

Interpoll Laboratories, Inc.  
4500 Ball Road N.E.  
Circle Pines, Minnesota 55014-1819

TEL: (763) 786-6020  
FAX: (763) 786-7854

**RECEIVED**

MAY 12 2014

**AIR QUALITY DIV.**

**RESULTS OF THE MARCH 2014  
LUMBER KILN TESTS CONDUCTED  
FOR POTLATCH FOREST PRODUCTS CORPORATION  
AT THE GWINN, MICHIGAN FACILITY**

Submitted to:

**POTLATCH FOREST PRODUCTS CORPORATION**

650 A. Avenue  
Gwinn, Michigan 49841

Attention:

Lauren Lueneburg

Reviewed by:



Kathleen Eickstadt  
Department Coordinator  
Field Services Department

Report Number 14-33009(kilns)  
April 8, 2014  
SF/sef

## ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	dry standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	Diameter
FT/SEC	feet per second
g	gram
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g/dscm	grams per dry standard meter
HP	horsepower
HRS	hours
IN.	inches
IN.HG.	inches of mercury
IN.WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10 <sup>6</sup> BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
MW	megawatt
mg/dscm	milligrams per dry standard cubic meter
ug/dscm	micrograms per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm,d	parts per million, dry
ppm,w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
TPD	tons per day
ug	micrograms
v/v	percent by volume
w/w	percent by weight

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure

**RECEIVED**

MAY 12 2014

**AIR QUALITY DIV.**

1 INTRODUCTION

During the weeks of March 4-6 and March 11-12, 2014 Interpoll Laboratories conducted air emission tests for the Potlatch Forest Products Corporation on the No. 4 Kiln at the Potlatch facility in Gwinn, Michigan. Kiln operation was supervised by Lauren Lueneburg of Potlatch. Testing was performed by Steve Edson and Jake Ward. A portion of the testing was witnessed by a Nathan Hude of the State of Michigan Department of Environmental Quality.

Potlatch Forest Products Corporation owns and operates four lumber kilns near Gwinn, Michigan. The purpose of these tests was to measure emissions for two species of wood: Red Pine and Jack Pine. These two species represent the majority of lumber dried at the Gwinn facility. Testing was conducted during two full kiln cycles, once while drying Red Pine, and once while drying Jack Pine. The kiln charges were selected from representative rough cut lumber for each species.

VOC concentrations (acetaldehyde, acrolein, formaldehyde, methanol, phenol and propionaldehyde) were determined in accordance with NCASI 99.02. The source gas was drawn through three midget impingers; each containing chilled organic free water. In accordance with NCASI 99.02, a slipstream was pulled off the sample stream (post impingers) and collected in a sample gas canister. The contents of the gas canister were then measured for VOC by utilizing GC Mass Spectrometry (GC/MS). The water samples were analyzed by direct injection into a gas chromatograph equipped with a flame ionization detector (GC/FID). The GC/FID system was calibrated for all listed pollutants to achieve at least a 0.2-ug/ml detection limit. The two analytical results were combined to give a final ppmvd result.

Continuous velocity pressures were monitored at a representative point in the 42" diameter stack. In addition, continuous temperature was monitored using a type-K thermocouple attached to the probe. Moisture content of the gas stream was also continuously measured and recorded using an MKS Multigas 2030 FTIR. The MKS MultiGas 2030 FTIR has a fixed gas cell path length of 5.11 meters and is operated throughout the test with a scan rate of 64 scans per minute. The detector was cooled by the use of liquid nitrogen. The sample gas was transported to the FTIR analyzer through a heat traced Teflon line, set for at a temperature of greater than 325°F, coming from a manifold system located within the test trailer. Prior to and following sampling the system was leak-checked and found to be acceptable in both cases. The collected data was then applied to

the continuous EPA Method 25a sampling results in order to calculate the total pounds of carbon that was emitted throughout each of the entire kiln cycles.

Total Volatile Organic Compounds (VOC's) were determined instrumentally using a VIG Industries heated flame ionization detector (HFID) calibrated against propane in air standards in accordance with EPA Method 25A. The VOC concentration was continuously monitored by extracting a slipstream of exhaust gas by means of a heated probe and filter holder set at a temperature of greater than 250°F. A heat-traced Teflon line set to maintain a temperature of greater than 325°F was used to transport the sample gas from the filter holder outlet to the analyzer inlet. The analog response of the analyzer was recorded using a computer data logger. The analyzer was calibrated with EPA Protocol I Gases.

A summary and discussion of all of the results of these tests is given in the following section. More detailed results of the various samplings are presented in Section 3, together with pertinent sampling parameters. Supplemental information such as field data sheets, laboratory results, procedures and calculation equations are presented in the appendices.

## 2 SUMMARY AND DISCUSSION

The results of the methanol determinations for each of the two kiln charges are summarized below:

Summary of the Results of the No. 4 Lumber Kiln Tests Performed for Potlatch Corporation at the Gwinn, Michigan Facility.

Parameter	Units	Red Pine	Jack Pine
<b>Lumber Conditions</b>			
Board Feet (per kiln Charge)	(mbf)	253	243
Charge Duration	(hrs)	53.1	26.8
<b>Acetaldehyde Data</b>			
	(lb/charge)	5.93	10.01
	(lb/mbf)	0.023	0.041
<b>Propionaldehyde Data</b>			
	(lb/charge)	2.82	0.73
	(lb/mbf)	0.011	0.003
<b>Acrolein Data</b>			
	(lb/charge)	3.04	0.83
	(lb/mbf)	0.012	0.003
<b>Methanol Data</b>			
	(lb/charge)	45.52	42.41
	(lb/mbf)	0.180	0.174
<b>Phenol Data</b>			
	(lb/charge)	2.72	0.86
	(lb/mbf)	0.011	0.004
<b>Formaldehyde Data</b>			
	(lb/charge)	1.94	1.79
	(lb/mbf)	0.008	0.007
VOC (EPA Method 25a)	(lb Carbon/mbf)	2.55	3.52

mbf = 1000 board feet

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Test 2 Summary of the Results of the March 3-6 , 2014, Method 25a (as Carbon) Emission Compliance Test on the No.4 Kiln Stack while drying Red Pine at the Potlatch Facility located in Gwinn, Michigan.

Item		Red Pine Kiln Cycle	
Date of test		03-04-14	to 3/6/2014
Time runs were done	(Hrs)	0943 / 1455	
Kiln Charge Time	(Hrs)	53.1	
Volumetric Flow			
	Actual (ACFM)	19,437	
	Standard (DSCFM)	15,529	
Gas Temperature	(°F)	105	
Moisture Content	(%v/v)	9.80	
Gas Composition	(%v/v, dry)		
	Carbon Dioxide	0.24	
	Oxygen	20.90	
	Nitrogen	78.86	
VOC	(EPA Method 25a)	Average (ppm C, d)	500.71
		Average (Lb Carbon/Hr)	12.18
		Total (Lb Carbon/Charge)	646.86
		Total (Lb Carbon/1000 Board Feet)	2.55
Total Board Feet in Kiln Charge	(mbf)	253	

Test 10 Summary of the Results of the March 11-12, 2014, Method 25a (as Carbon) Emission Compliance Test on the No.4 Kiln Stack while drying Jack Pine at the Potlatch Facility located in Gwinn, Michigan.

Item		Red Pine Kiln Cycle	
Date of test		03-11-14 to 3/12/2014	
Time runs were done	(Hrs)	0813 / 1220	
Kiln Charge Time	(Hrs)	26.8	
Volumetric Flow			
	Actual (ACFM)	14,647	
	Standard (DSCFM)	10,331	
Gas Temperature	(°F)	132	
Moisture Content	(%v/v)	23.07	
Gas Composition (%v/v, dry)			
	Carbon Dioxide	0.20	
	Oxygen	20.90	
	Nitrogen	78.90	
VOC (EPA Method 25a)		Average (ppm C, d)	2,485.44
		Average (Lb Carbon/Hr)	31.93
		Total (Lb Carbon/Charge)	855.83
		Total (Lb Carbon/1000 Board Feet)	3.52
Total Board Feet in Kiln Charge	(mbf)	243	

### 3 RESULTS

The results of individual NCASI 99.02 determinations are presented in this section. There were a total of 12 test runs completed on the Red Pine kiln charge, and 7 test runs on the Jack Pine kiln charge. The results of these test runs, and the continuous velocity, temperature and moisture readings were integrated into a continuous record for each kiln charge (Appendix D). The mass rate for total carbon was computed on a continuous basis, totaled and converted to units of lb/mbf. A copy of the test plan is included in the appendices which contains additional information on the facility.

The results have been calculated on a personal computer using programs written in Microsoft Excel specifically for source testing calculations. EPA-published equations have been used as the basis of the calculation techniques in these programs. Emission rates have been calculated using the product of the concentration times flow method.

### 3.1 Results of NCASI 99.02 Determinations (Red Pine)

Results of NCASI 99.02 Determinations

Interpol Laboratories Report Number 14-33009  
 Potlatch  
 Gwinn, MI

Test Number 2							
SV Kiln 4							
Red Pine		Run 1	Run 2	Run 3	Average		
Date of Test		03-04-14	03-04-14	03-04-14			
Time of Runs							
Start	(Hrs)	1015	1500	1930			
End	(Hrs)	1115	1600	2030			
Total	(Min)	60	60	60			
Moisture Content	(%v/v)	0.5	4.5	5.7			
Volumetric Flow Rate	(DSCFM)	3,957	4,741	15,123			
Sample Volume	(DSL)	24.23	Spike 24.87	Duplicate 24.66	24.83		
Acetaldehyde	(ppm,d)	< 0.43	13.12	0.83	< 0.43	0.43	
	(LB/HR)	< 0.01		0.03	< 0.04	0.04	
	(%)		82.40			0.81	
Propionaldehyde	(ppm,d)	< 0.33	5.04	< 0.34	< 0.32	0.33	
	(LB/HR)	< 0.01		< 0.01	< 0.04	0.04	
	(%)		84.51			0.81	
Acrolein	(ppm,d)	< 0.34	6.52	< 0.35	< 0.33	0.34	
	(LB/HR)	< 0.01		< 0.01	< 0.04	0.04	
	(%)		101.66			0.81	
Methanol	(ppm,d)	< 0.60	23.79	1.90	4.60	4.76	
	(LB/HR)	< 0.01		0.04	0.35	0.36	
	(%)		89.16			3.45	
Phenol	(ppm,d)	< 0.20	7.25	< 0.21	< 0.20	0.20	
	(LB/HR)	< 0.01		< 0.01	< 0.04	0.04	
	(%)		88.82			0.81	
Formaldehyde	(ppm,d)	< 0.07	13.14	< 0.07	< 0.07	0.07	
	(LB/HR)	< 0.001		< 0.002	< 0.005	0.005	
	(%)		94.86			0.81	

Results of NCASI 99.02 Determinations

Interpoll Laboratories Report Number 14-33009

Potlatch  
Gwinn, MI

Test Number 2

SV Kiln 4  
Red Pine

		Run 4	Run 5	Run 6
Date of Test		03-05-14	03-05-14	03-05-14
Time of Runs				
Start	(Hrs)	2330	0455	0930
End	(Hrs)	0030	0555	1030
Total	(Min)	60	60	60
Moisture Content	(%v/v)	10.4	13.3	10.7
Volumetric Flow Rate	(DSCFM)	17,886	13,630	20,375
Sample Volume	(DSL)	24.97	23.82	27.49
Acetaldehyde	(ppm,d)	0.62	0.70	14.37
	(LB/HR)	0.08	0.07	0.89
	(%)			84.85
Propionaldehyde	(ppm,d)	< 0.32	< 0.37	4.88
	(LB/HR)	< 0.05	< 0.05	< 0.07
	(%)			80.91
Acrolein	(ppm,d)	< 0.33	< 0.38	6.76
	(LB/HR)	< 0.05	< 0.05	< 0.38
	(%)			104.03
Methanol	(ppm,d)	9.00	8.93	36.63
	(LB/HR)	0.80	0.61	10.75
	(%)			102.58
Phenol	(ppm,d)	< 0.20	< 0.23	8.80
	(LB/HR)	< 0.05	< 0.05	< 0.23
	(%)			106.45
Formaldehyde	(ppm,d)	0.21	0.33	15.27
	(LB/HR)	0.02	0.02	0.43
	(%)			106.57

Results of NCASI 99.02 Determinations

Interpol Laboratories Report Number 14-33009  
 Potlatch  
 Gwinn, MI

Test Number 2

SV Kiln 4

Red Pine

		Run 7	Run 8	Run 9
Date of Test		03-05-14	03-05-14	3/5,6/14
Time of Runs				
	Start (Hrs)	1400	1900	2330
	End (Hrs)	1500	2000	0030
	Total (Min)	60	60	60
Moisture Content	(%v/v)	15.5	15.9	11.7
Volumetric Flow Rate	(DSCFM)	19,806	13,904	17,096
Sample Volume	(DSL)	23.82	23.27	24.71
Acetaldehyde	(ppm,d)	1.54	1.44	1.74
	(LB/HR)	0.21	0.14	0.20
	(%)			
Propionaldehyde	(ppm,d)	< 0.39	< 0.46	0.52
	(LB/HR)	< 0.07	< 0.06	0.08
	(%)			
Acrolein	(ppm,d)	0.65	< 0.47	0.54
	(LB/HR)	0.11	< 0.06	0.08
	(%)			
Methanol	(ppm,d)	17.75	17.32	17.62
	(LB/HR)	1.75	1.20	1.50
	(%)			
Phenol	(ppm,d)	< 0.24	< 0.28	< 0.25
	(LB/HR)	< 0.07	< 0.06	< 0.06
	(%)			
Formaldehyde	(ppm,d)	0.86	0.93	0.92
	(LB/HR)	0.08	0.06	0.07
	(%)			

Results of NCASI 99.02 Determinations

Interpoll Laboratories Report Number 14-33009  
 Potlatch  
 Gwinn, MI

Test Number 2

SV Kiln 4  
 Red Pine

		Run 10	Run 11	Run 12
Date of Test		03-06-14	03-06-14	03-06-14
Time of Runs				
	Start (Hrs)	0500	0930	1300
	End (Hrs)	0600	1030	1400
	Total (Min)	60	60	60
Moisture Content	(%v/v)	9.2	4.2	1.5
Volumetric Flow Rate	(DSCFM)	16,996	9,753	24,942
Sample Volume	(DSL)	24.13	24.06	24.22
		Duplicate		
		23.99		
Acetaldehyde	(ppm,d)	1.30	1.36	0.80
	(LB/HR)	0.15	0.16	0.14
	(%)		4.31	
Propionaldehyde	(ppm,d)	< 0.41	0.41	< 0.44
	(LB/HR)	< 0.063	0.063	< 0.039
	(%)		0.63	
Acrolein	(ppm,d)	< 0.42	0.43	< 0.45
	(LB/HR)	< 0.063	0.063	< 0.039
	(%)		0.63	
Methanol	(ppm,d)	14.69	15.60	13.14
	(LB/HR)	1.25	1.32	0.64
	(%)		6.03	
Phenol	(ppm,d)	< 0.25	0.25	< 0.27
	(LB/HR)	< 0.06	0.00	< 0.04
	(%)		0.63	
Formaldehyde	(ppm,d)	0.71	0.80	0.42
	(LB/HR)	0.06	0.06	0.02
	(%)		11.72	
Kiln Charge Time	(Hours)			53.1

**RECEIVED**

**MAY 12 2014**

**AIR QUALITY DIV.**

3.2 Results of NCASI 99.02 Determinations (Jack Pine)

Results of NCASI 99.02 Determinations

Interpoll Laboratories Report Number 14-33009  
 Potlatch  
 Gwinn, MI

Test Number 10  
 SV Kiin 4

		Run 1	Run 2	Run 3
Date of Test		03-11-14	03-11-14	03-11-14
Time of Runs				
Start	(Hrs)	0830	1230	1630
End	(Hrs)	0930	1330	1730
Total	(Min)	60	60	60
Moisture Content	(%v/v)	3.4	19.6	34.3
Volumetric Flow Rate	(DSCFM)	9,262	9,742	6,239
Sample Volume	(DSL)	23.55	23.04	22.64
			Spike	
Acetaldehyde	(ppm,d)	3.82	15.30	29.68
	(LB/HR)	0.24	1.02	0.41
	(%)		83.95	
Propionaldehyde	(ppm,d)	< 0.37	< 0.35	5.25
	(LB/HR)	< 0.03	< 0.03	< 0.02
	(%)		80.58	
Acrolein	(ppm,d)	< 0.38	< 0.36	5.04
	(LB/HR)	< 0.03	< 0.03	0.53
	(%)		72.48	
Methanol	(ppm,d)	1.22	23.43	56.47
	(LB/HR)	0.06	1.14	42.44
	(%)		116.01	1.32
Phenol	(ppm,d)	< 0.23	0.50	10.44
	(LB/HR)	< 0.03	0.07	< 0.26
	(%)		115.02	< 0.02
Formaldehyde	(ppm,d)	< 0.08	0.66	17.96
	(LB/HR)	< 0.003	0.03	1.81
	(%)		113.92	0.05

Results of NCASI 99.02 Determinations

Interpoll Laboratories Report Number 14-33009

Potlatch  
Gwinn, MI

Test Number 10  
SV Kiln 4

		Run 4	Run 5	Run 6	Average	
Date of Test		03-11-14	3/11,12/14	03-12-14		
Time of Runs						
	Start (Hrs)	2030	0030	0500		
	End (Hrs)	2130	0130	0600		
	Total (Min)	60	60	60		
Moisture Content	(%v/v)	31.1	33.7	32.4		
Volumetric Flow Rate	(DSCFM)	9,362	7,570	7,779		
Sample Volume	(DSL)	24.88	Duplicate 23.77	25.45	23.52	
Acetaldehyde	(ppm,d)	3.92	4.03	3.46	4.76	4.07
	(LB/HR)	0.25	0.26	0.18	0.25	0.23
	(%)		2.76			
Propionaldehyde	(ppm,d)	< 0.32	0.34	< 0.31	< 0.34	< 0.33
	(LB/HR)	< 0.027	0.029	< 0.021	< 0.024	< 0.024
	(%)		6.56			
Acrolein	(ppm,d)	< 0.33	0.36	< 0.32	< 0.35	< 0.34
	(LB/HR)	< 0.027	0.029	< 0.021	< 0.024	< 0.024
	(%)		6.56			
Methanol	(ppm,d)	34.63	39.55	44.70	62.34	48.05
	(LB/HR)	1.62	1.85	1.69	2.42	1.95
	(%)		13.25			
Phenol	(ppm,d)	< 0.20	0.21	< 0.19	< 0.21	< 0.20
	(LB/HR)	< 0.03	0.00	< 0.02	< 0.02	< 0.02
	(%)		6.56			
Formaldehyde	(ppm,d)	1.78	2.06	2.23	2.65	2.27
	(LB/HR)	0.08	0.09	0.08	0.10	0.09
	(%)		14.83			
Benzene	(ppm,d)	< 0.01	0.01	< 0.01	< 0.01	< 0.01
	(LB/HR)	< 0.002	0.002	< 0.001	< 0.001	< 0.001
	(%)		1.16			

Results of NCASI 99.02 Determinations

Interpol Laboratories Report Number 14-33009  
 Pottatch  
 Gwinn, MI

Test Number 10  
 SV Kiln 4

Run 7

Entire  
 Kiln

Date of Test		03-12-14		
Time of Runs				
	Start	(Hrs)	0900	
	End	(Hrs)	1000	
	Total	(Min)	60	
Moisture Content		(%v/v)	36.8	
Volumetric Flow Rate		(DSCFM)	5,834	
Sample Volume		(DSL)	23.89	Runs 1-7 Total Lb/charge
Acetaldehyde	(ppm,d)		7.23	
	(LB/HR)		0.29	10.01
	(%)			
Propionaldehyde	(ppm,d)		0.56	
	(LB/HR)		0.030	0.73
	(%)			
Acrolein	(ppm,d)		1.02	
	(LB/HR)		0.052	0.83
	(%)			
Methanol	(ppm,d)		97.24	
	(LB/HR)		2.83	42.41
	(%)			
Phenol	(ppm,d)	<	0.21	
	(LB/HR)	<	0.02	0.86
	(%)			
Formaldehyde	(ppm,d)		4.18	
	(LB/HR)		0.11	1.79
	(%)			
Kiln Charge Time		(Hours)		26.8