.0000	0.00000
Zinc	0.0580	0.0155	0.00015

**lb/trillion btu

Emissions of hazardous air pollutants from lumber drying

Mike Milota*
Paul Mosher

Abstract

NCASI Method 105 was used during lumber drying to measure emissions of methanol, phenol, formaldehyde, acetaldehyde, propionaldehyde, and acrolein from red alder (*Alnus rubra*), ponderosa pine (*Pinus ponderosa*), white wood (a mix of western pines, fir, and spruce), Douglas-fir (*Pseudotsuga menzeisii*), western hemlock (*Tsuga heterophylla*) and white spruce (*Picea glauca*). Methanol and acetaldehyde were emitted in the greatest quantities. Results indicate a strong dependence on temperature for methanol and formaldehyde while the other compounds do not show a consistent trend. At conventional temperature, the acetaldehyde was often emitted in a greater amount than the methanol. At the higher temperature the reverse was true. The information should be helpful to mills drying these species for making a decision about whether they are a major source for HAPs as defined by the Environmental Protection Agency. The results should also be helpful in planning future testing.

The emission of organic compounds is of great importance to the forest products industry due to current and pending federal maximum achievable control technology (MACT) rules related to the hazardous air pollutants (HAPs) emitted from dryers, presses, and boilers. Hazardous air pollutants are a subset of the total organic material or volatile organic compounds (VOCs) emitted during processing. For purposes of the MACT rules, methanol, phenol, formaldehyde, acetaldehyde, propionaldehyde, and acrolein are considered surrogates for all HAPs from wood dryers and presses. These HAPs were measured for some western species in the work presented.

A facility with the potential to emit greater than 10 t/y (tons per year) of any one HAP or 25 t/y of combined HAPs from the site is considered a major source for HAPs and must comply with the MACT rules. This means adding end-of-pipe control equipment on certain dryers, presses and boilers, continuous monitoring, and certain reporting requirements. Lumber dry kilns were excluded from the requirement for controls; however, this exclusion is in review due to court rulings in June of 2007.

Facilities had the opportunity to demonstrate that the concentration of HAPs crossing the fence line did not pose a health risk to neighbors in lieu of control equipment (known as the low-risk option). Qualifying for this required knowing how much HAPs are emitted and modeling the dispersion of the HAPs into the environment. Lumber dry kilns were particularly problematic in qualifying for this option because of small amounts of acrolein and the lack of a single discharge point. This option was also affected by recent court rulings and will probably not be available in the future.

Three methods are generally accepted by regulatory agencies for HAP testing from wood processing equipment. All can be found in the National Council for Air and Stream Improvement's Methods Manual (NCASI 2007). Methanol, formaldehyde, and phenol are measured using NCASI Method CI/WP–98.01 by bubbling a gas sample through water in chilled impingers and absorbing the HAPs into the water phase. The other HAPs are too volatile or unstable for Method 98.01 to work well. This is compensated for in NCASI Method 99.02 by sampling the gas leaving the impingers using an evacuated Summa canister. This method, however, is expensive, much more complex, and can give variable results. NCASI Method ISS/FP–A105.01 was recently developed as a modification to Method 98.01 to eliminate the need for canisters by derivatizing the aldehydes to more stable and less volatile aldehyde oximes which remain in the water phase.

NCASI (2002), one in a series of technical bulletins on the emissions from many types of wood processing equipment,

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*Forest Products Society Member.

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Table 1. — Past studies of MACT HAP emissions.

Source	Species	Temperature	MC Initial	MC Final	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
		(°F (°C))	(percent)		(lb/mbf)				
NCASI 2002	Loblolly pine[1]	235 (112.7)	NA	22	0.240	0.018	0.044	0.002	0.006
NCASI 2002	Loblolly pine[2]	235 (112.7)	NA	12 to 15	0.200	0.013	--	--	--
Milota 2005	White spruce[1]	221 (105)	32.4	15	0.021	0.0014	0.018	NA	0.0006
McDonald 2002	Radiata pine	212 (100)	140	3.5	0.139	0.005	0.042	NA	NA

[1]Measured using NCASI Method 99.02.
[2]Measured using NCASI Method 98.01.

reports on southern pine lumber dried in commercial and laboratory kilns. The HAPs were measured by Method 99.02, and the results are shown in **Table 1**. This was some of the first work on HAPs from lumber drying and formed a basis for regulations and agency testing requirements. Methanol was the HAP emitted in the largest quantity, and it seemed clear from the results that a producer would reach 10 t/y of methanol before reaching 25 t/y of combined HAPs from lumber kilns. Based on this assumption, most testing of kiln exhaust has been conducted using NCASI Method 98.01 for methanol and formaldehyde and, at least for lumber, the other four MACT HAPs have been largely ignored.

MacDonald et al. (2002) measured the full spectrum of compounds emitted from radiata pine. The methanol emissions from the radiata were lower than the southern pine, however, the drying temperature was lower. Milota and Mosher (2006) demonstrated that there is a strong effect of temperature on methanol emissions. In unpublished work done in 2005, Milota found low levels of HAP emissions from white spruce (**Table 1**). This was consistent with the low starting moisture content.

The present work was initiated after higher than expected levels of acetaldehyde were measured from lumber as it dried. This work had two main objectives. One was to determine the HAP emissions for several species. A second was to determine how the emissions of the lesser reported HAPs, such as acetaldehyde, vary with kiln temperature. The results are significant to many facilities that have based operating permits only on the levels of methanol and formaldehyde emitted. They are also important to facilities that want to use actual measured emission factors rather than Environmental Protection Agency (EPA) estimates.

Procedures

Red alder (*Alnus rubra*), ponderosa pine (*Pinus ponderosa*), white wood (a mix of western pines, fir, and spruce), Douglas-fir (*Pseudotsuga menzeisii*), and western hemlock (*Tsuga heterophylla*) were obtained from mills in western Oregon and Washington. White spruce (*Picea glauca*) was obtained from a western Canadian mill. All lumber was sampled by mill personnel, cut to 4-foot (1.22-m) lengths, and wrapped in plastic. Sampling was conducted over an extended time at the mills to assure that pieces from different logs were sampled. The lumber arrived in Corvallis within 48 hours of shipping. The lumber was then stored in either a refrigerator or freezer, depending on the length of time until it would be dried. The red alder lumber was 5/4 random width. The softwoods were 2 by 4 or 2 by 6 dimension lumber.

The small laboratory kiln and procedures described in Milota and Mosher (2006) were used to dry the wood. The kiln is approximately 1.22 m (4 ft.) on each side. Dry- and wet-bulb temperatures are measured on the entering-air side of the load. The kiln is indirectly heated by steam to maintain the desired dry-bulb temperature. Humidity is controlled by regulating dry compressed air entering the kiln to maintain the desired wet-bulb temperature.

Prior to drying, the lumber was trimmed to 1.12 m (44 in) by removing 50 mm from each end and placed in the kiln on 19-mm-thick stickers (3/4 in). The loads were two to three boards wide, depending on the lumber width, and 10 to 14 courses high, depending on thickness. The conventional temperature drying schedules (<94 °C) were provided by the mills supplying the lumber. The higher temperature drying schedule was selected to match that used in NCASI (2002). The final dry-bulb setting for each schedule is shown in the results. The air velocity was 750 ft/min (3.8 m/s). Each board was weighed prior to and after drying, then ovendried and reweighed so that the initial and kiln-dry moisture contents could be determined. Drying from green to the final moisture content was accomplished without opening the kiln or other interruptions.

Hydrocarbon measurement

A 1.8 L/min gas sample was withdrawn from the kiln near the exhaust port and directed to a JUM VE7 hydrocarbon analyzer. Heated dilution gas was metered into the hydrocarbon sample gas, if necessary, to lower the gas moisture content to less than 15 percent. All components were heated to prevent the condensation of water or organics. The hydrocarbon analyzer was calibrated every three to six hours by introducing calibration gases (EPA protocol 601 ppm, EPA Protocol 300 ppm, and < 0.1 ppm air) near the probe tip at ambient pressure. The methodology followed is similar to EPA Method 25A (Code of Federal Regulations 1991).

HAP sampling

The sampling train for Method 105 is shown in **Figure 1**. The impingers were in a stirred glycol solution maintained at −1 °C. Prior to each sampling interval, the impingers were lab washed and 15 mL of BHA solution were added to each. The solution contained a stoichiometric excess of 0-benzylhydroxylamine hydrochloride for derivitization of the aldehydes to aldehyde oximes. After assembly, the sampling train was checked for leaks by drawing a vacuum. The gas flow rate through the sampling train, 450 to 500 mL/min, was measured using a bubble meter before and after each sampling interval. There were 7 to 28 sampling intervals per kiln charge, each from two to three hours in duration after which the liquid from the impingers was weighed and placed in a vial. The impingers were rinsed with water, then hexane, and these rinses

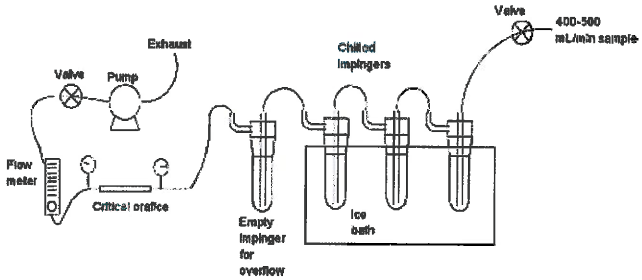

Figure 1. — HAPs sampling train. Three trains were used so that duplicates and recovery spikes could be run.

were added to the vial. It was then refrigerated. Blanks of BHA solution, duplicate samples, and recovery spikes were collected for almost every charge. In the lab the samples were extracted with hexane. The aqueous fraction was analyzed by gas chromatography with a flame ionization detector for methanol and phenol. The hexane fraction was analyzed by gas chromatography with a nitrogen-phosphorous detector for the oximes of formaldehyde, acetaldehyde, propionaldehyde, and acrolein. The complete procedures are described in NCASI (2007).

A kiln blank and a sticker blank were run by bringing the kiln to 82.2 °C over a 30-minute period with no wood or stickers. At this point, a 2-hour Method 105 sample was taken. The kiln was then briefly opened, the stickers normally used for drying were placed in the kiln, and the kiln was closed. Another 2-hour Method 105 sample was then taken. The samples were then analyzed as described above.

Calculations

Hydrocarbon emissions are calculated from the concentration detected by the analyzer and the vent rate of the dryer. The analyzer reading in parts per million is converted to a dry gas concentration (mass/volume) using psychrometric relations and the ideal gas law. This value is then is multiplied by the dry gas flow rate (volume/time) and the result integrated over time. The total hydrocarbon values are expressed as carbon (denoted as lb_c) meaning that only the mass of the carbon is used in calculating the hydrocarbon mass in the wood exhaust. No correction is made for the response of the analyzer to oxygenated compounds.

The mass of HAPs in the impingers is determined from the concentrations detected in the water or hexane and quantity of each solvent. The HAPs emitted from the kiln are calculated by scaling up the mass collected in the impingers by the ratio of the gas flow rate through the kiln to the gas flow rate through the impingers. This ratio varies from approximately 20 to 400 depending on the vent rate of the kiln. HAP sampling at the kiln occurred during 60 to 80 percent of the kiln cycle. For the periods between samples, an average emission rate was calculated based on the mass collected during the periods before and after the interval.

Results and discussion

VOC emissions of 1.6 and 3.0 lb_c/mbf were measured from ponderosa pine lumber at conventional and high temperature, respectively (**Table 2**). The value measured at low temperature compares favorably with1.42 lb_c/mbf measured previously (Milota 2006b) for drying at 82.2 °C. The value measured at high temperature was within the range of 2.4 to 4.4 reported in NCASI (2002) for loblolly pine dried at 112 °C. For Douglas-fir and western hemlock (**Tables 3** and **4**), the levels of VOC emissions are similar to those reported in Milota (2006b) and Milota and Mosher (2006), respectively. There are no values for comparison to the VOC emissions for the spruce and white wood (**Tables 5** and **6**). The 0.17 lb/mbf of VOC emissions from red alder lumber during drying (**Table 7**) are slightly lower than previously reported (Milota 2006a), 0.2 lb/mbf. However, given the variability in the past work, the present value is not inconsistent. VOC emissions increased to 0.66 at 235 °F. Current industrial practices do not use this high of a temperature; however, red alder can be dried with good quality at high temperature (Kozlik and Boone 1987).

The methanol emissions from ponderosa pine at conventional temperature were lower (0.035 versus 0.065 lb/mbf) and the formaldehyde emissions were similar (0.0027 versus 0.0029 ln/mbf) to those reported in Milota (2006b) for ponderosa pine at 82.2 °C. At high temperature, the methanol and formaldehyde emissions were lower than reported for loblolly pine dried at the same temperature (**Table 1**), 0.144 compared to 0.22 to 0.24 lb/mbf and 0.009 versus 0.013 to 0.018 lb/mbf, respectively.

The acetaldehyde and propionaldehyde emissions from ponderosa pine were similar to those reported for loblolly pine and the acrolein emissions were higher. The acrolein reported by NCASI was measured using Method 99.02 and the stability of acrolein might result in a low value. Phenol emissions were not detected for ponderosa pine or any other species in this study.

The methanol and formaldehyde emissions from Douglas-fir lumber (**Table 3**) measured at 76.7 °C (170 °F), 0.024 and 0.0008 lb/mbf, are almost identical to those previously reported at the same temperature (Milota 2006b), 0.023 and 0.0010 lb/mbf. These increase by over a factor of four as the temperature is raised to 112.7 °C (235 °F). The quantity of acetaldehyde emitted was similar to methanol at conventional temperature; however, at high temperature, the acetaldehyde emitted (0.067 lb/mbf) was considerably less than the methanol (0.117 lb/mbf).

The methanol emissions from western hemlock lumber (**Table 4**) ranged from 0.075 to 0.187 lb/mbf and the formaldehyde emissions from 0.0014 to 0.0045 lb/mbf. These are 10 to 20% lower than predicted by the equation in Milota and Mosher (2006). The equation, however, is based on emissions as measured by Method 98.01. Past work (Milota and Mosher 2008) suggests that Method 105 gives lower results, especially for formaldehyde. The methanol emissions more than double between 82.2 °C and 112.7 °C and the formaldehyde emissions more than triple. The quantity of acetaldehyde emitted was similar to or greater than the methanol at conventional temperature but less than the methanol at the high temperature.

White spruce (**Table 5**) had lower HAP emissions than the other species; however, the wood was at low initial moisture content. The past results in **Table 1** are from the same shipment of spruce; however, the previous work was done using NCASI Method 99.02 during drying at 105 °C. If one adjusts for temperature, it can be seen in **Table 6** that the HAP emissions in the present study are somewhat higher than

Table 2. — HAP emissions from ponderosa pine. The last row is the ratio of the emissions at high temperature to lower temperature.

Temperature	MC Initial	MC Final	VOC	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
(°F (°C))	(percent)		(lb/mbf)					
170 (76.7)	82.6	15.0	1.59	0.035	0.0027	0.042	0.0019	0.0017
235 (112.7)	89.1	15.0	3.00	0.144	0.0092	0.028	0.0032	0.0045
ratio				4.11	3.41	0.66	1.68	2.64

Table 3. — HAP emissions from Douglas-fir.

Sample	Temperature	MC Initial	MC Final	VOC	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
	(°F (°C))	(percent)		(lb/mbf)					
B	170 (76.7)	56.9	15.0	0.241	0.024	0.0008	0.030	0.0004	0.0005
C	180 (82.2)	43.7	15.0	0.575	0.050	0.0023	0.050	0.0005	0.0009
A	200 (93.3)	64.3	15.0	0.707	0.068	0.0018	0.043	0.0005	0.0009
A	200 (93.3)	59.5	15.0	0.879	0.069	0.0019	0.071	0.0006	0.0004
C	**235 (112.7)**	47.7	15.0	1.206	0.117	0.0043	0.067	0.0008	0.0012

Table 4. — HAP emissions from western hemlock.

Sample	Temperature	MC Initial	MC Final	VOC	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
	(°F (°C))	(percent)		(lb/mbf)					
D	180 (82.2)	102.3	15.0	0.142	0.075	0.0014	0.078	0.0020	0.0012
F	180 (82.2)	93.5	17.5	0.236	0.094	0.0015	0.141	0.0008	0.0012
E	200 (93.3)	83.9	15.0	0.214	0.044	0.0008	0.133	0.0008	0.0024
E	200 (93.3)	98.6	15.0	0.239	0.077	0.0014	0.128	0.0010	0.0011
F	235 (112.7)	81.6	15.0	0.247	--	--	--	--	--
F	**235 (112.7)**	76.2	15.0	0.226	0.187	0.0045	0.084	0.0014	0.0019

Table 5. — HAP emissions from white spruce. The last row is the ratio of the emissions at high temperature to lower temperature.

Temperature	MC Initial	MC Final	VOC	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
(°F (°C))	(percent)		(lb/mbf)					
180 (82.2)	33.5	15.0	NA	0.025	0.0013	0.036	0.0003	0.0005
235 (112.7)	32.7	15.0	0.11	0.078	0.0044	0.031	0.0007	0.0010
ratio				3.12	3.38	0.86	2.33	2.00

Table 6. — HAP emissions from white wood. The last row is the ratio of the emissions at high temperature to lower temperature.

Temperature	MC Initial	MC Final	VOC	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
(°F (°C))	(percent)		(lb/mbf)					
190 (87.7)	119.2	15.0	1.39	0.074	0.0045	0.144	0.0044	0.0050
235 (112.7)	106.8	15.0	2.31	0.188	0.0101	0.049	0.0043	0.0058
ratio			1.66	2.54	2.24	0.34	0.97	1.16

previously measured; however, the measurement method is different. Again in this data set, the methanol emissions greatly increase with temperature while the acetaldehyde emissions do not.

The exact values for the HAP emissions from the white wood sample are of limited value because it is a mixture of species that can change with log supply. The sample dried was at least 50 percent ponderosa pine accounting for the relatively high VOC emissions. The important thing to note from this data is the trend for methanol emissions to increase with temperature while acetaldehyde emissions do not (**Table 6**).

The methanol emissions from red alder at the lower temperature, 0.173 lb/mbf, were greater than for many of the softwoods. This may be due to the greater number of methoxy

Table 7. — HAP emissions from red alder. The last row is the ratio of the emissions at high temperature to lower temperature.

Temperature	MC Initial	MC Final	VOC	Methanol	Formaldehyde	Acetaldehyde	Propionaldehyde	Acrolein
(°F (°C))	(percent)		(lb/mbf)					
180 (82.2)	102.1	8.0	0.173	0.124	0.0009	0.114	0.0014	0.0011
235 (112.7)	100.1	10.2	0.659	0.416	0.0048	0.129	0.0016	0.0018
ratio				3.55	5.45	1.13	1.14	1.64

groups on the hardwood lignin compared to softwood lignin. Acidic conditions in the wood in the presence of water at the temperatures encountered during drying might cleave these groups. The acetaldehyde was also relatively high for the red alder compared to most of the softwoods. The glucuronoxylan component of the hardwood hemicellullose has a greater number of acetyl groups per monomer unit than the hemicellulose in softwoods. Acid hydrolysis of these groups at the dryer temperature may contribute to acetaldehyde formation. Neither of these suggested mechanisms has been proven, however. As with the softwoods, the HAP emissions increase with temperature. Despite the HAP emissions being higher from the red alder, hardwood mills tend to be smaller than softwood mills and are unlikely to be a major source for HAPs.

All of the HAPs measured in this paper were obtained by NCASI Method 105. The spike recoveries ranged from approximately 60 to 99 percent. The poorest spike recoveries were for the formaldehyde. The best spike recoveries were for methanol (usually > 90%) and acetaldehyde (usually > 80%). While these are satisfactory in the published method for the concentrations measured, they indicate that another method might give higher results for the emissions. A comparison of Method 105 to 98.01 can be found in Milota and Mosher (2008).

The pattern of emissions during the kiln cycle is shown for hemlock at high and conventional temperature in **Figure 2**. At the conventional temperature (top graph), the rate of emissions decreases with time for all compounds after the initial warm up period. This was generally true for all species tested. Acetaldehyde emissions in particular are high early in the cycle while the temperature is lower. At high temperature (bottom graph), the rate of methanol and formaldehyde emissions increased dramatically as the wood dries. This occurred with every species tested. At high temperature, the rate of emission of the other HAPs do not follow a consistent pattern.

The kiln and sticker blanks had minimal emissions. When the stickers were present, the emissions were similar to or less than less than from the empty kiln for all HAPs except methanol. Methanol was not detected from the empty kiln. We therefore conclude that the stickers are not contributing to the HAPs, except methanol. If the sticker blank had been a 48-hour cycle, the methanol, acetaldehyde, and formaldehyde released would have been approximately 1, 0.01, and 9 percent, respectively, of that emitted during a typical kiln cycle. The formaldehyde value is higher; however, it still constitutes only about 1 to 3 percent of the total HAPs that would be detected during a kiln cycle. Thus, any effect on total HAPs due the kiln and stickers is minor. Also, if the kiln had been run longer prior to testing, the results would likely be lower because the kiln would have had time to bake out. As run, the

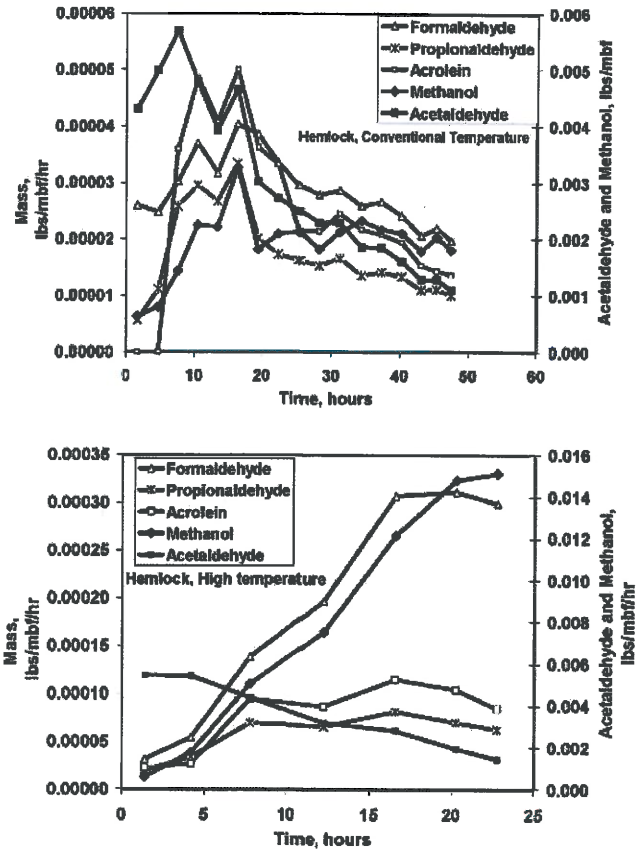

Figure 2. — Rate of HAP emissions (lb/mbf/hr) from hemlock lumber drying at conventional- (upper) and high-temperature (lower) drying.

kiln and sticker blanks represent a worst case. The results suggest that either HAPs are adsorbing onto the kiln walls or absorbing in the wet-bulb water and desorbing or, that residue in the kiln is degrading.

Subpart DDDD (Code of Federal Regulations 2004) contains some emission factors intended to be used with the low-risk option; however, they tend to be more broadly applied by state regulatory agencies. Data in this paper suggest that the acrolein estimate in Subpart DDDD is high by a factor of eight or more and mills could easily justify a lower value by site specific testing. The EPA estimate for acetaldehyde, 0.065 lb/mbf, is low for hemlock and alder and high for the other species tested. Similarly, the estimate for formaldehyde (0.034 lb/mbf) is high in many cases, but low at high temperature. In contrast to the EPA estimate of 0.01 lb/mbf, no phenol was detected.

To date, the industry has not paid much attention to acetaldehyde emissions from lumber drying when deciding if a facility is a major source for HAPs because the methanol emissions from lumber drying were assumed to be so much greater than the other HAPs. This assumption was based on the NCASI (2002) study in which southern pine lumber was dried at a 112.7 °C. As a result, other studies have concentrated on quantifying the methanol. The current research suggests that this is a poor assumption and the acetaldehyde emissions may be at least equal to and often greater than the methanol emissions at conventional kiln temperatures.

Conclusions

HAP emissions vary greatly among species. The hardwood species tested had the highest HAP emissions, probably due to the great number of methoxy groups in hardwood lignin and the higher hemicellulose content and number of acetyl groups.

Overall, HAP emissions increase with temperature; however, not all the HAPs are affected by temperature in the same way. Methanol and formaldehyde emissions increase dramatically with temperature while acetaldehyde emissions may decrease.

At conventional temperatures, the acetaldehyde emissions are on the same order as the methanol emissions and should not be neglected when calculating total HAPs.

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