Source Emissions Testing – Spring Round 2015

Stantec

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TABLE OF CONTENTS

LIST OF TABLES

List of Figures

List of Appendices

EXECUTIVE SUMMARY

Northern Pulp Nova Scotia Corporation, referred to herein as Northern Pulp, retained Stantec Consulting Ltd. to conduct source emissions testing at the Kraft pulp mill in New Glasgow, Nova Scotia. Source emissions testing was conducted on the Recovery Boiler, the Lime Kiln, the Smelt Dissolving Tank, the Power Boiler, and the High Level Roof Vent to fulfill the conditions specified in the current Certificate of Approval to Operate (CoA) 2011-076657-A01. The source emissions testing campaign was performed according to the pre-test plan submitted to the Nova Scotia Department of Environment, the United States Environmental Protection Agency Test Method 16B, under the Codes of Regulations (CFR) Part 60 Appendix A, Environment Canada's EPS 1/RM/8, and EPS 1/RM/15. The testing was conducted on April 28-29 and July 21-24, 2015.

In this report, source emissions testing data are presented for measurements which include combustion gases, total particulate matter (PM), total reduced sulphur (TRS) as well as exhaust gas temperature, exhaust flow rate, moisture content, velocity, and volumetric flow rate. The scope of work for the testing campaign is summarized in Table 1.1.

Table 1.1 Source Emissions Testing Matrix

Source	Number of Samples per Source	Approval Condition	Parameter	Sampling Method
Lime Kiln	3	6. a)	Total Particulate Matter (PM)	EPS 1/RM/8
	1	6. b)	Total Reduced Sulphur (TRS)	US EPA Method 16B/C
	3	-	Combustion Gases	EPS 1/RM/15
Recovery Boiler	3	6. a)	Total Particulate Matter (PM)	EPS 1/RM/8
	3	-	Combustion Gases	EPS 1/RM/15
Smelt Dissolving Tank	3	6. a)	Total Particulate Matter (PM)	EPS 1/RM/8
	3	-	Combustion Gases	EPS 1/RM/15
	1	6. b)	Total Reduced Sulphur (TRS)	US EPA Method 16B/C
Power Boiler	3	6. a)	Total Particulate Matter (PM)	EPS 1/RM/8
	3	-	Combustion Gases	EPS 1/RM/15
High Level Roof Vent	1	6. b)	Total Reduced Sulphur (TRS)	US EPA Method 16B/C
	3	-	Combustion Gases	EPS 1/RM/15

Currently there are specified regulatory limits in the facility's CoA for emissions of PM and/or TRS from four of the five exhaust stacks listed. The measured concentration of PM from the Lime Kiln, Smelt Dissolving Tank, Power Boiler, and Recovery Boiler were all below their respective regulatory stack limits. The maximum 4-hour rolling average concentration of TRS from the Lime Kiln was below the regulatory limit. No limit for TRS is specified for the High Level Roof Vent or the Dissolving Tank in the facility's approval. A summary of the results of the source emissions testing is provided in Table 1.2.

Table 1.2 Source Emissions Testing Results

Exhaust Gas Parameters	Recovery Boiler	Power Boiler	Lime Kiln	Smelt Dissolving Tank	HLRV
Total Particulate Matter – TPM (mg/Rm^3 at 11% O_2)	3.81	148	-	-	-
Total Particulate Matter - TPM (kg/adubmt)	-	-	0.37	0.33	-
Total Reduced Sulphur - TRS (ppm dv)	-	-	6.30	ND	36.0
Sulphur Dioxide – SO_2 (mg/Rm^3)	7.05	ND	4.38	ND	4.44
Nitrogen Oxides – NO_x (mg/Rm^3)	119	45.9	186	ND	35.8
Carbon Monoxide – CO (mg/Rm^3)	172	634	7.74	ND	158
Volumetric Flow Rate (Rm^3/s)	77.1	39.4	7.42	3.78	30.9
Velocity (m/s)	12.9	19.9	11.2	7.80	-
Temperature (°C)	66.4	56	70.5	79	-
Moisture Content (%)	28.3	16.3	32.1	50.5	-
Oxygen - O_2 (%)	6.23	15.4	4.47	20.9	-
Carbon Dioxide - CO_2 (%)	8.53	3.0	22.5	0	-

1.0 INTRODUCTION

Northern Pulp Nova Scotia Corporation, referred to herein as Northern Pulp, retained Stantec Consulting Ltd. (Stantec) to conduct source emissions testing at the Kraft pulp mill in New Glasgow, Nova Scotia. Source emissions testing was conducted on the Recovery Boiler, the Lime Kiln, the Smelt Dissolving Tank, the Power Boiler, and the High Level Roof Vent to fulfill the conditions specified in the current Certificate of Approval to Operate (CoA) 2011-076657-A01. The source emissions testing campaign was performed according the pre-test plan submitted to the Nova Scotia Department of Environment, the United States Environmental Protection Agency Test Method 16B, under the Codes of Regulations (CFR) Part 60 Appendix A, and the Environment Canada methods EPS 1/RM/8 and EPS 1/RM/15. The particulate matter and total reduced sulphur testing was conducted during the period of April 28-29 and July 21-24, 2015.

In this report, source emissions testing data are presented for combustion gases, total particulate matter (PM), total reduced sulphur (TRS), exhaust gas temperature, exhaust flow rate, moisture content, velocity, and volumetric flow rate. Source emissions testing were conducted on the following sources:

- Lime Kiln;
- Recovery Boiler;
- Smelt Dissolving Tank;
- Power Boiler; and
- High Level Roof Vent.

This report is in five sections. Section 1 contains the introduction and the scope of work for the project. The study approach and a brief description of the various parts of the project are in Section 2. Section 3 contains a brief description of the testing methodologies, equipment, and calibration techniques used during the source emissions testing program. In Section 4, the results of the source emissions testing are presented and discussed, and concluding remarks are presented in Section 5. Appendices A through E contain supporting information for the report.

2.0 OVERALL APPROACH

The project consisted of five parts:

1. Submission of the Pre-test Plan;
2. Site Preparation and Preliminary Survey;
3. On-site Source Emissions Testing;
4. Laboratory Analysis; and
5. Information Review and Reporting.

Each of these parts is described below.

2.1 SUBMISSION OF PRE-TEST PLAN

The on-site testing was conducted in accordance with the Pre-Test Plan (Appendix A) submitted on February 20, 2015 to Nova Scotia Environment (NSE). The Pre-Test Plan outlined the rationale for the selection of the associated contaminants to be tested, as well as the methodologies proposed for conducting the source testing on the exhaust stacks.

2.2 ON-SITE SOURCE EMISSIONS TESTING

Stantec set up the source emissions testing equipment and conducted a preliminary survey to measure the exhaust gas temperature, velocity, and flue gas composition in the five exhaust points. The data from this survey was used to determine the appropriate nozzle size to conduct isokinetic sampling (where the velocity of the gas entering the nozzle is equal to the gas velocity in the stack) for particulate matter during the source emissions testing part of the work.

Three (3) tests for total particulate matter were conducted at defined sampling locations on the exhaust stacks of the Recovery Boiler, the Lime Kiln, the Smelt Dissolving Tank, and the Power Boiler. Three tests for combustion gases were also conducted, near the centre of the exhaust stacks of the Recovery Boiler, the Lime Kiln, the Smelt Dissolving Tank, the Power Boiler and the High Level Roof Vent. All testing was completed in compliance with the sampling methods presented in Table 2.1, in accordance with the *Air Quality Regulation*, under the *Environment Act*, Section 112 issued by Nova Scotia Environment (NSE) and the requirements of the facility's approval (2011-076657-R03) issued by the NSE.

The source emissions testing of the Lime Kiln, Dissolving Tank and the High Level Roof Vent for total reduced sulphur (TRS) was conducted in accordance with US EPA Method 16B and the requirements of the facility's approval (2011-076657-R03) issued by NSE.

The methodologies used for testing the emissions from each exhaust stack are summarized in Table 2.1.

Table 2.1 Source Emissions Testing Matrix

Source	Number of Samples per Source	Approval Condition	Parameter	Sampling Method
Lime Kiln	3	6. a)	Total Particulate Matter (PM)	EPS 1/RM/8
	1	6. b)	Total Reduced Sulphur (TRS)	US EPA Method 16B/C
	3	-	Combustion Gases	EPS 1/RM/15
Recovery Boiler	3	6. a)	Total Particulate Matter (PM)	EPS 1/RM/8
	3	-	Combustion Gases	EPS 1/RM/15
Smelt Dissolving Tank	3	6. a)	Total Particulate Matter (PM)	EPS 1/RM/8
	3	-	Combustion Gases	EPS 1/RM/15
	1	6. b)	Total Reduced Sulphur (TRS)	US EPA Method 16B/C
Power Boiler	3	6. a)	Total Particulate Matter (PM)	EPS 1/RM/8
	3	-	Combustion Gases	EPS 1/RM/15
High Level Roof Vent	1	6. b)	Total Reduced Sulphur (TRS)	US EPA Method 16B/C
	3	-	Combustion Gases	EPS 1/RM/15

In addition to the above testing (as required to meet the Approval conditions), the exhaust flow rate was determined for the High Level Roof Vent.

2.3 LABORATORY ANALYSIS

Prior to the particulate matter testing, several filters were conditioned and pre-weighed. Following the testing, particulate matter was recovered from the nozzle, the sampling probe and the in-line filter. Following testing the filter, containing the particulate sample, was conditioned and weighed, and the net weight of the collected particulate matter was determined. After each test, the probe and nozzle were rinsed with acetone and this acetone was collected, placed into a pre-weighed container and evaporated until dry. The amount of particulate for each part of the sample was determined gravimetrically, and the mass of particulate matter collected for each test was calculated as the sum of the particulate matter collected in the filter, probe, and nozzle rinse. The contents of the impingers were recovered gravimetrically for particulate matter and reported separately. These recoveries were performed at Stantec's laboratory in Fredericton, New Brunswick.

2.4 INFORMATION REVIEW AND REPORTING

The data collected in the field, along with data from the laboratory analyses, were entered into the Stantec's source emissions testing spreadsheets for analysis. Emissions calculations were then performed to produce the detailed source emissions testing information. Spreadsheet calculations were verified by hand, and numerous spot checks of spreadsheet formulas were conducted to confirm the accuracy of data. Summary tables were prepared and incorporated into this report for submission to Northern Pulp.

3.0 TEST METHODS, EQUIPMENT, AND CALIBRATIONS

This section contains a description of the methods and equipment used to conduct the source emissions testing campaign. The calibration procedures used to ensure the quality of the source emissions testing data are also summarized in this section.

3.1 SAMPLING PROCEDURES AND EQUIPMENT

The following sub-sections contain brief descriptions of the sampling equipment and methodologies used during the source emissions testing campaign.

3.1.1 Total Particulate Matter

Particulate matter emissions from the four exhaust stacks (Recovery Boiler, Lime Kiln, Smelt Dissolving Tank, and Power Boiler) were measured in accordance with the Environment Canada Reference Method EPS 1/RM/8, entitled *Reference Methods for Source Testing: Measurement of Releases of Particulate from Stationary Sources*.

The sampling train, used specifically for isokinetic sampling of particulate matter, is described in detail in EPS 1/RM/8, and is generally referred to as the 'Method 5' sampling train for particulate matter, named after the United States Environmental Protection Agency (US EPA) protocol. The sampling train consists of several different components which include: a heated sampling probe (a nozzle, stainless steel liner,

thermocouple, and pitot tube assembly), a heated sample case containing a filter, an ice box containing impinger glassware, and an umbilical cord leading to the pump and control console. A schematic of the sampling system is shown in Figure 3.1. The operation of the Method 5 sampling train can be generally described as follows.

Exhaust gases are drawn through the probe nozzle at or near isokinetic conditions (*i.e.*, where the gas velocity in the nozzle is at the same velocity as the gas in the stack). The gases are then drawn through the inner stainless steel liner of the electrically heated sampling probe to the other components of the sampling train.

A pitot tube assembly is attached to the probe next to the nozzle to measure the exhaust gas velocity in the area of the probe nozzle. Using the differential pressure reading on the control console, the desired nozzle flow rate is determined from the differential pressure across a calibrated orifice.

The exhaust gases are drawn from the probe liner through a pre-weighed glass fiber filter, in the hot side of the sampling unit, and then through pre-weighed impingers in an ice bath to cool the gases and condense the moisture in the gas, before the gas enters the umbilical cord.

The umbilical cord carries the filtered, cooled exhaust gases from the sampling site to the control console. The control console contains a fiber vane vacuum pump, which is used to draw the exhaust gases through the sampling train. A calibrated dry gas meter records the volume of gas sampled.

After completion of testing, the impingers are re-weighed, with the difference in mass corresponding to the mass of water collected. This measurement is used to calculate the moisture content of the exhaust gas.

Total particulate matter is determined gravimetrically at Stantec's laboratory in Fredericton, New Brunswick.

Appendix B contains the calibration data.

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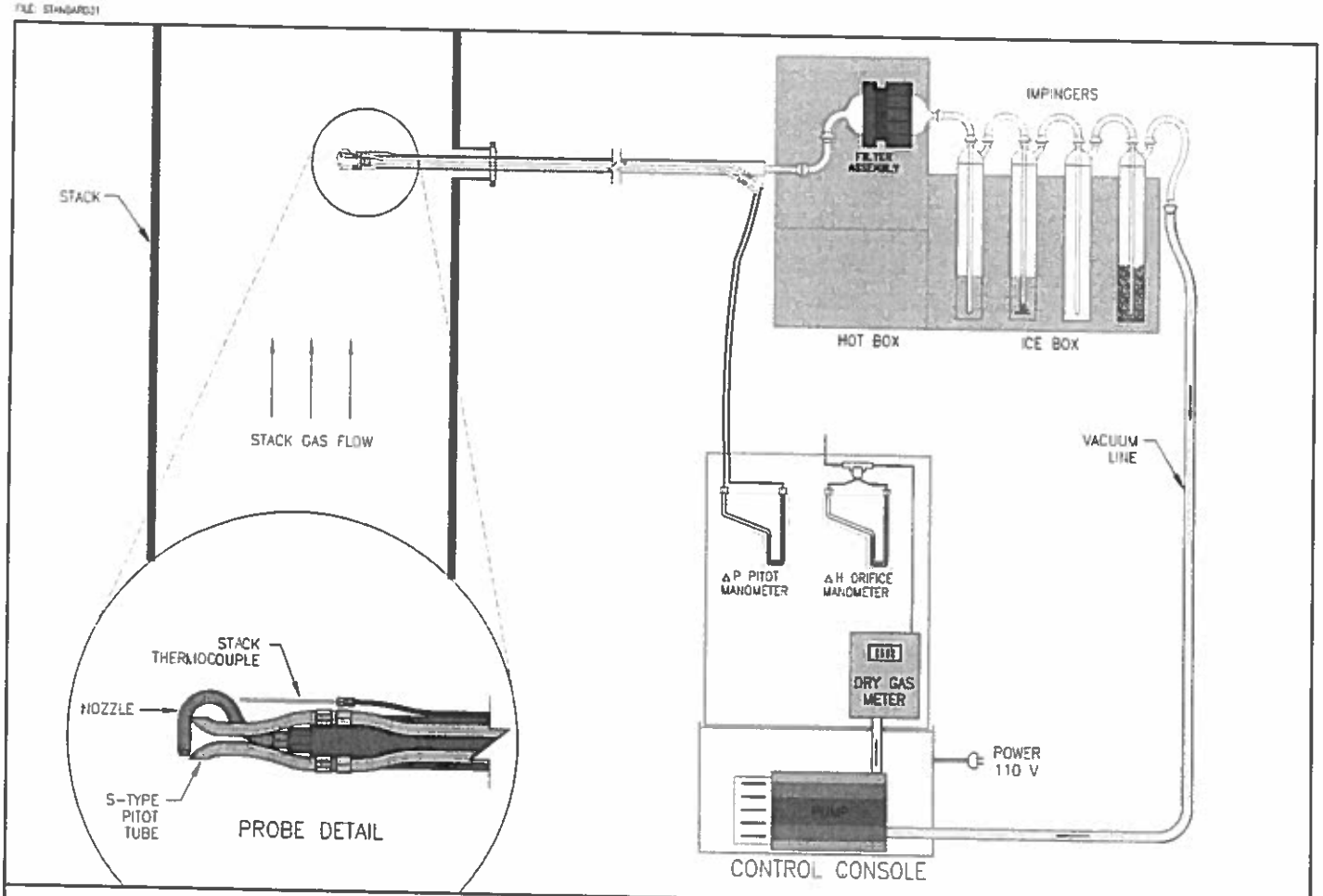

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SOURCE EMISSIONS TESTING
METHOD 5 SAMPLING TRAIN

Scale: N.T.S.

Fig. No.: 3.1

3.1.2 Combustion Gases

The combustion gases (O_2, CO_2, CO, NO_x, and SO_2) were sampled according to the Environment Canada reference method EPS 1/RM/15, entitled *Reference Method for the Monitoring of Gaseous Emissions from Fossil Fuel-fired Burners*. In this method, samples of flue gas are drawn through a probe, non-isokinetically, from a single point near the centre of the stack. The combustion gases were analyzed using a Testo 350 XL Flue Gas Analyzer manufactured by Testo GmbH and Co. This unit is equipped with electrochemical cells that are used to measure the concentrations of oxygen, carbon dioxide, sulphur dioxide, nitrogen oxides, carbon monoxide, and total hydrocarbons, in accordance with EPS 1/RM/15. The system is equipped with a flue gas probe that has an integrated filter trap and condensate trap and a housing unit that contains the pump and the electrochemical cells. The equipment is manufactured and calibrated to ensure high accuracy.

The concentrations and emission rates of oxygen, carbon dioxide, and SO_2 were measured continuously from the Lime Kiln, Dissolving Tank and the High Level Roof Vent during total reduced sulphur measurements in accordance with the following US EPA protocols for source emissions testing.

Carbon Dioxide (CO_2) and Oxygen (O_2): Carbon dioxide and oxygen are analyzed according to the US EPA Method 3A, entitled *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)*. In this method, a sample of stack gas is continuously extracted from the effluent stream at a single point near the centre of the stack through a heated filter and sample line. A portion of the sample is distributed to a paramagnetic analyzer for the determination of oxygen concentration, and to a Luft-type non-dispersive infrared (NDIR) analyzer or equivalent for the determination of carbon dioxide concentration.

Sulphur Dioxide (SO_2): Sulphur dioxide is analyzed according to the US EPA Method 6C, entitled *Determination of Sulphur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)*. In this method, a sample of stack gas is continuously extracted from the effluent stream at a single point near the centre of the stack through a heated filter and sample line. A portion of the sample is distributed to an instrumental ultraviolet (UV) analyzer for the determination of SO_2 concentration.

3.1.3 Total Reduced Sulphur

The source emissions testing of the Lime Kiln and the High Level Roof Vent for total reduced sulphur was conducted in accordance with US EPA Method 16B, entitled *Determination of Total Reduced Sulfur Emissions from Stationary Sources* and US EPA Method 16C *(real-time data)*.

Method 16C uses the sampling procedures of Method 16A/B and the analytical procedures of Method 6C (for SO_2 analysis) to measure TRS. Total reduced sulfur is defined as hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide (reported as H_2S). As in Method 16A and B, the sample is collected from the source through a heated probe. Stantec modified Method 16 by omitting the citrate buffer scrubber. The citrate buffer scrubber is used to remove SO_2 from the gas stream prior to the oxidizing oven. This modification was done to facilitate 24-hour sampling as removal of SO2 using the scrubber requires frequent stops and starts and checks on the buffer to ensure the buffer does not become saturated. This modification thus improves the accuracy of sampling over using the buffer.

The sample is extracted from the exhaust gas of the stack through a heated Teflon line and directed through a first SO_2 analyzer (non-dispersive ultra-violet (NDUV) continuous analyzer) to confirm SO_2 present prior to the oven. The sample is then directed through an oven to thermally oxidize any reduced sulphur compounds to SO_2. Following oxidation of the sample, the exhaust gas from the oven is drawn through a second SO_2 non-dispersive ultra-violet (NDUV) continuous analyzer to analyze the gas for SO_2. The concentration of Total Reduced Sulphur (TRS) is then calculated by subtracting any SO_2 measured in the gas prior to oxidation (measured via the first SO_2 analyzer prior to the oven) from the total SO_2 present after the oxidation oven. Monitoring was conducted continuously over a 24-hour period on each source.

3.2 QUALITY ASSURANCE AND QUALITY CONTROL

Throughout the source emissions testing program, quality assurance and quality control procedures were applied to confirm the accuracy of the accurate emissions data. These checks were performed by test personnel throughout the program under the guidance of the source testing crew chief in the field and the project manager during post testing review.

The quality control (QC) checks included the following:

- use of standardized checklists and field notebooks to ensure completeness, traceability, and comparability of the process information and samples collected;
- field checking of standardized forms by a second person to confirm completeness;
- testing for cyclonic or reverse flow, as well as stratified flow conditions; and
- leak checks of sampling trains

Equipment was calibrated according to the protocols and schedule as prescribed by Environment Canada. These calibrations include the following:

Pitots: Calibrated in a wind tunnel with probe and nozzles attached.

Gas meters: Calibrated using a critical orifice calibration set.

Nozzle: Four diameter measurements made using a micrometer across the sharpened edges.

Thermocouples: Calibrated using a potentiometric technique.

Gas Analyzer: Calibrated against reference gases using standard calibration gases within the expected range of concentrations from the source.

Calibration data are in Appendix B of this report.

4.0 RESULTS AND DISCUSSION

The results of the source emissions testing campaigns are provided and discussed in this section.

Appendices B through D contain supporting information including calibration information, field data sheets, and calculations.

4.1 EXHAUST STACK SAMPLE LOCATION DETAILS

Table 4.1 provides a summary of the sample location details for each exhaust stack sampled.

Table 4.1 Sample Location Details

Parameter	Recovery Boiler	Lime Kiln	Smelt Dissolving Tank	Power Boiler	High Level Roof Vent
Stack Height – Above Grade (m)	69	37	51	51	65
Diameter / Equivalent Diameter (m)	3.51	1.22	1.22	1.93	1.83
Stack/Duct Description	Circular	Circular	Circular	Circular	Circular
Stack Orientation	Vertical	Vertical	Vertical	Vertical	Vertical
Number of Sample Ports	4	2	2	2	1
Sample Port Diameter (m)	0.1	0.15	0.1	0.1	0.1
Location Upstream from any Disturbance,	>2	2	>2	>2	-
Location Downstream from any Disturbance,	1.45	8	6	>4	-
Ideal or Non Ideal Flow Characteristics at The Sample Location[1]	Not Ideal	Not Ideal[2]	Not Ideal	Not Ideal	-
Total Number of Sample Points	24	24	20	24	1
Number of Sample Points per Traverse	12	12	10	12	NA
Sample Time per Point (min)	5	5	5	5	NA
Sample time per Test for PM (min)	120	120	100	120	NA
Sample time per Test for TRS (min)	NA	1,440	1,440	NA	1,440

Notes:

1 The exhaust gas flow characteristics at the sampling location are referred to as being "Ideal" if the sample ports are located in a straight section of stack at least eight stack diameters downstream and two stack diameters upstream of any flow disturbance.

2 The Lime Kiln sampling location is not ideal due to the cyclonic flow.

4.2 LIME KILN

The results of the source emissions testing for total particulate matter from the Lime Kiln exhaust stack are in Table 4.2. The results of the source emissions testing for combustion gases and total reduced sulphur are in Tables 4.3 and 4.4, respectively.

Table 4.2 Source Testing Results - Lime Kiln - Particulate Matter

Parameter	Test #1	Test #2	Test #3	Average	Stack Emission Limit (Table 1 of Approval)
Test Date	July 21, 2015	July 22, 2015	July 22, 2015	-	-
Test Start time	09:05	14:00	17:10	-	-
Test Duration (min)	120	120	120	120	-
Volume of Gas Sampled (Rm^3)	0.89	0.76	0.80	0.82	-
Average Isokineticity (%)	108	108	102	106	-
Total Volume of Moisture Collected in Impingers (mL)	359	251	250	286	-
Particulate Matter From Filter and Probe Wash (mg)	285	389	255	310	-
Particulate Matter From Impingers (mg)	20.5	3.3	3.5	9.1	-
Plant Production (adubmt/day)	596	701	701	666	-
Exhaust Gas Parameters					
Exhaust Gas Temperature (°C)	71.1	70.0	70.6	70.5	-
Exhaust Gas Moisture Content (%)	35.5	30.9	29.9	32.1	-
Exhaust Gas Velocity (m/s)	12.1	10.7	10.9	11.2	-
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	7.86	7.41	7.67	7.64	-
Oxygen - O_2 (%)	4.64	4.59	4.2	4.47	-
Carbon Dioxide - CO_2 (%)	22.1	22.5	23.0	22.5	-
Total Particulate Matter - PM					
Concentration at 11% O_2 (mg/Rm^3)	322	510	320	384	-
Emission Rate (g/s)	2.46	3.67	2.37	2.83	-
Emission metric (kg/adubmt)	0.36	0.45	0.29	0.37	0.50

Legend:

°C	Degrees Celsius.
m/s	Metres per second.
Rm^3/s	Dry cubic metres per second at reference conditions (25°C and 101.3 kPa).
mg/Rm^3	Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr	Kilograms per hour.
adubmt	Reference production rate in air dried unbleached metric tonnes.

The average measured emission rate of particulate matter was 0.37 kg/adubmt, which is below the stack emission limit of 0.50 kg/adubmt presented in Table 5 of the facility's Approval (No. 2011-076657-A01).

It should be noted that, as with previous testing, cyclonic flow is present at the sampling location for this source. Sampling was conducted following the angle adjustment approach with the cosine correction applied, as per the US EPA Guidance Document – GD-008.

Table 4.3 Source Testing Results - Lime Kiln - Combustion Gases

Parameter	Test #1	Test #2	Test #3	Average
Test Date	April 29, 2015	April 29, 2015	April 29, 2015	-
Test Duration (min)	60	60	60	60
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	7.64	7.20	7.42	7.42
Sulphur Dioxide - SO_2				
Concentration (ppm)	1.68	1.67	1.67	1.67
Concentration (mg/Rm^3)	4.41	4.37	4.37	4.38
Emissions Rate (kg/hr)	0.12	0.11	0.12	0.12
Nitrogen Oxides - NO_x*				
Concentration (ppm)	117	131	47.9	98.7
Concentration (mg/Rm^3)	220	247	90.1	186
Emissions Rate (kg/hr)	6.05	6.41	2.41	4.95
Carbon Monoxide - CO				
Concentration (ppm)	6.93	6.78	6.57	6.76
Concentration (mg/Rm^3)	7.94	7.76	7.52	7.74
Emissions Rate (kg/hr)	0.22	0.20	0.20	0.21

Legend:

Rm^3/s	Dry cubic metres per second at reference conditions (25°C and 101.3 kPa) based on average of PM test measurements.
mg/Rm^3	Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr	Kilograms per hour.
ND	Not detected.
*	NO_x concentration was measured during the particulate matter testing while other gases were measured during the TRS sampling period.

The average emission rates for SO_2 NO_x and CO for the Lime Kiln were 0.12 kg/hr, 4.95 kg/hr and 0.21 kg/hr, respectively.

Table 4.4 Source Testing Results – Lime Kiln – Total Reduced Sulphur

Parameter	24-hour TRS Monitoring	Stack Emission Limit (Table 1 of Approval)
Test Start	April 29, 2015 08:25	-
Test Finish	April 30, 2015 08:25	-
Average exhaust gas concentration (ppm dv)	6.30	-
Maximum 4-hour rolling average exhaust gas concentration (ppm dv)	11.7	20

Legend:
ppm dv Parts per million, dry volume.

The maximum 4-hour rolling average observed during the testing was 11.7 ppm (dry basis), which is below the stack emission limit of 20 ppm presented in Table 5 of the facility's Approval (No. 2011-076657-A01).

4.3 RECOVERY BOILER

The results of the source emissions testing for total particulate matter and combustion gases from the Recovery Boiler exhaust stack are in Tables 4.5 and 4.6, respectively.

Table 4.5 Source Testing Results - Recovery Boiler - Particulate Matter

Parameter	Test #1	Test #2	Test #3	Average	Stack Emission Limit (Table 1 of Approval)
Test Date	July 23, 2015	July 23, 2015	July 24, 2015	-	-
Test Start	09:45	13:20	08:12	-	-
Test Duration (min)	120	120	120	120	-
Volume of Gas Sampled (Rm^3)	1.42	1.58	1.87	1.62	-
Average Isokineticity (%)	96.9	101	107	102	-
Total Volume of Moisture Collected in Impingers (mL)	393	443	587	474	-
Particulate Matter From Filter and Probe Wash (mg)	15.5	8.58	0.20	8.08	-
Particulate Matter From Impingers (mg)	1.50	1.04	1.47	1.34	-
Exhaust Gas Parameters					
Exhaust Gas Temperature (°C)	65.5	65.5	68.1	66.4	-
Exhaust Gas Moisture Content (%)	27.4	27.6	29.9	28.3	-
Exhaust Gas Velocity (m/s)	11.8	12.7	14.3	12.9	-
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	70.7	76.2	84.5	77.1	-
Oxygen - O_2 (%)	6.72	6.64	5.31	6.23	-
Carbon Dioxide - CO_2 (%)	7.97	8.02	9.59	8.53	-
Total Particulate Matter - PM Concentration at 11% O_2 (mg/Rm^3)	7.61	3.76	0.07	3.81	77
Emission Rate (g/s)	0.77	0.41	0.01	0.40	-

Legend:

°C	Degrees Celsius.
m/s	Metres per second.
Rm^3/s	Dry cubic metres per second at reference conditions (25°C and 101.3 kPa).
mg/Rm^3	Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr	Kilograms per hour.

The average measured concentration of particulate matter was 3.81 mg/Rm^3 (corrected to 11% O_2), which is below the current stack emission limit of 77 mg/Rm^3 presented in Table 5 of the facility's Approval (No. 2011-076657-A01).

Table 4.6 Source Testing Results - Recovery Boiler - Combustion Gases

Parameter	Test #1	Test #2	Test #3	Average
Test Date	July 23, 2015	July 23, 2015	July 24, 2015	-
Test Duration (min)	30	30	30	30
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	70.7	76.2	84.5	77.1
Sulphur Dioxide - SO_2				
Concentration (ppm)	2.71	4.71	4.57	4.00
Concentration (mg/Rm^3)	4.97	8.58	7.61	7.05
Emissions Rate (kg/hr)	1.81	3.39	3.64	2.95
Nitrogen Oxides - NO_x				
Concentration (ppm)	66.6	63.1	59.4	63.0
Concentration (mg/Rm^3)	125	119	112	119
Emissions Rate (kg/hr)	31.9	32.6	34.0	32.8
Carbon Monoxide - CO				
Concentration (ppm)	96.1	120	236	151
Concentration (mg/Rm^3)	110	137	270	172
Emissions Rate (kg/hr)	28.0	37.6	82.0	49.2

Legend:
Rm^3/s Dry cubic metres per second at reference conditions (25°C and 101.3 kPa).
mg/Rm^3 Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr Kilograms per hour.

The emission rates for SO_2, NO_x and CO for the Recovery Boiler were 2.95 kg/hr, 32.8 kg/hr, and 49.2 kg/hr, respectively.

4.4 SMELT DISSOLVING TANK

The results of the source emissions testing for total particulate matter from the Smelt Dissolving Tank exhaust stack are in Table 4.7. The results of the source emissions testing for combustion gases and total reduced sulphur are in Tables 4.8 and 4.9, respectively.

Table 4.7 Source Testing Results - Smelt Dissolving Tank - Particulate Matter

Parameter	Test #1	Test #2	Test #3	Average	Stack Emission Limit (Table 1 of Approval)
Test Date	July 21, 2015	July 22, 2015	July 22, 2015	-	-
Test Start	09:00	12:45	15:55	-	-
Test Duration (min)	100	100	100	100	-
Volume of Gas Sampled (Rm^3)	0.92	0.81	0.86	0.86	-
Average Isokineticity (%)	91.1	97.4	93.2	93.9	-
Total Volume of Moisture Collected in Impingers (mL)	695	642	610	649	-
Particulate Matter From Filter and Probe Wash (mg)	438	770	533	581	-
Particulate Matter From Impingers (mg)	29.4	21.8	13.7	21.7	

Table 4.7 Source Testing Results - Smelt Dissolving Tank - Particulate Matter

Parameter	Test #1	Test #2	Test #3	Average	Stack Emission Limit (Table 1 of Approval)
Pulp Production (adubmt/day)	596	701	701	666	-
Exhaust Gas Parameters					
Exhaust Gas Temperature (°C)	77	83	78	79	-
Exhaust Gas Moisture Content (%)	50.5	51.8	49.2	50.5	-
Exhaust Gas Velocity (m/s)	8.53	7.28	7.59	7.80	-
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	4.16	3.42	3.77	3.78	-
Oxygen - O_2 (%)	20.9	20.9	20.9	20.9	-
Carbon Dioxide - CO_2 (%)	0.0	0.0	0.0	0.0	-
Total Particulate Matter - PM					
Concentration (mg/Rm^3)	474	951	622	682	-
Emission Rate (g/s)	1.97	3.25	8.44	9.08	-
Emission metric (kg/adubmt)	0.29	0.40	0.29	0.33	0.50

Legend:

°C	Degrees Celsius.
m/s	Metres per second.
Rm^3/s	Dry cubic metres per second at reference conditions (25°C and 101.3 kPa).
mg/Rm^3	Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr	Kilograms per hour.
adubmt	Reference production rate in air dried unbleached metric tonnes.

The average measured emission rate of particulate matter was 0.33 kg/adubmt, which is below the stack emission limit of 0.50 kg/adubmt presented in Table 5 of the facility's Approval (No. 2011-076657-A01).

Table 4.8 Source Testing Results - Smelt Dissolving Tank - Combustion Gases

Parameter	Test #1	Test #2	Test #3	Average
Test Date	July 21, 2015	July 22, 2015	July 22, 2015	-
Test Duration (min)	30	30	30	30
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	4.16	3.42	3.77	3.78
Sulphur Dioxide - SO_2				
Concentration (ppm)	ND	ND	ND	ND
Concentration (mg/Rm^3)	ND	ND	ND	ND
Emissions Rate (kg/hr)	ND	ND	ND	ND
Nitrogen Oxides - NO_x				
Concentration (ppm)	ND	ND	ND	ND
Concentration (mg/Rm^3)	ND	ND	ND	ND
Emissions Rate (kg/hr)	ND	ND	ND	ND
Carbon Monoxide - CO				
Concentration (ppm)	ND	ND	ND	ND
Concentration (mg/Rm^3)	ND	ND	ND	ND

Table 4.8 Source Testing Results - Smelt Dissolving Tank - Combustion Gases

Parameter	Test #1	Test #2	Test #3	Average
Emissions Rate (kg/hr)	ND	ND	ND	ND

Legend:
Rm³/s Dry cubic metres per second at reference conditions (25°C and 101.3 kPa).
mg/Rm³ Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr Kilograms per hour.
ND Not detected.

Sulphur dioxide, nitrogen oxides, and carbon monoxide were not detected from the smelt dissolving tank.

Table 4.9 Source Testing Results – Dissolving Tank – Total Reduced Sulphur

Parameter	24-hour TRS Monitoring	Stack Emission Limit (Table 1 of Approval)
Test Start	April 28, 2015 17:40	-
Test Finish	April 29, 2015 17:40	-
Average exhaust gas concentration (ppm dv)	ND	nl
Maximum 4-hour rolling average exhaust gas concentration (ppm dv)	3.82	nl

Legend:
ppm dv Parts per million, dry volume.
nl No limit established.
ND not detected

The average TRS measured was below the detection limit of the sampling system. The maximum 4-hour rolling average observed during the testing was 3.82 ppm (dry basis). There is no stack emission limit specified in the facility's Approval (No. 2011-076657-A01).

4.5 POWER BOILER

The results of the source emissions testing for total particulate matter and combustion gases from the Power Boiler exhaust stack are in Tables 4.10 and 4.11, respectively.

Table 4.10 Source Testing Results - Power Boiler - Particulate Matter

Parameter	Test #1	Test #2	Test #3	Average	Stack Emission Limit (Table 1 of Approval)
Test Date	July 23, 2015	July 23, 2015	July 24, 2015	-	-
Test Start	09:42	13:25	08:00	-	-
Test Duration (min)	120	120	120	120	-
Volume of Gas Sampled (Rm³)	1.62	1.63	1.61	1.62	-
Average Isokineticity (%)	98.6	101	101	100	-
Total Volume of Moisture Collected in Impingers (mL)	204	258	238	233	-
Particulate Matter From Filter and Probe Wash (mg)	97.2	97.3	208	134	-

Table 4.10 Source Testing Results - Power Boiler - Particulate Matter

Parameter	Test #1	Test #2	Test #3	Average	Stack Emission Limit (Table 1 of Approval)
Particulate Matter From Impingers (mg)	23.7	1.2	3.7	9.5	
Exhaust Gas Parameters					
Exhaust Gas Temperature (°C)	53.9	56.8	57.4	56.0	-
Exhaust Gas Moisture Content (%)	14.6	17.7	16.7	16.3	-
Exhaust Gas Velocity (m/s)	19.7	20.3	19.7	19.9	-
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	40.0	39.3	38.9	39.4	-
Oxygen - O_2 (%)	16.1	17.0	13.2	15.4	-
Carbon Dioxide - CO_2 (%)	2.53	2.24	4.23	3.00	-
Total Particulate Matter - PM					
Concentration at 11% O_2 (mg/Rm^3)	125	150	167	148	150
Emission Rate (g/s)	2.40	2.34	5.03	3.26	-

Legend:

°C	Degrees Celsius.
m/s	Metres per second.
Rm^3/s	Dry cubic metres per second at reference conditions (25°C and 101.3 kPa).
mg/Rm^3	Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr	Kilograms per hour.

The average measured concentration of particulate matter (corrected to 11% O_2) was 148 mg/Rm^3, which is below the stack emission limit of 150 mg/Rm^3 presented in Table 5 of the facility's Approval (No. 2011-076657-A01).

Table 4.11 Source Testing Results - Power Boiler - Combustion Gases

Parameter	Test #1	Test #2	Test #3	Average
Test Date	July 23, 2015	July 23, 2015	July 24, 2015	-
Test Duration (min)	30	30	30	-
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	40.0	39.3	38.9	39.4
Sulphur Dioxide - SO_2				
Concentration (ppm)	ND	ND	ND	ND
Concentration (mg/Rm^3)	ND	ND	ND	ND
Emissions Rate (kg/hr)	ND	ND	ND	ND
Nitrogen Oxides - NO_x				
Concentration (ppm)	18.9	17.6	36.7	24.4
Concentration (mg/Rm^3)	35.5	33.1	69.1	45.9
Emissions Rate (kg/hr)	5.11	4.68	9.67	6.49
Carbon Monoxide - CO				
Concentration (ppm)	1,037	235	388	554
Concentration (mg/Rm^3)	1188	269	444	634
Emissions Rate (kg/hr)	171	38.1	62.2	90.4

Legend:

Rm^3/s	Dry cubic metres per second at reference conditions (25°C and 101.3 kPa).
mg/Rm^3	Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr	Kilograms per hour.

The emission rates of NOx and CO from the Power Boiler were 6.49 kg/hr and 90.4 kg/hr, respectively. No SO_2 was detected.

4.6 HIGH LEVEL ROOF VENT

The results of the source emissions testing for combustion gases and total reduced sulphur from the High Level Roof Vent exhaust stack are in Tables 4.12 and 4.13, respectively.

Table 4.12 Source Testing Results - HLRV - Combustion Gases

Parameter	Test #1	Test #2	Test #3	Average
Test Date	July 23, 2015	July 23, 2015	July 23, 2015	-
Test Duration (min)	30	30	30	30
Exhaust Gas Volumetric Flow Rate (Rm^3/s)	30.9	30.8	31.0	30.9
Sulphur Dioxide SO_2				
Concentration (ppm)	1.76	1.66	1.66	1.70
Concentration (mg/Rm^3)	4.62	4.35	4.36	4.44
Emissions Rate (kg/hr)	0.51	0.48	0.49	0.49
Nitrogen Oxides - NO_x				
Concentration (ppm)	18.9	19.6	18.7	19.0
Concentration (mg/Rm^3)	35.5	36.8	35.2	35.8
Emissions Rate (kg/hr)	3.95	4.09	3.93	3.99
Carbon Monoxide - CO				
Concentration (ppm)	132	138	145	138
Concentration (mg/Rm^3)	151	157	166	158
Emissions Rate (kg/hr)	16.9	17.5	18.5	17.6

Legend:

Rm^3/s	Dry cubic metres per second at reference conditions (25°C and 101.3 kPa).
ppm	Parts per million by volume at reference conditions.
mg/Rm^3	Milligrams per dry cubic metre at reference conditions (25°C and 101.3 kPa).
kg/hr	Kilograms per hour.

The emission rates for SO_2, NOx, and CO from the High Level Roof Vent were 0.49 kg/hr, 3.99 kg/hr, and 17.7 kg/hr, respectively.

Table 4.13 Source Testing Results - High Level Roof Vent - Total Reduced Sulphur

Parameter	24-hour TRS Monitoring	Stack Emission Limit (Table 1 of Approval)
Test Start	July 22, 2015 08:45	-
Test Finish	July 23, 2015 08:45	-
Average exhaust gas concentration (ppm dv)	36.0	nl
Maximum 4-hour rolling average exhaust gas concentration (ppm dv)	57	nl

Legend:

ppm dv	Parts per million, dry volume.
nl	No limit established.

The maximum 4-hour rolling average observed during the testing was 57 ppm (dry basis). There is no stack emission limit specified in the facility's Approval (No. 2011-076657-A01).

4.7 SUMMARY OF RESULTS

Currently there are specified regulatory limits in the facility's approval (2011-076657-A01) for emissions of PM and/or TRS from four of the five exhaust stacks listed. The measured concentration of PM from the Lime Kiln, the Smelt Dissolving Tank, the Power Boiler and the Recovery Boiler were all below their respective regulatory stack limits. The maximum 4-hour rolling average concentration of TRS from the Lime Kiln was below the regulatory limit. No limit for TRS is specified for the Dissolving Tank or the High Level Roof Vent in the facility's approval.

5.0 CLOSURE

This report has been prepared for the sole benefit of Northern Pulp Nova Scotia Corporation. This report may not be relied upon by any other person or entity without the express written consent of Stantec and Northern Pulp Nova Scotia Corporation. Any use of this report by a third party, or any reliance on decisions made based upon this report, are the responsibility of the third party. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Stantec makes no representation or warranty with respect to this report, other than the work was undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Any information or facts provided by others and referred to or utilized in the preparation of this report was assumed by Stantec to be accurate.

This study was undertaken exclusively for the purpose outlined herein and was limited to those contaminants and sources specifically referenced in this report. It should be noted that the measurements were taken over a relatively short time period on-site, and the emissions results may be considered representative only for the conditions present at the time of testing. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations.

This report was developed by Tristan Blair-Hicks, EIT, and reviewed by Gillian Hatcher, M.A.Sc. and Vicki Corning, P.Eng.

Stantec

If you have any questions regarding the contents of this report, or require any additional information, please do not hesitate to contact the undersigned.

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Stantec

Appendix A

Pre-test plan

Stantec Consulting Ltd.
102 - 40 Highfield Park Drive
Dartmouth NS B3A 0A3
Tel: (902) 468-7777
Fax: (902) 468-9009

February 20, 2015
File: 121413456

Attention: Mr. Marc Theriault
Nova Scotia Environment
20 Pumphouse Road
Pictou, NS B2H 5C6

Dear Mr. Theriault,

Reference: Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year

Please accept this Pre-test Plan for the completion of source emissions required at the Pictou Mill in New Glasgow, Nova Scotia for the 2015 calendar year.

Introduction

Northern Pulp is required to perform source emissions testing on the Recovery Boiler, Lime Kiln, Smelt Dissolving Tank, Power Boiler and the High Level Roof Vent to fulfil the conditions specified in the current Certificate of Approval (CoA) to Operate 2011-076657-R03. The required annual testing for 2015 consists of:

- Recovery Boiler and Power Boiler particulate matter testing 4 times per year;
- Lime Kiln and Smelt Dissolving Tank particulate matter testing 2 times per year;
- Lime Kiln, High Level Roof Vent and Smelt Dissolving Tank total reduced sulphur (TRS) testing 2 times per year;
- One $PM_{2.5}$ testing event per year on the four stacks noted above for particulate matter; and
- One Chlorine (Cl) and Chlorine Dioxide (ClO_2) event per year on the bleach plant exhaust (High Level Roof Vent being the source of these emissions).

Test Program Organization

The source emissions testing will be performed for:

Company Name:	Northern Pulp
Company Address:	P.O. Box 549, Station Main, New Glasgow, NS, B2H 5E8
Contact Name:	
Position:	Environmental/Technical Leader
Telephone Number:	(902) 752-8461
Email:	@northernpulp.com

Reference: Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year

Sampling Company: Stantec Consulting Ltd.
Project Manager: Gillian Hatcher
Telephone Number: (902) 468-7777
Fax Number: (902) 468-9009
Email: @Stantec.com
Key Sampling Team: (with support from other staff as needed)

Source Emissions Testing Program

The proposed source emissions testing methodology and proposed sampling timeframes are presented in Table 1.

Table 1 Source Emissions Testing Matrix

Source	Number of Visits	Number of Tests per Visit	Parameter	Sampling Method	Proposed Timeframe
Recovery Boiler	4	3	Total Particulate Matter (PM)	EPS 1/RM/8	Winter, Spring, Summer, Fall
	4	3	Combustion Gases	EPS 1/RM/15	Winter, Spring, Summer, Fall
	1	3	Particle Size Analysis	Microscopic technique	Fall
Power Boiler	4	3	Total Particulate Matter (PM)	EPS 1/RM/8	Winter, Spring, Summer, Fall
	4	3	Combustion Gases	EPS 1/RM/15	Winter, Spring, Summer, Fall
	1	3	Particle Size Analysis	Microscopic technique	Fall
Lime Kiln	2	3	Total Particulate Matter (PM)	EPS 1/RM/8	Spring, Fall
	2	3	Combustion Gases	EPS 1/RM/15	Spring, Fall
	1	3	Particle Size Analysis	Microscopic technique	Fall
	2	3	Total Reduced Sulphur (TRS)	US EPA Method 16B/C	Spring, Fall
Smelt Dissolving Tank	2	3	Total Particulate Matter (PM)	EPS 1/RM/8	Spring, Fall
	2	3	Combustion Gases	EPS 1/RM/15	Spring, Fall
	1	3	Particle Size Analysis	Microscopic technique	Fall
	2	3	Total Reduced Sulphur (TRS)	US EPA Method 16B/C	Winter, Summer
High Level Roof Vent	2	3	Total Reduced Sulphur (TRS)	US EPA Method 16B/C	Spring, Fall
	2	3	Combustion Gases	EPS 1/RM/15	Spring, Fall

Reference: Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year

Table 1 Source Emissions Testing Matrix

Source	Number of Visits	Number of Tests per Visit	Parameter	Sampling Method	Proposed Timeframe
	1	3	Chlorine and chlorine dioxide	NCASI Special Report 91-07	Spring

Note:
Timeframes are as follows based on the approval deadlines-Winter: January-March 31, 2015, Spring: April – June 30, 2015, Summer: July-September 30, 2015, Fall: October-December 31, 2015

Details of each of the methods identified in Table 1, in addition to the preliminary testing methodology, are provided in the sections that follow.

Preliminary Testing: Upon arrival at each sampling location, Stantec will set up the source emissions testing equipment and conduct a preliminary survey to measure the average velocity, flue gas composition, and moisture content in the stack gases using EPS 1/RM/8 Methods B, C, and D, respectively. The data from this survey will be used to determine the appropriate nozzle size to conduct isokinetic sampling (where the velocity of the gas entering the nozzle is equal to the gas velocity in the stack) for particulate matter during the official testing part of the work. Verification for cyclonic or reverse flow will also be conducted during the preliminary survey, according to procedures outlined in the Environment Canada reference method EPS 1/RM/8.

Should fluctuations in the velocity pressure at a selected traverse point exceed 20% of the average pressure for that point; the diameter of the testing cross section will be reduced to include only those areas along the traverse which meet this requirement (less than 20% of the average). Although the diameter may be reduced, the number of sampling points along each traverse will remain the same as determined from EPS 1/RM/8, Method A, using the equivalent diameter.

Volumetric flow and exhaust gas emissions will be calculated using the full cross sectional area.

Particulate Matter: The source emissions testing of the Recovery Boiler, Lime Kiln, Smelt Dissolving Tank, and the Power Boiler for total particulate matter will be conducted in accordance with the Environment Canada reference method EPS 1/RM/8, entitled "Measurement of Releases of Particulate from Stationary Sources". In addition the alignment approach, as specified in the US EPA Guidance Document – GD-008, will be applied when source testing the Lime Kiln due to the cyclonic flow this source exhibits.

The particulate sampling train, used specifically for isokinetic sampling, is described in detail in EPS 1/RM/8, and is generally referred to as the "Method 5" sampling train for particulate matter (after the US EPA protocol). The sampling train has several different components which include: a heated sampling probe (a nozzle, stainless steel liner, thermocouple, and pitot tube assembly), a heated sample case containing a filter, an ice box containing impinger glassware, and an

umbilical cord leading to the pump, and control console. A schematic of the sampling system is shown in Figure 1.

For all source tests, leak checks of the sampling train will be performed as per accepted US EPA and Environment Canada methods. For each official test, two (2) traverses with up to twelve (12) sampling points per traverse will be used. Sampling will be conducted for five (5) minutes per sampling point, up to a maximum sampling time of 120 minutes per test.

The amount of material caught in the impingers will be determined gravimetrically and reported separately from the calculated total particulate matter emissions. All particulate matter samples will be recovered and analyzed at the Stantec laboratory in Fredericton, NB.

Microscopic Analysis (Fine Particulate, $PM_{2.5}$): As per the facility's Industrial Approval to Operate, the Environment Canada EPS 1/RM/55 or an alternative method acceptable to the Department is required for $PM_{2.5}$ testing. As the method quoted in the approval is not valid for stacks with potential for entrained water droplets in the exhaust (which applies to boilers and dissolving tank at Northern) or cyclonic flow (which applies to the Lime Kiln), we propose microscopic analysis of filters as the viable option. This method involves analysis of total particulate matter filters (collected as described above) for fine particulate percentage.

The particle size analyses will be performed by MVA Scientific Consultants, based in Duluth, GA, using a JEOL JSM-6500F field emission scanning electron microscope operating in automated mode under the control of a Thermo Scientific Noran System SIX x-ray analysis system, using their automated particle size analysis method.

Total Reduced Sulphur: The source emissions testing of the Lime Kiln, the Smelt Dissolving Tank and the High Level Roof Vent for total reduced sulphur will be conducted in accordance with US EPA Method 16B. In this method, the sample is extracted from the exhaust gas of the stack through a heated Teflon line. The sample is chilled and then passes through an SO_2 analyzer to measure SO_2 from the source. The sample exits the analyzer and is then passed through a furnace where all sulphur compounds in the gas stream are thermally oxidized to SO_2, this SO_2 is measured in a second inline analyzer. The difference in the initial SO_2 and the final SO_2 measurement is the total reduced sulphur concentration (reported as H_2S). The analyzers are both Western Research SO_2 non-dispersive ultra-violet (NDUV) continuous analyzer. Monitoring will be conducted continuously over a 24 hour period as required by the approval condition.

Chlorine, Chlorine Dioxide (Cl_2, ClO_2): Sampling will be conducted in accordance with NCASI's sampling method which consists of the extraction of a sample bubbling through midget impingers and subsequent analysis by titration. The sampling train for the Cl_2 and ClO_2 consists of series of three mini impingers, connected by Teflon tubing. The first two impingers each contain 20 ml of potassium iodide (KI) solution buffered with potassium di-hydrogen phosphate (KH_2PO_4). The third impinger contains silica gel to remove any remaining moisture from the gas stream. The impingers are cooled by an ice bath, and the dried gas is then drawn through the sampling train with a calibrated pump. Total sampling time for each test is sixty (60) minutes.

Reference: Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year

Following completion of each test for Cl_2 and ClO_2, the contents of the first two impingers are combined in a pre-cleaned beaker. Subsequent analysis via titration will be performed onsite by Stantec. The combined impinger solutions and de-ionized water rinse of the sample line and empty impingers would be titrated with sodium thiosulphate solution (0.010 N). The volume of titrant required to reach the first colorless endpoint would be recorded on a recovery data form. Five (5) ml of 10% sulphuric acid would be added to the sample and the titration continued. The volume of titrant required to reach the second colorless endpoint would be recorded on a recovery data form. These titrations would be conducted on site shortly following sampling by one of the field staff during the testing due to the instability of the samples, which begin to degrade after 24 hours.

Combustion Gases:

The combustion gases (O_2, CO_2, CO, NO_x, and SO_2) will be sampled according to the Environment Canada reference method EPS 1/RM/15, entitled *Reference Method for the Monitoring of Gaseous Emissions from Fossil Fuel-fired Burners*. In this method, samples of flue gas are drawn through a probe, non-isokinetically, from a single point near the centre of the stack. An ENERAC Model 500 Micro-Emission Analyzer, manufactured by ENERAC Inc., will be used to conduct the sampling. The Model 500 is equipped with a flue gas probe that has an integrated filter trap and condensate trap, and a housing unit that contains the pump and the electrochemical cells which are used to measure concentrations of sulphur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, and oxygen.

In accordance with the regulatory requirements for compliance testing, three replicate tests for each contaminant will be conducted on each stack.

Reporting

As per Approval No. 2011-076657-R03, actual particulate matter emission rates will be reported in units of g/s. The concentration released to the atmosphere will be reported in units of mg/m^3 at reference conditions of 25 °C and 101.3 kPa corrected for 11 % oxygen for the Recovery Boiler and Power Boiler and in units of kg/adubmt for the Lime Kiln and the Dissolving Tank. Fine particulate matter concentrations for the Lime Kiln, Dissolving Tank, Power Boiler and Recovery Boiler will be reported in units of mg/m^3 at reference conditions of 25 °C and 101.3 kPa corrected for 11 % oxygen. Total reduced sulphur will be reported in units of parts per million by dry volume (ppmdv). Emission rates of chlorine and chlorine dioxide from the High Level Roof Vent will be reported in units of g/s and the concentrations released to the atmospheric will be reported in units of mg/m^3.

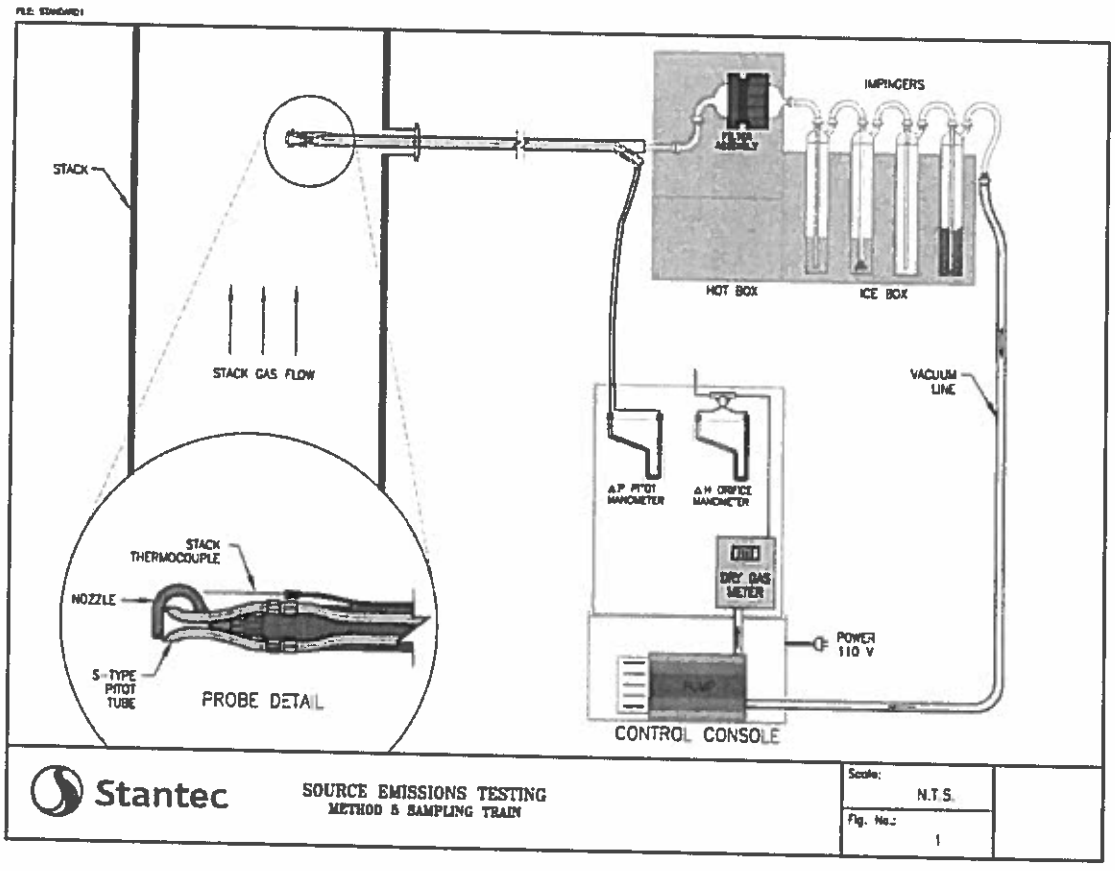
Results of each source emissions testing event will be documented in a final report for submission to Nova Scotia Environment (NSE) for review and approval within 60 days of completing the testing.

Reference: **Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year**

Sampling Locations

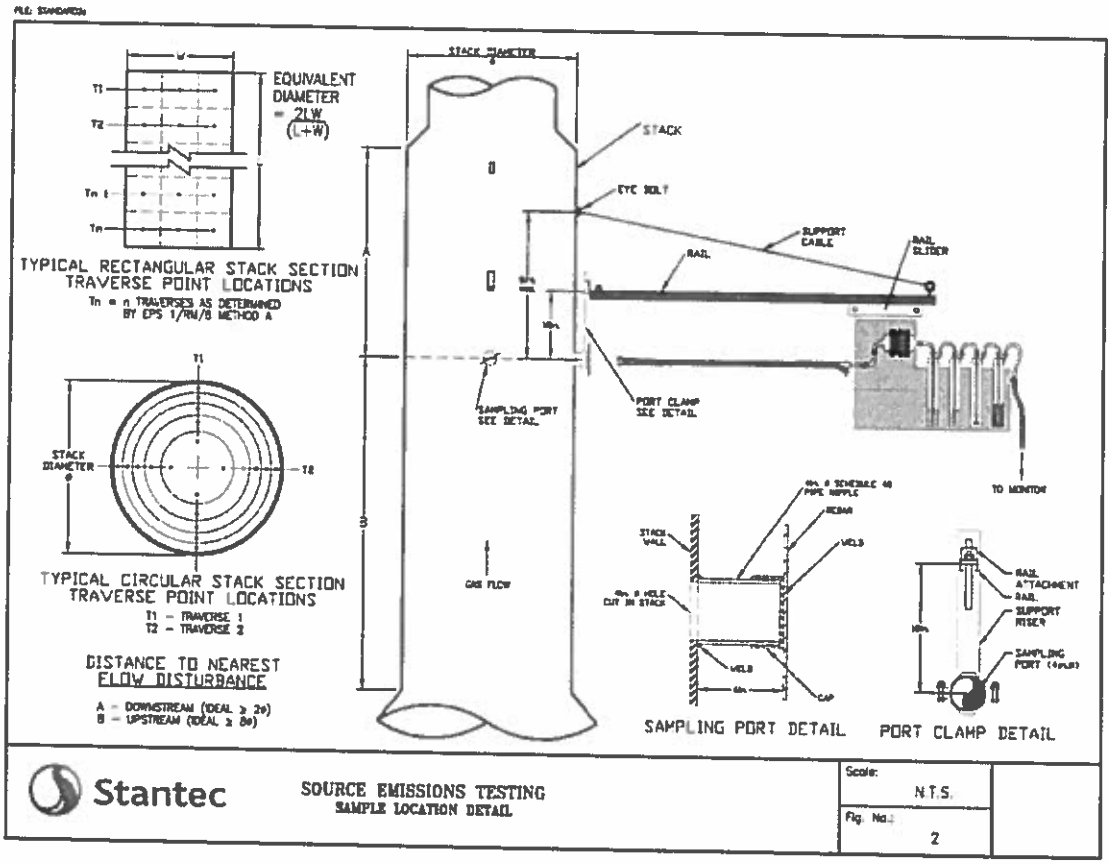
The number and location of sample points along each traverse were previously determined according to EPS 1/RM/8, Method A, using the exhaust stack diameter. A diagram of a typical sample location is provided in Figure 2.

Figure 1 Source Emission Testing, Method 5 Sampling Train



Reference: **Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year**

Figure 2 Source Emissions Testing, Sample Location Details



Reference: Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year

A summary of the sample location details is provided in Table 2.

Table 2 Sample Location Details

Parameter	Recovery Boiler	Lime Kiln	Smelt Dissolving Tank	Power Boiler Scrubber Stack	High Level Roof Vent
Stack Height – Above Grade (m)	69	37	51	51	65
Diameter / Equivalent Diameter (m)	3.51	1.22[3]	1.22	1.93	1.83
Stack/Duct Description	Circular	Circular	Circular	Circular	Circular
Stack Orientation	Vertical	Vertical	Vertical	Vertical	Vertical
Location of Source Testing	In Stack	In Stack	In Stack	In Stack	In Stack
Number of Sample Ports	4	2	2	2	1
Sample Port Diameter (m)	0.1	0.15	0.1	0.1	0.1
Location Upstream from any Disturbance,	>2	2	>2	>2	-
Location Downstream from any Disturbance,	1.45	8	6	> 4	-
Ideal or Non Ideal Flow Characteristics at The Sample Location[1]	Not Ideal	Not Ideal[2]	Not Ideal	Not Ideal	-
Total Number of Sample Points	24 (for PM)	24 (for PM) 1 (for TRS)	20 (for PM) 1(for TRS)	24 (for PM)	1 (for TRS and Cl, ClO_2)
Number of Sample Points per Traverse (PM sampling)	12	12	10	12	NA
Sample Time per Point for PM samples (min)	5	5	5	5	NA
Sample time per Test for PM (min)	120	120	100	120	NA
Sample time per Test for combustion gas (min)	30	30	30	30	30 (for TRS) 60 (for Cl, ClO_2)
Sample time per Test for TRS (min)	NA	1,440	1,440	NA	1,440

[1] The exhaust gas flow characteristics at the sampling location are referred to as being "Ideal" if the sample ports are located in a straight section of stack at least eight stack diameters downstream and two stack diameters upstream of any flow disturbance.
[2] The lime kiln sampling location has been changed from ideal to not ideal due to the cyclonic flow.
[3] Field measurement – to be confirmed during the Winter/Spring Event

Quality Assurance / Quality Control

Throughout the stack testing program, rigorous quality assurance and quality control procedures will be applied to ensure the collection of reliable, representative, and reproducible emissions data. All equipment will be calibrated according to the protocols as prescribed by Environment Canada, and the US EPA. These calibrations include the following:

Reference: Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year

Pitots:	calibrated in a wind tunnel with probe and nozzles attached;
Gas meters:	calibrated against a critical orifice set;
Thermocouples:	calibrated using a potentiometric technique;
Nozzle:	four diameter measurements made using a micrometer across the sharpened edges; and
Combustion Gas Analyser:	2 point calibrations using span gases of known concentrations.

Calibration data will be provided in the final report.

Quality control checks will be performed at several stages during the testing program to ensure the collection of representative samples and the generation of valid results. These checks are performed by test personnel throughout the program under the guidance of the source testing crew chief. The Quality Control (QC) checks include the following:

- Use of standardized checklists and field notebooks to ensure completeness, traceability, and comparability of the process information and samples collected;
- Field checking of standardized forms by a second person to ensure accuracy and completeness;
- Strict adherence to sample chain-of-custody procedures;
- Use of appropriate field blanks (e.g., filter and solution samples); and
- Leak checks of sample trains.

All internal quality assurance and quality control procedures will be strictly adhered to during all test programs to ensure the production of useful and high quality data throughout the course of the program.

Qualifications of Source Testing Team

The successful completion of this project requires the skills of competent and experienced professionals who have a strong commitment to complete the project quickly and efficiently and to produce high quality results. The source testing team we have assembled to meet the challenges of this assignment consists of highly trained professionals who bring a broad range of expertise and experience to the project. The following paragraphs provide brief descriptions of the qualifications of the source emissions testing team:

Senior Reviewer:

Reference: **Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year**

Project Manager and Report Writer:

Reference: **Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year**

Source Testing Team:

Reference: Pre-Test Plan for Source Emissions Testing Northern Pulp, Pictou Mill – 2015 Calendar Year

Table 3 Proposed Schedule

Event	Proposed Date	Scope
Winter	February-March 31 (March 9th week)	Recovery and Power Boiler PM, gases, dissolving tank TRS
Spring	April-June 30	Recovery, Power Boiler, kiln, dissolving tank PM, gases, kiln, HLRV TRS, HLRV chlorine
Summer	July-Sept. 30	Recovery and Power Boiler PM, gases, dissolving tank TRS
Fall	October-Dec. 31	Recovery, Power Boiler, kiln, dissolving tank PM, $PM_{2.5}$, gases, kiln, HLRV TRS

Closing

Your timely written approval of this pre-test plan is greatly appreciated. If you have any questions, please do not hesitate to contact me directly at (902) 468-7777.

Regards,

STANTEC CONSULTING LTD.

Gillian Hatcher
Project Manager – Environmental Services
Phone: (902) 468-7777
Fax: (902) 468-9009
@stantec.com

Vicky Corning
Team Lead
Phone: (506) 457-3200
Fax: (506) 452-7652
@stantec.com

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Stantec

Appendix B

Calibration Data

VALLEY ENVIRONMENTAL CALIBRATION SERVICES

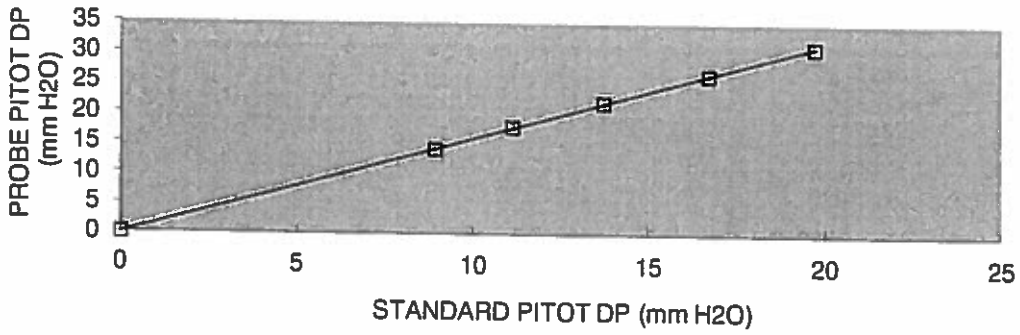
PITOT TUBE CALIBRATION REPORT

CLIENT - Stantec
PROBE ID - 2FT M5
NOZZLE - #8- 0.250"
DATE - February 23, 2015

FAN SPEED m/s	STANDARD PITOT (mm H2O)	PROBE PITOT (mm H2O)
0.00	0.00	0.00
12.2	8.90	14.10
13.6	11.10	17.80
15.1	13.70	21.80
16.7	16.70	26.40
18.1	19.70	31.10

PITOT FACTOR Cp = **0.794**

PITOT - **2FT M5** **NOZZLE - #8- 0.250"**
February 23, 2015



Technician: T. Ryan

Signature

VALLEY ENVIRONMENTAL SERVICES
160 Pony Drive #1
Newmarket, Ontario L3Y 7B6
PH: (905) 830 0136
FAX: (905) 830 0137

Tunnel	VES
Std. Pitot Cp	0.999
Static	-0.25
Barometric	29.15
Temperature	65
Abs Static	29.13

VALLEY ENVIRONMENTAL CALIBRATION SERVICES

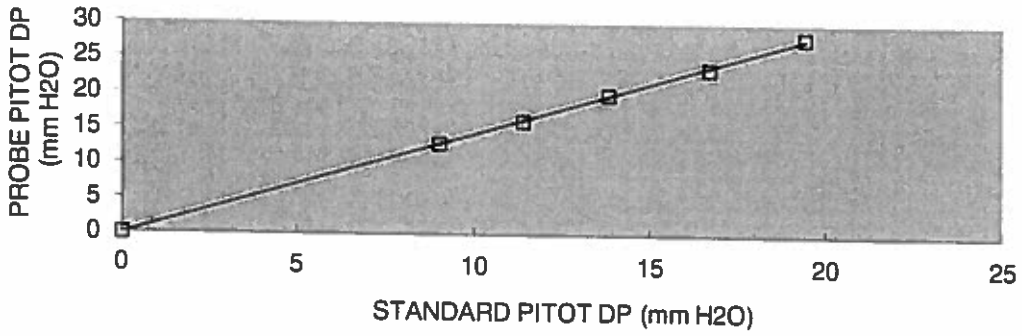
PITOT TUBE CALIBRATION REPORT

CLIENT - Stantec
PROBE ID - 5FT M5
NOZZLE - #10- 0.3125"
DATE - February 24, 2015

FAN SPEED m/s	STANDARD PITOT (mm H2O)	PROBE PITOT (mm H2O)
0.00	0.00	0.00
12.4	9.00	12.90
13.9	11.40	16.20
15.3	13.80	19.90
16.8	16.70	23.60
18.1	19.40	28.00

PITOT FACTOR Cp = **0.836**

PITOT - **5FT M5** **NOZZLE -** **#10- 0.3125"**
February 24, 2015



Technician: T. Ryan

Signature

VALLEY ENVIRONMENTAL SERVICES
160 Pony Drive #1
Newmarket, Ontario L3Y 7B6
PH: (905) 830 0136
FAX: (905) 830 0137

Tunnel	VES
Std. Pitot Cp	0.999
Static	-0.25
Barometric	28.7
Temperature	65
Abs Static	28.68

VALLEY ENVIRONMENTAL CALIBRATION SERVICES

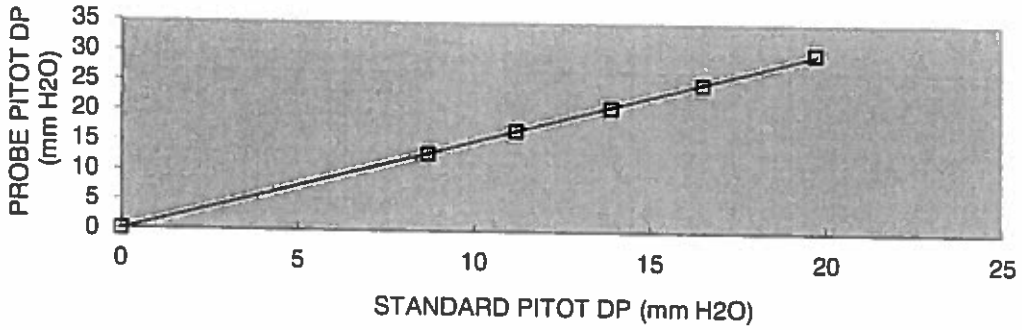
PITOT TUBE CALIBRATION REPORT

CLIENT -	**Stantec**
PROBE ID -	**8-1 FT M5**
NOZZLE -	**#6- 0.1875"**
DATE -	**March 3, 2015**

FAN SPEED m/s	STANDARD PITOT (mm H2O)	PROBE PITOT (mm H2O)
0.00	0.00	0.00
12.1	8.70	13.00
13.7	11.20	16.80
15.2	13.90	20.70
16.6	16.50	24.70
18.1	19.70	29.90

PITOT FACTOR Cp = 0.816

PITOT - 8-1 FT M5 NOZZLE - #6- 0.1875"
March 3, 2015



Technician: T. Ryan

Signature

VALLEY ENVIRONMENTAL SERVICES
160 Pony Drive #1
Newmarket, Ontario L3Y 7B6
PH: (905) 830 0136
FAX: (905) 830 0137

Tunnel	VES
Std. Pitot Cp	0.999
Static	-0.25
Barometric	29.1
Temperature	65
Abs Static	29.08

Pre-Test Dry Gas Meter - Control Unit Calibration

Date : 6/29/2015
Barometric Pressure, Pb : 29 7
Model Number : 1646
Calibrated By : JJB
Job #:

Orifice Manometer Setting, deltaH (in. H2O)				Dry Gas Meter Volume, Vm (cu.ft)			Temperatures (F)				Time, theta (min)
								Dry Gas Meter			
						Total			Outlet, to	Average, tm	
0 9						5 430			64	65	10
1 5						5 353			66	66	8
2.3						5 803			67	67	7

Calculations

Orifice Manometer Setting, deltaH (in. H2O)	Dry Gas Correction Factor, gamma (Tolerance = 0.95 - 1.05, +/-1.5% of avg)	Orifice Pressure Differential (delta H@) yielding 0.75 cfm of air at 68F and 29.92 in.Hg as in. H2O (Tolerance = +/- 0.15 in.)	Orifice Coefficient Ko
0.9	1 039	1 590	0 758
1 5	1 030	1 776	0 723
2.3	1 032	1 770	0.723
Average	1.033	1.712	0.734

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the GREEN cells, YELLOW cells are calculated.

DATE: 6/29/2015
METER PART #: 1646
METER SERIAL #: 17483069
CRITICAL ORIFICE SET SERIAL #: 1463a

BAROMETRIC PRESSURE (in Hg): INITIAL 29.7, FINAL 29.7, AVG (P_{bar}) 29.7

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS (FT^3) FINAL	DGM READINGS (FT^3) NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH ($in H_2O$)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
15	1	0.4164	18	983.61	989.03	5.420	20.2	63	66	63	64	64	10.00	0.90	5.4343	5.6454	1.039		1.59
	2	0.4164	18	989.03	994.47	5.440	20.4	66	66	64	65	65.25	10.00	0.90	5.4414	5.6442	1.037		1.59
	3	0.4164	18	994.47	999.90	5.430	20.5	66	66	65	65	65.5	10.00	0.90	5.4298	5.6437	1.040		1.59
																AVG =	1.039	0.51	
18	1	0.5065	17	999.90	1,005.25	5.350	20.5	66	67	65	65	65.75	8.00	1.50	5.3542	5.5135	1.030		1.78
	2	0.5065	17	1,005.25	1,010.61	5.360	20.5	67	67	65	66	66.25	8.00	1.50	5.3591	5.5135	1.029		1.78
	3	0.5065	17	1,010.61	1,015.96	5.350	20.5	67	67	66	66	66.5	8.00	1.50	5.3466	5.5135	1.031		1.78
																AVG =	1.030	-0.13	
23	1	0.6307	16	1,015.96	1,021.77	5.810	20.5	67	68	66	67	67	7.00	2.30	5.8122	5.9837	1.030		1.77
	2	0.6307	16	1,021.77	1,027.56	5.790	20.5	68	69	67	66	67.5	7.00	2.30	5.7867	5.9837	1.034		1.77
	3	0.6307	16	1,027.56	1,033.37	5.810	20.5	69	69	66	67	67.75	7.00	2.30	5.8040	5.9837	1.031		1.77
																AVG =	1.032	-0.18	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.033

AVERAGE $\Delta H_@$ = 1.71

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)
K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

$$\Delta H_@ = \left(\frac{0.75\,\theta}{V_m(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

Pre-Test Dry Gas Meter - Control Unit Calibration

Date : 6/29/2015
Barometric Pressure, Pb : 29.7
Model Number : 1848
Calibrated By : JJB
Job #:

Orifice Manometer Setting, deltaH (in. H2O)				Dry Gas Meter Volume, Vm (cu.ft)			Temperatures (F)				Time, theta (min)
								Dry Gas Meter			
						Total			Outlet, to	Average, tm	
0.9						5.000			59	61	10
1.5						4.943			64	65	8
2.3						5.343			66	67	7

Calculations

Orifice Manometer Setting, deltaH (in. H2O)	Dry Gas Correction Factor, gamma (Tolerance = 0.95 - 1.05, +/-1.5% of avg)	Orifice Pressure Differential (delta H@) yielding 0.75 cfm of air at 68F and 29.92 in.Hg as in. H2O (Tolerance = +/- 0.15 in.)	Orifice Coefficient Ko
0.9	1.119	1.602	0.757
1.5	1.113	1.780	0.722
2.3	1.120	1.770	0.720
Average	1.117	1.717	0.733

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

6/29/2015

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range
2) Record barometric pressure before and after calibration procedure.
3) Run at test JJB
   necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the GREEN cells, YELLOW cells are calculated.

DATE: 6/29/2015
METER PART #: 1648
METER SERIAL #: 16605036
CRITICAL ORIFICE SET SERIAL #: 1463e

BAROMETRIC PRESSURE (In Hg): INITIAL 29.7, FINAL 29.7, AVG (P_{bar}) 29.7

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (In Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS (FT^3) FINAL	DGM READINGS (FT^3) NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (In H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
15	1	0.4164	18	544.80	549.78	4.980	19.8	55	62	54	59	57.5	10.00	0.90	5.0559	5.0478	1.117		1.61
	2	0.4164	18	549.78	554.79	5.010	19.8	62	64	59	61	61.5	10.00	0.90	5.0473	5.0478	1.119		1.60
	3	0.4164	18	554.79	559.80	5.010	19.9	64	64	61	62	62.75	10.00	0.90	5.0353	5.0472	1.122		1.60
																AVG =	1.119	0.18	
18	1	0.9085	18	559.80	564.72	4.920	20.1	64	66	62	63	63.75	8.00	1.50	4.9427	5.5159	1.116		1.78
	2	0.9085	18	564.72	569.67	4.950	20.3	66	67	63	64	65	8.00	1.50	4.9619	5.5147	1.112		1.78
	3	0.9085	18	569.67	574.63	4.960	20.3	67	67	64	65	65.75	8.00	1.50	4.9639	5.5147	1.111		1.78
																AVG =	1.113	-0.36	
23	1	0.6307	18	574.63	579.97	5.340	20.3	67	68	65	66	66.5	7.00	2.30	5.3471	5.9650	1.119		1.77
	2	0.6307	18	579.97	585.31	5.340	20.2	66	68	66	66	67	7.00	2.30	5.3420	5.9658	1.120		1.77
	3	0.6307	18	585.31	590.66	5.350	20.1	66	68	66	67	67.25	7.00	2.30	5.3495	5.9662	1.119		1.77
																AVG =	1.120	0.21	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.117

AVERAGE $\Delta H_@$ = 1.72

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K_1 = 17.64 °R/in. Hg (English); 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English; °K - Metric)

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English; °K - Metric)
K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

$$\Delta H_@ = \left(\frac{0.75\,\theta}{V_{cr(std)}}\right)^2 \Delta H \left(\frac{V_{m(std)}}{V_m}\right)$$

CONTINUOUS EMISSION MONITORS
SYSTEM CALIBRATION AND DRIFT

Client:	Northern Pulp
Plant:	Pictou
Location:	DIS TANK
Project No.:	121413456
Personnel:	NGM

Test No.:	TRS
Date:	April 28 2015
Time Start:	5:40 PM
Time Finish:	7:40 AM

INSTRUMENT SPAN VALUES			
Oxygen (%):	25	Carbon Dioxide (%):	25
Sulphur Dioxide (ppm):	500	Carbon Monoxide (ppm):	300
		TRS (ppm):	500

Analyzer Setting	Cal. Gas Value	Initial Values			Final Values		Drift (<3% Span)
		Analyzer Calibration	System Calibration	System Cal. Bias (<5% Span)	System Calibration	System Cal. Bias (<5% Span)	
O2 Zero	0.00	0.00	0.00	0.00%	-0.27	-1.08%	-1.08%
O2 Span	21.53	21.53	21.52	-0.04%	21.63	0.40%	0.44%
CO2 Zero	0.00	0.00	0.00	0.00%	0.00	0.00%	0.00%
CO2 Span	20.84	20.86	20.84	-0.08%	20.83	-0.12%	-0.04%
CO Zero	0.00	0.00	0.00	0.00%	0.4	0.12%	0.12%
CO Span	290.0	290.0	289.8	-0.08%	298.1	2.70%	2.78%
SO2 Zero	0.00	0.00	0.00	0.00%	4.1	0.83%	0.83%
SO2 Span	490.0	490.2	490.0	-0.04%	491.5	0.27%	0.30%
TRS Zero	0.00	0.00	0.00	0.00%	3.3	0.66%	0.66%
TRS Span	490.0	490.0	498.89	1.78%	481.15	-1.77%	-3.55%

15:40-16:00

	ZERO	SPAN
TRS	-9.9	496.78
SO2	0	498.43

Logger date 02 01 2016 1:32 actual 30 04 2015 15:37

PRAXAIR

Praxair Distribution Mid-Atlantic
One Steel Road East
Morrisville, PA 19067
Tel:(800)638-6360 Fax:(215)736-5240
PGVP ID: F32014

DocNumber 000007823

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PDI WHSE SAINT JOHN NB BRAN
28 MCILVEEN DR
SAINT JOHN NB E2J 4Y

Praxair Order Number: 04821650
Customer P O Number: STANTEC CONS
Customer Reference Number:

Fill Date: 3/14/2014
Part Number: NI OX21E-AS
Lot Number: 301603073403
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure & Volume: 2000 psig 140 cu ft

Certified Concentration:

Expiration Date:	3/18/2022		NIST Traceable
Cylinder Number:	CC244607		Analytical Uncertainty:
21.53	%	OXYGEN	± 0.3 %
Balance		NITROGEN	

Certification Information: *Certification Date:* 3/18/2014 *Term:* 96 Months *Expiration Date:* 3/18/2022

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Do Not Use this Standard if Pressure is less than 100 PSIG

Analytical Data: (R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1 Component: OXYGEN

Requested Concentration	21 %
Certified Concentration	21.53 %
Instrument Used	SIEMENS OXYMAT 5F
Analytical Method	PARAMAGNETIC
Last Multipoint Calibration	3/11/2014

First Analysis Data: Date: 3/18/2014

Z:	0	R:	21	C:	21.55	Conc:	21.53
R:	21	Z:	0	C:	21.55	Conc:	21.53
Z:	0	C:	21.55	R:	21	Conc:	21.53

UOM: % Mean Test Assay: 21.53 %

Analyzed by: Jeff Gosner

Reference Standard Type	GMIS
Ref Std Cylinder #	CC207156
Ref Std Conc	20.98 %
Ref Std Traceable to SRM #	2659A
SRM Sample #	71-D-14
SRM Cylinder #	CAL015789

Second Analysis Data: Date:

Z:	0	R:	0	C:	0	Conc:	0
R:	0	Z:	0	C:	0	Conc:	0
Z:	0	C:	0	R:	0	Conc:	0

UOM: % Mean Test Assay: 0 %

Certified by: Megha Patel

PRAXAIR

Praxair Distribution Mid-Atlantic
One Steel Road East,
Morrisville, PA 19067
Tel: (800) 638-6360 Fax:(215) 736 5240
PGVP ID: F32012

DocNumber: 000002252

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PDI WHSE SAINT JOHN, NB BRA
28 MCILVEEN DR
SAINT JOHN NB CAN E2J4Y

Praxair Order Number: 03982335
Customer P. O. Number: STANEC CONSU
Customer Reference Number:

Fill Date: 11/29/2012
Part Number: NI CO100E-AS
Lot Number: 301910332206
Cylinder Style & Outlet: AS CGA 350
Cylinder Pressure & Volume: 2000 psig 140 cu ft

Certified Concentration:

Expiration Date:		12/3/2020	NIST Traceable
Cylinder Number:		CC137349	Analytical Uncertainty:
1003	ppm	CARBON MONOXIDE	± 1 %
Balance		NITROGEN	

Certification Information: *Certification Date:* 12/3/2012 *Term:* 96 Months *Expiration Date:* 12/3/2020

This cylinder was certified according to the 1997 EPA Traceability Protocol, Document #EPA-600/R-97/121, using Procedure G1

Do Not Use this Standard if Pressure is less than 150 PSIG

Analytical Data: *(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)*

1 . Component: CARBON MONOXIDE

Requested Concentration: 1000 ppm
Certified Concentration: 1003 ppm
Instrument Used: HORIBA VIA-510,S/N 577172041
Analytical Method: NON-DISPERSIVE INFRARED
Last Multipoint Calibration: 11/13/2012

First Analysis Data: Date: 12/3/2012

Z:	0	R:	1018	C:	1003	Conc:	1003
R:	1018	Z:	0	C:	1003	Conc:	1003
Z:	0	C:	1003	R:	1018	Conc:	1003

UOM: PPM Mean Test Assay: 1003 PPM

Reference Standard Type: GMIS
Ref Std Cylinder #: CC265152
Ref Std Conc: 1018 PPM
Ref Std Traceable to SRM #: 1680B
SRM Sample #: 02-J-49
SRM Cylinder #: CAL018038

Second Analysis Data: Date:

Z:	0	R:	0	C:	0	Conc:	0
R:	0	Z:	0	C:	0	Conc:	0
Z:	0	C:	0	R:	0	Conc:	0

UOM: PPM Mean Test Assay: 0 PPM

Analyzed by: Megha Patel
Megha Patel

Certified by:
Judith Imperial

PRAXAIR

Praxair Distribution Mid-Atlantic
One Steel Road East,
Morrisville, PA 19067
Tel (800)638-6360 Fax.(215)736-5240
PGVP ID F32012

DocNumber: 000000948

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PDI WHSE SAINT JOHN, NB BRA
28 MCILVEEN DR
SAINT JOHN NB CAN E2J4Y

Praxair Order Number: 03816407
Customer P. O. Number: STANEC CONSU
Customer Reference Number:

Fill Date: 9/10/2012
Part Number: NI CD21E-AS
Lot Number: 304325254203
Cylinder Style & Outlet: AS CGA 660
Cylinder Pressure & Volume: 2000 psig 140 cu ft

Certified Concentration:

Expiration Date:	9/21/2015		NIST Traceabl
Cylinder Number:	CC181318		Analytical Uncertainty:
20.84	%	CARBON DIOXIDE	± 1 %
Balance		NITROGEN	

Certifcation Information: *Certification Date:* 9/21/2012 *Term:* 36 Months *Expiration Date:* 9/21/2015

This cylinder was certified according to the 1997 EPA Traceability Protocol, Document #EPA-600/R-97/121, using Procedure G1

Do Not Use this Standard if Pressure is less than 150 PSIG

Analytical Data: *(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)*

1 . Component: CARBON DIOXIDE

Requested Concentration: 21 %
Certified Concentration: 20.84 %
Instrument Used: SIEMENS ULTRAMAT 5E SN. D2-412
Analytical Method: NON-DISPERSIVE INFRARED
Last Multipoint Calibration: 9/8/2012

First Analysis Data:					Date: 9/21/2012
Z: 0	R: 19.94	C: 20.86	Conc:	20.839	
R: 19.94	Z: 0	C: 20.86	Conc:	20.839	
Z: 0	C: 20.86	R: 19.94	Conc:	20.839	
UOM: %		Mean Test Assay:		20.839 %	

Reference Standard Type: GMIS
Ref. Std. Cylinder #: CC163802
Ref. Std. Conc: 19.92 %
Ref. Std. Traceable to SRM #: 2745
SRM Sample #: 9-C-34
SRM Cylinder #: CAL016129

Second Analysis Data:					Date:
Z: 0	R: 0	C: 0	Conc:	0	
R: 0	Z: 0	C: 0	Conc:	0	
Z: 0	C: 0	R: 0	Conc:	0	
UOM: %		Mean Test Assay:		0 %	

Analyzed by: Megha Patel

Certified by: Judith Imperial

CONTINUOUS EMISSION MONITORS
SYSTEM CALIBRATION AND DRIFT

Client:	Northern Pulp
Plant:	Pictou
Location:	HLRV
Project No.:	121413456
Personnel:	NGM

Test No.:	TRS
Date:	22/07/2015 23/07/2015
Time Start:	8:45 AM
Time Finish:	2:30 PM

INSTRUMENT SPAN VALUES			
Oxygen (%):	25	Carbon Dioxide (%):	25
Sulphur Dioxide (ppm):	500	Carbon Monoxide (ppm):	300
		TRS (ppm):	500

Analyzer Setting	Cal. Gas Value	Initial Values			Final Values		Drift (<3% Span)
		Analyzer Calibration	System Calibration	System Cal. Bias (<5% Span)	System Calibration	System Cal. Bias (<5% Span)	
O2 Zero	0.00	0.00	0.00	0.00%	-0.01	-0.04%	-0.04%
O2 Span	21.53	21.53	21.51	-0.08%	21.63	0.40%	0.48%
CO2 Zero	0.00	0.01	0.00	-0.04%	0.01	0.00%	0.04%
CO2 Span	20.95	20.95	20.93	-0.08%	20.97	0.08%	0.16%
CO Zero	0.00	0.00	0.00	0.00%	-1.9	-0.65%	-0.65%
CO Span	290.0	290.2	290.0	-0.05%	286.1	-1.34%	-1.29%
SO2 Zero	0.00	0.00	0.00	0.00%	-3.3	-0.66%	-0.66%
SO2 Span	490.0	490.2	490.0	-0.04%	480.2	-2.00%	-1.96%
TRS Zero	0.00	0.00	0.00	0.00%	-6.6	-1.32%	-1.32%
TRS Span	490.0	490.2	490	-0.04%	476.6	-2.72%	-2.68%

CONTINUOUS EMISSION MONITORS
SYSTEM CALIBRATION AND DRIFT

Client:	Northern Pulp
Plant:	Pictou
Location:	LIME KILN
Project No.:	121413456
Personnel:	NGM

Test No.:	TRS
Date:	April 29 2015
Time Start:	8:25 AM
Time Finish:	9:00 AM

INSTRUMENT SPAN VALUES			
Oxygen (%):	25	Carbon Dioxide (%):	25
Sulphur Dioxide (ppm):	500	Carbon Monoxide (ppm):	300
		TRS (ppm):	500

Analyzer Setting	Cal. Gas Value	Initial Values			Final Values		Drift (<3% Span)
		Analyzer Calibration	System Calibration	System Cal. Bias (<5% Span)	System Calibration	System Cal. Bias (<5% Span)	
O2 Zero	0.00	0.00	0.00	0.00%	0.24	0.96%	0.96%
O2 Span	21.53	21.53	21.53	0.00%	21.12	-1.64%	-1.64%
CO2 Zero	0.00	0.00	0.00	0.00%	-0.02	-0.08%	-0.08%
CO2 Span	20.84	20.86	20.80	-0.24%	20.23	-2.52%	-2.28%
CO Zero	0.00	0.00	0.00	0.00%	-2.0	-0.66%	-0.66%
CO Span	290.0	290.0	289.2	-0.27%	282.7	-2.44%	-2.16%
SO2 Zero	0.00	0.00	0.00	0.00%	-3.3	-0.66%	-0.66%
SO2 Span	490.0	490.2	490.0	-0.03%	476.5	-2.73%	-2.70%
TRS Zero	0.00	0.00	0.00	0.00%	-14.85	-2.97%	-2.97%
TRS Span	490.0	490.0	487.86	-0.43%	463.63	-5.27%	-4.85%

	16:40 ZERO	17:10 SPAN	10ppm
TRS	-3.3	476.74	6.78
SO2	-14.85	483.85	8.89

PRAXAIR

Praxair Distribution Mid-Atlantic
One Steel Road East,
Morrisville, PA 19067
Tel:(800)638-6360 Fax:(215)736-5240
PGVP ID: F32014

DocNumber: 000010131

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PDI WHSE SAINT JOHN NB BRAN
28 MCILVEEN DR
SAINT JOHN NB E2J 4Y

Praxair Order Number: 05101372
Customer P. O. Number: STANEC AEC51
Customer Reference Number:

Fill Date: 9/9/2014
Part Number: NI NO1000E-AS
Lot Number: 304613252401
Cylinder Style & Outlet: AS CGA 660
Cylinder Pressure & Volume: 2000 psig 140 cu ft

Certified Concentration:

Expiration Date:	9/23/2022		NIST Traceable
Cylinder Number:	CC24169		Analytical Uncertainty:
979.2	ppm	NITRIC OXIDE	± 0.5 %
	Balance	NITROGEN	

NOx = 980 ppm

NOx for Reference Only

Certifcation Information: *Certification Date:* 9/23/2014 *Term:* 96 Months *Expiration Date:* 9/23/2022

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data: *(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)*

1. Component: NITRIC OXIDE

Requested Concentration: 1000 ppm
Certified Concentration: 979.2 ppm
Instrument Used: TECO MODEL 42i-HL 0928837883
Analytical Method: CHEMILUMINESCENCE
Last Multipoint Calibration: 9/17/2014

Reference Standard Type: GMIS
Ref. Std. Cylinder #: CC244881
Ref. Std. Conc: 962.2 PPM
Ref. Std. Traceable to SRM #: 1686b
SRM Sample #: 42-M-47
SRM Cylinder #: CAL016047

First Analysis Data: Date: 9/16/2014

Z: 0	R: 982	C: 981	Conc:	980.19	
R: 985	Z: 0	C: 979	Conc:	978.19	
Z: 0	C: 979	R: 982	Conc:	978.19	
UOM: PPM		Mean Test Assay:		978.85 PPM	

Second Analysis Data: Date: 9/23/2014

Z: 0	R: 956	C: 971	Conc:	977.98	
R: 954	Z: 0	C: 973	Conc:	979.99	
Z: 0	C: 974	R: 956	Conc:	981	
UOM: PPM		Mean Test Assay:		979.66 PPM	

Analyzed by: Judith Imperial

Certified by: Jeff Gosner

Probe Stack Thermocouple Calibration

Calibration Date: 19-Mar-15

Calibrated By: NGM, JJB

Reference ID: Fisher Scientific catalog #150414E

Stantec

Ice Bath

Thermocouple #	Reference Temp (F)	Observed Temp (F)	Percent Difference (Absolute Temp)
#1 -2' probe	32	32.3	-0.06%
#1 -3' probe	32	32.1	-0.02%
#1 -4' probe	32	33.7	-0.34%
#1 -5' probe	32	33.1	-0.22%
#1 - 6' probe	32	32.5	-0.10%
#1 - 8'-1 probe	32	32.7	-0.14%
#1 -8'-2 probe	32	32.6	-0.12%
#1 -10'-1 probe	32	33	-0.20%
#1 -10'-2 probe	32	33	-0.20%
#6 -1848	32		
#7 -1848	32		
#6 -1646	32		
#7 -1646	32		

Boiling Water

Thermocouple #	Reference Temp (F)	Observed Temp (F)	Percent Difference (Absolute Temp)
#1 -2' probe	202	206.7	-0.70%
#1 -3' probe	201	208.7	-1.15%
#1 -4' probe	203	201.6	0.21%
#1 -5' probe	203	206.3	-0.50%
#1 - 6' probe	202	203.3	-0.20%
#1 - 8'-1 probe	203	204.5	-0.23%
#1 -8'-2 probe	202	202.3	-0.05%
#1 -10'-1 probe	200	212.1	-1.80%
#1 -10'-2 probe	202	210.3	-1.24%
#6 -1848	202		
#7 -1848	203		
#6 -1646	203		
#7 -1646	201		

Error should be < 1.5%

CAL-CHEK CANADA

250 GOVERNOR'S ROAD - DUNDAS, ONTARIO L9H 3K3
TELEPHONE: (905) 628-4636 FAX: (905) 627-5903
email calchek@cogeco.ca

Scale / Balance Certification

Date: February 9, 2015

Certificate Number: S150165

Customer: Stantec Consulting Ltd.
845 Prospect Street
Fredericton, New Brunswick E3B 2T7

Room Temperature: 20.1°C

Calibration Location: 10 Timothy Road North Kingsclear Lab

Scale / Balance Manufacturer: Radwag

Resolution: 0.0001g

Model Number: XA220-2X

Serial Number: 336271

Capacity: 220 g

Capacity Calibrated To: 220 g

ACTUAL WEIGHT APPLIED GRAMS	SCALE READINGS AS FOUND	ERROR AS FOUND	ACTUAL WEIGHT APPLIED GRAMS	SCALE READINGS AS LEFT	ERROR AS LEFT
0.0020	0.0020	0.0000	0.0020	0.0020	0.0000
0.0050	0.0050	0.0000	0.0050	0.0050	0.0000
0.0100	0.0100	0.0000	0.0100	0.0100	0.0000
0.0500	0.0500	0.0000	0.0500	0.0500	0.0000
0.1000	0.1000	0.0000	0.1000	0.1000	0.0000
0.5000	0.5001	-0.0001	0.5000	0.5000	0.0000
1.0000	0.9998	0.0002	1.0000	0.9999	0.0001
5.0000	4.9999	0.0001	5.0000	4.9990	0.0010
10.0000	10.0001	-0.0001	10.0000	10.0000	0.0000
20.0000	20.0016	-0.0016	20.0000	20.0009	-0.0009
50.0000	50.0030	-0.0030	50.0000	50.0020	-0.0020
100.0000	99.9982	0.0018	100.0000	99.9992	0.0008
200.0000	200.0134	-0.0134	200.0000	200.0027	-0.0027
220.0000	220.0170	-0.0170	220.0000	220.0110	-0.0110

The above mentioned Scale / Balance has been checked for accuracy using the following N.I.S.T. calibrated dead weights as per the CSA method.

STANDARD	CAL DATE	NIST LAB #
22XE	03/10/13	681/280058-10

Obtained results are within the manufacturer's stated accuracy and/or are within +/-0.01% or 1 division whichever is greater at any point of the calibrated range.

Pass/Fail statements are based on data from measurements made, procedures utilized, professional experience and the uncertainty associated with this calibration. It is the responsibility of the user of this equipment to determine if the results identified meet specific requirements for its intended application.

Calibration Technician: Dave Newitt

Authorized Signatory: Roni Newitt

Suggested Calibration Due Date: February 2016

Due dates appearing on the certificate of calibration and label are determined by client for administrative purposes and do not imply continued conformance to specifications.

All calibrations performed at customer location unless otherwise noted.

PRAXAIR

Praxair Distribution Mid-Atlantic
One Steel Road East,
Morrisville, PA 19067
Tel:(800)638-6360 Fax:(215)736-5240
PGVP ID: F32014

DocNumber: 000010141

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PDI WHSE SAINT JOHN NB BRAN
28 MCILVEEN DR
SAINT JOHN NB E2J 4Y

Praxair Order Number: 05101372
Customer P. O. Number: STANEC AEC51
Customer Reference Number:

Fill Date: 9/15/2014
Part Number: NI SD2500E-AS
Lot Number: 304613258406
Cylinder Style & Outlet: AS CGA 660
Cylinder Pressure & Volume: 2000 psig 140 cu. ft.

Certified Concentration:

Expiration Date:	9/26/2022		NIST Traceable
Cylinder Number:	CC121441		Analytical Uncertainty:
2497	ppm	SULFUR DIOXIDE	± 0.6 %
Balance		NITROGEN	

Certifcation Information: *Certification Date:* 9/26/2014 *Term:* 96 Months *Expiration Date:* 9/26/2022

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data: *(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)*

1. Component: SULFUR DIOXIDE

Requested Concentration: 2500 ppm
Certified Concentration: 2497 ppm
Instrument Used: SIEMENS ULTRAMAT 6E S/N:J2-36
Analytical Method: NON-DISPERSIVE INFRARED
Last Multipoint Calibration: 9/17/2014

Reference Standard Type: GMIS
Ref. Std. Cylinder #: SA7629
Ref. Std. Conc: 2957 PPM
Ref. Std. Traceable to SRM #: 1664A
SRM Sample #:
SRM Cylinder #:

First Analysis Data:					Date: 9/19/2014
Z: 0	R: 2954	C: 2488	Conc:	2493.3	
R: 2948	Z: 0	C: 2495	Conc:	2500.4	
Z: 0	C: 2496	R: 2950	Conc:	2501.4	
UOM: PPM		Mean Test Assay:		2498.4 PPM	

Second Analysis Data:					Date: 9/26/2014
Z: 0	R: 2956	C: 2474	Conc:	2488	
R: 2937	Z: 0	C: 2477	Conc:	2491	
Z: 0	C: 2478	R: 2928	Conc:	2492	
UOM: PPM		Mean Test Assay:		2490.4 PPM	

Analyzed by: Judith Imperial

Certified by: Jeff Gosner

Stantec Consulting Ltd.

Steel Nozzle Calibration Data Sheet

NozzleID	Nozzle Diameter (inches)					
Set - 1	<1>	<2>	<3>	<4>	Hi-Lo	Avg.
1-4	0.125	0.124	0.125	0.125	0.001	**0.125**
1-6	0.175	0.173	0.165	0.175	0.010	**0.172**
1-8	0.236	0.232	0.234	0.232	0.004	**0.234**
1-10	0.307	0.305	0.308	0.305	0.003	**0.306**
1-12	0.367	0.372	0.367	0.371	0.005	**0.369**
1-14	0.434	0.434	0.433	0.434	0.001	**0.434**
1-16	0.500	0.497	0.503	0.501	0.006	**0.500**

QA/QC Check

Each Diameter Measured To Within = 0.001 Inches
High - Low </= 0.004

Prepared By: JJB

Date: Feb 05, 2015

QRM ELECTRONICS

QRM Electronics Inc. calibration laboratory certifies that the described instrument has been presented for inspection and the tests as shown indicate that the work performed has been completed and that the standard used in obtaining data are calibrated regularly traceable to the **National Institute of Standards and Technology**

Date:	6/24/2015	Customer:	STANTEC
Control Number:	8309	Address:	845 PROSPECT ST. FREDERICTON, NEW BRUNSWICK E3B 2T7
Description:	350M/XL		
Serial Number:	00968835/404 – 00959384/404		

SUGGESTED RECALIBRATION DATE: 6/24/2016

Parameter: Combustion **Accuracy Statement: +/- 20 ppm or 5% of m.v.**

STANDARD	AS RECEIVED				AFTER CALIBRATION			
	PPM	°F	PASS/FAIL	NOTE	PPM	°F	PASS/FAIL	NOTE
O2 3.06 %	3.00 %	76.2	PASS		3.05 %	76.2	PASS	SR
CO 497 PPM	482 PPM	76.2	PASS		496 PPM	76.2	PASS	
NO 824 PPM	795 PPM	76.2	PASS		832 PPM	76.2	PASS	
NO2 96 PPM	94.1 PPM	76.2	PASS		97.0 PPM	76.2	PASS	
SO2 994.7 PPM	985 PPM	76.2	PASS		995 PPM	76.2	PASS	
HC 4980 PPM	4160 PPM	76.2	PASS		4990 PPM	76.2	PASS	

*NOTE: SR = Sensor Replaced, RNS = Response Not Stable

Test Equipment
Transfer standards from:

Cylinder #	Gas	Concentration	Certification Date	Expiration Date
RA56616	CO / O2	996.9 PPM / 3.10 %	03/27/2014	03/27/2017
XF000167B	SO2	994.7 PPM	03/31/2014	03/31/2016
SV14124	NO2	96 PPM	04/09/2014	04/09/2016
SX34940	NO / CO2	824 PPM / 17 %	05/01/2014	05/01/2017
S970111A	CO / H2	497 PPM / 296 PPM	05/10/2014	05/10/2017
CC107025	NO	81.3 PPM	03/05/2015	03/05/2017
SX21602	CO / O2	99.2 PPM / 3.06 %	03/11/2015	03/11/2018

Calibrated at:
QRM Electronics Inc.
250 West Beaver Creek Rd.
Unit 15, Richmond Hill, ON
L4B 1C7

Phone: (905) 771 5009
Fax : (905) 771 6041

KYLE ANDERSON
Calibrated By

Authorized Signature

QRM ELECTRONICS INCORPORATED
CALIBRATION CERTIFICATE

Stantec

Appendix C

Field data sheets

0716-15

MOISTURE FIELD DATA SHEET

Project No.: 121413456
Client: Northern Pulp
Plant: Lime Kiln
Location: Pictou, NS
Test: PM-1
Date: July 20, 2015
Analyst: TBH/SF

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	994.1	670.2	323.9
2	100 mL H2O	732.5	708.2	24.3
3	Blank	668.3	665.7	2.6
4	200g Silica Gel	966.3	958.5	7.8
		Total Weight Gain (g)		358.6
		Moisture Volume (mL)		

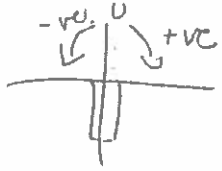
Volume H_2O Collected: 358.6 ml
X 0.048 = 17.21 ft^3 H_2O (Vwc)

DGM Final 187.12 ft^3
DGM Initial 156.76 ft^3
Final - Initial = 30.36 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{\text{(Vwc + Vmc)}}$$

$$\text{Moisture} = \frac{17.21}{17.21 + 30.36}$$

Moisture = 0.36 = 36%



SOURCE TESTING FIELD DATA SHEET

Job No.: 121413456
Client: Northern Pulp
Plant: Dump kiln
Location: Pictou, NS
Test: PM-1
Date: Jul. 21, 2015
Operators: TBH / SF
Gamma: 1.033
Delta H@: 1.712
Pitot Coeff.: 0.816
Start: 6:05
Finish: 10:05

Static Pressure (In.H2O): 0.51
Port Length (in): 12"
Stack Dia. (in.): 48"
Probe Length (ft): 8'
Nozzle ID (in.): 1-6 (0.172)
Console S/N: 1646

Pre-Test Leak Check: ✓
Vacuum Pressure: -18
Post-Test Leak Check: ✓
Vacuum Pressure: -12

K': 0.48

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				156.76						
1	2.5	157	0.58	0.24	157.46	264	242	65	87	66	-1
	5	159	0.56	0.23	158.14	295	245	58	85	66	-1
2	7.5	158	0.58	0.24	158.83	299	245	56	86	66	-1
	10	161	0.60	0.25	159.49	300	244	55	85	66	-1
3	12.5	161	0.52	0.22	160.12	300	245	55	85	66	-1
	15	162	0.50	0.21	160.74	300	248	54	85	66	-1
4	17.5	162	0.35	0.14	161.27	300	249	54	85	66	-1
	20	162	0.35	0.14	161.81	300	251	54	85	66	-1
5	22.5	162	0.40	0.17	162.39	299	250	54	85	66	-1
	25	162	0.40	0.17	162.98	300	249	56	85	66	-1
6	27.5	162	0.45	0.19	163.59	299	248	56	85	66	-1
	30	162	0.42	0.17	164.15	299	249	56	85	66	-1
7	32.5	162	0.44	0.18	164.74	299	248	54	86	66	-1
	35	162	0.47	0.19	165.34	296	248	54	86	66	-1
8	37.5	162	0.53	0.22	165.99	296	249	54	86	66	-1
	40	163	0.52	0.21	166.63	298	248	51	85	66	-1
9	42.5	165	0.50	0.21	167.27	297	247	51	85	66	-1
	45	165	0.51	0.21	167.89	299	248	51	85	66	-1
10	47.5	164	0.50	0.21	168.55	299	249	50	85	66	-1
	50	162	0.50	0.21	169.18	297	248	50	85	66	-1
11	52.5	162	0.48	0.20	169.82	296	247	50	85	65	-1
	55	161	0.47	0.19	170.38	297	250	50	85	65	-1
12	57.5	161	0.48	0.20	171.00	297	250	50	85	65	-1.5
	60	161	0.47	0.19	171.59	297	252	50	85	65	-1.5

Pump oil

SOURCE TESTING FIELD DATA SHEET

Job No.: 121415456
Client: Northern Aglp
Plant: #1 Lime kiln
Location: Pictou NS
Test: PM-1
Date: July 21, 2015
Operators: TH/SF
Gamma: 1.073
Delta H@: 1.717
Pitot Coeff.: 0.816
Start: 10:12
Finish: 11:12

Static Pressure (in.H2O): 0.51
Port Length (in): 12"
Stack Dia. (in.): 48"
Probe Length (ft): 8'
Nozzle ID (in.): 1-6 (0.172)
Console S/N: 1646

Pre-Test Leak Check: ✓
Vacuum Pressure: -19
Post-Test Leak Check: ✓
Vacuum Pressure: -19

K': 0.48

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0				171.59						
1	2.5	159	0.61	0.25	172.26	301	246	58	85	64	-1.5
	5	159	0.63	0.26	172.96	300	247	58	85	64	-2
2	7.5	159	0.60	0.25	173.64	300	246	58	85	64	-2
	10	161	0.62	0.26	174.35	300	247	54	84	64	-2
3	12.5	161	0.58	0.24	175.04	299	248	54	84	64	-2
	15	160	0.59	0.24	175.72	300	249	53	84	64	-2
4	17.5	161	0.54	0.22	176.38	298	249	53	84	64	-3
	20	161	0.51	0.21	177.02	299	248	53	84	64	-3
5	22.5	161	0.42	0.17	177.60	300	250	53	84	64	-3
	25	161	0.40	0.17	178.15	300	253	53	84	64	-3
6	27.5	160	0.35	0.14	178.72	300	253	53	84	64	-3
	30	156	0.30	0.12	179.17	300	253	54	84	64	-3
7	32.5	155	0.40	0.17	179.74	301	253	54	84	64	-3
	35	155	0.43	0.18	180.34	300	252	54	84	64	-2
8	37.5	155	0.45	0.19	180.95	300	252	54	84	63	-2
	40	154	0.60	0.21	181.57	301	253	54	84	63	-2
9	42.5	155	0.69	0.29	182.30	300	254	54	84	63	-2
	45	156	0.71	0.30	183.05	300	256	54	84	63	-2
10	47.5	158	0.79	0.33	183.89	299	257	55	85	64	-3
	50	158	0.80	0.33	184.61	300	258	53	85	64	-3
11	52.5	158	0.50	0.21	185.25	298	258	53	85	64	-3
	55	160	0.48	0.20	185.88	299	258	53	85	64	-3
12	57.5	158	0.48	0.20	186.51	300	260	53	85	64	-3
	60	155	0.45	0.19	187.12	300	261	55	87	65	-3

COMBUSTION GAS ANALYSIS CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413454
Client: Northern Pulp
Plant: Lime kiln
Location: Pictou, NS

Fuel Type: Nat gas

Time Start: 10:30
Time Finish: 11:00

Test No.: Gas # 1
Date: July 21, 2015

Personnel: TBH/

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_x (ppm)	NO (ppm)	NO_2 (ppm)	THC (%)
0	7.70	7.34	4	2	102			
5	7.72	7.35	3	6	111			
10	7.49	7.51	3	7	129			
15	7.72	7.39	5	7	125			
20	7.45	7.52	3	6	114			
25	7.46	7.53	3	6	117			
30	7.40	7.52	4	5	120			

MOISTURE FIELD DATA SHEET

Project No.: 121413456
Client: Northern Pulp
Plant: Lime kiln
Location: Pictou, NS
Test: PM-7
Date: July 22, 2015
Analyst: TBLT/SF

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	897.5	463.9	233.6
2	100 mL H2O	725.9	715.5	10.4
3	Blank	667.9	666.3	1.6
4	200g Silica Gel	971.7	966.1	5.6
		Total Weight Gain (g)		251.2
		Moisture Volume (mL)		

Volume H_2O Collected: 251.2 ml
X 0.048 = 12.06 ft^3 H_2O (Vwc)

DGM Final 713.37 ft^3
DGM Initial 187.47 ft^3
Final - Initial = 525.90 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{\text{(Vwc + Vmc)}}$$

$$\text{Moisture} = \frac{12.06}{37.96}$$

Moisture = 0.31 × 100 = 31%

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 121413456
Client: Alcoa P-H
Plant: Lime kiln
Location: Pickens, MS
Test: PM-2
Date: Jul 22, 2015
Operators: TGH/SE
Gamma: 1.033
Delta H@: 1.717
Pitot Coeff.: 0.816
Start: 12:30
Finish:

Static Pressure (in.H2O): 0.51
Port Length (in): 12"
Stack Dia. (in.): 48"
Probe Length (ft): 8'
Nozzle ID (in.): 1-6 (0.172)
Console S/N: 1646

Pre-Test Leak Check: ✓
Vacuum Pressure: -18
Post-Test Leak Check:
Vacuum Pressure:

K': 0.48

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				187.47						
1	2.5	157	0.42	0.16	187.95	295	238	50	78	60	-1
	5	160	0.40	0.16	188.55 *	300	244	50	80	60	-1
2	7.5	160	0.35	0.14	189.08	300	243	50	80	60	-1
	10	162	0.35	0.14	189.61	299	244	48	80	60	-1
3	12.5	161	0.35	0.14	190.15	298	243	48	80	60	-1
	15	161	0.30	0.12	190.65	296	244	48	80	60	-1
4	17.5	161	0.29	0.12	191.13	298	227	50	80	60	-1
	20	161	0.27	0.11	191.61	292	240	50	79	59	-1
5	22.5	159	0.25	0.10	192.09	291	228	50	79	59	-1
	25	158	0.25	0.10	192.59	291	228	47	79	59	-1
6	27.5	158	0.25	0.10	193.01	286	226	47	79	59	-1
	30	157	0.29	0.10	193.47	285	227	47	79	59	-1
7	32.5	158	0.20	0.08	193.90	281	225	47	80	60	-1
	35	156	0.33	0.16	194.49	276	227	47	80	60	-1
8	37.5	156	0.40	0.17	195.07	279	230	50	80	60	-1
	40	155	0.39	0.16	195.63	278	230	50	80	60	-1
9	42.5	155	0.38	0.16	196.18	278	229	50	80	60	-1
	45	155	0.39	0.16	196.70 *	274	228	50	80	60	-1
10	47.5	155	0.41	0.17	197.36	274	226	49	80	60	-1
	50	154	0.40	0.17	197.92	275	228	47	80	60	-1
11	52.5	154	0.37	0.15	198.47	274	228	47	80	60	-1
	55	154	0.36	0.15	199.01	273	230	47	80	60	-1
12	57.5	154	0.35	0.14	199.46	275	228	47	80	60	-1
	60	155	0.35	0.14	200.18	280	231	47	80	60	-1

2/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 121411345G
Client: Northern P-ID
Plant: Lime kiln
Location: Pulton, MS
Test: PM-2
Date: Jan 22, 2015
Operators: TBH / SF
Gamma: 1.033
Delta H@: 1.717
Pitot Coeff.: 0.8116
Start: 2:40
Finish: 4:05

Static Pressure (in.H2O): 0.51
Port Length (in): 12"
Stack Dia. (in.): 48"
Probe Length (ft): 8'
Nozzle ID (in.): 1-6 (0.172)
Console S/N: 16046

Pre-Test Leak Check: ✓
Vacuum Pressure: -17
Post-Test Leak Check: ✓
Vacuum Pressure: -17

K: 948

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				200.10						
1	2.5	155	0.43	0.18	200.666	279	231	52	80	61	-1
	5	158	0.45	0.19	201.29	282	231	52	80	61	-1
2	7.5	158	0.42	0.17	201.87	298	225	51	80	60	-1
	10	158	0.42	0.17	202.45	295	228	50	80	60	-1
3	12.5	159	0.35	0.14	203.00	291	229	46	80	60	-1
	15	159	0.36	0.15	203.53	290	283	46	80	60	-1
4	17.5	161	0.30	0.12	204.03	282	226	46	80	60	-1
	20	162	0.32	0.13	204.54	283	227	45	81	61	-1
5	22.5	163	0.31	0.13	205.08	281	229	46	81	61	-1
	25	163	0.31	0.13	205.58	278	231	46	81	61	-1
6	27.5	162	0.32	0.13	206.00 *	281	235	46	81	61	-1
	30	162	0.32	0.13	206.59	279	233	46	81	61	-1
7	32.5	161	0.30	0.12	207.08	279	237	46	81	61	-1
	35	161	0.32	0.13	207.60	285	240	46	81	61	-1
8	37.5	161	0.33	0.14	208.14	284	240	46	81	61	-1
	40	161	0.33	0.14	208.78	286	242	46	81	61	-1
9	42.5	159	0.37	0.15	209.25	293	245	46	82	62	-1
	45	160	0.37	0.15	209.79	298	250	46	82	62	-1
10	47.5	160	0.38	0.16	210.28	253	252	46	82	62	-1
	50	160	0.40	0.16	210.95	253	252	46	82	62	-1
11	52.5	160	0.45	0.19	211.56	277	253	46	82	62	-1
	55	160	0.45	0.19	212.19	285	254	47	82	62	-1
12	57.5	159	0.43	0.18	212.70 *	297	254	47	82	62	-1
	60	158	0.44	0.18	213.37	301	257	47	82	62	-1

OMBUSTION GAS ANALYSIS
CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: Northern Pulp
Plant: Lime kiln
Location: Pictou, NS

Test No.: Gas #2
Date: July 22/2015

Fuel Type: Nat. Gas
Time Start: 3:10
Time Finish: 9:40
Personnel: TB/H

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_x (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
0	8.44	6.99	2	19	110			
5	8.33	7.84	1	4	114			
10	8.12	7.19	1	4	115			
15	7.44	7.55	2	4	142			
20	7.13	7.69	1	4	150			
25	7.24	7.66	1	4	143			
30	7.30	7.62	2	4	146			

MOISTURE FIELD DATA SHEET

Project No.: 121418456
Client: Northern Pulp
Plant: Lime Kiln
Location: Pictou, NS
Test: PM-8 3
Date: July 22nd, 2015
Analyst: TBH / SF

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	893.7	658.8	234.9
2	100 mL H2O	708.5	698.8	9.7
3	Blank	666.9	666.7	0.2
4	200g Silica Gel	976.4	971.6	4.8
		Total Weight Gain (g)		249.6
		Moisture Volume (mL)		

Volume H_2O Collected: 249.6 ml
X 0.048 = 11.98 ft^3 H_2O (Vwc)

DGM Final 240.99 ft^3
DGM Initial 213.63 ft^3
Final - Initial = 24.36 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{\text{(Vwc + Vmc)}}$$

$$\text{Moisture} = \frac{11.98}{36.34}$$

Moisture = 0.32 32%

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 121413456
Client: Norbec Pulp
Plant: Lime kiln
Location: Picton, NS
Test: PM-2
Date: July 22, 2015
Operators: TDH / SS
Gamma: 1.033
Delta H@: 1.717
Pitot Coeff.: 0.816
Start: 5:10
Finish: 6:10

Static Pressure (in.H2O): 0.51
Port Length (in): 12"
Stack Dia. (in.): 48"
Probe Length (ft): 8'
Nozzle ID (in.): 1-16 (0.172)
Console S/N: 1046

Pre-Test Leak Check: ✓
Vacuum Pressure: -20
Post-Test Leak Check:
Vacuum Pressure:

K': 0.48

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				213.63						
1	2.5	158	0.50	0.21	214.30	225	225	54	79	61	-1
	5	159	0.50	0.21	214.95	226	230	52	79	61	-1
2	7.5	159	0.48	0.20	215.58	261	230	52	79	61	-1
	10	159	0.49	0.20	216.21	270	228	51	79	61	-1
3	12.5	159	0.40	0.16	216.74	273	225	95	80	62	-1
	15	160	0.38	0.16	217.32	282	226	45	80	62	-1
4	17.5	160	0.35	0.14	217.87	287	227	45	81	62	-1
	20	160	0.35	0.14	218.43	287	229	45	81	62	-1
5	22.5	160	0.30	0.12	218.92	289	229	45	81	62	-1
	25	160	0.28	0.12	219.44	288	235	45	82	62	-1
6	27.5	160	0.27	0.11	219.95	288	234	45	82	62	-1
	30	160	0.25	0.10	220.41	286	237	45	82	62	-1
7	32.5	161	0.26	0.11	220.91	288	239	45	82	63	-1
	35	161	0.28	0.12	221.41	288	241	45	82	63	-1
8	37.5	161	0.29	0.12	221.92	286	240	45	82	63	-1
	40	161	0.30	0.12	222.43	284	241	45	82	63	-1
9	42.5	161	0.34	0.14	222.98	283	242	45	82	63	-1
	45	161	0.33	0.14	223.51	279	233	44	83	63	-1
10	47.5	161	0.35	0.14	224.07	279	233	44	83	63	-1
	50	160	0.38	0.16	224.79	281	237	44	83	63	-1
11	52.5	160	0.39	0.16	225.26	300	241	44	83	63	-1
	55	159	0.41	0.17	225.88	300	242	44	83	63	-1
12	57.5	160	0.45	0.19	226.52	299	244	44	83	64	-1
	60	159	0.46	0.19	227.16	300	244	44	80	64	-1

2/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 12141345G
Client: Northern Pulp
Plant: Lime kiln
Location: Pictou, NS
Test: PM-3
Date: July 22, 2015
Operators: TBH / SF
Gamma: 1.033
Delta H@: 1.717
Pitot Coeff.: 0.816
Start: 6:12
Finish: 7:12

Static Pressure (in.H2O): 0.51
Port Length (in): 12"
Stack Dia. (in.): 42"
Probe Length (ft): 8'
Nozzle ID (in.): 1-6 (0.172)
Console S/N: 1846

Pre-Test Leak Check: ✓
Vacuum Pressure: -18
Post-Test Leak Check: ✓
Vacuum Pressure: -18

'K': 0.48

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0				227.16						
1	2.5	159	0.51	0.21	227.87	249	241	49	81	64	-1
	5	160	0.51	0.21	228.50	253	241	49	81	64	-1
2	7.5	159	0.49	0.20	229.13	266	240	49	81	64	-1
	10	158	0.49	0.20	229.76	281	241	49	82	64	-1
3	12.5	158	0.42	0.17	230.36	289	241	49	82	64	-1
	15	158	0.40	0.17	230.90	298	241	44	82	64	-1
4	17.5	159	0.35	0.14	231.49	297	240	44	82	64	-1
	20	159	0.34	0.14	232.01	297	240	44	82	64	-1
5	22.5	159	0.36	0.17	232.52	301	240	44	82	64	-1
	25	160	0.28	0.12	233.02	299	241	44	82	64	-1
6	27.5	159	0.25	0.10	233.51	300	240	46	83	64	-1
	30	159	0.29	0.12	234.01	300	241	46	83	64	-1
7	32.5	159	0.31	0.13	234.52 *	299	241	46	83	64	-1
	35	160	0.32	0.13	235.08	300	244	46	83	64	-1
8	37.5	158	0.37	0.15	235.60	300	246	46	83	64	-1
	40	158	0.33	0.14	236.18	300	246	47	83	65	-1
9	42.5	157	0.33	0.14	236.70 *	301	250	47	83	65	-1
	45	158	0.39	0.16	237.28	300	250	47	83	65	-1
10	47.5	158	0.40	0.17	237.88	300	251	47	83	65	-1
	50	158	0.40	0.17	238.50	300	251	47	83	65	-1
11	52.5	158	0.41	0.17	239.10	300	251	47	83	65	-1.5
	55	158	0.44	0.18	239.75 *	300	250	49	83	65	-1.5
12	57.5	157	0.44	0.18	240.35	301	250	49	83	65	-1.5
	60	158	0.46	0.19	240.99	300	252	49	83	65	-1.5

COMBUSTION GAS ANALYSIS
CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: Northern Pulp
Plant: Lime kiln
Location: Pictou, NS

Test No.: Gas #3
Date: July 22, 2015

Fuel Type: Nat gas

Time Start: 6:20
Time Finish: 6:50

Personnel: TBH / SF

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
0	9.99	6.13	4	2	77			
5	11.10	5.50	3	1	44			
10	11.15	5.40	4	2	42			
15	11.21	5.43	4	1	42			
20	11.23	5.43	3	2	44			
25	11.10	5.45	3	2	41			
30	11.19	5.45	4	2	45			

07-16-13

MOISTURE FIELD DATA SHEET

Project No.: 121113456
Client: Northern Pulp
Plant: Dissolving Tank
Location: Pictou NS
Test: PM-1
Date: July 20, 2015
Analyst: JS/FS

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	988.1	708.5	279.6
2	100 mL H2O	820.0	743.1	76.9
3	Blank 2	595.1	593.7	1.4
4	200g Silica Gel	953.9	947.1	6.8
		Total Weight Gain (g)		694.8
		Moisture Volume (mL)		694.8

Volume H_2O Collected: 694.8 ml
X 0.048 = 33.35 ft^3 H_2O (Vwc)

DGM Final 762.79 ft^3
DGM Initial 732.77 ft^3
Final - Initial = 30.02 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{(\text{Vwc} + \text{Vmc})}$$

Moisture = 33.35 / (33.35 + 30.02)

Moisture = 0.526 = 52.6%

SOURCE TESTING FIELD DATA SHEET

Job No.: 17H13456
Client: Nucor
Plant:
Location:
Test: RM 1
Date:
Operators:
Gamma: 1.117
Delta H@: 1.713
Pitot Coeff.: 0.836
Start : 9:00
Finish : 10:50

Static Pressure (in.H2O): -0.20
Port Length (in): 6"
Stack Dia. (in.): 42"
Probe Length (ft): 5'
Nozzle ID (in.): 1-0/1206
Console S/N: 1343

Pre-Test Leak Check: OK
Vacuum Pressure: -15
Post-Test Leak Check:
Vacuum Pressure:

K': 2.23

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				732.77						
1	2.5	171	0.10	0.19	733.32	328	261	80	87	87	-1
	5	187	0.10	0.19	733.90	264	266	80	87	87	-1
2	7.5	184	0.15	0.27	734.55	265	273	79	87	87	-1
	10	184	0.15	0.27	735.25	267	264	77	87	87	-1
3	12.5	184	0.15	0.29	735.94	269	266	77	87	87	-1
	15	183	0.15	0.29	736.66	263	268	77	87	87	-1
4	17.5	183	0.15	0.29	737.37	265	264	77	87	87	-1
	20	180	0.15	0.29	739.07	263	262	77	87	87	-1
5	22.5	172	0.10	0.19	736.68	267	263	77	87	87	-1
	25	181	0.15	0.28	739.37	263	265	77	87	87	-1
6	27.5	185	0.15	0.28	740.07	263	266	77	87	87	-1
	30	185	0.15	0.29	740.78	263	262	76	88	87	-1
7	32.5	183	0.15	0.29	741.47	262	258	75	88	87	-1
	35	183	0.10	0.17	742.04	262	260	73	88	87	-1
8	37.5	160	0.10	0.20	742.66	265	266	74	89	89	-1
	40	174	0.10	0.20	743.26	267	270	74	89	85	-2
9	42.5	173	0.10	0.19	743.88	263	268	80	89	88	-2
	45	175	0.10	0.19	744.45	263	268	77	88	88	-2
10	47.5	175	0.10	0.19	745.04	265	267	77	88	89	-2
	50	174	0.10	0.19	745.61	263	267	77	88	89	-2

4/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 121413-3
Client: Northern Star
Plant: Mississippi Pellets
Location: Pellet Line
Test: RM-1
Date: Jan 21 2015
Operators: JTH, EL
Gamma: 1.12
Delta H@: 1.717
Pitot Coeff.: 0.836
Start :
Finish :

Static Pressure (in.H2O): -0.20
Port Length (in): 6"
Stack Dia. (in.): 48"
Probe Length (ft): 5'
Nozzle ID (in.): 1-10 (0.302)
Console S/N: 1204

Pre-Test Leak Check:
Vacuum Pressure:
Post-Test Leak Check:
Vacuum Pressure:

K' : 2.23

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				745.61						
1	2.5	162	0.09	0.17	746.16	259	259	77	85	89	-1
	5	172	0.08	0.15	746.70	256	263	80	85	92	-1
2	9.5	180	0.10	0.19	747.26	255	263	80	88	94	-1
	10	180	0.10	0.19	747.83	255	264	76	88	89	-1
3	12.5	180	0.13	0.25	748.48	256	266	71	93	95	-1
	15	181	0.13	0.25	749.15	257	264	70	95	95	-2
4	18.5	175	0.12	0.23	749.81	262	265	66	95	95	-2
	20	176	0.12	0.23	750.44	263	264	65	88	90	-2
5	22.5	176	0.13	0.25	751.11	262	266	63	85	89	-2
	25	156	0.14	0.28	751.81	265	266	60	88	88	-2
6	27.5	170	0.17	0.33	752.55	264	266	60	87	88	-2
	30	172	0.25	0.48	753.45	265	266	60	87	93	-2
7	32.5	143	0.28	0.54	754.41	262	266	60	88	88	-3
	35	141	0.30	0.61	755.43	262	268	60	89	95	-3
8	38.5	140	0.33	0.67	756.45	263	270	60	89	97	-3
	40	142	0.33	0.67	757.54	265	267	55	90	93	-4
9	42.5	140	0.35	0.71	758.64	267	267	55	90	93	-4
	45	137	0.50	1.01	759.84	260	268	55	90	91	-5
10	47.5	140	0.71	1.43	761.30	262	266	55	91	93	-6
	50	141	0.70	1.43	762.79	262	267	55	91	93	-6

COMBUSTION GAS ANALYSIS
CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121113456
Client: Northern Pulp
Plant: Digester Tank
Location: Pictou NS

Test No.: 1
Date: Jul 21 2015

Fuel Type: _____

Time Start: 9:00
Time Finish: 9:30

Personnel: JTR / ES

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_x (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
9:00	20.9	0	0	0	0			
9:05	20.9	0	0	0	0			
9:10	20.9	0	0	0	0			
9:15	20.9	0	0	0	0			
9:20	20.9	0	0	0	0			
9:25	20.9	0	0	0	0			
9:30	20.9	0	0	0	0			

MOISTURE FIELD DATA SHEET

Project No.: [illegible]
Client: [illegible]
Plant: [illegible]
Location: Pine Bluff, AR
Test: PM-2
Date: 1.1.21.2015
Analyst: JJE, [illegible]

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g) 1067.8	Tare Weight (g) 655.1	Weight of Moisture (g) 411.7
1	100 mL H2O	919.7	705.9	213.8
2	100 mL H2O	736.6	728.7	7.9
3	Blank	595.9	594.3	1.6
4	200g Silica Gel	964.4	957.4	7.0
		Total Weight Gain (g)		642.0
		Moisture Volume (mL)		642.0

Volume H_2O Collected: 642.0 ml
X 0.048 = 30.42 ft^3 H_2O (Vwc)

DGM Final 403.17 ft^3
DGM Initial 376.99 ft^3
Final - Initial = 26.18 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{(\text{Vwc} + \text{Vmc})}$$

Moisture = 30.42 / (30.42 + 26.18)

Moisture = [illegible]

SOURCE TESTING FIELD DATA SHEET

Job No.: 12[illegible]56
Client: N[illegible]
Plant: [illegible]
Location: [illegible]
Test: EPA 2
Date: [illegible]
Operators: [illegible]
Gamma: [illegible]
Delta H@: [illegible]
Pitot Coeff.: [illegible]
Start : 12:45
Finish : 2:25

Static Pressure (in.H2O): -0.20
Port Length (in): 6"
Stack Dia. (in.): 48"
Probe Length (ft): 5'
Nozzle ID (in.): 1-10 (0.366)
Console S/N: 1848

Pre-Test Leak Check: -15
Vacuum Pressure: -15
Post-Test Leak Check:
Vacuum Pressure:

K' : 2.40

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				776.99						
1	2.5	183	0.16	0.31	777.73	262	264	90	85	85	-1
	5	188	0.15	0.30	778.46	226	228	86	85	85	-1
2	7.5	196	0.17	0.34	779.19	230	253	95	85	85	-1
	10	197	0.17	0.34	779.97	249	267	97	85	85	-1
3	12.5	198	0.17	0.24	780.67	262	267	79	85	85	-1
	15	177	0.17	0.25	781.35	263	267	78	85	85	-1
4	17.5	177	0.16	0.33	782.05	264	266	76	86	85	-1
	20	185	0.16	0.32	782.77	263	264	75	86	85	-1
5	22.5	185	0.12	0.24	783.47	263	262	74	86	86	-1
	25	185	0.12	0.24	784.13	262	265	74	86	86	-1
6	27.5	185	0.12	0.24	784.77	262	263	74	87	86	-1
	30	185	0.12	0.24	785.78	263	263	74	87	86	-1
7	32.5	186	0.10	0.20	786.02	263	268	75	87	85	-2
	35	175	0.10	0.20	786.63	263	267	75	87	86	-2
8	37.5	182	0.10	0.20	787.21	263	266	76	87	86	-2
	40	183	0.10	0.20	787.79	263	264	77	87	86	-2
9	42.5	182	0.11	0.22	788.40	262	267	78	87	86	-2
	45	184	0.10	0.20	789.01	263	267	78	88	86	-2
10	47.5	180	0.12	0.24	789.65	263	264	79	87	86	-2
	50	177	0.12	0.24	790.28	263	263	78	87	86	-2

SOURCE TESTING FIELD DATA SHEET

Job No.: [illegible]
Client: [illegible]
Plant: [illegible]
Location: [illegible]
Test: [illegible]
Date: [illegible]
Operators: [illegible]
Gamma: 1.117
Delta H@: 1.717
Pitot Coeff.: 0.836
Start :
Finish :

Static Pressure (in.H2O): [illegible]
Port Length (in): [illegible]
Stack Dia. (in.): [illegible]
Probe Length (ft): [illegible]
Nozzle ID (in.): [illegible]
Console S/N: [illegible]

Pre-Test Leak Check: [illegible]
Vacuum Pressure: [illegible]
Post-Test Leak Check:
Vacuum Pressure:

K' : 2.40

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				790.28						
1	2.5	181	0.12	0.24	790.92	263	266	76	52	87	-2
	5	180	0.12	0.24	791.55	263	270	74	48	85	-2
2	7.5	175	0.12	0.24	792.18	263	271	72	51	87	-2
	10	179	0.12	0.24	792.81	263	270	72	48	87	-2
3	12.5	180	0.13	0.27	793.50	263	261	72	48	87	-2
	15	178	0.13	0.27	794.17	263	267	70	45	87	-2
4	17.5	179	0.13	0.27	794.84	263	264	69	48	87	-2
	20	183	0.13	0.27	795.49	263	264	68	48	87	-2
5	22.5	182	0.13	0.27	796.17	263	264	68	48	87	-2
	25	180	0.11	0.23	796.84	263	264	68	49	87	-2
6	27.5	169	0.11	0.23	797.49	263	265	68	50	88	-2
	30	180	0.11	0.23	798.11	263	271	69	84	88	-2
7	32.5	180	0.11	0.23	798.74	263	266	69	94	94	-2
	35	180	0.11	0.23	799.36	264	263	69	89	89	-3
8	37.5	179	0.10	0.21	799.97	263	261	70	88	88	-3
	40	180	0.10	0.21	800.58	263	265	71	88	89	-3
9	42.5	181	0.10	0.21	401.18	263	264	70	88	89	-3
	45	183	0.10	0.21	401.80	263	265	70	88	89	-3
10	47.5	177	0.13	0.27	802.50	264	269	71	88	88	-3
	50	176	0.13	0.27	403.17	263	266	71	88	88	-4

COMBUSTION GAS ANALYSIS
CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: Acadian Pile
Plant: Dissolving Tank
Location: Pictou NS

Fuel Type: _____

Time Start: 13:00
Time Finish: 13:30

Test No.: 2
Date: July 22 2015

Personnel: JJB/FS

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
13:00	20.9	0	0	0	0			
13:05	20.9							
13:10	20.9							
13:15	20.9							
13:20	20.9							
13:25	20.9							
13:30	20.9	V	V	V	V			

MOISTURE FIELD DATA SHEET

Project No.: 121412156
Client: Northern Tier
Plant: Superior Plant
Location: Superior, WI
Test: RM-3
Date: 10/15/2015
Analyst: MEH

Stantec

Moisture Data

Impinger No	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
	Blank 1	1064.6	655.4	409.2
1	100 mL H2O	491.0	703.0	188.0
2	100 mL H2O	740.0	733.5	6.5
3	Blank 2	595.0	594.1	0.9
4	200g Silica Gel	981.1	975.5	5.6
		Total Weight Gain (g)		610.2
		Moisture Volume (mL)		610.2

Volume H_2O Collected: 610.2 ml
X 0.048 = 29.29 ft^3 H_2O (Vwc)

DGM Final 831.67 ft^3
DGM Initial 803.66 ft^3
Final - Initial = 28.01 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{(\text{Vwc} + \text{Vmc})}$$

$$\text{Moisture} = \frac{29.29}{(29.29 + 28.01)}$$

Moisture = 0.511 51.1%

SOURCE TESTING FIELD DATA SHEET

Job No.: 1714113456
Client: Northern [illegible]
Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-3
Date: [illegible]
Operators: [illegible]
Gamma: 1.117
Delta H@: 1.717
Pitot Coeff.: 0.836
Start : 3:55
Finish : 5:40

Static Pressure (in.H2O): -0.20
Port Length (in): 6"
Stack Dia. (in.): 48"
Probe Length (ft): 5'
Nozzle ID (in.): [illegible]
Console S/N: [illegible]

Pre-Test Leak Check: -12
Vacuum Pressure: -18
Post-Test Leak Check:
Vacuum Pressure:

K' : [illegible]

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				803.66						
	2.5	170	0.10	0.21	804.26	246	272	81	86	86	-1
	5	169	0.16	0.21	804.45	262	262	76	91	86	-
	7.5	170	0.10	0.21	805.43	263	264	75	76	85	-1
	10	170	0.10	0.21	806.04	263	264	74	92	93	-
	12.5	171	0.12	0.26	806.67	263	267	73	93	92	-
	15	162	0.12	0.25	807.32	262	262	73	96	93	-1
4	17.5	170	0.12	0.25	807.96	264	266	72	97	96	-1
	20	171	0.13	0.27	808.67	263	264	71	97	96	-1
5	22.5	170	0.13	0.27	809.35	262	263	71	97	96	-1
	25	171	0.13	0.27	810.04	263	266	70	97	97	-1
6	27.5	171	0.13	0.27	810.72	263	265	70	97	97	-1
	30	170	0.13	0.27	811.42	263	267	69	97	97	-1
7	32.5	170	0.13	0.27	812.11	265	264	68	97	97	-1
	35	170	0.13	0.27	812.80	263	268	67	97	97	-1
8	37.5	172	0.15	0.31	813.54	263	265	67	98	97	-1
	40	171	0.15	0.31	814.29	263	267	67	98	97	-1
9	42.5	171	0.15	0.31	815.04	263	265	66	98	97	-1
	45	172	0.15	0.31	815.78	265	268	66	98	97	-1
10	47.5	172	0.15	0.31	816.52	263	264	66	98	97	-2
	50	172	0.13	0.27	817.24	264	266	66	98	97	-2

SOURCE TESTING FIELD DATA SHEET

Job No.: 1214134456
Client: Northern Tier
Plant: Dickinson Terminal
Location: Dickinson, ND
Test: DRE3
Date: July 21, 2015
Operators: SJR/MS
Gamma: 1.017
Delta H@: 1.717
Pitot Coeff.: 0.836
Start :
Finish :

Static Pressure (in.H2O): -0.20
Port Length (in): 6"
Stack Dia. (in.): 48"
Probe Length (ft): 6'
Nozzle ID (in.): 1-10 (0.160")
Console S/N: 2548

Pre-Test Leak Check: OK
Vacuum Pressure: -15
Post-Test Leak Check:
Vacuum Pressure:

K' : 34

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				817.24						
1	2.5	173	0.13	0.27	817.96	262	267	67	85	87	-2
	5	173	0.13	0.27	818.66	262	265	67	88	87	-2
2	7.5	172	0.13	0.27	819.35	263	269	68	87	88	-2
	10	171	0.13	0.27	820.05	264	265	68	89	88	-2
3	12.5	172	0.14	0.29	820.76	262	264	65	91	89	-2
	15	172	0.14	0.29	821.47	263	264	68	91	89	-2
4	17.5	173	0.14	0.29	822.17	262	267	69	89	88	-2
	20	172	0.15	0.31	822.93	263	266	69	89	88	-2
5	22.5	171	0.15	0.31	823.68	263	265	69	87	88	-2
	25	171	0.15	0.31	824.42	263	266	68	89	88	-2
6	27.5	175	0.15	0.31	825.16	263	264	64	89	88	-2
	30	177	0.15	0.31	825.91	262	269	60	89	88	-2
7	32.5	177	0.15	0.31	826.64	263	265	60	89	88	-2
	35	178	0.15	0.31	827.37	262	267	60	89	89	-3
8	37.5	175	0.15	0.31	828.09	264	264	60	89	89	-3
	40	176	0.15	0.31	828.82	264	267	60	89	89	-3
9	42.5	174	0.13	0.27	829.55	263	264	62	90	89	-3
	45	173	0.13	0.27	830.26	264	263	62	90	89	-3
10	47.5	174	0.13	0.27	830.97	263	263	62	90	89	-3
	50	174	0.13	0.27	831.67	263	266	62	90	89	-3

COMBUSTION GAS ANALYSIS CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: Northern Pulp
Plant: Dissolving Tank
Location: Pictou NS

Fuel Type: _____

Time Start: 16:00
Time Finish: 16:30

Test No.: 3
Date: July 22, 2015

Personnel: JJB / FS

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_x (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
16:00	20.9	0	0	0	0			
16:05	20.9	"	"	"	"			
16:10	20.9	"	"	"	"			
16:15	20.9	"	"	"	"			
16:20	20.9	"	"	"	"			
16:25	20.9	"	"	"	"			
16:30	20.9	"	"	"	"			

MOISTURE FIELD DATA SHEET

Project No.: 121413456
Client: Northern Pine
Plant: Dryer 3 Baghouse
Location: Pinon, NS
Test: PM-1
Date: 11.23.2018
Analyst: JE, SC

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
	Silica Gel	0664.8	6543	111.8
1	100 mL H2O	753.7	700.1	53.6
2	100 mL H2O	742.6	732.7	10.9
3	Blank 2	596.1	593.9	2.2
4	200g Silica Gel	992.0	981.0	11
		Total Weight Gain (g)		393.1
		Moisture Volume (mL)		393.1

Volume H_2O Collected: 393.1 ml
X 0.048 = 18.87 $ft^3 H_2O$ (Vwc)

DGM Final 879.23 ft^3
DGM Initial 833.33 ft^3
Final - Initial = 45.9 ft^3 (Vmc)

18.87
(18.87 + 45.9)

Moisture = $\frac{Vwc}{(Vwc + Vmc)}$

Moisture = 29.1 %

Moisture = 29.1 %

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 21413456
Client: [illegible]
Plant: [illegible]
Location: [illegible]
Test: [illegible]
Date: [illegible]
Operators: [illegible]
Gamma: 1.03
Delta H@: 1.717
Pitot Coeff.: 0.84
Start : 9:45
Finish : 11:45

Static Pressure (in.H2O): 1.10
Port Length (in): 6"
Stack Dia. (in.): 13.81
Probe Length (ft): 21
Nozzle ID (in.): 1-8/16 (0.375)
Console S/N: [illegible]

Pre-Test Leak Check: -18
Vacuum Pressure: -18
Post-Test Leak Check:
Vacuum Pressure:

K': 1.61

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	2				433.33						
1	2½	150	0.41	0.60	831.34	259	270	62	67	67	-1
	5	149	0.42	0.58	835.30	264	265	62	69	64	-1
2	7.5	149	0.42	0.58	436.27	262	266	63	70	68	-1
	10	149	0.42	0.58	437.22	265	266	64	71	69	-1
3	12.5	150	0.42	0.58	438.20	262	270	64	71	69	-1
	15	149	0.41	0.57	439.17	259	260	65	72	69	-1
4	17.5	149	0.41	0.57	440.12	260	257	64	72	69	-1
	20	150	0.41	0.57	841.07	262	266	59	73	70	-1
5	22.5	150	0.41	0.57	842.04	261	268	58	73	71	-1
	25	150	0.41	0.57	443.01	262	264	57	74	71	-1
6	27.5	150	0.41	0.57	843.95	262	265	57	74	71	-1
	30	150	0.41	0.57	844.92	263	265	56	74	71	-1
7	32.5	150	0.42	0.58	845.89	267	274	55	75	71	-1
	35	149	0.42	0.59	846.89	263	268	54	75	72	-1
8	37.5	150	0.41	0.57	847.85	263	268	53	75	72	-1
	40	150	0.41	0.57	448.81	264	267	53	75	72	-1
9	42.5	151	0.41	0.58	849.80	263	265	53	76	73	-1
	45	150	0.41	0.58	850.78	261	261	53	76	72	-1
10	47.5	150	0.41	0.58	851.75	262	258	53	76	72	-1
	50	150	0.41	0.58	852.70	[illegible]	[illegible]	53	[illegible]	[illegible]	-1
11	52.5	150	0.41	0.58	853.68	[illegible]	[illegible]	53	76	[illegible]	[illegible]
	55	150	0.41	0.58	854.66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	57.5	[illegible]	0.41	0.58	855.62	[illegible]	[illegible]	[illegible]	76	72	-1
	60	150	0.41	0.58	856.58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SOURCE TESTING FIELD DATA SHEET

Job No.: 12141546
Client:
Plant:
Location:
Test:
Date:
Operators:
Gamma:
Delta H@:
Pitot Coeff.: 0.794
Start :
Finish :

Static Pressure (in.H2O):
Port Length (in):
Stack Dia. (in.):
Probe Length (ft):
Nozzle ID (in.):
Console S/N:

Pre-Test Leak Check:
Vacuum Pressure:
Post-Test Leak Check:
Vacuum Pressure:

K' : 1.61

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (In.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	0				456.58						
	2.5	150	0.40	0.56	457.55	266	262	53	77	74	-1
	5	150	0.40	0.56	458.52	265	267	57	74	73	-1
	7.5	150	0.40	0.56	459.49	267	266	59	74	73	-1
	10	150	0.40	0.56	460.89	267	264	59	74	73	-
	12.5	149	0.41	0.59	460.87	268	271	58	75	74	-
	15	149	0.41	0.58	461.85	270	273	59	75	74	-1
	17.5	150	0.41	0.58	462.79	269	271	56	75	74	-1
	20	150	0.41	0.58	463.76	268	269	58	76	74	-1
	22.5	150	0.41	0.58	464.74	268	266	59	76	74	-6
	25	150	0.41	0.59	465.74	267	264	58	76	74	-3
	27.5	150	0.41	0.58	466.72	266	269	58	76	74	-2
	30	150	0.41	0.59	467.69	266	272	58	76	74	-1
	32.5	150	0.41	0.58	468.67	263	271	59	77	75	-1
	35	150	0.41	0.58	469.66	263	269	59	77	75	-1
	37.5	149	0.40	0.56	470.64	263	267	60	77	76	-1
	40	149	0.40	0.56	471.59	263	276	60	77	75	-1
	42.5	150	0.40	0.56	472.53	263	266	61	78	75	-1
	45	150	0.40	0.56	473.47	262	270	61	79	76	-1
	47.5	150	0.40	0.56	474.44	262	262	59	78	76	-1
	50	150	0.41	0.58	475.40	262	263	59	78	75	-1
	52.5	150	0.41	0.58	476.35	263	263	59	78	75	-1
	55	150	0.41	0.58	477.30	264	260	58	78	75	-1
	57.5	150	0.41	0.58	478.26	261	272	57	78	75	-1
	60	150	0.41	0.57	479.23	262	267	56	78	76	-

COMBUSTION GAS ANALYSIS
CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: Nat... P...
Plant: Recovery Boiler
Location: P... NS

Fuel Type: _____

Time Start: 10:00
Time Finish: 10:30

Test No.: 1
Date: JJ 23 2015

Personnel: JJB / FS

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
10:00	6.55	4.04	46	0	66	0	66	
10:05	6.62	4.02	94	0	66	0	66	
10:10	6.93	7.93	63	2	66	0	66	
10:15	6.66	7.98	69	4	66	0	66	
10:20	6.70	7.95	72	0	64	0	64	
10:25	6.76	7.95	159	6	67	0	57	
10:30	6.42	8.00	171	7	67	0	67	

MOISTURE FIELD DATA SHEET

Project No.: [illegible]
Client: [illegible]
Plant: [illegible]
Location: [illegible]
Test: [illegible]
Date: [illegible]
Analyst: [illegible]

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g) 1034.3	Tare Weight (g) 636.6	Weight of Moisture (g) 377.7
1	100 mL H2O	746.9	700.3	46.6
2	100 mL H2O	733.2	726.3	6.9
3	Blank	575.3	573.4	1.9
4	200g Silica Gel	1052.2	1001.4	10.8
		Total Weight Gain (g)		443.4
		Moisture Volume (mL)		443.4

Volume H_2O Collected: 443.4 ml
X 0.048 = 21.28 ft^3 H_2O (Vwc)

DGM Final 931.70 ft^3
DGM Initial [illegible] ft^3
Final - Initial = 51.93 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{\text{(Vwc + Vmc)}}$$

$$\text{Moisture} = \frac{21.28}{(21.28 + 51.93)}$$

Moisture = 0.291 = 29.1%

SOURCE TESTING FIELD DATA SHEET

Job No.: 17141134136
Client: [illegible]
Plant: [illegible]
Location: [illegible] NC
Test: Run 3
Date: 3.1.[illegible]
Operators: [illegible]
Gamma: 1.117
Delta H@: 1.3117
Pitot Coeff.: 0.794
Start: 1120
Finish: 1320

Static Pressure (in.H2O): 1.10
Port Length (in): 6"
Stack Dia. (in.): 138"
Probe Length (ft): 21
Nozzle ID (in.): 1-8 (0.[illegible])
Console S/N: 1598

Pre-Test Leak Check: -18
Vacuum Pressure: -18
Post-Test Leak Check:
Vacuum Pressure:

K': 1.68

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	0				879.47						
1	2.5	150	0.45	0.66	880.50	225	232	67	76	76	-1
	5	150	0.43	0.63	881.51	247	231	55	77	76	-1
2	7.5	150	0.43	0.63	882.52	262	231	50	77	76	-1
	10	150	0.43	0.63	883.52	262	237	50	77	76	-1
3	12.5	151	0.42	0.62	884.51	263	248	48	79	77	-1
	15	150	0.42	0.62	885.53	261	246	48	77	77	-1
4	17.5	150	0.42	0.62	886.55	261	248	48	79	77	-1
	20	150	0.42	0.62	887.56	261	247	50	80	78	-1
5	22.5	150	0.42	0.62	888.56	261	260	50	80	78	-1
	25	151	0.42	0.62	889.57	263	261	51	81	78	-1
6	27.5	151	0.42	0.62	890.59	261	261	51	81	78	-1
	30	150	0.42	0.62	891.61	263	257	52	81	79	-1
7	32.5	150	0.41	0.61	892.60	262	251	52	82	79	-1
	35	150	0.41	0.61	893.60	262	257	52	82	79	-1
8	37.5	150	0.41	0.61	894.62	263	264	53	82	79	-1
	40	150	0.42	0.62	895.63	266	271	53	83	80	-1
9	42.5	150	0.42	0.62	896.63	267	273	53	83	80	-1
	45	151	0.42	0.62	897.63	265	267	53	83	80	-1
10	47.5	151	0.42	0.62	898.64	265	269	53	83	80	-1
	50	150	0.42	0.62	899.65	263	262	53	83	80	-1
11	52.5	150	0.41	0.61	900.66	261	260	53	83	80	-1
	55	150	0.44	0.66	901.72	261	256	54	83	81	-1
12	57.5	150	0.43	0.64	902.79	264	242	54	82	81	-1
	60	150	0.43	0.64	903.81	265	237	54	83	81	-1

SOURCE TESTING FIELD DATA SHEET

Job No.: 12141346
Client: Nestle - Tidy
Plant: Recovery Boiler
Location: Fort, NC
Test: PM 2
Date: 1 [illegible] 2014
Operators: [illegible]
Gamma: 1.117
Delta H@: 1.717
Pitot Coeff.: 0.794
Start :
Finish :

Static Pressure (in.H2O): -0.70
Port Length (in): 6"
Stack Dia. (in.): 138"
Probe Length (ft): 7'
Nozzle ID (in.): 1-8 (0.234)
Console S/N: 1848

Pre-Test Leak Check:
Vacuum Pressure:
Post-Test Leak Check:
Vacuum Pressure:

K' : 1.68

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				903.81						
1	2.5	151	0.44	0.66	904.86	262	253	54	83	81	-1
	5	151	0.44	0.66	905.92	263	247	54	83	81	-1
2	7.5	149	0.45	0.67	906.96	263	252	54	83	81	-1
	10	150	0.44	0.66	908.03	262	254	54	80	80	—
3	12.5	150	0.40	0.60	909.01	262	250	54	80	80	—
	15	151	0.50	0.75	909.92	261	225	54	80	79	-1
4	17.5	149	0.50	0.75	911.02	262	227	54	80	79	-1
	20	149	0.52	0.75	912.12	262	237	54	80	79	-1
5	22.5	151	0.45	0.67	913.17	262	249	54	79	79	-1
	25	150	0.44	0.66	914.24	262	252	54	79	79	-1
6	27.5	151	0.37	0.55	915.28	263	255	54	79	79	-1
	30	150	0.51	0.76	916.38	264	238	54	79	79	-1
7	32.5	150	0.63	0.94	917.61	263	247	54	79	79	-1
	35	150	0.74	1.10	918.92	263	251	54	79	79	-1
8	37.5	149	0.70	1.04	920.21	263	264	53	80	78	-1
	40	149	0.62	0.93	921.44	261	268	50	80	79	-1
9	42.5	150	0.54	0.81	922.62	263	267	50	80	79	-2
	45	149	0.60	0.89	923.82	263	260	50	80	79	-2
10	47.5	149	0.70	1.04	925.13	263	266	52	80	79	-2
	50	149	0.79	1.17	926.48	263	267	52	80	79	-2
11	52.5	149	0.90	1.34	927.92	261	266	53	82	80	-2
	55	150	0.70	1.04	929.23	263	263	54	82	80	-2
12	57.5	150	0.42	0.62	930.29	262	260	54	82	80	-2
	60	150	0.42	0.62	931.30	261	264	55	82	80	-2

COMBUSTION GAS ANALYSIS
CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: N...
Plant: ...Baker
Location: ... NS

Fuel Type: _____

Time Start: 13:20
Time Finish: 13:50

Test No.: 2
Date: July 23, 2015

Personnel: JJB/FS

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
13:20	6.66	7.83	115	2	63	0	63	
13:25	6.65	7.94	117	2	65	0	63	
13:30	6.72	7.97	117	4	67	0	63	
13:35	6.53	7.99	116	6	62	0	62	
13:40	6.61	7.97	104	2	65	0	63	
13:45	6.54	8.10	132	4	64	0	64	
13:50	6.54	8.06	137	9	64	0	64	

MOISTURE FIELD DATA SHEET

Project No.: 121413456
Client: Nutrien PLP
Plant: Redwater Facility
Location: Redwater, AB
Test: PM-3
Date: Jul 23 2025
Analyst: JJB/FS

Stantec

Moisture Data

Impinger No.	Impinger Contents Blank #1	Final Weight (g) 1038.2	Tare Weight (g) 655.2	Weight of Moisture (g) 383.6
1	100 mL H2O	871.7	697.6	174.1
2	100 mL H2O	738.5	726.1	12.2
3	Blank 2	597.8	595.0	2.8
4	200g Silica Gel	924.1	910.1	14
		Total Weight Gain (g)		586.7
		Moisture Volume (mL)		

Volume H_2O Collected: _____ ml

X 0.048 = _____ ft^3 H_2O (Vwc)

DGM Final _____ ft^3

DGM Initial _____ ft^3

Final - Initial = _____ ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{\text{(Vwc + Vmc)}}$$

Moisture = _____

Moisture = _____

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 19141346
Client: Nu-Ha
Plant:
Location:
Test: RM-3
Date:
Operators: JJB/ES
Gamma: 1.017
Delta H@: 1.717
Pitot Coeff.: 0.794
Start: 9:12
Finish: 10:12

Static Pressure (in.H2O): -0.40
Port Length (in):
Stack Dia. (in.):
Probe Length (ft): 2'
Nozzle ID (in.): 1-8(0.236)
Console S/N: 1848

Pre-Test Leak Check: -15
Vacuum Pressure: -15
Post-Test Leak Check:
Vacuum Pressure:

K': 1.64

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				937.11						
1	2.5	154	0.61	0.88	933.37	263	249	70	69	62	-1
	5	154	0.63	0.91	934.56	264	267	56	69	61	-1
2	7.5	154	0.63	0.91	935.90	263	265	55	69	62	-1
	10	155	0.63	0.91	937.04	267	265	51	71	62	-1
3	12.5	156	0.62	0.90	938.27	263	266	51	71	69	-1
	15	154	0.62	0.90	939.49	263	264	50	71	62	-1
4	17.5	154	0.62	0.90	940.72	267	264	49	71	62	-1
	20	154	0.62	0.90	941.95	263	265	49	74	70	-1
5	22.5	154	0.62	0.90	943.17	267	263	48	74	71	-1
	25	155	0.62	0.90	944.42	263	265	48	74	71	-1
6	27.5	155	0.62	0.90	945.64	263	263	51	74	71	-1
	30	154	0.62	0.90	946.86	264	265	51	75	71	-1
7	32.5	154	0.62	0.90	948.06	263	264	51	75	72	-1
	35	155	0.62	0.90	949.29	262	266	51	75	72	-1
8	37.5	155	0.62	0.90	950.51	263	265	52	75	72	-1
	40	155	0.62	0.90	951.74	264	264	52	75	73	-1
9	42.5	155	0.61	0.88	952.98	263	265	52	75	72	-1
	45	155	0.61	0.88	954.20	264	266	52	75	72	-1
10	47.5	154	0.61	0.88	955.47	263	266	53	75	72	-1
	50	154	0.61	0.88	956.65	262	266	53	75	72	-1
11	52.5	155	0.60	0.86	957.87	262	265	53	75	72	-1
	55	155	0.61	0.89	959.08	263	264	53	76	73	-1
12	57.5	155	0.60	0.88	960.30	263	265	54	76	73	-1
	60	155	0.60	0.88	961.54	263	265	54	76	73	-1

SOURCE TESTING FIELD DATA SHEET

Job No.: 17H13456
Client: Nutrien Ltd.
Plant: Vanscoy Potash
Location: Vanscoy, SK
Test: PM-3
Date: Nov 24 2015
Operators: SSD, ES
Gamma: 1.117
Delta H@: 1.717
Pitot Coeff.: 0.794
Start :
Finish : 10:17

Static Pressure (in.H2O): -0.20
Port Length (in): 6"
Stack Dia. (in.): 138"
Probe Length (ft): 4'
Nozzle ID (in.): 1.8 (0.250)
Console S/N: 1042

Pre-Test Leak Check: -1.8
Vacuum Pressure: -15
Post-Test Leak Check:
Vacuum Pressure:

K' : 1.68

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (In.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				961.54						
1	2.5	154	0.61	0.89	962.76	263	266	56	75	73	-1
	5	154	0.61	0.89	964.00	263	265	56	75	73	-1
2	7.5	154	0.60	0.88	965.21	263	266	57	75	73	-1
	10	155	0.61	0.88	966.43	262	265	55	75	73	-1
3	12.5	155	0.60	0.88	967.66	263	265	55	76	73	-1
	15	154	0.60	0.88	968.87	263	265	45	75	73	-1
4	17.5	154	0.60	0.88	970.09	263	265	47	75	73	-1
	20	154	0.61	0.89	971.30	263	265	47	75	73	-1
5	22.5	154	0.61	0.89	972.54	264	264	47	75	73	-1
	25	155	0.60	0.88	973.77	263	265	47	75	73	-1
6	27.5	156	0.60	0.87	974.99	262	265	46	75	73	-1
	30	155	0.60	0.87	976.20	262	265	46	75	73	-1
7	32.5	156	0.60	0.87	977.41	265	265	46	75	73	-1
	35	156	0.60	0.87	978.63	262	266	46	75	73	-1
8	37.5	156	0.60	0.87	979.84	262	265	46	75	73	-1
	40	156	0.60	0.87	981.05	263	266	46	75	73	-2
9	42.5	154	0.61	0.89	982.27	263	265	47	76	73	-2
	45	154	0.62	0.91	983.57	263	264	47	76	73	-2
10	47.5	152	0.62	0.91	984.76	262	264	47	75	73	-2
	50	152	0.60	0.90	985.98	262	265	47	75	73	-2
11	52.5	154	0.60	0.87	987.19	263	264	50	75	73	-2
	55	154	0.60	0.87	988.39	263	266	50	75	73	-2
12	57.5	155	0.60	0.87	989.61	263	265	50	75	73	-2
	0	155	0.60	0.87	990.82	263	266	50	75	73	-2

COMBUSTION GAS ANALYSIS
CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: N.H.L. P.L.
Plant: Recovery Boiler
Location: Point Tupper NS

Fuel Type: _____

Time Start: 8:20
Time Finish: 4:50

Test No.: 3
Date: July 24, 2015

Personnel: JJB/CFS

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
8:20	5.04	9.67	176	6	58	0	58	
8:25	5.12	9.69	192	6	58	0	58	
8:30	5.52	9.53	147	6	58	0	58	
8:35	5.57	9.76	272	0	60	0	60	
8:40	5.37	9.90	263	5	61	0	61	
8:45	5.50	10.67	262	4	61	0	61	
8:50	5.46	9.65	297	5	60	0	60	

MOISTURE FIELD DATA SHEET

Project No.: 121413456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS
Test: PM-1
Date: 23rd July 15
Analyst: TBH / SF

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	812.1	656.2	155.9
2	100 mL H2O	729.2	696.8	32.4
3	Blank	668.7	665.2	3.5
4	200g Silica Gel	986.9	975.0	11.9
		Total Weight Gain (g)		203.7
		Moisture Volume (mL)		

Volume H_2O Collected: 203.7 ml
X 0.048 = 9.78 ft^3 H_2O (Vwc)

DGM Final 296.48 ft^3
DGM Initial 241.26 ft^3
Final - Initial = 55.22 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{\text{(Vwc + Vmc)}}$$

$$\text{Moisture} = \frac{9.78}{9.78 + 55.22}$$

Moisture = 15.7 %

SOURCE TESTING FIELD DATA SHEET

Job No.: 121413456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS
Test: PM-1
Date: July 23, 2015
Operators: TBH/SF
Gamma: 1.273
Delta H@: 1.712
Pitot Coeff.: 0.816
Start: 9:42
Finish: 10:42

Static Pressure (In.H2O): 0.20
Port Length (In): 6"
Stack Dia. (In.): 72"
Probe Length (ft): 8'
Nozzle ID (In.): 1-6 (0.172)
Console S/N: 1646

Pre-Test Leak Check:
Vacuum Pressure:
Post-Test Leak Check:
Vacuum Pressure:

K': 0.62

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (In.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	0				241.126						
1	2.5	132	0.85	0.48	242.23	289	235	62	92	62	-1
	5	128	0.80	0.46	243.10 *	300	245	62	95	64	-1
2	7.5	132	0.80	0.45	244.12	299	246	58	95	64	-1.5
	10	132	0.99	0.56	245.18	301	251	58	95	64	-2
3	12.5	131	0.93	0.55	246.23	300	254	54	96	64	-2
	15	130	0.93	0.53	247.23	300	253	54	96	64	-2
4	17.5	131	0.90	0.50	248.21	294	250	54	68	65	-2
	20	129	0.95	0.53	249.22	302	253	54	68	65	-2
5	22.5	129	0.91	0.50	250.22	301	254	54	69	65	-2
	25	126	0.90	0.50	251.24	299	260	54	69	65	-2
6	27.5	124	0.88	0.49	252.23	300	260	54	69	66	-2
	30	124	0.88	0.49	253.22	297	263	54	69	66	-2
7	32.5	124	0.90	0.50	254.23	299	264	54	69	66	-2
	35	125	0.88	0.49	255.22	295	261	55	70	67	-2
8	37.5	128	0.96	0.53	256.25	288	261	55	70	67	-2
	40	128	0.99	0.55	257.29	299	258	55	70	67	-2
9	42.5	129	1.20	0.67	258.47	301	253	55	70	67	-2
	45	128	1.10	0.61	259.55	299	255	55	70	67	-2
10	47.5	130	1.40	0.78	260.78	300	253	55	70	67	-2
	50	131	1.35	0.75	261.99	289	256	55	70	67	-2
11	52.5	130	1.60	0.89	263.30 *	297	260	55	70	69	-2
	55	129	1.60	0.89	264.603	300	262	58	73	69	-3
12	57.5	130	1.60	0.89	265.90	299	257	58	73	69	-3
	60	133	1.50	0.83	267.24	297	255	58	73	69	-3

SOURCE TESTING FIELD DATA SHEET

Job No.: 121413456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou NS
Test: PM-1
Date: July 23 2015
Operators: TBH/SF
Gamma: 1.033
Delta H@: 1.712
Pitot Coeff.: 0.816
Start: 10:51
Finish: 11:51

Static Pressure (in.H2O): 0.20
Port Length (in): 6"
Stack Dia. (in.): 72"
Probe Length (ft): 8'
Nozzle ID (in.): 1-0 (0.172)
Console S/N: 11646

Pre-Test Leak Check:
Vacuum Pressure:
Post-Test Leak Check: ✓
Vacuum Pressure: -19

K': 0.162

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (In.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	0				267.24						
1	2.5	131	1.40	0.78	268.44	287	262	64	70	70	-2
	5	130	1.40	0.78	269.64	297	264	60	71	70	-2
2	7.5	129	1.35	0.75	270.87	300	265	60	71	70	-2
	10	129	1.40	0.78	272.07	300	266	51	72	71	-2
3	12.5	128	1.30	0.73	273.25	300	268	51	72	71	-2
	15	132	1.25	0.69	274.41	300	268	48	72	69	-3
4	17.5	132	1.20	0.67	275.56	300	268	48	72	69	-3
	20	131	1.20	0.67	276.71	300	290	47	72	69	-3
5	22.5	129	1.10	0.61	277.83	300	270	47	72	69	-3
	25	130	1.05	0.59	278.90	300	267	47	72	69	-3
6	27.5	129	1.10	0.61	280.01	300	268	47	72	69	-3
	30	129	1.10	0.61	281.17	301	2610	47	72	69	-3
7	32.5	137	1.20	0.67	282.27	299	2606	48	72	69	-3
	35	130	1.25	0.70	283.47	299	266	48	73	70	-3
8	37.5	129	1.30	0.73	284.666	300	267	48	73	70	-3
	40	128	1.35	0.76	285.87	300	268	48	73	70	-3
9	42.5	128	1.40	0.78	287.09	300	267	48	73	70	-4
	45	129	1.40	0.78	288.31	299	268	48	73	70	-4
10	47.5	128	1.40	0.78	289.62	300	272	49	74	71	-5
	50	128	1.35	0.76	290.94	300	271	49	74	71	-5
11	52.5	127	1.80	1.01	292.25 *	300	2601	49	74	71	-9
	55	126	1.75	0.99	293.90 *	300	271	49	74	71	-10
12	57.5	126	1.60	0.90	295.17	300	270	49	74	71	-10
	60	127	1.50	0.84	296.48	299	271	49	74	71	-5

COMBUSTION GAS ANALYSIS CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS

Test No.: Gas #1
Date: July 23, 2015

Fuel Type: Nat gas / biomass

Time Start: 11:00
Time Finish: 11:30

Personnel: TBH

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
0	16.81	2.26	801	0	11			
5	16.99	2.21	622	0	13			
10	16.11	2.68	344	0	20			
15	16.52	2.47	1368	0	14			
20	15.37	3.14	1121	0	28			
25	15.35	3.12	1132	0	20			
30	15.93	2.81	1374	0	26			

MOISTURE FIELD DATA SHEET

Project No.: 121413456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS
Test: PM-2
Date: July 23, 2015
Analyst: JBH

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	883.6	666.4	217.2
2	100 mL H2O	741.5	715.3	26.2
3	Blank	668.9	666.1	2.8
4	200g Silica Gel	1037.2	1025.6	11.6
		Total Weight Gain (g)		257.8
		Moisture Volume (mL)		

Volume H_2O Collected: 257.8 ml
X 0.048 = 12.37 ft^3 H_2O (Vwc)

DGM Final 352.41 ft^3
DGM Initial 296.72 ft^3
Final - Initial = 55.69 ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{\text{(Vwc + Vmc)}}$$

$$\text{Moisture} = \frac{12.37}{68.06}$$

Moisture = 0.18 3

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 121413456
Client: Northern P-LP
Plant: Power Boiler
Location: Picton ON
Test: PM-3
Date: July 23 2015
Operators: TA#/SE
Gamma: 1.033
Delta H@: 1.712
Pitot Coeff.: 0.816
Start: 13:25
Finish: 14:25

Static Pressure (In.H2O): 0.20
Port Length (in): 6"
Stack Dia. (in.): 72"
Probe Length (ft): 8'
Nozzle ID (in.): 1-Tot (0.172)
Console S/N: 10446

Pre-Test Leak Check: ✓
Vacuum Pressure: -18
Post-Test Leak Check: ✓
Vacuum Pressure: -18

K': 0.62

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (In.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	0				296.72						
1	2.5	136	1.50	0.83	298.01	256	256	72	71	71	-1
	5	137	1.60	0.88	299.32	295	261	69	73	71	-1
2	7.5	137	1.40	0.77	300.60*	300	267	63	72	71	-1
	10	137	1.50	0.83	301.80	300	271	57	72	71	-1
3	12.5	134	1.30	0.72	303.00*	300	273	54	72	71	-1
	15	134	1.30	0.72	304.21	300	275	50	72	71	-3
4	17.5	135	1.25	0.69	305.41	300	276	50	72	71	-3
	20	134	1.25	0.69	306.52	300	280	48	72	71	-3
5	22.5	135	1.20	0.666	307.610	300	279	48	72	70	-3
	25	136	1.20	0.666	308.79	300	282	48	72	70	-3
6	27.5	135	1.15	0.64	309.91	300	284	48	72	70	-3
	30	137	1.20	0.666	311.06	300	286	47	74	71	-3
7	32.5	138	1.15	0.63	312.110	300	288	47	74	71	-3
	35	135	1.10	0.61	313.26	287	286	47	74	71	-3
8	37.5	137	1.05	0.58	314.34	297	285	47	74	71	-3
	40	137	1.05	0.58	315.39	299	282	48	75	72	-3
9	42.5	137	1.20	0.666	316.54	300	286	48	75	72	-3
	45	135	1.15	0.64	317.89	300	287	48	75	72	-3
10	47.5	136	1.40	0.78	319.08	299	286	48	75	72	-3
	50	134	1.30	0.72	320.07	299	291	48	75	72	-3
11	52.5	134	1.20	0.73	321.27	299	290	48	77	73	-3
	55	134	1.50	0.84	322.54	291	292	48	77	73	-3
12	57.5	137	1.80	1.00	323.93	297	291	48	77	73	-3
	60	135	1.75	0.98	325.31	293	293	48	77	73	-3

2/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 121413454
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS
Test: PM-2
Date: July 23, 2013
Operators: TBH/SF
Gamma: 1.033
Delta H@: 1.712
Pitot Coeff.: 0.846
Start: 13:40
Finish: 16:40

Static Pressure (In.H2O): 0.20
Port Length (In): 16"
Stack Dia. (In.): 72"
Probe Length (ft): 8'
Nozzle ID (In.): 1-6 (0.142)
Console S/N: 11046

Pre-Test Leak Check: ✓
Vacuum Pressure: -12
Post-Test Leak Check: ✓
Vacuum Pressure: -12

K': 062

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (In.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	0				325.31						
1	2.5	130	0.98	0.55	326.38	287	286	67	74	74	-5
	5	132	0.94	0.53	327.40	300	285	63	74	74	-3.5
2	7.5	128	0.94	0.53	328.46	300	286	53	74	73	-3
	10	127	0.92	0.52	329.47	300	286	58	74	73	-3
3	12.5	128	0.88	0.50	330.47	300	285	49	74	73	-3
	15	132	0.85	0.47	331.44	300	287	48	73	73	-3
4	17.5	133	0.80	0.45	332.38	301	289	48	73	73	-3
	20	136	0.82	0.45	333.35	299	290	48	73	73	-3
5	22.5	137	0.83	0.46	334.31	299	285	48	73	73	-3
	25	131	0.84	0.47	335.30	300	281	48	73	73	-3
6	27.5	128	0.95	0.53	336.32	300	284	49	74	73	-3
	30	130	0.97	0.54	337.36	300	284	49	74	73	-3
7	32.5	130	1.00	0.56	338.40	300	282	49	74	73	-3
	35	132	1.20	0.67	339.50	300	281	49	74	73	-3
8	37.5	139	1.40	0.77	340.76	300	280	49	74	73	-3
	40	137	1.40	0.78	341.99	301	283	54	75	72	-5
9	42.5	135	1.50	0.83	343.26	300	282	54	75	72	-5
	45	135	1.50	0.83	344.51	300	285	54	75	72	-5
10	47.5	135	1.60	0.89	345.85	300	285	53	76	73	-5
	50	135	1.55	0.86	347.14	300	284	53	76	73	-5
11	52.5	136	1.60	0.89	348.44	299	286	52	78	74	-5
	55	136	1.60	0.89	349.75	301	289	52	78	74	-5
12	57.5	135	1.60	0.89	351.08	300	291	52	78	74	-6
	60	134	1.65	0.92	352.41	300	289	53	79	74	-6

COMBUSTION GAS ANALYSIS CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121913456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS

Fuel Type: Nat gas/biomass

Time Start: 2:00
Time Finish: 2:30

Test No.: Gas #2
Date: July 28, 2015

Personnel: TBH

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
0	17.94	1.86	80	0	14			
5	18.15	1.58	122	0	12			
10	18.05	1.63	124	0	13			
15	16.65	2.66	340	0	21			
20	16.20	2.67	343	0	20			
25	16.05	2.70	310	0	22			
30	16.32	2.57	347	0	21			

COMBUSTION GAS ANALYSIS CONCENTRATION FIELD SHEET

Sampling Methodology: Environment Canada EPS 1/RM/15

Stantec

Project No.: 121413456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS

Fuel Type: Nat gas

Time Start: 8:10
Time Finish: 8:40

Test No.: Gas #3
Date: July 24, 2015

Personnel: TBH/SF

Time	Concentrations							
	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)	NO_2 (ppm)	NO (ppm)	THC (%)
0	14.19	3.02	473	0	20			
5	13.93	4.01	421	0	32			
10	13.32	4.25	329	0	37			
15	13.36	4.21	362	0	36			
20	13.17	4.32	393	0	37			
25	12.41	4.82	344	0	49			
30	12.21	4.95	395	0	46			

MOISTURE FIELD DATA SHEET

Project No.: 121413456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS
Test: PM-3
Date: 24th July, 15
Analyst: TBH

Stantec

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	778.1	594.3	183.8
2	100 mL H2O	671.7	637.9	33.8
3	Blank	672.2	665.6	6.6
4	200g Silica Gel	1050.6	1037.1	13.5
		Total Weight Gain (g)		
		Moisture Volume (mL)		

Volume H_2O Collected: _____ ml
X 0.048 = _____ ft^3 H_2O (Vwc)

DGM Final _____ ft^3
DGM Initial _____ ft^3
Final - Initial = _____ ft^3 (Vmc)

$$\text{Moisture} = \frac{\text{Vwc}}{(\text{Vwc} + \text{Vmc})}$$

Moisture = _____

Moisture = _____

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 1214 13456
Client: Northern Pulp
Plant: Power Boiler
Location: Pictou, NS
Test: PM-3
Date: July 29, 2015
Operators: TB/HT/ES
Gamma: 1.033
Delta H@: 1.717
Pitot Coeff.: 0.8816
Start: 8:00
Finish: 9:00

Static Pressure (in.H2O): 0.20
Port Length (in): 64
Stack Dia. (in.): 72"
Probe Length (ft): 8'
Nozzle ID (in.): 1-6/0.172)
Console S/N: 1646

Pre-Test Leak Check:
Vacuum Pressure:
Post-Test Leak Check:
Vacuum Pressure:

K': 0.62

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (In.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	0				352.66						
1	2.5	130	0.80	0.45	353.62	255	252	69	73	73	-1
	5	131	0.82	0.46	354.58	291	259	64	74	73	-2
2	7.5	132	0.92	0.51	355.60	300	263	64	74	73	-2
	10	135	0.92	0.51	356.61	302	271	57	74	73	-2
3	12.5	135	0.85	0.47	357.57	300	275	56	75	73	-2
	15	134	0.86	0.48	358.55	300	275	56	75	73	-2
4	17.5	124	0.85	0.47	359.51	300	277	56	75	73	-2
	20	134	0.84	0.47	360.49	300	281	56	75	73	-2
5	22.5	135	0.82	0.46	361.45	300	282	55	76	73	-2
	25	135	0.80	0.45	362.38	300	283	55	76	73	-2
6	27.5	135	0.84	0.47	363.37	300	282	55	76	73	-2
	30	136	0.82	0.46	364.21	300	283	55	76	73	-2
7	32.5	137	0.84	0.47	365.28	300	283	58	77	74	-2
	35	137	0.86	0.48	366.25	300	284	58	77	74	-2
8	37.5	142	0.86	0.47	367.23	300	283	58	77	74	-2
	40	140	0.85	0.47	368.19	300	286	57	77	74	-2
9	42.5	140	1.10	0.61	369.27	300	286	57	77	74	-2
	45	139	1.10	0.61	370.37	300	286	57	77	74	-2
10	47.5	140	1.40	0.77	371.59	300	285	57	77	74	-2
	50	142	1.45	0.80	372.85	300	284	62	79	75	-4
11	52.5	134	1.53	0.84	374.17	300	284	52	79	75	-4
	55	134	1.70	0.95	375.49	300	283	52	79	75	-4
12	57.5	134	1.75	0.98	376.87	300	284	52	79	75	-4
	60	134	1.70	0.95	378.23	300	282	50	80	75	-5

SOURCE TESTING FIELD DATA SHEET

Job No.: 17141456
Client: Nachurs Only
Plant: Paper Divisor
Location: Picton, NS
Test: PM-3
Date: July 29/2015
Operators: TBH/SF
Gamma: 1.013
Delta H@: 1.772
Pitot Coeff.: 0.816
Start: 9:08
Finish: 10:03

Static Pressure (in.H2O): 0.20
Port Length (in): 6"
Stack Dia. (in.): 72"
Probe Length (ft): 8'
Nozzle ID (in.): 1-6 (0.172)
Console S/N: 1646

Pre-Test Leak Check: ✓
Vacuum Pressure: -18

K': 0.62

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (In.H2O)	Orifice dH (In.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (In.Hg)
									In	Out	
	0				378.23						
1	2.5	134	1.50	0.84	379.51	245	269	65	76	76	-5
	5	132	1.50	0.84	380.79	271	272	58	76	76	-5
2	7.5	133	1.35	0.76	382.05	299	276	50	76	76	-5
	10	134	1.45	0.81	383.27	300	278	49	78	75	-5
3	12.5	135	1.10	0.62	384.39	300	280	48	78	76	-5
	15	136	1.20	0.67	385.54	301	283	48	78	76	-5
4	17.5	135	1.15	0.64	386.67	300	285	48	78	76	-5
	20	134	1.10	0.62	387.78	296	280	48	78	76	-5
5	22.5	135	1.10	0.62	388.89	302	280	48	78	76	-5
	25	135	1.15	0.64	390.02	300	283	48	78	76	-5
6	27.5	135	1.10	0.62	391.15	300	282	48	78	76	-5
	30	135	1.10	0.62	392.27	300	285	47	78	76	-5
7	32.5	136	1.20	0.67	393.39	300	285	47	78	76	-5
	35	136	1.20	0.67	394.58	299	292	47	78	76	-5
8	37.5	136	1.30	0.73	395.77	299	291	47	78	76	-5
	40	135	1.25	0.70	396.97	300	293	47	78	76	-5
9	42.5	136	1.30	0.73	398.19	300	293	49	78	76	-5
	45	135	1.40	0.78	399.40	300	291	49	78	76	-5
10	47.5	135	1.50	0.84	400.603	300	290	49	78	76	-5
	50	135	1.50	0.84	401.97	297	286	49	78	76	-5
11	52.5	135	1.70	0.95	403.27	300	287	49	78	76	-5
	55	135	1.80	1.01	404.69	300	289	49	78	75	-5
12	57.5	136	1.80	1.00	406.10	300	287	49	78	75	-5
	60	135	1.85	1.03	407.48	300	288	49	78	75	-5

Stantec

Appendix D

Calculations

Raw Data for: Northern Pulp Recovery Boiler PM
Test #1

Client: Northern Pulp
Job Number: 121413458

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-1
Date: 23-Jul-13
Personnel: [illegible]

Test Start: 9:45 AM
Test Finish: 11:41 AM

Particulate Collected from Filter (mg):	12.2
Particulate Collected from Probe Wash (mg):	3.3
Particulate Collected from Impinger Wash (mg):	1.5
Total Particulate Collected (mg):	15.5

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	757.3	700.1	57.2
2	100 mL H2O	743.6	732.7	10.9
3	Blank	696.1	693.9	2.2
4	200g Silica Gel	992.0	981.0	11.0
5	Blank	998.5	654.7	311.8
			Total Weight Gain (g)	393.1
			Moisture Volume (mL)	393.1

Parameters

Barometric Pressure, Pbar (in. Hg)	29.90	O2, (%)	6.7	Stack Diameter, (in.)	138
Stack Static Pressure, Pstatic (in. H2O)	1.10	CO2, (%)	8.0	Stack Area, (sq. ft.)	103.87
Ambient Temp, (°F)	64	N2, (%)	85.3	Probe Length, (ft.)	6
H2O Volume Collected, Vw (mL)	393.1	CO(ppm)	91.1	Nozzle Diameter, (in.)	0.234
Total # Sampling Points,	24	NOx (ppm)	86.6	Pitot Coefficient, (Cp)	0.794
Sampling Time per Point, (min)	5	SO2 (ppm)	2.7	Gamma, meter constant	1.117
Readings Taken Every _ mins	2.5			Port length (in.)	6
Regulatory Agency	NSEMV				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						333.330		
Traverse 1	1	2.5	150	0.43	0.60	334.340	67	67
		5	149	0.42	0.58	335.300	69	68
	2	7.5	149	0.42	0.58	336.270	70	68
		10	149	0.42	0.58	337.230	71	69
	3	12.5	150	0.42	0.58	338.200	71	69
		15	149	0.41	0.57	339.170	72	69
	4	17.5	149	0.41	0.57	340.120	72	69
		20	150	0.41	0.57	341.070	73	70
	5	22.5	150	0.41	0.57	342.040	73	71
		25	150	0.41	0.57	343.010	74	71
	6	27.5	150	0.41	0.57	343.950	74	71
		30	150	0.41	0.57	344.920	74	71
	7	32.5	150	0.42	0.58	345.890	75	71
		35	149	0.42	0.59	346.880	75	72
	8	37.5	150	0.41	0.58	347.850	75	72
		40	150	0.41	0.58	348.820	75	72
	9	42.5	151	0.41	0.58	349.800	76	72
		45	150	0.41	0.58	350.780	76	72
	10	47.5	150	0.41	0.58	351.750	76	72
		50	150	0.41	0.58	352.700	76	72
	11	52.5	150	0.41	0.58	353.680	76	72
		55	150	0.41	0.58	354.660	76	72
	12	57.5	150	0.41	0.58	355.620	76	72
		60	150	0.41	0.58	356.590	76	72
						356.590		
Traverse 2	1	62.5	150	0.40	0.56	357.450	77	73
		65	150	0.40	0.56	358.220	77	73
	2	67.5	150	0.40	0.56	359.010	74	73
		70	150	0.40	0.56	359.890	74	73
	3	72.5	149	0.41	0.58	360.870	73	74
		75	149	0.41	0.58	361.850	73	74
	4	77.5	150	0.41	0.58	362.790	73	74
		80	150	0.41	0.58	363.750	76	74
	5	82.5	150	0.41	0.58	364.740	76	74
		85	150	0.41	0.58	365.700	76	74
	6	87.5	150	0.41	0.58	366.720	76	74
		90	150	0.41	0.58	367.690	76	74
	7	92.5	150	0.41	0.58	368.680	77	75
		95	150	0.41	0.58	369.660	77	75
	8	97.5	149	0.40	0.56	370.640	77	75
		100	149	0.40	0.56	371.590	77	75
	9	102.5	150	0.40	0.56	372.530	76	75
		105	150	0.40	0.56	373.470	76	75
	10	107.5	150	0.40	0.56	374.440	76	76
		110	150	0.41	0.58	375.400	76	75
	11	112.5	150	0.41	0.58	376.350	76	75
		115	150	0.41	0.58	377.300	76	75
	12	117.5	150	0.41	0.58	378.290	76	75
		120	150	0.41	0.58	379.230	76	76

Calculations for: Northern Pulp Recovery Boiler PM
Test #1

Client: Northern Pulp
Job Number: 1214134S8

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-1
Date: 23-Jul-13
Personnel: JJ/PB

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.08
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	29.54
Volume of Water Vapour Collected, Vwc (cu.ft)	18.668
Stack Gas Moisture Content (% as decimal)	0.274
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	26.36

Isokineticity Checks

Check range	Within Criteria
Check average	Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	610	0.43	0.60	39.81	29.04	527	1.010	1.116	101.21
	2	5	609	0.42	0.58	39.12	29.04	528	0.960	1.058	96.98
		7.5	609	0.42	0.58	39.12	29.04	529	0.970	1.068	97.89
	3	10	609	0.42	0.58	39.12	29.04	530	0.960	1.053	96.70
		12.5	610	0.42	0.58	39.15	29.04	530	0.970	1.068	97.79
	4	15	609	0.41	0.57	38.65	29.04	531	0.970	1.065	98.80
		17.5	609	0.41	0.57	38.65	29.04	531	0.950	1.043	96.76
	5	20	610	0.41	0.57	38.68	29.04	532	0.950	1.041	96.66
		22.5	610	0.41	0.57	38.68	29.04	532	0.970	1.062	98.60
	6	25	610	0.41	0.57	38.68	29.04	533	0.970	1.061	98.51
		27.5	610	0.41	0.57	38.89	29.04	533	0.940	1.028	95.46
	7	30	610	0.41	0.57	38.89	29.04	533	0.970	1.061	98.51
		32.5	610	0.42	0.58	39.15	29.04	533	0.970	1.060	97.24
	8	35	609	0.42	0.58	39.12	29.04	534	0.960	1.060	98.07
		37.5	610	0.41	0.58	38.68	29.04	534	0.970	1.059	98.33
	9	40	610	0.41	0.58	38.68	29.04	534	0.970	1.059	98.33
		42.5	611	0.41	0.58	38.71	29.04	534	0.960	1.058	98.33
	10	45	610	0.41	0.58	38.68	29.04	534	0.960	1.058	98.25
		47.5	610	0.41	0.58	38.68	29.04	534	0.970	1.058	98.23
	11	50	610	0.41	0.58	38.68	29.04	534	0.950	1.036	96.21
		52.5	610	0.41	0.58	38.68	29.04	534	0.960	1.058	98.25
	12	55	610	0.41	0.58	38.68	29.04	534	0.960	1.058	98.25
		57.5	610	0.41	0.58	38.68	29.04	534	0.960	1.047	97.22
		60	610	0.41	0.58	38.68	29.04	534	0.960	1.047	97.22
Traverse 2	1	62.5	610	0.40	0.56	38.21	29.04	535	0.970	0.947	88.03
		65	610	0.40	0.56	38.21	29.04	535	0.770	0.838	78.80
	2	67.5	610	0.40	0.56	38.21	29.04	534	0.790	0.862	81.07
		70	610	0.40	0.56	38.21	29.04	534	0.960	0.960	90.31
	3	72.5	609	0.41	0.56	38.65	29.04	535	0.960	1.068	98.07
		75	609	0.41	0.56	38.65	29.04	535	0.960	1.068	98.07
	4	77.5	610	0.41	0.56	38.68	29.04	535	0.940	1.024	95.11
		80	610	0.41	0.56	38.68	29.04	535	0.960	1.045	97.04
	5	82.5	610	0.41	0.56	38.68	29.04	535	0.980	1.077	100.07
		85	610	0.41	0.56	38.68	29.04	535	1.000	1.088	101.08
	6	87.5	610	0.41	0.56	38.68	29.04	535	0.960	1.067	99.08
		90	610	0.41	0.56	38.68	29.04	535	0.970	1.058	98.05
	7	92.5	610	0.41	0.56	38.68	29.04	536	0.960	1.075	99.88
		95	610	0.41	0.56	38.68	29.04	536	0.960	1.065	98.88
	8	97.5	609	0.40	0.56	38.18	29.04	536	0.960	1.064	100.02
		100	609	0.40	0.56	38.18	29.04	536	0.940	1.021	95.93
	9	102.5	610	0.40	0.56	38.21	29.04	537	0.950	1.031	96.94
		105	610	0.40	0.56	38.21	29.04	537	0.940	1.020	95.82
	10	107.5	610	0.40	0.56	38.21	29.04	537	0.970	1.052	98.89
		110	610	0.41	0.56	38.68	29.04	537	0.960	1.042	98.77
	11	112.5	610	0.41	0.56	38.68	29.04	537	0.950	1.031	96.78
		115	610	0.41	0.56	38.68	29.04	537	0.950	1.031	96.78
	12	117.5	610	0.41	0.56	38.68	29.04	537	0.960	1.064	99.79
		120	610	0.41	0.56	38.68	29.04	537	0.950	1.030	96.67
		Total 120	Average 610	Average 0.41	Average 0.56	Average 38.68	Average 29.04	Average 534	Total 45.900	Total 50.083	Average 98.87

Combustion Gas Data for: **Northern Pulp**

Client: Northern Pulp
Job Number: 121413456

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-1
Date: 23-Jul-15
Personnel: JJB/FS

Test Start:
Test Finish:

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)	NO (ppm)	NO2 (ppm)
0	6.6	8.0	46	0	66	0	66
5	6.6	8.0	94	0	66	0	66
10	6.9	7.8	63	2	66	0	66
15	6.7	8.0	68	4	66	0	66
20	6.7	8.0	72	0	68	0	68
25	6.8	8.0	159	6	67	0	67
30	6.8	8.0	171	7	67	0	67
Average:	6.7	8.0	96	3	67	0	67

Raw Data for: Northern Pulp Recovery Boiler PM
Test #2

Client: Northern Pulp
Job Number: 1214134/58

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-2
Date: 23-Jul-13
Personnel: JT/TS

Test Start: 1:20 PM
Test Finish: 3:30 PM

Particulate Collected from Filter (mg):	1.2
Particulate Collected from Probe Wash (mg):	7.4
Particulate Collected from Impinger Wash (mg):	1.0
Total Particulate Collected (mg):	9.6

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	746.9	700.3	46.6
2	100 mL H2O	733.2	726.3	6.9
3	Blank	685.3	683.9	1.4
4	200g Silica Gel	1032.2	991.4	10.8
5	Blank	1034.3	656.8	377.7
			Total Weight Gain (g)	443.4
			Moisture Volume (mL)	443.4

Parameters

Barometric Pressure, Pbar (in. Hg)	29.00	O2, (%)	0.6	Stack Diameter, (in.)	138
Stack Static Pressure, Pstatic (in. H2O)	1.16	CO2, (%)	8.0	Stack Area, (sq. ft.)	103.87
Ambient Temp, (°F)	63	N2, (%)	85.3	Probe Length, (ft.)	6
H2O Volume Collected, Vw (mL)	443.4	CO(ppm)	119.7	Nozzle Diameter, (in.)	0.234
Total # Sampling Points,	24	NOx (ppm)	63.1	Pitot Coefficient, (Cp)	0.794
Sampling Time per Point, (min)	5	SO2 (ppm)	4.7	Gamma, meter constant	1.117
Readings Taken Every __ mins	2.5			Port length (in.)	6
Regulatory Agency	NSE/MV				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						879.470		
Traverse 1	1	2.5	150	0.45	0.66	880.500	76	76
		5	150	0.43	0.63	881.510	77	76
	2	7.5	150	0.43	0.63	882.520	77	76
		10	150	0.43	0.63	883.530	77	76
	3	12.5	151	0.42	0.62	884.510	79	77
		15	150	0.42	0.62	885.530	79	77
	4	17.5	150	0.42	0.62	886.550	79	77
		20	150	0.42	0.62	887.550	80	78
	5	22.5	150	0.42	0.62	888.560	80	78
		25	151	0.42	0.62	889.570	81	78
	6	27.5	151	0.43	0.63	890.590	81	78
		30	150	0.43	0.63	891.610	81	79
	7	32.5	150	0.41	0.61	892.600	82	79
		35	150	0.41	0.61	893.600	82	79
	8	37.5	150	0.41	0.61	894.620	82	79
		40	150	0.42	0.62	895.630	83	80
	9	42.5	150	0.42	0.62	896.630	83	80
		45	151	0.42	0.62	897.630	83	80
	10	47.5	151	0.42	0.62	898.640	83	80
		50	150	0.42	0.62	899.650	83	80
	11	52.5	150	0.41	0.61	900.660	83	80
		55	150	0.44	0.66	901.720	83	81
	12	57.5	150	0.43	0.64	902.790	83	81
		60	150	0.43	0.64	903.810	83	81
						903.810		
Traverse 2	1	62.5	151	0.44	0.66	904.860	83	81
		65	151	0.44	0.66	905.920	83	81
	2	67.5	149	0.45	0.67	906.960	83	81
		70	150	0.33	0.67	907.930	80	80
	3	72.5	150	0.40	0.59	908.910	80	80
		75	150	0.50	0.73	909.920	80	79
	4	77.5	149	0.50	0.75	911.020	80	79
		80	149	0.52	0.73	912.120	80	79
	5	82.5	151	0.45	0.67	913.170	79	79
		85	150	0.44	0.66	914.240	79	78
	6	87.5	151	0.37	0.59	915.290	79	79
		90	150	0.51	0.76	916.380	79	79
	7	92.5	150	0.63	0.94	917.610	79	79
		95	150	0.74	1.10	918.920	79	79
	8	97.5	149	0.70	1.04	920.210	80	79
		100	149	0.62	0.93	921.440	80	79
	9	102.5	150	0.54	0.81	922.620	80	79
		105	149	0.60	0.89	923.830	80	79
	10	107.5	149	0.70	1.04	925.130	80	79
		110	149	0.79	1.17	926.480	80	79
	11	112.5	148	0.90	1.34	927.920	82	80
		115	150	0.70	1.04	929.230	82	80
	12	117.5	150	0.42	0.62	930.250	82	80
		120	150	0.42	0.62	931.300	82	80

Calculations for: Northern Pulp Recovery Boiler PM
Test #2

Client: Northern Pulp
Job Number: 121413456

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-2
Date: 23-Jul-15
Personnel: JJB/PS

Calculated Parameters

Stack Gas Pressure, Ps (in Hg)	29.09
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	29.55
Volume of Water Vapour Collected, Vwc (cu. ft)	21.253
Stack Gas Moisture Content (% as decimal)	0.270
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	26.37

Isokinetricity Checks

Check range	Within Criteria
Check average	Within Criteria

	Traverse Point	Time (mins)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	610	0.45	0.66	40.54	29.05	536	1.030	1.119	99.44
	2	5	610	0.43	0.63	39.63	29.05	537	1.010	1.096	99.65
		7.5	610	0.43	0.63	39.63	29.05	537	1.010	1.096	99.65
	3	10	610	0.43	0.63	39.63	29.05	537	1.010	1.096	99.65
		12.5	611	0.42	0.62	39.20	29.05	538	0.980	1.061	97.84
	4	15	610	0.42	0.62	39.16	29.05	538	1.020	1.104	101.54
		17.5	610	0.42	0.62	39.16	29.05	538	1.020	1.104	101.54
	5	20	610	0.42	0.62	39.16	29.05	539	1.000	1.080	99.37
		22.5	610	0.42	0.62	39.16	29.05	539	1.010	1.091	100.36
	6	25	611	0.42	0.62	39.20	29.05	540	1.010	1.090	100.35
		27.5	611	0.42	0.62	39.20	29.05	540	1.020	1.101	101.34
	7	30	610	0.42	0.62	39.16	29.05	540	1.020	1.100	101.17
		32.5	610	0.41	0.61	38.70	29.04	541	0.990	1.067	98.29
	8	35	610	0.41	0.61	38.70	29.04	541	1.000	1.077	100.29
		37.5	610	0.41	0.61	38.70	29.04	541	1.020	1.098	102.30
	9	40	610	0.42	0.62	39.16	29.05	542	1.010	1.088	99.80
		42.5	610	0.42	0.62	39.16	29.05	542	1.000	1.075	98.81
	10	45	611	0.42	0.62	39.20	29.05	542	1.000	1.075	98.86
		47.5	611	0.42	0.62	39.20	29.05	542	1.010	1.086	99.86
	11	50	610	0.42	0.62	39.16	29.05	542	1.010	1.086	99.80
		52.5	610	0.41	0.61	38.70	29.04	542	1.010	1.086	101.11
	12	55	610	0.44	0.66	40.09	29.05	542	1.060	1.139	103.35
		57.5	610	0.43	0.64	39.63	29.05	542	1.070	1.150	104.50
		60	610	0.43	0.64	39.63	29.05	542	1.020	1.096	99.62
Traverse 2	1	62.5	611	0.44	0.66	40.13	29.05	542	1.050	1.128	101.47
		65	611	0.44	0.66	40.13	29.05	542	1.060	1.139	102.43
	2	67.5	609	0.45	0.67	40.51	29.05	542	1.040	1.117	99.22
		70	610	0.33	0.67	34.72	29.05	540	0.970	1.046	108.55
	3	72.5	610	0.40	0.59	38.22	29.04	540	0.960	1.057	99.99
		75	610	0.50	0.75	42.73	29.06	540	1.010	1.090	91.83
	4	77.5	609	0.50	0.75	42.70	29.06	540	1.100	1.188	100.04
		80	609	0.52	0.75	43.54	29.06	540	1.100	1.188	96.09
	5	82.5	611	0.45	0.67	40.57	29.05	539	1.050	1.134	100.69
		85	610	0.44	0.66	40.09	29.05	539	1.070	1.157	103.99
	6	87.5	611	0.37	0.55	36.79	29.04	539	1.040	1.123	110.16
		90	610	0.51	0.76	43.16	29.06	539	1.100	1.188	99.23
	7	92.5	610	0.63	0.94	47.97	29.07	539	1.230	1.330	99.88
		95	610	0.74	1.10	51.99	29.08	539	1.310	1.417	99.19
	8	97.5	609	0.70	1.04	50.52	29.08	540	1.280	1.384	99.22
		100	608	0.62	0.93	47.95	29.07	540	1.230	1.329	100.56
	9	102.5	610	0.54	0.81	44.41	29.06	540	1.160	1.274	103.34
		105	609	0.60	0.89	46.77	29.07	540	1.200	1.296	99.66
	10	107.5	609	0.70	1.04	50.52	29.08	540	1.310	1.415	100.78
		110	608	0.78	1.17	53.67	29.09	540	1.390	1.458	97.78
	11	112.5	608	0.90	1.34	57.24	29.10	541	1.440	1.553	97.41
		115	610	0.70	1.04	50.56	29.08	541	1.310	1.412	100.57
	12	117.5	610	0.42	0.62	39.16	29.05	541	1.060	1.141	104.94
		120	610	0.42	0.62	39.16	29.05	541	1.010	1.087	99.99
		Total 120	Average 610	Average 0.48	Average 0.72	Average 41.76	Average 29.05	Average 540	Total 51.830	Total 55.824	Average 100.54

Combustion Gas Data for: **Northern Pulp**

Client: Northern Pulp
Job Number: 121413456

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-2
Date: 23-Jul-15
Personnel: JJB/FS

Test Start: 1:20 PM
Test Finish: 1:50 PM

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)	NO (ppm)	NO2 (ppm)
0	6.6	8.0	115	2	63	63	0
5	6.7	8.0	117	2	63	63	0
10	6.7	8.0	117	4	63	63	0
15	6.8	8.0	116	6	62	62	0
20	6.6	8.0	104	2	63	63	0
25	6.5	8.1	132	8	64	64	0
30	6.5	8.1	137	9	64	64	0
Average:	**6.6**	**8.0**	**120**	**5**	**63**	**63**	**0**

Raw Data for: Northern Pulp Recovery Boiler PM
Test #3

Client: Northern Pulp
Job Number: 121413456

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-3
Date: 24-Jul-13
Personnel: JSS PS

Test Start: 8:12 AM
Test Finish: 10:12 AM

Particulate Collected from Filter (mg):	0.2
Particulate Collected from Probe Wash (mg):	0.0
Particulate Collected from Impinger Wash (mg):	1.5
Total Particulate Collected (mg):	0.2

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	871.7	697.6	174.1
2	100 mL H2O	738.3	726.1	12.2
3	Blank	697.8	695.0	2.8
4	200g Silica Gel	924.1	910.1	14.0
5	blank	1038.8	655.2	383.6
			Total Weight Gain (g)	586.7
			Moisture Volume (mL)	586.7

Parameters

Barometric Pressure, Pbar (in. Hg)	29.90	O2, (%)	5.3	Stack Diameter, (in.)	138
Stack Static Pressure, Pstatic (in. H2O)	1.10	CO2, (%)	9.6	Stack Area, (sq. ft.)	103.87
Ambient Temp, (°F)	60	N2, (%)	85.1	Probe Length, (ft.)	6
H2O Volume Collected, Vw (mL)	586.70	CO(ppm)	235.6	Nozzle Diameter, (in.)	0.234
Total # Sampling Points,	24	NOx (ppm)	59.4	Pitot Coefficient, (Cp)	0.794
Sampling Time per Point, (min)	5	SO2 (ppm)	4.8	Gamma, meter constant	1.117
Readings Taken Every __ mins	2.5			Port length (in.)	6
Regulatory Agency	NSEMV				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						932.110		
Traverse 1	1	2.5	134	0.61	0.86	933.320	69	69
		5	134	0.63	0.91	934.940	69	69
	2	7.5	134	0.63	0.91	935.810	69	69
		10	139	0.63	0.91	937.040	71	69
	3	12.5	139	0.63	0.90	938.270	71	69
		15	134	0.62	0.90	939.490	71	69
	4	17.5	134	0.63	0.90	940.720	71	69
		20	134	0.62	0.90	941.950	74	70
	5	22.5	134	0.62	0.90	943.170	74	71
		25	139	0.62	0.90	944.420	74	71
	6	27.5	139	0.62	0.89	945.640	74	71
		30	134	0.62	0.90	946.960	73	71
	7	32.5	134	0.62	0.90	948.060	73	72
		35	139	0.62	0.90	949.290	73	72
	8	37.5	139	0.62	0.90	950.510	73	72
		40	139	0.62	0.90	951.740	73	72
	9	42.5	139	0.61	0.88	952.960	73	72
		45	139	0.61	0.88	954.200	73	72
	10	47.5	134	0.60	0.88	955.420	73	72
		50	134	0.61	0.88	956.630	73	72
	11	52.5	139	0.60	0.88	957.870	73	73
		55	139	0.61	0.89	959.080	74	73
	12	57.5	139	0.60	0.88	960.300	74	73
		60	139	0.60	0.88	961.54	74	73
						961.540		
Traverse 2	1	62.5	134	0.61	0.89	962.760	73	73
		65	134	0.61	0.89	964.010	73	73
	2	67.5	134	0.60	0.88	965.210	73	73
		70	132	0.60	0.88	966.430	73	73
	3	72.5	132	0.60	0.88	967.660	74	73
		75	134	0.60	0.88	968.870	73	73
	4	77.5	134	0.60	0.88	970.090	73	73
		80	134	0.61	0.89	971.300	73	73
	5	82.5	134	0.61	0.89	972.540	73	73
		85	139	0.60	0.88	973.770	73	73
	6	87.5	136	0.60	0.87	974.990	73	73
		90	139	0.60	0.87	976.200	73	73
	7	92.5	136	0.60	0.87	977.420	73	73
		95	136	0.60	0.87	978.640	73	73
	8	97.5	136	0.60	0.87	979.860	73	73
		100	136	0.60	0.87	981.050	73	73
	9	102.5	134	0.61	0.89	982.270	74	73
		105	134	0.62	0.91	983.520	74	73
	10	107.5	132	0.62	0.91	984.760	73	73
		110	132	0.60	0.87	985.980	73	73
	11	112.5	134	0.60	0.87	987.190	73	73
		115	134	0.60	0.87	988.390	73	73
	12	117.5	133	0.60	0.87	989.610	73	73
		120	133	0.60	0.87	990.820	73	73

Calculations for: Northern Pulp Recovery Boiler PM
Test #3

Client: Northern Pulp
Job Number: 121413456

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-3
Date: 24-Jul-13
Personnel: JJB/PB

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.99
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	29.75
Volume of Water Vapour Collected, Vwc (cu.ft)	26.162
Stack Gas Moisture Content (% as decimal)	0.280
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	26.24

Isokineticity Checks

Check range	Within Criteria
Check average	Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	614	0.61	0.88	46.75	29.96	528	1 210	1 374	108.78
		5	614	0.63	0.91	47.51	29.97	529	1 240	1 406	107.86
	2	7.5	614	0.63	0.91	47.51	29.97	529	1 240	1 406	107.86
		10	615	0.63	0.91	47.55	29.97	530	1 240	1 408	107.54
	3	12.5	615	0.62	0.90	47.17	29.97	530	1 230	1 394	107.53
		15	614	0.62	0.90	47.13	29.97	530	1 220	1 383	108.97
	4	17.5	614	0.62	0.90	47.13	29.97	530	1 230	1 394	107.44
		20	614	0.62	0.90	47.13	29.97	532	1 230	1 388	107.04
	5	22.5	614	0.62	0.90	47.13	29.97	533	1 220	1 378	106.07
		25	615	0.62	0.90	47.17	29.97	533	1 250	1 410	106.77
	6	27.5	615	0.62	0.89	47.17	29.95	533	1 220	1 378	106.10
		30	614	0.62	0.90	47.13	29.97	533	1 220	1 375	105.87
	7	32.5	614	0.62	0.90	47.13	29.97	534	1 200	1 351	104.14
		35	615	0.62	0.90	47.17	29.97	534	1 230	1 385	106.83
	8	37.5	615	0.62	0.90	47.17	29.97	534	1 220	1 374	105.96
		40	615	0.62	0.90	47.17	29.97	534	1 230	1 385	106.83
	9	42.5	615	0.61	0.88	46.78	29.96	534	1 240	1 396	108.57
		45	615	0.61	0.88	46.79	29.96	534	1 220	1 374	106.82
	10	47.5	614	0.60	0.88	46.36	29.96	534	1 220	1 374	107.62
		50	614	0.61	0.88	46.75	29.96	534	1 230	1 385	107.61
	11	52.5	615	0.60	0.88	46.40	29.96	534	1 220	1 374	107.70
		55	615	0.61	0.89	46.78	29.97	535	1 210	1 360	105.75
	12	57.5	615	0.60	0.88	46.40	29.96	535	1 220	1 371	107.50
		60	615	0.60	0.88	46.40	29.96	535	1 240	1 394	109.26
Traverse 2	1	62.5	614	0.61	0.88	46.75	29.90	534	1 220	1 388	108.40
		65	614	0.61	0.88	46.75	29.87	534	1 240	1 395	108.38
	2	67.5	614	0.60	0.88	46.36	29.87	534	1 210	1 361	106.64
		70	615	0.60	0.88	46.40	29.96	534	1 220	1 372	107.80
	3	72.5	615	0.60	0.88	46.40	29.96	535	1 230	1 382	108.38
		75	614	0.60	0.88	46.36	29.96	534	1 210	1 361	106.63
	4	77.5	614	0.60	0.88	46.36	29.96	534	1 220	1 372	107.52
		80	614	0.61	0.88	46.75	29.96	534	1 210	1 361	105.76
	5	82.5	614	0.61	0.88	46.75	29.97	534	1 240	1 395	108.38
		85	615	0.60	0.88	46.40	29.97	534	1 230	1 384	108.49
	6	87.5	616	0.60	0.87	46.44	29.96	534	1 220	1 372	107.69
		90	615	0.60	0.87	46.40	29.96	534	1 210	1 361	106.72
	7	92.5	616	0.60	0.87	46.44	29.96	534	1 220	1 372	107.69
		95	616	0.60	0.87	46.44	29.96	534	1 220	1 372	107.69
	8	97.5	616	0.60	0.87	46.44	29.96	534	1 220	1 372	107.69
		100	616	0.60	0.87	46.44	29.96	534	1 190	1 339	105.04
	9	102.5	614	0.61	0.88	46.75	29.96	535	1 220	1 371	108.53
		105	614	0.62	0.91	47.13	29.97	535	1 250	1 405	108.27
	10	107.5	612	0.62	0.91	47.05	29.97	534	1 240	1 395	107.33
		110	612	0.60	0.87	46.29	29.97	534	1 220	1 373	107.35
	11	112.5	614	0.60	0.87	46.36	29.96	534	1 210	1 361	106.63
		115	614	0.60	0.87	46.36	29.96	534	1 200	1 350	105.79
	12	117.5	615	0.60	0.87	46.40	29.96	534	1 220	1 372	107.60
		120	615	0.60	0.87	46.40	29.96	534	1 210	1 361	106.72
		Total 120	Average 615	Average 0.61	Average 0.88	Average 46.78	Average 29.96	Average 533	Total 58 710	Total 66 148	Average 107.14

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Recovery Boiler
Location: Pictou, NS
Test: PM-3
Date: 24-Jul-15
Personnel: JJB/FS

Test Start: 8:20 AM
Test Finish: 8:50 AM

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	5.0	9.7	176	6	58
5	5.1	9.6	192	6	58
10	5.3	9.8	187	6	58
15	5.4	9.8	272	0	60
20	5.4	7.9	263	5	61
25	5.5	10.7	262	4	61
30	5.5	9.7	297	5	60
Average:	**5.3**	**9.6**	**236**	**5**	**59**

DATA ENTRY

Northern Pulp
Pictou, NS
Fuel: Fuel oil
Operating Conditions: normal
Emission Control Equipment: precipitator
Stack Height from Grade: 69 m
Stack Diameter: 3.51 m

Reference Temperature, Tref (F):	77
(K):	298
Reference Pressure, Pref (in.Hg):	29.92
(Bar):	1.0

Parameter	Symbol	Units	Test 1	Test 2	Test 3	Average
Test ID	-	-	PM-1	PM-2	PM-3	-
Date	-	-	23-Jul-15	23-Jul-15	24-Jul-15	n/a
Start Time	-	-	9:45 AM	1:20 PM	8:12 AM	n/a
End Time	-	-	11:45 AM	3:20 PM	10:12 AM	n/a
Total Sampling Time	-	min	120	120	120	120
Stack Diameter	D	in.	138	138	138	138
Average Stack Gas Temperature	Ts	F	150	150	155	151
Average Dry Gas Meter Temperature	Tm	F	74	80	73	76
Barometric Pressure	Pbar	in.Hg	29.00	29.00	29.90	29.30
Stack Static Pressure	Pstatic	in.H2O	1.10	1.10	1.10	1.10
Average Pressure Drop (Head)	dP	in.H2O	0.41	0.48	0.61	0.50
Average deltaH Orifice	dH	in.H2O	0.58	0.72	0.88	0.73
Average Meter Temperature	Tm	F	74	80	73	76
Gas Sample Volume	Vm	cu.ft	45.90	51.83	58.71	52.15
Average Isokinetics	I	%	96.87	100.56	107.14	101.52
Nozzle Diameter	Dn	in.	0.234	0.234	0.234	0.234
Pitot Coefficient	Cp	-	0.794	0.794	0.794	0.794
Gamma, meter constant	y	-	1.117	1.117	1.117	1.117
Reference Temperature	Tref	R	537	537	537	537
Reference Pressure	Pref	in.Hg	29.92	29.92	29.92	29.92
Stack Gas Oxygen Content	Co2	%	6.7	6.6	5.3	6.2
Stack Gas Carbon Dioxide Content	Cco2	%	8.0	8.0	9.6	8.5
Stack Gas Nitrogen Content	Cn2	%	85.3	85.3	85.1	85.2
Stack Gas Sulphur Dioxide Content	Cso2	ppm	2.7	4.7	4.6	4.0
Stack Gas Nitrogen Oxides Content	Cnox	ppm	66.6	63.1	59.4	63.0
Stack Gas Carbon Monoxide Content	Cco	ppm	96.1	119.7	235.6	150.5
Volume of Water Collected	Vw	mL	393.1	443.4	586.7	474.4
Particulate Collected from Filter	-	mg	12.2	1.2	0.2	4.5
Particulate Collected from Probe Wash	-	mg	3.3	7.4	0.0	3.5
Particulate Collected from Impinger Wash	-	mg	1.50	1.04	1.47	1.34
Total Particulate Collected (excluding impingers)	Mp	mg	15.5	8.58	0.20	8.08

Legend:
F - degrees Fahrenheit
K - degrees Kelvin
Bar - bars
in.Hg - inches of mercury
in. - inches
in H2O - inches of water
cu.ft - cubic feet
R - degrees Rankin
NOx - as NO2

CALCULATIONS

Northern Pulp
Pictou, NS
Fuel: Fuel oil
Operating Conditions: normal
Emission Control Equipment: precipitator
Stack Height from Grade: 69 m
Stack Diameter: 3.51 m

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Stack Area	As	sq ft	As = Pi x ((Ds/12)^2)/4	103.87	103.87	103.87	103.87
		sq m	As (sq m) = As (sq ft) x 0.0929	9.65	9.65	9.65	9.65
Barometric Pressure	Pbar	kPa	Pbar (kPa) = Pbar (in.Hg) x 3.386	98.2	98.2	101.2	99.2
Stack Static Pressure	Pstatic	kPa	Pstatic (kPa) = Pstatic (in.H2O) x 0.249	0.27	0.27	0.27	0.27
Avg. Stack Temperature	Ts	R	Ts (R) = Ts (F) + 460	610	610	615	611
Avg. Meter Temperature	Tm	R	Tm (R) = Tm (F) + 460	534	540	533	535.6
Nozzle Diameter	Dn	mm	Dn (mm) = Dn (in.) x 25.4	6	6	6	5.9
Gas Meter Pressure	Pm	in.Hg	Pm = Pbar + (dH / 13.6)	29.04	29.05	29.96	29.35
Sample Volume at Ref Cond	Vmc	cu.ft	Vmc = Tref/Pref x (Vm x Pm x y) / Tm	50.06	55.92	66.15	57.4
		cu.m	Vmc (cu.m) = 0.02832 x Vmc (cu.ft)	1.42	1.58	1.87	1.62
Volume of Water Vapour	Vwc	cu.ft	Vwc = 0.0480 x Vlc	18.87	21.28	28.16	22.77
Water Fraction	Bwo	-	Bwo = Vwc / (Vwc + Vmc)	0.274	0.276	0.299	0.3
Molecular Weight, Dry	Md	lb/lb-mol	Md = 0.44 (Cco2) + 0.32 (Co2) + 0.28 (Cn2)	29.54	29.55	29.75	29.6
Molecular Weight, Wet	Ms	lb/lb-mol	Ms = Md (1 - Bwo) + (18 x Bwo)	26.38	26.36	26.24	26.3
Stack Pressure	Ps	in.Hg	Ps = Pbar + (Pstatic / 13.6)	29.08	29.08	29.98	29.38
Stack Gas Velocity	Us	ft/s	Us = 85.33 x Cp x ((dP x Ts)/(Ps x Ms))^0.5	38.66	41.78	46.76	42.4
		m/s	Us (m/s) = 0.3048 x Us (ft/s)	11.78	12.74	14.25	12.9
Actual Stack Gas Flow Rate	Q	acfm	Q = 60 x Us x As	240,962	260,402	291,414	264,259
Dry Stack Gas Flow Rate	Qs	Rcfm	Qs = Q x (1-Bwo) x (Tref/Ts) x (Ps/Pref)	149,784	161,393	178,976	163,384
		Rcms	Qs (Rcms) = 0.000472 x Qs (Rcfm)	70.70	76.18	84.48	77.1
Sulphur Dioxide - SO2							
SO2 Measured Concentration	Cso2	ppm	Measurement from Flue Gas Analyzer	2.71	4.71	4.57	4.00
Uncorrected @ Ref Cond	Cso2	mg/Rcm	Cso2 (mg/Rcm) = Cso2 (ppm) x 2.62	7.11	12.35	11.98	10.48
SO2 Emission Rate	ERso2	g/s	ERso2 = Cso2/1000 x Qs	0.50	0.94	1.01	0.82
		kg/hr	ERso2 (kg/hr) = 3.6 x ERso2 (g/s)	1.81	3.39	3.64	2.95
SO2 Concentration							
Corrected to 11% O2	Cso2	mg/Rcm	Cso2 (11% O2) = Cso2 (mg/Rcm) x (20.9-11) / (20.9-Co2)	4.97	8.58	7.61	7.05
Corrected to 3% O2	Cso2	mg/Rcm	Cso2 (3% O2) = Cso2 (mg/Rcm) x (20.9-3) / (20.9-Co2)	8.98	15.51	13.75	12.75
Corrected to 12% CO2	Cso2	mg/Rcm	Cso2 (12% CO2) = Cso2 (mg/Rcm) x (12/Cco2)	10.71	18.48	14.99	14.73
Nitrogen Oxides - NOx							
NOx Measured Concentration	Cnox	ppm	Measurement from Flue Gas Analyzer	66.57	63.14	59.43	63.05
Uncorrected @ Ref Cond	Cnox	mg/Rcm	Cnox (mg/Rcm) = Cnox (ppm) x 1.882	125.29	118.83	111.84	118.66
NOx Emission Rate	ERnox	g/s	ERnox = Cnox/1000 x Qs	8.86	9.05	9.45	9.12
		kg/hr	ERnox (kg/hr) = 3.6 x ERnox (g/s)	31.89	32.59	34.01	32.83
NOx Concentration							
Corrected to 11% O2	Cnox	mg/Rcm	Cnox (11% O2) = Cnox (mg/Rcm) x (20.9-11) / (20.9-Co2)	87.50	82.51	71.03	80.35
Corrected to 3% O2	Cnox	mg/Rcm	Cnox (3% O2) = Cnox (mg/Rcm) x (20.9-3) / (20.9-Co2)	158.20	149.18	128.43	145.27
Corrected to 12% CO2	Cnox	mg/Rcm	Cnox (12% CO2) = Cnox (mg/Rcm) x (12/Cco2)	188.60	177.84	140.01	168.82
Carbon Monoxide - CO							
CO Measured Concentration	Cco	ppm	Measurement from Flue Gas Analyzer	96.14	119.71	235.57	150.48
Uncorrected @ Ref Cond	Cco	mg/Rcm	Cco (mg/Rcm) = Cco (ppm) x 1.145	110.08	137.07	269.73	172.30
CO Emission Rate	ERco	g/s	ERco = Cco/1000 x Qs	7.78	10.44	22.79	13.67
		kg/hr	ERco (kg/hr) = 3.6 x ERco (g/s)	28.02	37.59	82.03	49.21
CO Concentration							
Corrected to 11% O2	Cco	mg/Rcm	Cco (11% O2) = Cco (mg/Rcm) x (20.9-11) / (20.9-Co2)	78.88	95.17	171.30	114.45
Corrected to 3% O2	Cco	mg/Rcm	Cco (3% O2) = Cco (mg/Rcm) x (20.9-3) / (20.9-Co2)	139.01	172.08	309.72	206.94
Corrected to 12% CO2	Cco	mg/Rcm	Cco (12% CO2) = Cco (mg/Rcm) x (12/Cco2)	165.72	205.13	337.66	236.17
Particulate Concentration	Cs	mg/Rcm	Cs = Mp / Vmc	10.90	5.42	0.11	5.48
Particulate Emission Rate	ERp	g/s	ERp = Cs/1000 x Qs	0.77	0.41	0.01	0.40
		kg/hr	ERp (kg/hr) = 3.6 x ERp (g/s)	2.77	1.49	0.03	1.43
Particulate Concentration							
Corrected to 11% O2	Cs	mg/Rcm	Cs (11% O2) = Cs x (20.9-11) / (20.9-Co2)	7.61	3.76	0.07	3.81
Corrected to 3% O2	Cs	mg/Rcm	Cs (3% O2) = Cs x (20.9-3) / (20.9-Co2)	13.77	6.80	0.12	6.90
Corrected to 12% CO2	Cs	mg/Rcm	Cs (12% CO2) = Cs x (12/Cco2)	16.41	8.11	0.13	8.22

Legend:
sq ft = square feet
sq m = square metres
Pi = 3.142
R = degrees Rankin
ppm = parts per million

in.Hg = inches of mercury
cu.ft = cubic feet
cu.m = cubic metres
Ref Cond = reference temperature and pressure (25 C and 101.3 kPa)
Rcms = dry reference cubic metres per second
Rcfm = dry reference cubic feet per minute

mg/Rcm = milligrams per dry reference cubic metre
g/s = grams per second
NOx = as NO2
acfm = actual cubic feet per minute

OFFICIAL STACK TESTING RESULTS
Northern Pulp
Pictou, NS

Fuel: Fuel oil
Operating Conditions: normal
Emission Control Equipment: precipitator
Stack Height from Grade: 69 m
Stack Diameter: 3.51 m

Parameter	Test 1	Test 2	Test 3	Average	NSENV Limits
Test ID	PM-1	PM-2	PM-3	-	-
Test Date	23-Jul-15	23-Jul-15	24-Jul-15	-	-
Stack Gas Temperature (C)	65.5	65.5	68.1	66.4	-
Moisture Content (%)	27.4	27.6	29.9	28.3	-
Velocity (m/s)	11.8	12.7	14.3	12.9	-
Volumetric Flow (Rcms)	70.7	76.2	84.5	77.1	-
Oxygen - O2 (%)	6.72	6.64	5.31	6.23	-
Carbon Dioxide - CO2 (%)	7.97	8.02	9.59	8.53	-
Sulphur Dioxide - SO2					
SO2 Measured Concentration (ppm)	2.71	4.71	4.57	4.00	-
Uncorrected at Ref Cond (mg/Rcm)	4.97	8.58	7.61	7.05	-
Emission Rate (kg/hr)	1.81	3.39	3.64	2.95	-
Nitrogen Oxides - NOx					
NOx Measured Concentration (ppm)	66.6	63.1	59.4	63.0	-
Uncorrected at Ref Cond (mg/Rcm)	125.3	118.8	111.8	118.7	-
Emission Rate (kg/hr)	31.89	32.59	34.01	32.83	-
Carbon Monoxide - CO					
CO Measured Concentration (ppm)	96.1	119.7	235.6	150.5	-
Uncorrected at Ref Cond (mg/Rcm)	110.1	137.1	269.7	172.3	-
Emission Rate (kg/hr)	28.02	37.59	82.03	49.21	-
Particulate Matter - PM					
Particulate Concentration (mg/Rcm)	10.9	5.42	0.11	5.48	-
Concentration, Corrected to 11% O_2(mg/Rcm)	7.61	3.76	0.07	3.81	375
Particulate Emission Rate (kg/hr)	2.77	1.49	0.03	1.43	-

Legend:
C - degrees Celsius
m/s - metres per second
Rcms - dry reference cubic metres per second
ppm - parts per million
Ref Cond - reference temperature and pressure (25 C and 101.3 kPa)
mg/Rcm - milligrams per dry reference cubic metre
NOx - as NO2
ND - non-detectable

Particulate Recovery: Impinger Catch, Probe Wash, Filter Catch

Client: Northern Pipe
Facility: Redberry Bridge
Location: Petrox, MB
Job Number: 12-413-009

IMPINGER CATCH

Container ID	Beaker Pre Weights (g)				Sample ID	Recovering					Beaker Post Weights (g)				Uncorrected Particulate Weight (g)	Corrected Particulate Weight (g)
	Data Analyzed by					Jar + Sample + Rinse (g)	Jar Tare (g)	Recovered Sample (g)	Rinse Water (g)	Total Rinse Water (g)	Data Analyzed by					
	Trial 1	Trial 2	Trial 3	Average							Trial 1	Trial 2	Trial 3	Average		
B1	111.9951	111.9951		111.9951	Pre 1	963.9	393.3	393.1	9.5	175.7	111.9956	111.9957		111.9956	0.0005	0.0013
M4	117.6483	117.6480		117.6482	Pre 2	806.4	392.6	443.4	9.3	68.7	117.6524	117.6525		117.6525	0.0043	0.0067
C3	108.0019	108.0019		108.0019	Pre 3	1048.6	393.7	566.7	9.7	82.3	108.2054	108.2049		108.2052	0.2033	0.2057
																Corrs. (ppm)
L1	109.1970	109.1974		109.1972	WR	486.7	368.0	66.7		84.2	109.1844	109.1847		109.1847	0.0125	0.0117

PROBE WASH

Container ID	Beaker Pre Weights (g)				Sample ID	Recovering					Beaker Post Weights (g)				Uncorrected Particulate Weight (g)	Corrected Particulate Weight (g)
	Data Analyzed by					Acetone (g)	Jar Tare (g)	Recovered Acetone (g)	Rinse Acetone (g)	Total Acetone (g)	Data Analyzed by					
	Trial 1	Trial 2	Trial 3	Average							Trial 1	Trial 2	Trial 3	Average		
P1	112.8048	112.8043		112.8046	Pre 1	473.2	391.9	63.5	4.8	81.4	112.8102	112.8100		112.8101	0.0055	0.0033
L3	111.1018	111.1018		111.1018	Pre 2	434.5	392.5	44.0	4.0	46.0	111.1125	111.1124		111.1125	0.0081	0.0071
W1	113.9877	113.9879		113.9878	Pre 3	449.1	392.1	56.8	4.4	61.2	113.9367	113.9732		113.9549	0.0671	0.0000
																Corrs. (ppm)
I2	113.2480	113.2481		113.2481	AR	373.2	322.2	51.0		51.0	113.2484	113.2481		113.2484	0.0003	0.0001

Density of Acetone = 0.7893 g/ml

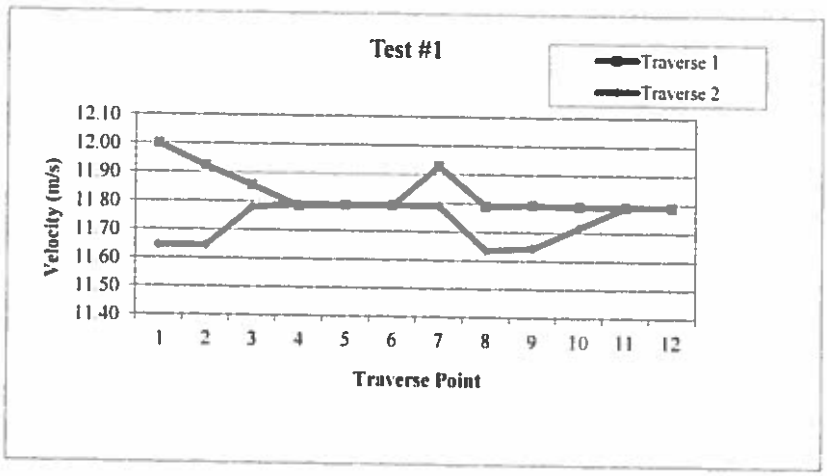
FILTER CATCH

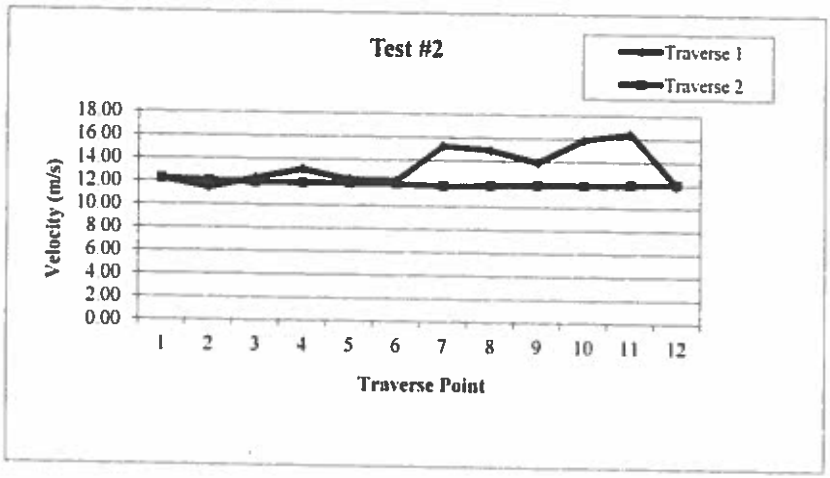
Filter ID	Pre Weights (g)				Sample ID	Post Weights (g)				Particulate Weight from Filter (g)
	Data Analyzed by					Data Analyzed by				
	Trial 1	Trial 2	Trial 3	Average		Trial 1	Trial 2	Trial 3	Average	
0716-17	0.3004	0.3002		0.3004	Pre 1 1	0.3049	0.3049		0.3049	0.0045
0716-18	0.3027	0.3030		0.3028	Pre 1 2	0.3079	0.3079		0.3079	0.0051
0716-19	0.3527	0.3519		0.3523	Pre 2	0.3530	0.3536		0.3533	0.0077
0716-15	0.3414	0.3412		0.3413	Pre 3	0.3419	0.3415		0.3417	0.0004

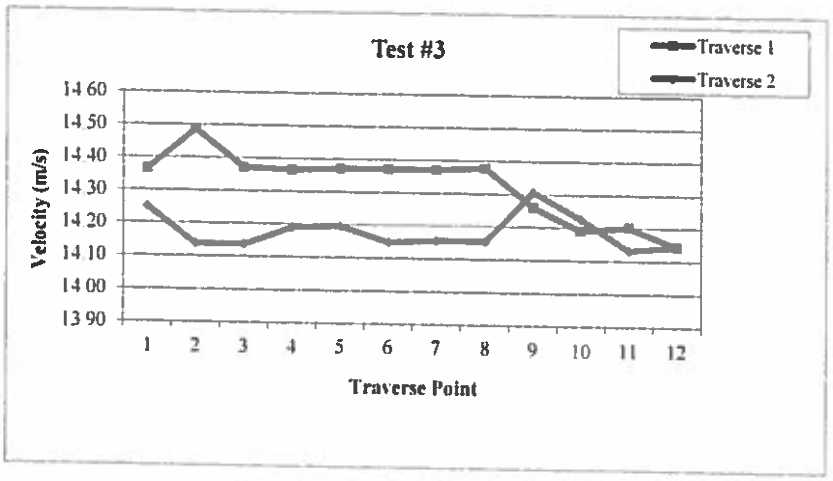
Northern Pulp
Recovery Boiler

121413456

Stack Gas Velocity Profiles
Pictou, NS







GAS CALCULATIONS

Client: Northern Pulp
Plant: Pictou
Location: High Level Roof Vent

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
ave. Gas 1	20.9	0.2	132.2	1.8	18.9
ave. Gas 2	20.9	0.2	137.5	1.7	19.6
ave. Gas 3	20.9	0.2	145.2	1.7	18.7

All gas data except Nox obtained from TRS data

Test 1	O_2	CO_2	CO	SO_2	NO_X
Time	(%)	(%)	(ppm)	(ppm)	(ppm)
12:00	20.90	0.23	132.23	1.76	15
12:05					19
12:10					23
12:15					21
12:20					19
12:25					17
12:30					18

All gas data except Nox obtained from TRS data

Test 2	O_2	CO_2	CO	SO_2	NO_X
Time	(%)	(%)	(ppm)	(ppm)	(ppm)
11:00	20.90	0.23	137.55	1.66	24
11:05					17
11:10					16
11:15					21
11:20					22
11:25					20
11:30					17

All gas data except Nox obtained from TRS data

Test 3	O_2	CO_2	CO	SO_2	NO_X
Time	(%)	(%)	(ppm)	(ppm)	(ppm)
13:00	20.89	0.23	145.15	1.66	13
13:05					19
13:10					27
13:15					21
13:20					16
13:25					15
13:30					20

Raw Data for: Northern Pulp Fall Source Testing
Test #1

Client: Northern Pulp
Job Number: 121413456

Plant: Pictou
Location: High Level Rec Vent
Test: Flow 1
Date: 24-Jul-15
Personnel: TB/[illegible]M

Test Start: 10:30 AM
Test Finish: 11:00 AM

Parameters

Barometric Pressure, Pbar (in. Hg)	30.09	O2, (%)	20.9	Stack Diameter, (in.)	72
Stack Static Pressure, Pstatic (in. H2O)	0.17	CO2, (%)	0.2	Stack Area, (sq. ft.)	28.27
Ambient Temp, (°F)	61	N2, (%)	79.9	Pitot Coefficient, (Cp)	0.840
Assumed Moisture Content (as decimal)	0.3				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)
1	1	30	129	0.74
	2		129	0.78
	3		129	0.82
	4		129	0.84
	5		130	0.95
	6		130	0.99
	7		130	1.05
	8		130	1.10
	9		130	1.05
	10		130	0.99
	11		129	0.99
	12		131	0.95
2	1		129	0.76
	2		129	0.78
	3		128	0.84
	4		128	0.89
	5		130	0.90
	6		130	0.99
	7		130	1.00
	8		129	1.10
	9		129	1.05
	10		129	0.98
	11		130	0.89
	12		130	0.84

Calculations for: Northern Pulp Fait Source Testing
Test #1

Client: Northern Pulp
Job Number: 121413456

Plant: Pictou
Location: High Level Roof Vent
Test: Flow 1
Date: 24-Jul-15
Personnel: TBH/NGM

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	30.01
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	28.87
Volume of Water Vapour Collected, Vwc (cu.ft)	0.014
Stack Gas Moisture Content (% as decimal)	0.300
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	25.61

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Stack Gas Velocity, Us (ft/s)
1	1	30	589	0.74	53.97
	2		589	0.78	55.41
	3		589	0.82	56.82
	4		589	0.84	57.51
	5		590	0.95	61.21
	6		590	0.99	62.48
	7		590	1.05	64.35
	8		590	1.10	65.66
	9		590	1.05	64.35
	10		590	0.99	62.48
	11		589	0.99	62.43
	12		591	0.95	61.28
2	1		589	0.76	54.70
	2		589	0.78	55.41
	3		588	0.84	57.46
	4		588	0.89	59.14
	5		590	0.90	59.58
	6		590	0.99	62.48
	7		590	1.00	62.80
	8		589	1.10	65.81
	9		589	1.05	64.29
	10		589	0.98	62.11
	11		590	0.89	59.24
	12		590	0.84	57.55
		Total	Average	Average	Average
		30	589	0.93	60.4

Raw Data for: Northern Pulp Fall Source Testing
Test #2

Client: Northern Pulp
Job Number: 121413456

Plant: Pictou
Location: High Level Rad Vent
Test: Flow 2
Date: 24-Jul-15
Personnel: BH/NGM

Test Start: 11:00 AM
Test Finish: 11:30 AM

Parameters

Barometric Pressure, Pbar (in. Hg)	30.08	O2, (%)	20.9	Stack Diameter, (in.)	72
Stack Static Pressure, Pstatic (in. H2O)	0.17	CO2, (%)	0.2	Stack Area, (sq. ft.)	28.27
Ambient Temp, (°F)	63	N2, (%)	78.9	Pitot Coefficient, (Cp)	0.840
Assumed Moisture Content (as decimal)	0.3				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)
1	1	30	130	0.79
	2		131	0.82
	3		131	0.88
	4		131	0.92
	5		132	0.96
	6		135	0.99
	7		131	1.10
	8		130	1.00
	9		129	1.00
	10		126	0.95
	11		127	0.85
	12		128	0.80
2	1		130	0.79
	2		131	0.82
	3		131	0.88
	4		131	0.92
	5		131	0.96
	6		132	0.99
	7		131	1.10
	8		130	1.00
	9		129	1.00
	10		126	0.95
	11		127	0.85
	12		128	0.80

Calculations for: Northern Pulp Fall Source Testing
Test #1

Client: Northern Pulp
Job Number: 121413458

Plant: Pictou
Location: High Level Roof Vent
Test: Flow 2
Date: 24-Jul-15
Personnel: BH/NGM

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	30.01
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	28.87
Volume of Water Vapour Collected, Vwc (cu.ft)	0.014
Stack Gas Moisture Content (% as decimal)	0.300
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	25.61

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Stack Gas Velocity, Us (ft/s)
1	1	30	590	0.79	55.82
	2		591	0.82	56.91
	3		591	0.88	58.96
	4		591	0.92	60.28
	5		591	0.96	61.58
	6		591	0.99	62.54
	7		591	1.10	65.92
	8		590	1.00	62.80
	9		589	1.00	62.74
	10		588	0.95	61.10
	11		587	0.85	57.75
	12		588	0.80	56.07
2	1		590	0.79	55.82
	2		591	0.82	56.91
	3		591	0.88	58.96
	4		591	0.92	60.28
	5		591	0.96	61.58
	6		591	0.99	62.54
	7		591	1.10	65.92
	8		590	1.00	62.80
	9		589	1.00	62.74
	10		588	0.95	61.10
	11		587	0.85	57.75
	12		588	0.80	56.07
		Total	Average	Average	Average
		30	590	0.92	60.2

Raw Data for: Northern Pulp Fall Source Testing
Test #3

Client: Northern Pulp
Job Number: 121413456

Plant: Pictou
Location: High Level Roof Vent
Test: Flow 3
Date: 24-Jul-15
Personnel: TBH/NGM

Test Start: 11:30 AM
Test Finish: 12:00 PM

Parameters

Barometric Pressure, Pbar (in. Hg)	30.01	O2, (%)	20.9	Stack Diameter, (in.)	72
Stack Static Pressure, Pstatic (in. H2O)	0.17	CO2, (%)	0.2	Stack Area, (sq. ft.)	28.27
Ambient Temp, (°F)	65	N2, (%)	78.9	Pitot Coefficient, (Cp)	0.840
Assumed Moisture Content (as decimal)	0.3				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)
1	1	30	127	0.78
	2		130	0.84
	3		127	0.89
	4		128	0.92
	5		129	0.97
	6		130	0.99
	7		131	1.00
	8		130	1.10
	9		129	1.00
	10		128	0.99
	11		130	0.89
	12		130	0.80
2	1		127	0.78
	2		128	0.84
	3		127	0.89
	4		127	0.92
	5		129	0.99
	6		130	1.00
	7		128	1.10
	8		131	1.00
	9		131	0.99
	10		131	0.99
	11		131	0.90
	12		131	0.80

Calculations for: Northern Pulp Fall Source Testing
Test #1

Client: Northern Pulp
Job Number: 121413458

Plant: Pictou
Location: High Level Roof Vent
Test: Flow 3
Date: 24-Jul-15
Personnel: TB/HT/GM

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	30.01
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	28.87
Volume of Water Vapour Collected, Vwc (cu.ft)	0.014
Stack Gas Moisture Content (% as decimal)	0.300
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	25.81

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Stack Gas Velocity, Us (ft/s)
1	1	30	587	0.74	53.88
	2		590	0.86	58.24
	3		587	0.89	59.09
	4		588	0.92	60.13
	5		589	0.97	61.80
	6		590	0.99	62.48
	7		591	1.00	62.85
	8		590	1.10	65.86
	9		589	1.00	62.74
	10		588	0.99	62.36
	11		590	0.89	59.24
	12		590	0.80	56.17
2	1		587	0.78	55.32
	2		588	0.84	57.46
	3		587	0.89	59.09
	4		587	0.92	60.08
	5		589	0.99	62.43
	6		590	1.00	62.80
	7		588	1.10	65.75
	8		591	1.00	62.85
	9		591	0.99	62.54
	10		591	0.95	61.26
	11		591	0.90	59.63
	12		591	0.80	56.22
		Total 30	Average 589	Average 0.93	Average 60.4

CALCULATIONS

Northern Pulp
Pictou
High Level Roof Vent
Operating Conditions: Normal

Reference Temperature, Tref (F):	77
(K):	298
Reference Pressure, Pref (in.Hg):	29.92
(Bar):	1.0

Parameter	Symbol	Units	Test 1	Test 2	Test 3	Average
Test ID	-	-	Flow 1	Flow 2	Flow 3	n/a
Date	-	-	24-Jul-15	24-Jul-15	24-Jul-15	n/a
Start Time	-	-	10:30 AM	11:00 AM	11:30 AM	n/a
End Time	-	-	11:00 AM	11:30 AM	12:00 PM	n/a
Total Sampling Time	-	min	30	30	30	30
Stack Diameter	D	in.	72	72	72	72
Average Stack Gas Temperature	Ts	F	129	130	129	129
Barometric Pressure	Pbar	in.Hg	30.0	30.0	30.0	30.0
Stack Static Pressure	Pstatic	in.H_2O	0.17	0.17	0.17	0.17
Average Pressure Drop (Head)	dP	in.H_2O	0.93	0.92	0.93	0.93
Pitot Coefficient	Cp	-	0.840	0.840	0.840	0.840
Reference Temperature	Tref	R	537	537	537	537
Reference Pressure	Pref	in.Hg	29.92	29.92	29.92	29.92
Water Fraction	Bwo		0.30	0.30	0.30	0.30
Average Stack Velocity	Us	ft/s	60.4	60.2	60.4	60.3
Actual Flow Rate	Acfm	cu.ft/m	102,404	102,137	102,514	102,352
Dry Standard Flow Rate	Dscfm	cu.ft/m	65,505	65,293	65,608	65,469
Dry Standard Flow Rate	MMSCFH		3.93	3.92	3.94	3.93
Dry Standard Flow Rate	Rm3/s		30.9	30.8	31.0	30.9

GAS CALCULATIONS
Northern Pulp
Pictou
High Level Roof Vent

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Dry Stack Gas Flow Rate	Qs	dscfm dscms	Qs (dscms) = 0.000472 x Qs (dscfm)	65,505 30 9	65,293 30 8	65,608 31.0	65,469 30 9
Stack Gas Oxygen Content	Co2	%	Measurement from Flue Gas Analyzer	20 9	20 9	20 9	20 9
Stack Gas Carbon Dioxide Content	Cco2	%	Measurement from Flue Gas Analyzer	0 2	0 2	0 2	0 2
Sulphur Dioxide - SO2							
SO2 Measured Concentration	Cso2	ppm	Measurement from Flue Gas Analyzer	1 76	1 66	1 68	1 70
Uncorrected @ STP	Cso2	mg/dscm	Cso2 (mg/dscm) = Cso2 (ppm) x 2.62	4 62	4 35	4.36	4 44
SO2 Emission Rate	ERso2	g/s	ERso2 = Cso2/1000 x Qs	0.14	0 13	0.13	0 14
		kg/hr	ERso2 (kg/hr) = 3 6 x ERso2 (g/s)	0 51	0 48	0 49	0 49
SO2 Concentration							
Nitrogen Oxides - NOx							
NOx Measured Concentration	Cnox	ppm	Measurement from Flue Gas Analyzer	18 9	19 6	18 7	19 0
Uncorrected @ STP	Cnox	mg/dscm	Cnox (mg/dscm) = Cnox (ppm) x 1 882	35 5	36 8	35 2	35 8
NOx Emission Rate	ERnox	g/s	ERnox = Cnox/1000 x Qs	1 10	1 14	1 09	1 11
		kg/hr	ERnox (kg/hr) = 3 6 x ERnox (g/s)	3 95	4 09	3 93	3 99
NOx Concentration							
Carbon Monoxide - CO							
CO Measured Concentration	Cco	ppm	Measurement from Flue Gas Analyzer	132	138	145	138
Uncorrected @ STP	Cco	mg/dscm	Cco (mg/dscm) = Cco (ppm) x 1 145	151	157	166	158
CO Emission Rate	ERco	g/s	ERco = Cco/1000 x Qs	4 68	4 85	5 15	4 89
		kg/hr	ERco (kg/hr) = 3 6 x ERco (g/s)	16 9	17 5	18 5	17 6
CO Concentration							

Legend:
sq ft = square feet
sq m = square metres
Pi = 3 142
R = degrees Rankin
ppm = parts per million
in Hg = inches of mercury
cu ft = cubic feet
cu m = cubic metres
STP = standard temperature and pressure (25 C and 101 3 kPa)
dscms = dry standard cubic metres per second
dscfm = dry standard cubic feet per minute
mg/dscm = milligrams per dry standard cubic metre
g/s = grams per second
NOx = as NO2
acfm = actual cubic feet per minute

STACK TESTING RESULTS
GAS CALCULATIONS
Northern Pulp
Pictou
High Level Roof Vent

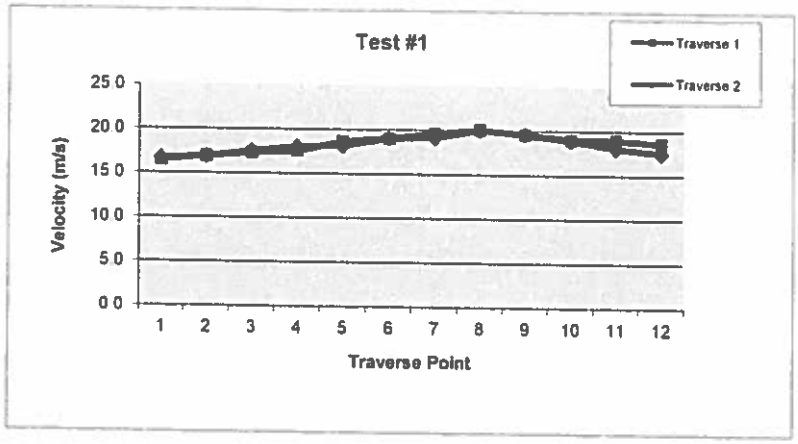
Parameter	Test 1	Test 2	Test 3	Average	Limits
Oxygen - O2 (%) Carbon Dioxide - CO2 (%)	20.9 0.2	20.9 0.2	20.9 0.2	20.9 0.2	- -
Sulphur Dioxide - SO2 SO2 Measured Concentration (ppm) Uncorrected at STP (mg/dscm) Emission Rate (kg/hr)	 1.76 4.62 0.51	 1.66 4.35 0.48	 1.66 4.36 0.49	 1.70 4.44 0.49	 - - -
Nitrogen Oxides - NOx NOx Measured Concentration (ppm) Uncorrected at STP (mg/dscm) Emission Rate (kg/hr)	 18.9 35.5 3.95	 19.6 36.8 4.09	 18.7 35.2 3.93	 19.0 35.8 3.99	 - - -
Carbon Monoxide - CO CO Measured Concentration (ppm) Uncorrected at STP (mg/dscm) Emission Rate (kg/hr)	 132 151 16.9	 138 157 17.5	 145 166 18.5	 138 158 17.6	 - - -

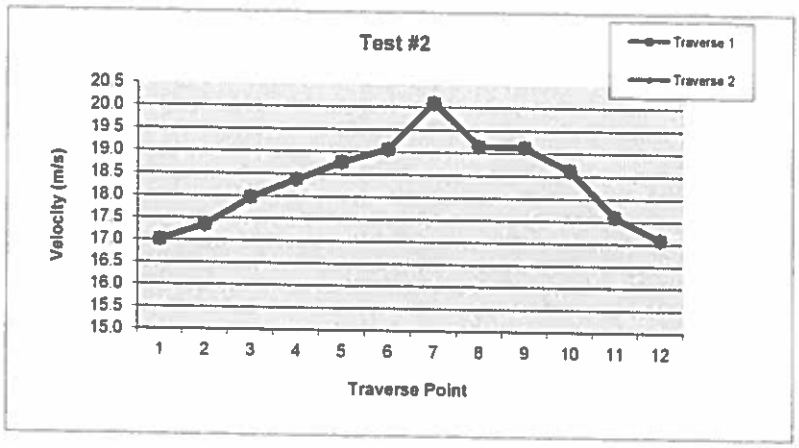
Legend:
C - degrees Celsius
m/s - metres per second
dscms - dry standard cubic metres per second
ppm - parts per million
STP - standard temperature and pressure (25 C and 101.3 kPa)
mg/dscm - miligrams per dry standard cubic metre
NOx - as NO2
ND - non-detectable

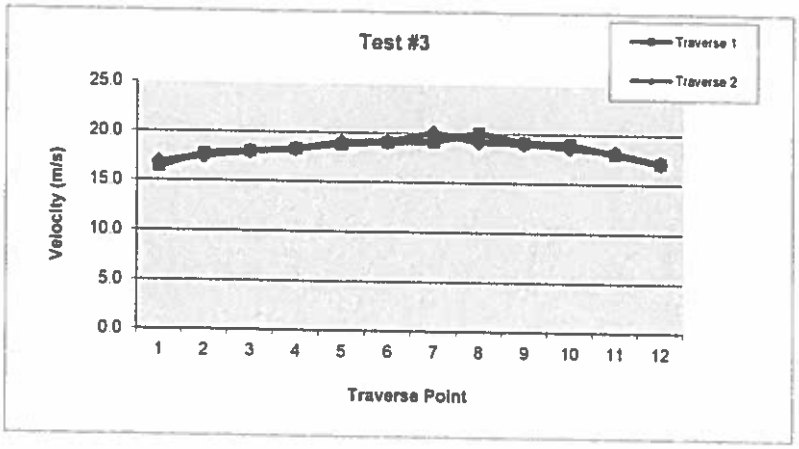
Raw Data for:
Pictou

Job No. 121413456

Northern Pulp Fail Source Testing
Velocity Profile







Raw Data for: Lime Kiln Particulate Matter Testing
Test #1

Client: Northern Pulp
Job Number: 121413456

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-1
Date: 21-Jul-15
Personnel: TSH, SF

Test Start: 9:05 AM
Test Finish: 11:13 AM

Particulate Collected from Filter (mg):	242.4
Particulate Collected from Probe Wash (mg):	43.1
Particulate Collected from Impinger Wash (mg):	20.5
Total Particulate Collected (mg):	305.9

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	994.1	670.2	323.9
2	100 mL H2O	732.5	708.2	24.3
3	Blank	988.3	988.7	2.6
4	200g Silica Gel	988.3	980.5	7.8

Total Weight Gain (g): 358.6
Moisture Volume (mL): 358.6

Parameters

Barometric Pressure, Pbar (in. Hg)	29.70	CARIBOU POINT	O2, (%)	4.64	
Stack Static Pressure, Pstatic (in. H2O)	-0.31		CO2, (%)	21.12	
Ambient Temp, (°F)	63		N2, (%)	73.2	
H2O Volume Collected, Vw (mL)	358.6				
Total # Sampling Points,	24				
Sampling Time per Point, (min)	5				
Readings Taken Every __ mins	2.5				
Regulatory Agency	NSENV				

Stack Diameter, (in.)	48
Stack Area, (sq. ft.)	12.57
Probe Length, (in.)	8
Nozzle Diameter, (in.)	0.172
Pitot Coefficient, (Cp)	0.816
Gamma, meter constant	1.039

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)	Nozzle Angle (Cyclonic Flow) (deg. from vert.) (+ clockwise)
						156.790			
Traverse 1	1	2.5	157	0.58	0.24	157.460	87	64	-45
		5	159	0.56	0.23	158.140	85	66	-45
	2	7.5	158	0.58	0.24	158.830	86	66	-36
		10	161	0.60	0.25	159.490	85	66	-36
	3	12.5	161	0.52	0.22	160.120	85	66	-22
		15	162	0.50	0.21	160.740	85	66	-25
	4	17.5	162	0.35	0.14	161.270	85	66	-20
		20	162	0.33	0.14	161.810	85	66	-20
	5	22.5	162	0.40	0.17	162.390	85	66	-18
		25	162	0.40	0.17	162.980	83	66	-10
	6	27.5	162	0.45	0.19	163.590	85	66	0
		30	163	0.42	0.17	164.150	83	66	0
	7	32.5	162	0.44	0.18	164.740	84	66	0
		35	163	0.47	0.19	165.340	86	66	0
	8	37.5	162	0.53	0.22	165.990	86	66	10
		40	163	0.52	0.21	166.630	83	66	10
	9	42.5	163	0.50	0.21	167.270	85	66	20
		45	163	0.51	0.21	167.920	85	66	20
	10	47.5	164	0.50	0.21	168.530	83	66	23
		50	162	0.50	0.21	169.180	85	66	28
	11	52.5	162	0.48	0.20	169.760	83	63	33
		55	161	0.47	0.19	170.380	83	63	33
	12	57.5	161	0.48	0.20	171.000	85	63	42
		60	161	0.47	0.19	171.590	85	63	42
						171.590			
Traverse 2	1	62.5	159	0.61	0.25	172.260	85	64	-45
		65	159	0.63	0.26	172.968	85	64	-45
	2	67.5	159	0.60	0.25	173.640	85	64	-35
		70	161	0.62	0.26	174.350	84	64	-35
	3	72.5	161	0.76	0.34	175.040	84	64	-25
		75	160	0.69	0.24	175.720	84	64	-23
	4	77.5	161	0.54	0.22	176.380	84	64	-20
		80	161	0.51	0.21	177.020	84	64	-20
	5	82.5	161	0.42	0.17	177.608	84	64	-10
		85	161	0.40	0.17	178.190	84	64	-10
	6	87.5	160	0.35	0.14	178.720	84	64	0
		90	156	0.30	0.12	179.170	84	64	0
	7	92.5	155	0.40	0.17	179.740	84	64	0
		95	153	0.43	0.18	180.340	84	64	0
	8	97.5	158	0.45	0.19	180.950	84	63	12
		100	154	0.50	0.21	181.570	84	63	12
	9	102.5	155	0.69	0.28	182.300	84	63	20
		105	156	0.71	0.30	183.050	84	63	20
	10	107.5	158	0.79	0.33	183.840	85	64	30
		110	158	0.80	0.33	184.610	83	64	30
	11	112.5	158	0.50	0.21	185.250	83	64	35
		115	160	0.48	0.20	185.880	85	64	35
	12	117.5	158	0.48	0.20	186.510	85	64	45
		120	155	0.45	0.19	187.120	87	65	45

Calculations for: Lime Kin Particulate Meter Testing
Test #1

Client: Northern Pulp
Job Number: 121413438

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-1
Date: 21-Jul-15
Personnel: TB/HSF

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.74
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	31.72
Volume of Water Vapour Collected, Vwc (cu ft)	17.313
Stack Gas Moisture Content (% as decimal)	0.356
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	28.68

Isokinetcity Checks

Check range	Within Criteria
Check average	Outside of Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Measured Stack Gas Velocity, Us (fps)	Vertical Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	617	0.58	0.24	46.61	32.96	29.72	537	0.700	0.719	114.15
		5	618	0.58	0.23	45.87	32.44	29.72	536	0.680	0.700	113.25
	2	7.5	618	0.58	0.24	46.64	37.74	29.72	536	0.690	0.709	112.72
		10	621	0.60	0.25	47.58	38.47	29.72	536	0.660	0.679	108.38
	3	12.5	621	0.52	0.22	44.27	40.13	29.72	536	0.630	0.648	109.05
		15	622	0.50	0.21	43.45	39.38	29.72	536	0.620	0.636	109.53
	4	17.5	622	0.35	0.14	36.35	34.18	29.71	536	0.530	0.545	111.88
		20	622	0.35	0.14	36.35	34.18	29.71	536	0.540	0.556	114.01
	5	22.5	622	0.40	0.17	38.88	36.27	29.71	536	0.560	0.587	114.55
		25	622	0.40	0.17	38.88	36.27	29.71	536	0.580	0.607	116.53
	6	27.5	622	0.45	0.19	41.22	41.22	29.71	536	0.610	0.628	113.59
		30	622	0.42	0.17	39.62	39.62	29.71	536	0.560	0.578	107.63
	7	32.5	622	0.44	0.18	40.78	40.78	29.71	536	0.590	0.606	111.00
		35	623	0.47	0.19	42.12	42.12	29.71	536	0.600	0.617	108.22
	8	37.5	622	0.53	0.22	44.73	44.05	29.72	536	0.650	0.668	111.43
		40	622	0.53	0.22	44.73	44.05	29.72	536	0.650	0.668	111.43
	9	42.5	623	0.52	0.21	44.34	41.87	29.72	536	0.640	0.658	110.96
		45	625	0.50	0.21	43.56	40.83	29.72	536	0.640	0.658	113.34
	10	47.5	625	0.51	0.21	43.99	38.84	29.72	536	0.650	0.668	113.97
		50	624	0.50	0.21	43.52	38.42	29.72	536	0.630	0.648	111.46
	11	52.5	622	0.50	0.21	43.46	35.59	29.72	536	0.630	0.648	111.39
		55	623	0.48	0.20	42.57	34.87	29.71	535	0.580	0.597	104.67
	12	57.5	621	0.47	0.19	42.08	31.28	29.71	535	0.620	0.639	112.98
		60	621	0.48	0.20	42.54	31.61	29.71	535	0.620	0.639	111.80
Traverse 2	1	62.5	619	0.61	0.25	47.87	33.85	29.72	535	0.670	0.691	107.12
		65	619	0.63	0.26	48.65	34.40	29.72	535	0.700	0.722	110.12
	2	67.5	619	0.60	0.25	47.48	38.99	29.72	535	0.680	0.701	109.62
		70	621	0.62	0.26	48.34	39.60	29.72	534	0.710	0.733	112.88
	3	72.5	621	0.58	0.24	46.78	42.38	29.72	534	0.690	0.712	113.41
		75	620	0.58	0.24	47.12	42.71	29.72	534	0.680	0.702	110.73
	4	77.5	621	0.54	0.22	45.12	42.40	29.72	534	0.680	0.691	112.43
		80	621	0.51	0.21	43.85	41.20	29.72	534	0.640	0.660	112.18
	5	82.5	621	0.42	0.17	39.79	39.18	29.71	534	0.580	0.598	112.01
		85	621	0.40	0.17	38.83	38.24	29.71	534	0.550	0.567	108.84
	6	87.5	620	0.35	0.14	36.29	36.29	29.71	534	0.570	0.588	120.48
		90	618	0.35	0.12	33.49	33.49	29.71	534	0.450	0.464	102.40
	7	92.5	615	0.40	0.17	38.64	38.64	29.71	534	0.570	0.588	112.25
		95	615	0.43	0.18	40.07	40.07	29.71	534	0.600	0.619	113.97
	8	97.5	615	0.45	0.19	40.89	40.89	29.71	534	0.610	0.630	113.37
		100	614	0.50	0.21	43.17	42.22	29.72	534	0.620	0.640	108.23
	9	102.5	615	0.69	0.29	50.75	47.88	29.72	534	0.730	0.754	108.59
		105	616	0.71	0.30	51.52	48.42	29.72	534	0.750	0.775	111.09
	10	107.5	616	0.78	0.33	54.44	47.14	29.72	535	0.760	0.815	110.81
		110	618	0.83	0.33	54.78	47.44	29.72	535	0.770	0.794	107.43
	11	112.5	616	0.50	0.21	43.31	35.48	29.72	535	0.640	0.660	112.81
		115	620	0.48	0.20	42.50	34.82	29.71	535	0.630	0.649	113.62
	12	117.5	616	0.48	0.20	42.43	30.01	29.71	535	0.630	0.648	113.44
		120	615	0.45	0.19	40.99	28.98	29.71	536	0.610	0.627	112.84
		Total 60	Average 620	Average 0.51	Average 0.21	Average 43.80	Average 38.64	Average 29.72	Average 534.88	Total 30.420	Total 31.338	Average 111.46

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-1
Date: 21-Jul-15
Personnel: TBH/SF

Test Start: 10:30
Test Finish: 11:00

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	4.64	22.12	7	2	102
5					111
10					129
15					125
20					114
25					117
30					120
Average:	4.6	22.1	6.9	1.7	116.9

Raw Data for: Lime Kiln Particulate Matter Testing
Test #2

Client: Northern Pulp
Job Number: 121413466

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-2
Date: 22-Jul-15
Personnel: TBM,ST

Test Start: 2:00 PM
Test Finish: 4:03 PM

Particulate Collected from Filter (mg):	257.8
Particulate Collected from Probe Wash (mg):	30.8
Particulate Collected from Impinger Wash (mg):	3.3
Total Particulate Collected (mg):	291.9

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	867.5	863.8	233.6
2	100 mL H2O	725.9	715.5	10.4
3	Blank	667.9	666.3	1.6
4	200g Silica Gel	871.7	866.1	5.6
			Total Weight Gain (g)	251.2
			Moisture Volume (mL)	251.2

Parameters

Barometric Pressure, Pbar (in. Hg)	29.60	O2, (%)	4.6	Stack Diameter, (in.)	48
Stack Static Pressure, Pstatic (in. H2O)	0.51	CO2, (%)	22.5	Stack Area, (sq. ft.)	12.57
Ambient Temp, (°F)	59	N2, (%)	72.9	Probe Length, (in.)	8
H2O Volume Collected, Vw (mL)	251.2			Nozzle Diameter, (in.)	0.172
Total # Sampling Points,	24			Pitot Coefficient, (Cp)	0.816
Sampling Time per Point, (min)	5			Gamma, meter constant	1.033
Readings Taken Every __ mins	2.5				
Regulatory Agency	NSENV				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)	Nozzle Angle (Cyclonic Flow) (deg. from vert.)
						187.460			
Traverse 1	1	2.5	157	0.40	0.16	187.950	78	60	-45
		5	160	0.40	0.16	188.530	80	60	-45
	2	7.5	160	0.35	0.14	189.080	80	60	-30
		10	162	0.35	0.14	189.610	80	60	-30
	3	12.5	161	0.35	0.14	190.150	80	60	-30
		15	161	0.30	0.12	190.670	80	60	-30
	4	17.5	161	0.29	0.12	191.130	79	59	-15
		20	161	0.27	0.11	191.610	79	59	-15
	5	22.5	159	0.25	0.10	192.090	79	59	-5
		25	158	0.23	0.10	192.590	79	59	-5
	6	27.5	158	0.23	0.10	193.010	79	59	0
		30	157	0.24	0.10	193.470	79	59	0
	7	32.5	158	0.20	0.08	193.900	80	60	0
		35	156	0.38	0.16	194.480	80	60	0
	8	37.5	156	0.40	0.17	195.070	80	60	0
		40	155	0.39	0.16	195.630	80	60	0
	9	42.5	153	0.38	0.16	196.180	80	60	0
		45	153	0.38	0.16	196.730	80	60	15
	10	47.5	155	0.41	0.17	197.360	80	60	15
		50	154	0.40	0.17	197.920	80	60	22
	11	52.5	154	0.37	0.15	198.475	80	60	30
		55	154	0.36	0.13	199.010	80	60	30
	12	57.5	153	0.35	0.14	199.530	80	60	45
		60	155	0.35	0.14	200.100	80	60	45
						200.100			
Traverse 2	1	62.5	155	0.43	0.18	200.660	80	61	-45
		65	158	0.45	0.19	201.290	80	61	-45
	2	67.5	158	0.42	0.17	201.900	80	60	-30
		70	159	0.33	0.14	202.490	80	60	-30
	3	72.5	159	0.36	0.15	203.020	80	60	-30
		75	161	0.30	0.12	203.530	80	60	-25
	4	77.5	162	0.32	0.13	204.030	81	61	-15
		80	163	0.31	0.13	204.540	81	61	-15
	5	82.5	163	0.31	0.13	205.060	81	61	-10
		85	163	0.31	0.13	205.580	81	61	-10
	6	87.5	162	0.32	0.13	206.070	81	61	0
		90	162	0.32	0.13	206.590	81	61	0
	7	92.5	161	0.30	0.12	207.080	81	61	0
		95	161	0.32	0.13	207.600	81	61	0
	8	97.5	161	0.33	0.14	208.140	81	61	5
		100	161	0.33	0.14	208.680	81	61	5
	9	102.5	159	0.37	0.15	209.230	82	62	15
		105	160	0.37	0.15	209.790	82	62	15
	10	107.5	160	0.38	0.16	210.370	82	62	30
		110	160	0.40	0.16	210.970	82	62	30
	11	112.5	160	0.43	0.19	211.560	82	62	30
		115	160	0.43	0.19	212.190	82	62	30
	12	117.5	159	0.43	0.18	212.770	82	62	45
		120	158	0.44	0.18	213.370	82	62	45

Calculations for: Lime Kiln Particulate Matter Testing
Test #2

Client: Northern Pulp
Job Number: 121413466

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-2
Date: 22-Jul-15
Personnel: TBH/BF

Calculated Parameters

Stack Gas Pressure, Ps (in Hg)	29.64
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	31.79
Volume of Water Vapour Collected, Vwc (cu ft)	12.058
Stack Gas Moisture Content (% as decimal)	0.310
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	27.52

Isokineticity Checks

Check range	Outside of Criteria
Check average	Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Measured Stack Gas Velocity, Us (ft/s)	Vertical Stack Gas Velocity, Us (ft/s)	Meter Press. Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Std. Vmstd (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	617	0.40	0.16	38.30	37.08	29.61	529	0.950	0.971	103.12
	2	5	620	0.40	0.16	38.40	37.15	29.61	530	0.800	0.822	112.56
		7.5	620	0.35	0.14	35.92	29.42	29.61	530	0.530	0.549	108.29
	3	10	622	0.35	0.14	35.97	29.47	29.61	530	0.530	0.549	108.48
		12.5	621	0.35	0.14	35.94	33.78	29.61	530	0.540	0.559	108.38
	4	15	621	0.30	0.12	33.28	31.27	29.61	530	0.520	0.538	108.38
		17.5	621	0.29	0.12	32.72	31.80	29.61	529	0.480	0.498	108.03
	5	20	621	0.27	0.11	31.57	30.49	29.61	529	0.480	0.498	108.88
		22.5	619	0.28	0.10	30.33	30.21	29.61	529	0.480	0.498	114.01
	6	25	618	0.25	0.10	30.31	30.19	29.61	529	0.460	0.477	108.17
		27.5	618	0.25	0.10	30.31	30.31	29.61	529	0.460	0.477	108.17
	7	30	617	0.24	0.10	29.67	29.67	29.61	529	0.460	0.477	111.33
		32.5	618	0.20	0.08	27.11	27.11	29.61	529	0.430	0.445	113.87
	8	35	616	0.38	0.16	37.30	37.30	29.61	530	0.580	0.601	111.27
		37.5	616	0.40	0.17	38.27	37.80	29.61	530	0.960	0.611	110.23
	9	40	615	0.39	0.16	37.76	37.39	29.61	530	0.560	0.580	105.36
		42.5	615	0.38	0.16	37.27	36.00	29.61	530	0.550	0.570	105.43
	10	45	615	0.38	0.16	37.27	36.00	29.61	530	0.570	0.591	109.26
		47.5	615	0.41	0.17	38.72	35.90	29.61	530	0.610	0.632	112.58
	11	50	614	0.40	0.17	38.21	35.43	29.61	530	0.560	0.580	104.55
		52.5	614	0.37	0.15	36.75	31.83	29.61	530	0.550	0.570	108.78
	12	55	614	0.36	0.15	36.25	31.38	29.61	530	0.540	0.559	108.26
		57.5	615	0.35	0.14	35.77	25.29	29.61	530	0.540	0.559	107.85
		60	615	0.35	0.14	35.77	25.29	29.61	530	0.550	0.570	108.85
Traverse 2	1	62.5	615	0.43	0.18	39.65	29.46	29.61	531	0.560	0.580	100.82
		65	618	0.45	0.19	40.66	30.22	29.61	531	0.630	0.652	111.15
	2	67.5	618	0.42	0.17	39.26	34.02	29.61	530	0.610	0.632	111.50
		70	619	0.35	0.14	35.89	31.06	29.61	530	0.550	0.570	110.21
	3	72.5	619	0.36	0.15	36.40	32.99	29.61	530	0.570	0.590	112.62
		75	621	0.32	0.12	33.26	30.16	29.61	530	0.510	0.528	110.55
	4	77.5	622	0.32	0.13	34.40	33.23	29.61	531	0.500	0.517	104.83
		80	623	0.31	0.13	33.88	32.73	29.61	531	0.510	0.527	108.73
	5	82.5	623	0.31	0.13	33.88	33.37	29.61	531	0.540	0.558	115.12
		85	623	0.31	0.13	33.88	33.37	29.61	531	0.500	0.517	106.59
	6	87.5	622	0.32	0.13	34.40	34.40	29.61	531	0.480	0.507	102.74
		90	622	0.32	0.13	34.40	34.40	29.61	531	0.520	0.538	109.05
	7	92.5	621	0.30	0.12	33.28	33.28	29.61	531	0.490	0.507	106.02
		95	621	0.32	0.13	34.37	34.37	29.61	531	0.520	0.538	108.94
	8	97.5	621	0.33	0.14	34.80	34.77	29.61	531	0.540	0.558	111.40
		100	621	0.33	0.14	34.80	34.77	29.61	531	0.540	0.558	111.40
	9	102.5	618	0.37	0.15	36.80	35.64	29.61	531	0.540	0.558	110.67
		105	620	0.37	0.15	36.93	35.67	29.61	532	0.570	0.588	104.93
	10	107.5	620	0.38	0.16	37.42	35.17	29.61	532	0.540	0.557	107.38
		110	620	0.40	0.16	38.40	36.08	29.61	532	0.560	0.579	112.14
	11	112.5	620	0.45	0.19	40.72	35.27	29.61	533	0.600	0.619	107.48
		115	620	0.45	0.19	40.72	35.27	29.61	532	0.610	0.630	111.01
	12	117.5	619	0.43	0.18	39.79	28.13	29.61	532	0.630	0.650	104.47
		120	618	0.44	0.18	40.20	29.43	29.61	532	0.580	0.598	108.75
		Total 90	Average 619	Average 0.35	Average 0.14	Average 35.78	Average 32.37	Average 29.61	Average 530.42	Total 25.970	Total 26.801	Average 108.85

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-2
Date: 22-Jul-15
Personnel: TBH/SF

Test Start: 3:10
Test Finish: 3:40

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	4.59	22.53	7	2	110
5					114
10					115
15					142
20					150
25					143
30					146
Average:	4.6	22.5	6.8	1.7	131.4

Raw Data for: Lime Kiln Particulate Matter Testing
Test #3

Client: Northern Pulp
Job Number: 121413456

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-3
Date: 22-Jul-15
Personnel: TB/LS/

Test Start: 5:10 PM
Test Finish: 7:13 PM

Particulate Collected from Filter (mg):	233.7
Particulate Collected from Probe Wash (mg):	21.1
Particulate Collected from Impinger Wash (mg):	3.5
Total Particulate Collected (mg):	258.3

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	863.7	658.8	234.9
2	100 mL H2O	708.5	698.8	9.7
3	Blank	668.9	668.7	0.2
4	200g Silica Gel	976.4	971.6	4.8
			Total Weight Gain (g)	249.6
			Moisture Volume (mL)	249.6

Parameters

Barometric Pressure, Pbar (in. Hg)	29.50	O2, (%)	4.17	Stack Diameter, (in.)	48
Stack Static Pressure, Pstatic (in. H2O)	0.51	CO2, (%)	22.96	Stack Area, (sq. ft.)	12.57
Ambient Temp, (°F)	60.60	N2, (%)	72.9	Probe Length, (in.)	8
H2O Volume Collected, Vw (mL)	249.60			Nozzle Diameter, (in.)	0.172
Total # Sampling Points,	24			Pitot Coefficient, (Cp)	0.816
Sampling Time per Point, (min)	5			Gamma, meter constant	1.033
Readings Taken Every __ mins	2.5				
Regulatory Agency	NSENV				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)	Nozzle Angle (Cyclonic Flow) (deg. from vert.)
						213.630			
Traverse 1	1	2.5	158	0.50	0.21	214.300	79	61	-45
		5	159	0.50	0.21	214.990	79	61	-45
	2	7.5	159	0.48	0.20	215.580	79	61	-30
		10	159	0.49	0.20	216.210	79	61	-30
	3	12.5	159	0.40	0.16	216.740	80	62	-25
		15	160	0.38	0.16	217.320	80	63	-25
	4	17.5	160	0.35	0.14	217.870	81	63	-15
		20	160	0.33	0.14	218.430	81	63	-15
	6	22.5	160	0.30	0.12	218.920	81	62	-5
		25	160	0.28	0.12	219.440	82	62	-5
	8	27.5	160	0.27	0.11	219.950	82	62	0
		30	160	0.25	0.10	220.410	82	62	0
	7	32.5	161	0.26	0.11	220.910	82	63	0
		35	161	0.28	0.12	221.410	82	63	0
	8	37.5	161	0.29	0.12	221.930	82	63	5
		40	161	0.30	0.12	222.430	82	63	5
	9	42.5	161	0.34	0.14	222.980	82	63	15
		45	161	0.33	0.14	223.510	83	63	15
	10	47.5	161	0.33	0.14	224.070	83	63	25
		50	161	0.38	0.16	224.660	83	63	25
	11	52.5	161	0.39	0.16	225.240	83	63	30
		55	159	0.41	0.17	225.830	83	63	30
	12	57.5	160	0.45	0.19	226.720	80	64	45
		60	159	0.46	0.19	227.160	80	64	45
						227.160			
Traverse 2	1	62.5	159	0.51	0.21	227.870	81	64	-45
		65	160	0.51	0.21	228.560	81	64	-45
	2	67.5	159	0.48	0.20	229.130	81	64	-35
		70	158	0.49	0.20	229.760	82	64	-30
	3	72.5	158	0.42	0.17	230.340	82	64	-20
		75	158	0.40	0.17	230.950	82	64	-20
	4	77.5	159	0.33	0.14	231.480	82	64	-15
		80	159	0.34	0.14	232.010	82	64	-15
	6	82.5	159	0.30	0.12	232.520	82	64	-5
		85	160	0.28	0.12	233.020	82	64	-5
	8	87.5	159	0.23	0.10	233.510	83	64	0
		90	159	0.29	0.12	234.010	83	64	0
	7	92.5	159	0.31	0.13	234.540	83	64	0
		95	160	0.32	0.13	235.080	83	64	0
	8	97.5	159	0.31	0.13	235.600	83	64	10
		100	158	0.33	0.14	236.140	83	65	10
	9	102.5	157	0.33	0.14	236.700	83	65	15
		105	156	0.39	0.16	237.280	83	65	15
	10	107.5	156	0.40	0.17	237.880	83	65	24
		110	156	0.40	0.17	238.500	83	65	24
	11	112.5	156	0.41	0.17	239.100	83	65	32
		115	156	0.44	0.18	239.730	83	65	32
	12	117.5	157	0.44	0.18	240.350	83	65	48
		120	157	0.46	0.19	240.990	83	65	48

Calculations for: Lime Kiln Particulate Meter Testing
Test #3

Client: Northern Pulp
Job Number: 121413498

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-3
Date: 22-Jul-13
Personnel: TB/MP

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.94
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	31.64
Volume of Water Vapour Collected, Vwc (cu ft)	11.981
Stack Gas Moisture Content (% as decimal)	0.298
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	27.70

Isokineticity Checks

Check range — Outside of Criteria
Check average — Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Measured Stack Gas Velocity, Us (ft/s)	Vertical Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmstd (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	618	0.50	0.21	42.79	30.26	29.52	530	0.670	0.692	111.07
		5	619	0.50	0.21	42.82	30.28	29.53	530	0.650	0.671	107.85
	2	7.5	619	0.48	0.20	41.88	29.34	29.51	530	0.630	0.651	108.68
		10	619	0.49	0.20	42.39	29.71	29.51	530	0.630	0.651	105.58
	3	12.5	619	0.40	0.16	38.30	34.71	29.51	531	0.530	0.546	86.12
		15	620	0.38	0.16	37.36	33.86	29.51	531	0.540	0.558	110.25
	4	17.5	620	0.35	0.14	35.88	34.63	29.51	532	0.550	0.566	106.83
		20	620	0.35	0.14	35.88	34.63	29.51	532	0.540	0.577	110.81
	5	22.5	620	0.30	0.12	33.20	33.07	29.51	532	0.490	0.504	104.72
		25	620	0.28	0.12	32.07	31.95	29.51	532	0.520	0.535	114.83
	6	27.5	620	0.27	0.11	31.48	31.48	29.51	532	0.510	0.525	114.75
		30	620	0.25	0.10	30.30	30.30	29.51	532	0.460	0.473	107.59
	7	32.5	621	0.26	0.11	30.83	30.83	29.51	533	0.500	0.514	114.66
		35	621	0.28	0.12	32.10	32.10	29.51	533	0.500	0.514	110.49
	8	37.5	621	0.29	0.12	32.66	32.54	29.51	533	0.510	0.524	110.74
		40	621	0.30	0.12	33.22	33.10	29.51	533	0.510	0.524	108.68
	9	42.5	621	0.34	0.14	35.37	34.18	29.51	533	0.550	0.565	110.30
		45	621	0.33	0.14	34.84	33.68	29.51	533	0.530	0.544	107.78
	10	47.5	621	0.33	0.14	34.84	31.58	29.51	533	0.560	0.575	113.89
		50	621	0.38	0.16	37.36	33.89	29.51	533	0.590	0.606	111.82
	11	52.5	621	0.39	0.16	37.68	32.61	29.51	533	0.600	0.616	112.25
		55	619	0.41	0.17	38.78	33.59	29.51	533	0.620	0.637	112.95
	12	57.5	620	0.45	0.18	40.86	29.75	29.51	532	0.640	0.656	111.58
		60	619	0.46	0.18	41.07	29.04	29.51	532	0.640	0.656	110.29
Traverse 2	1	62.5	619	0.51	0.21	43.25	30.58	29.52	533	0.710	0.730	118.09
		65	620	0.51	0.21	43.28	30.61	29.52	533	0.630	0.647	103.10
	2	67.5	618	0.48	0.20	42.39	34.73	29.51	533	0.630	0.647	105.08
		70	618	0.49	0.20	42.36	34.70	29.51	533	0.630	0.647	104.91
	3	72.5	618	0.42	0.17	38.22	36.85	29.51	533	0.600	0.616	107.91
		75	618	0.40	0.17	38.27	35.96	29.51	533	0.590	0.606	108.73
	4	77.5	619	0.35	0.14	35.83	34.61	29.51	533	0.540	0.554	108.47
		80	619	0.34	0.14	35.31	34.11	29.51	533	0.520	0.534	104.02
	5	82.5	619	0.30	0.12	33.17	33.04	29.51	533	0.510	0.524	108.60
		85	620	0.28	0.12	32.07	31.95	29.51	533	0.500	0.513	110.30
	6	87.5	619	0.25	0.10	30.28	30.28	29.51	534	0.490	0.503	114.18
		90	619	0.28	0.12	32.61	32.61	29.51	534	0.500	0.513	106.18
	7	92.5	619	0.31	0.13	33.72	33.72	29.51	534	0.530	0.544	110.63
		95	620	0.32	0.13	34.29	34.29	29.51	534	0.540	0.554	111.33
	8	97.5	618	0.31	0.13	33.69	33.19	29.51	534	0.520	0.533	108.74
		100	618	0.33	0.14	34.78	34.23	29.51	534	0.540	0.553	109.35
	9	102.5	617	0.33	0.14	34.73	33.95	29.51	534	0.560	0.574	113.31
		105	618	0.36	0.16	37.79	36.50	29.51	534	0.580	0.594	108.05
	10	107.5	618	0.40	0.17	38.27	34.96	29.51	534	0.600	0.615	110.37
		110	618	0.40	0.17	38.27	34.96	29.51	534	0.620	0.635	114.09
	11	112.5	618	0.41	0.17	38.75	32.86	29.51	534	0.600	0.615	109.01
		115	618	0.44	0.18	40.14	34.04	29.51	534	0.650	0.666	114.00
	12	117.5	617	0.44	0.18	40.11	28.84	29.51	534	0.600	0.615	105.19
		120	617	0.48	0.19	41.01	27.44	29.51	534	0.640	0.656	109.70
		Total 90	Average 619	Average 0.37	Average 0.15	Average 38.83	Average 32.84	Average 29.51	Average 532.63	Total 27.380	Total 28.110	Average 109.55

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Lime Kiln
Location: Pictou, NS
Test: PM-2
Date: 22-Jul-15
Personnel: TBH/SF

Test Start: 2:00
Test Finish: 2:30

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	4.17	22.96	7	2	77
5					44
10					42
15					42
20					44
25					41
30					45
Average:	4.2	23.0	6.6	1.7	47.9

DATA ENTRY

Northern Pulp
Pictou, NS
Fuel Burned: Natural Gas
Stack Height from Grade: 37 m
Stack Diameter: 1.22 m

Standard Temperature, Tstd (F):	77
(K):	298
Standard Pressure, Pstd (in.Hg):	29.92
(Bar):	1.0

Parameter	Symbol	Units	Test 1	Test 2	Test 3	Average
Test ID	-	-	PM-1	PM-2	PM-3	-
Date	-	-	21-Jul-15	22-Jul-15	22-Jul-15	n/a
Start Time	-	-	9:05 AM	2:00 PM	5:10 PM	n/a
End Time	-	-	11:12 AM	4:05 PM	7:15 PM	n/a
Total Sampling Time	-	min	90	67.5	67.5	75
Stack Diameter	D	in.	48	48	48	48
Average Stack Gas Temperature	Ts	F	160	158	159	159
Average Dry Gas Meter Temperature	Tm	F	75	70	73	72
Barometric Pressure	Pbar	in.Hg	29.70	29.60	29.50	29.60
Stack Static Pressure	Pstatic	in.H2O	0.51	0.51	0.51	0.51
Average Pressure Drop (Head)	dP	in.H2O	0.51	0.42	0.49	0.47
Average deltaH Orifice	dH	in.H2O	0.21	0.17	0.20	0.20
Average Meter Temperature	Tm	F	75	70	73	72
Gas Sample Volume	Vm	cu.ft	30.4	26.0	27.4	27.9
Average Isokinetics	I	%	111.5	111.5	105.1	109.4
Nozzle Diameter	Dn	in.	0.172	0.172	0.172	0.172
Pitot Coefficient	Cp	-	0.816	0.816	0.816	0.816
Gamma, meter constant	y	-	1.033	1.033	1.033	1.033
Reference Temperature	Tref	R	537	537	537	537
Reference Pressure	Pref	in.Hg	29.92	29.92	29.92	29.92
Stack Gas Oxygen Content	Co2	%	4.64	4.59	4.17	4.47
Stack Gas Carbon Dioxide Content	Cco2	%	22.1	22.5	23.0	22.5
Stack Gas Nitrogen Content	Cn2	%	73.2	72.9	72.9	73.0
Volume of Water Collected	Vw	mL	359	251	250	286
Particulate Collected from Filter	-	mg	242	358	234	278
Particulate Collected from Probe Wash	-	mg	43.1	30.8	21.1	31.7
Particulate Collected from Impinger Wash	-	mg	20.5	3.3	3.5	9.1
Total Particulate Collected (excl. impingers)	Mp	mg	285	389	255	310
Pulp Production		adubmt/day	596	701	701	666

Legend:
F - degrees Fahrenheit
K - degrees Kelvin
Bar - bars
in.Hg - inches of mercury
in. - inches
in H2O - inches of water
cu.ft - cubic feet
R - degrees Rankin
NOx - as NO2

CALCULATIONS

Northern Pulp
Pictou, NS
Stack Height from Grade: 37 m
Stack Diameter: 1.22 m

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Stack Area	As	sq.ft	As = Pi x ((D/12)^2) / 4	12.57	12.57	12.57	12.57
		sq.m	As (sq.m) = As (sq.ft) x 0.0929	1.17	1.17	1.17	1.17
Barometric Pressure	Pbar	kPa	Pbar (kPa) = Pbar (in.Hg) x 3.386	101	100	100	100
Stack Static Pressure	Pstatic	kPa	Pstatic (kPa) = Pstatic (in.H2O) x 0.249	0.13	0.13	0.13	0.13
Avg. Stack Temperature	Ts	R	Ts (R) = Ts (F) + 460	620	618	619	619.0
Avg. Meter Temperature	Tm	R	Tm (R) = Tm (F) + 460	535	530	533	532.5
Nozzle Diameter	Dn	mm	Dn (mm) = Dn (in.) x 25.4	4	4	4	4.4
Gas Meter Pressure	Pm	in.Hg	Pm = Pbar + (dH / 13.6)	29.7	29.6	29.5	29.6
Sample Volume at STP	Vmc	cu.ft	Vmc = Tref/Pref x (Vm x Pm x y) / Tm	31.3	26.9	28.1	28.8
		cu.m	Vmc (cu.m) = 0.02832 x Vmc (cu.ft)	0.89	0.76	0.80	0.82
Volume of Water Vapour	Vwc	cu.ft	Vwc = 0.0480 x Vw	17.2	12.1	12.0	13.8
Water Fraction	Bwo	-	Bwo = Vwc / (Vwc + Vmc)	0.35	0.31	0.30	0.32
Molecular Weight, Dry	Md	lb/lb-mol	Md = 0.44 (Cco2) + 0.32 (Co2) + 0.28 (Cn2)	31.7	31.8	31.8	31.8
Molecular Weight, Wet	Ms	lb/lb-mol	Ms = Md (1 - Bwo) + (18 x Bwo)	26.9	27.5	27.7	27.4
Stack Pressure	Ps	in.Hg	Ps = Pbar + (Pstatic / 13.6)	29.7	29.6	29.5	29.6
Stack Gas Velocity	Us	ft/s	Us = 85.33 x Cp x ((dP x Ts)/(Ps x Ms))^0.5	38.6	34.0	34.7	35.8
		m/s	Us (m/s) = 0.3048 x Us (ft/s)	11.8	10.4	10.6	10.9
Actual Stack Gas Flow Rate	Q	acfm	Q = 60 x Us x As	29,136	25,649	26,182	26,989
Dry Stack Gas Flow Rate	Qs	dscfm	Qs = Q x (1-Bwo) x (Tref/Ts) x (Ps/Pref)	16,190	15,244	15,723	15,719
		dscms	Qs (dscms) = 0.000472 x Qs (dscfm)	7.64	7.20	7.42	7.42
Particulate Concentration	Cs	mg/dscm	Cs = Mp / Vmc	322	510	320	384
Particulate Emission Rate	ERp	g/s	ERp = Cs/1000 x Qs	2.46	3.67	2.37	2.83
		kg/hr	ERp (kg/hr) = 3.6 x ERp (g/s)	8.85	13.2	8.5	10.2
		kg/adubmt	ERp (kg/adubmt) = ERp (kg/hr) * 24 / pulp production (adubmt/day)	0.36	0.45	0.29	0.4
Particulate Concentration Corrected to 11% O2	Cc	mg/dscm	Cc (11% O2) = Cs x (20.9-11) / (20.9-Co2)	196	310	189	232
Corrected to 3% O2	Cc	mg/dscm	Cc (3% O2) = Cs x (20.9-3) / (20.9-Co2)	354	560	342	419
Corrected to 12% CO2	Cc	mg/dscm	Cc (12% CO2) = Cs x (12/Cco2)	175	272	167	204

Legend:
sq ft - square feet
sq m - square metres
Pi - 3.142
R - degrees Rankin
ppm - parts per million

In Hg - inches of mercury
cu ft - cubic feet
cu m - cubic metres
STP - standard temperature and pressure (25 C and 101.3 kPa)
dscfm - dry standard cubic feet per minute

mg/dscm - milligrams per dry standard cubic metre
g/s - grams per second
NOx - as NO2
acfm - actual cubic feet per minute
dscms - dry standard cubic metres per second

OFFICIAL STACK TESTING RESULTS
Northern Pulp
Pictou, NS
Stack Height from Grade: 37 m
Stack Diameter: 1.22 m

Parameter	Test 1	Test 2	Test 3	Average	NSENV Limits
Test ID	PM-1	PM-2	PM-3	-	-
Test Date	21-Jul-15	22-Jul-15	22-Jul-15	-	-
Stack Gas Temperature (C)	71.1	70.0	70.6	70.5	-
Moisture Content (%)	35.5	30.9	29.9	32.1	-
Velocity (m/s)	11.8	10.4	10.6	10.9	-
Volumetric Flow (dscms)	7.64	7.20	7.42	7.42	-
Oxygen - O2 (%)	4.64	4.59	4.2	4.47	-
Carbon Dioxide - CO2 (%)	22.1	22.5	23.0	22.5	-
Particulate Matter - PM					
Particulate Concentration (mg/dscm)	322	510	320	384	-
Particulate Emission Rate (kg/hr)	8.85	13.2	8.55	10.2	-
Particulate Emission Rate (kg/adubmt)	0.36	0.45	0.29	0.37	0.50

Legend:
C - degrees Celsius
m/s - metres per second
dscms - dry standard cubic metres per second
ppm - parts per million
adubmt - air dried unbleached metric tonne (772 08 adubmt/d)
STP - standard temperature and pressure (25 C and 101.3 kPa)
mg/dscm - miligrams per dry standard cubic metre
NOx - as NO2
ND - non-detectable

Particulate Recoveries: Impinger Catch, Probe Wash, Filter Catch

Client:
Facility:
Location:
Job Number:

IMPINGER CATCH

Container ID	Beaker Pre Weights (g)				Sample ID	Recoveries					Beaker Post Weights (g)				Uncorrected Particulate Weight (g)	Corrected Particulate Weight (g)
	Data Analyzed by					Jar + Acetone + Rinse (g)	Jar Tare (g)	Recovered Acetone (g)	Rinse Water (g)	Total Rinse Water (g)	Data Analyzed by					
	Trial 1	Trial 2	Trial 3	Average							Trial 1	Trial 2	Trial 3	Average		
P2	110.3814	110.3815		110.3815	PM 1	822.5	391.1	358.9	10.9	183.9	110.4728	110.4725		110.4727	0.0742	0.0720
T3	114.7488	114.7489		114.7489	PM 2	771.1	382.4	251.2	10.3	137.8	114.7961	114.7957		114.7959	0.0061	0.0033
Q4	107.4492	107.4490		107.4491	PM 3	750.2	382.5	206.8	10.2	117.8	107.4952	107.4948		107.4950	0.0519	0.0731
																Conc. (g/mL)
C9	109.1875	109.1874		109.1875	MR	494.2	164.0	98.2		98.2	109.1944	109.1941		109.1943	0.0068	0.0069720

PROBE WASH

Container ID	Beaker Pre Weights (g)				Sample ID	Recoveries					Beaker Post Weights (g)				Uncorrected Particulate Weight (g)	Corrected Particulate Weight (g)
	Data Analyzed by					Jar + Acetone (g)	Jar Tare (g)	Recovered Acetone (g)	Rinse Acetone (g)	Total Acetone (g)	Data Analyzed by					
	Trial 1	Trial 2	Trial 3	Average							Trial 1	Trial 2	Trial 3	Average		
P1	112.3790	112.3787		112.3788	PM 1	304.5	160.1	116.4	17.8	133.2	112.4254	112.4253		112.4253	0.0465	0.0431
T1	112.0195	112.0195		112.0195	PM 2	321.9	160.5	150.5	4.8	155.4	112.0546	112.0541		112.0544	0.0349	0.0308
C8	113.1424	113.1423		113.1423	PM 3	418.8	160.9	150.0	17.3	167.3	113.1877	113.1872		113.1875	0.0452	0.0511
																Conc. (g/mL)
R2	111.2480	111.2481		111.2481	AR	371.2	322.2	49.0		49.0	111.2484	111.2483		111.2484	0.0004	0.0005721

Density of Acetone 0.7895 g/mL

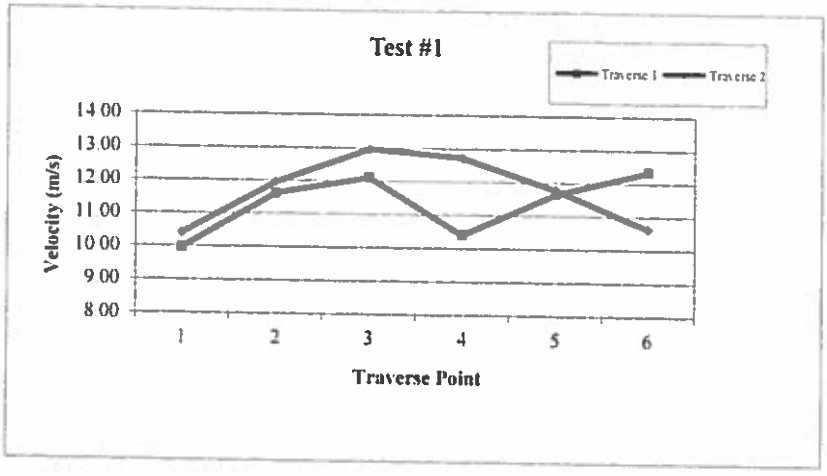
FILTER CATCH

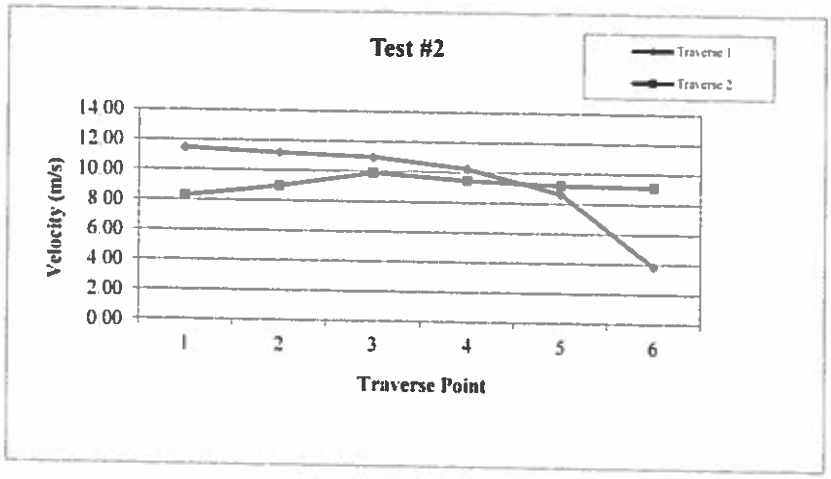
Filter ID	Pre Weights (g)				Sample ID	Post Weights (g)				Particulate Weight from Filter (g)
	Data Analyzed by					Data Analyzed by				
	Trial 1	Trial 2	Trial 3	Average		Trial 1	Trial 2	Trial 3	Average	
CF19-15	0.3303	0.3304		0.3304	PM 1	0.5779	0.5775		0.5777	0.2474
CF19-26	0.3497	0.3501		0.3499	PM2-1	0.5343	0.5340		0.5342	0.1843
CF19-27	0.3662	0.3667		0.3665	PM2-2	0.5295	0.5291		0.5293	0.1628
CF19-23	0.3581	0.3581		0.3581	PM 3	0.5478	0.5475		0.5477	0.1896

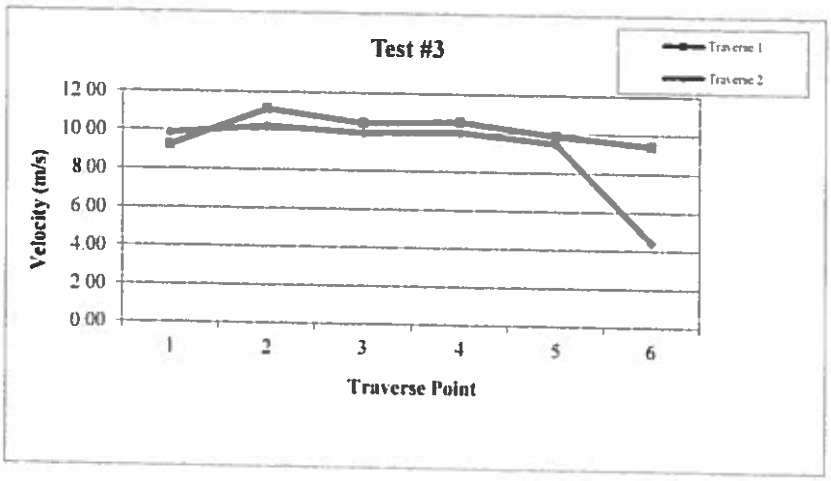
Northern Pulp
Lime Kiln

121413456

Stack Gas Velocity Profiles
Pictou, NS







Raw Data for: Northern Pulp Power Boiler PM
Test #1

Client: Northern Pulp
Job Number: 121413456

Plant: Power Boiler
Location: Pictou, NS
Test: PM-1
Date: 23-Jul-13
Personnel: TIM/ ST

Test Start: 9:42 AM
Test Finish: 11:51 AM

Particulate Collected from Filter (mg):	70.9
Particulate Collected from Probe Wash (mg):	26.3
Particulate Collected from Impinger Wash (mg):	23.7
Total Particulate Collected (mg):	97.2

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	812.1	656.2	155.9
2	100 mL H2O	728.2	696.8	32.4
3	Blank	688.7	685.2	3.5
4	200g Silica Gel	986.9	975.0	11.9
			Total Weight Gain (g)	203.7
			Moisture Volume (mL)	203.7

Parameters

Barometric Pressure, Pbar (in. Hg)	29.60	O2, (%)	18.1	Stack Diameter, (in.)	72
Stack Static Pressure, Pstatic (in. H2O)	0.30	CO2, (%)	2.5	Stack Area, (sq. ft.)	28.27
Ambient Temp, (°F)	64	N2, (%)	81.3	Probe Length, (ft.)	8
H2O Volume Collected, Vw (mL)	203.7	CO(ppm)	1037.4	Nozzle Diameter, (in.)	0.172
Total # Sampling Points,	24	NOx (ppm)	18.9	Pitot Coefficient, (Cp)	0.816
Sampling Time per Point, (min)	5	SO2 (ppm)	0.0	Gamma, meter constant	1.033
Readings Taken Every _ mins	2.5			Port length (in.)	6
Regulatory Agency	NSDOE				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						241.260		
Traverse 1	1	2.5	132	0.83	0.48	242.230	92	62
		5	128	0.80	0.46	243.180	97	64
	2	7.5	132	0.90	0.45	244.120	95	64
		10	132	0.99	0.56	245.180	95	64
	3	12.5	131	0.97	0.55	246.230	96	64
		15	130	0.95	0.53	247.230	96	64
	4	17.5	131	0.90	0.50	248.210	65	65
		20	129	0.95	0.53	249.230	65	65
	5	22.5	129	0.91	0.50	250.230	66	65
		25	126	0.90	0.50	251.240	66	65
	6	27.5	124	0.88	0.49	252.230	66	66
		30	124	0.88	0.49	253.220	66	66
	7	32.5	124	0.90	0.50	254.230	66	66
		35	123	0.88	0.49	255.220	70	67
	8	37.5	122	0.96	0.53	256.230	70	67
		40	126	0.99	0.55	257.290	70	67
	9	42.5	129	1.20	0.67	258.470	70	67
		45	128	1.10	0.61	259.550	70	67
	10	47.5	130	1.40	0.78	260.780	70	67
		50	131	1.35	0.73	261.990	70	67
	11	52.5	130	1.60	0.89	263.300	70	67
		55	129	1.60	0.89	264.630	73	69
	12	57.5	130	1.60	0.89	265.900	73	69
		60	133	1.50	0.83	267.240	73	69
						267.240		
Traverse 2	1	62.5	131	1.40	0.78	268.440	70	70
		65	130	1.40	0.78	269.640	70	71
	2	67.5	128	1.35	0.73	270.870	71	70
		70	129	1.40	0.78	272.070	72	71
	3	72.5	128	1.30	0.73	273.230	72	71
		75	132	1.25	0.68	274.410	72	69
	4	77.5	132	1.20	0.67	275.560	73	69
		80	131	1.20	0.67	276.710	72	69
	5	82.5	129	1.10	0.61	277.830	72	69
		85	130	1.05	0.59	278.908	72	69
	6	87.5	129	1.10	0.61	280.010	72	69
		90	129	1.10	0.61	281.170	72	69
	7	92.5	132	1.20	0.67	282.270	72	69
		95	128	1.25	0.70	283.470	73	70
	8	97.5	129	1.30	0.73	284.660	73	70
		100	128	1.33	0.76	285.870	73	70
	9	102.5	128	1.40	0.78	287.090	73	70
		105	129	1.40	0.78	288.310	73	70
	10	107.5	128	1.40	0.78	289.520	73	70
		110	128	1.35	0.76	290.940	74	71
	11	112.5	127	1.80	1.01	292.400	74	71
		115	126	1.75	0.99	293.900	74	71
	12	117.5	126	1.60	0.90	295.170	74	71
		120	127	1.50	0.84	296.480	74	71

Calculations for: Northern Pulp Power Boiler PM
Test #1

Client: Northern Pulp
Job Number: 121413456

Plant: Power Boiler
Location: Pictou, NS
Test: PM-1
Date: 23-Jul-13
Personnel: TBH/BP

Calculated Parameters

Stack Gas Pressure, Ps (in Hg)	29.81
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	29.05
Volume of Water Vapour Collected, Vwc (cu ft)	8.778
Stack Gas Moisture Content (% as decimal)	0.148
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	27.44

Isokineticity Checks

Check range	Within Criteria
Check average	Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	582	0.85	0.46	54.80	29.84	537	0.870	0.882	87.62
		5	588	0.80	0.46	52.98	29.83	540	0.850	0.847	87.76
	2	7.5	582	0.83	0.45	53.18	29.83	540	0.840	0.857	87.06
		10	582	0.99	0.56	58.14	29.84	540	1.080	1.080	88.41
	3	12.5	581	0.97	0.55	56.48	29.84	540	1.050	1.068	88.30
		15	580	0.93	0.53	57.22	29.84	540	1.000	1.018	85.53
	4	17.5	581	0.90	0.50	56.34	29.84	537	0.980	1.023	87.68
		20	589	0.95	0.53	57.78	29.84	537	1.010	1.054	87.83
	5	22.5	589	0.91	0.50	56.55	29.84	537	1.000	1.043	86.87
		25	586	0.90	0.50	56.10	29.84	537	1.020	1.063	109.14
	6	27.5	584	0.85	0.49	55.38	29.84	538	0.990	1.031	99.01
		30	584	0.86	0.49	55.38	29.84	538	0.990	1.031	99.01
	7	32.5	584	0.90	0.50	56.00	29.84	538	1.010	1.052	99.69
		35	585	0.88	0.49	55.42	29.84	529	0.990	1.029	98.91
	8	37.5	588	0.94	0.53	58.04	29.84	529	1.030	1.071	98.79
		40	588	0.88	0.55	58.84	29.84	529	1.040	1.081	98.23
	9	42.5	589	1.20	0.67	64.94	29.85	529	1.180	1.227	101.35
		45	589	1.10	0.61	62.12	29.85	528	1.080	1.123	99.79
	10	47.5	590	1.40	0.78	70.20	29.86	529	1.230	1.280	97.91
		50	591	1.35	0.75	69.00	29.86	529	1.210	1.259	96.18
	11	53.5	590	1.60	0.89	75.05	29.87	529	1.310	1.362	97.57
		56	589	1.60	0.89	74.99	29.87	531	1.330	1.378	98.51
	12	57.5	590	1.60	0.89	75.05	29.87	531	1.270	1.315	94.15
		60	593	1.50	0.83	72.85	29.86	531	1.340	1.388	102.84
Traverse 2	1	62.5	591	1.40	0.78	70.26	29.86	530	1.200	1.245	95.34
		65	590	1.40	0.78	70.20	29.86	531	1.200	1.244	95.17
	2	67.5	589	1.35	0.75	68.88	29.86	531	1.330	1.375	98.24
		70	589	1.40	0.78	70.15	29.86	532	1.200	1.241	94.91
	3	72.5	588	1.30	0.73	67.54	29.85	532	1.180	1.221	93.75
		75	592	1.25	0.69	66.45	29.85	531	1.180	1.202	87.50
	4	77.5	592	1.20	0.67	65.11	29.85	531	1.150	1.192	88.65
		80	591	1.20	0.67	65.05	29.85	531	1.150	1.192	88.56
	5	82.5	589	1.10	0.61	62.18	29.85	531	1.120	1.160	100.06
		85	590	1.05	0.59	60.80	29.84	531	1.070	1.108	97.94
	6	87.5	589	1.10	0.61	62.16	29.85	531	1.110	1.150	99.18
		90	589	1.10	0.61	62.18	29.85	531	1.180	1.202	103.69
	7	92.5	592	1.20	0.67	65.11	29.85	531	1.100	1.140	84.38
		95	590	1.25	0.70	66.34	29.85	532	1.200	1.241	100.50
	8	97.5	589	1.30	0.73	67.59	29.85	532	1.180	1.231	97.65
		100	588	1.35	0.76	68.82	29.86	532	1.210	1.252	97.38
	9	102.5	588	1.40	0.78	70.08	29.86	532	1.220	1.262	98.41
		105	589	1.40	0.78	70.15	29.86	532	1.220	1.262	98.48
	10	107.5	588	1.40	0.78	70.08	29.86	532	1.310	1.355	103.52
		110	588	1.35	0.76	68.82	29.86	533	1.320	1.363	106.02
	11	112.5	587	1.80	1.01	78.40	29.87	533	1.460	1.508	101.53
		115	586	1.75	0.99	78.22	29.87	533	1.500	1.550	105.69
	12	117.5	586	1.60	0.90	74.80	29.87	533	1.270	1.312	93.57
		120	587	1.50	0.84	72.48	29.86	533	1.310	1.353	98.75
		Total 120	Average 589	Average 1.21	Average 0.68	Average 64.77	Average 29.85	Average 531	Total 55.220	Total 57.156	Average 96.57

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Power Boiler
Location: Pictou, NS
Test: PM-1
Date: 23-Jul-15
Personnel: TBH/SF

Test Start: 11:00 AM
Test Finish: 11:30 AM

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	16.8	2.3	801	0	11
5	17.0	2.2	622	0	13
10	16.1	2.7	344	0	20
15	16.5	2.5	1868	0	14
20	15.3	3.1	1121	0	28
25	15.4	2.1	1132	0	20
30	15.9	2.8	1374	0	26
Average:	**16.1**	**2.5**	**1037**	**0**	**19**

Raw Data for: Northern Pulp Power Boiler PM
Test #2

Client: Northern Pulp
Job Number: 12141.3498

Plant: Power Boiler
Location: Pictou, NS
Test: PM-2
Date: 23-Mar-15
Personnel: TSH/ ST

Test Start: 1:25 PM
Test Finish: 3:40 PM

Particulate Collected from Filter (mg): 77.9
Particulate Collected from Probe Wash (mg): 19.4
Particulate Collected from Impinger Wash (mg): 1.2
Total Particulate Collected (mg): 97.3

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	883.6	666.4	217.2
2	100 mL H2O	741.5	715.3	26.2
3	Blank	668.8	666.1	2.8
4	200g Silica Gel	1037.2	1025.6	11.6
			Total Weight Gain (g)	257.8
			Moisture Volume (mL)	257.8

Parameters

Barometric Pressure, Pbar (in. Hg)	29.79	O2, (%)	17.0	Stack Diameter, (in.)	72
Stack Static Pressure, Pstatic (in. H2O)	0.20	CO2, (%)	2.2	Stack Area, (sq. ft.)	28.27
Ambient Temp, (°F)	43	N2, (%)	80.6	Probe Length, (ft.)	6
H2O Volume Collected, Vw (mL)	257.8	CO(ppm)	235.1	Nozzle Diameter, (in.)	0.172
Total # Sampling Points,	24	NOx (ppm)	17.6	Pitot Coefficient, (Cp)	0.818
Sampling Time per Point, (min)	5	SO2 (ppm)	0.0	Gamma, meter constant	1.033
Readings Taken Every __ mins	2.5			Port length (in.)	6
Regulatory Agency	MDDE				

	Traverse Point	Time (mins)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						296.720		
Traverse 1	1	2.5	136	1.30	0.83	298.010	71	71
		5	137	1.40	0.88	299.320	73	71
	2	7.5	137	1.45	0.77	300.600	72	71
		10	137	1.30	0.83	301.890	72	71
	3	12.5	134	1.30	0.72	303.080	72	71
		15	134	1.30	0.72	304.210	72	71
	4	17.5	135	1.25	0.88	305.410	72	72
		20	134	1.25	0.69	306.520	72	71
	5	22.5	135	1.20	0.68	307.660	72	71
		25	136	1.20	0.66	308.790	72	71
	6	27.5	135	1.15	0.64	309.910	72	70
		30	137	1.20	0.66	311.060	74	71
	7	32.5	138	1.15	0.63	312.160	74	71
		35	135	1.10	0.61	313.260	74	71
	8	37.5	137	1.05	0.58	314.340	74	71
		40	137	1.05	0.58	315.390	75	71
	9	42.5	137	1.20	0.66	316.540	75	72
		45	139	1.15	0.64	317.650	75	72
	10	47.5	136	1.40	0.78	318.900	75	72
		50	134	1.30	0.72	320.070	75	73
	11	52.5	134	1.30	0.73	321.270	77	73
		55	134	1.30	0.84	322.540	77	73
	12	57.5	137	1.80	1.00	323.930	77	73
		60	135	1.75	0.98	325.310	77	73
						325.310		
Traverse 2	1	62.5	136	0.96	0.55	326.580	74	74
		65	132	0.94	0.53	327.800	74	74
	2	67.5	128	0.94	0.53	328.960	74	73
		70	127	0.92	0.52	329.970	74	73
	3	72.5	128	0.88	0.50	330.970	74	73
		75	132	0.95	0.47	331.948	73	73
	4	77.5	113	0.80	0.45	332.880	73	73
		80	136	0.82	0.45	333.130	73	73
	5	82.5	137	0.83	0.46	334.310	73	73
		85	131	0.84	0.47	335.360	73	73
	6	87.5	128	0.95	0.53	336.320	74	73
		90	130	0.97	0.54	337.360	74	73
	7	92.5	130	1.00	0.56	338.480	74	73
		95	132	1.20	0.67	339.500	74	73
	8	97.5	139	1.40	0.77	340.760	74	73
		100	137	1.40	0.78	341.990	75	72
	9	102.5	133	1.30	0.83	343.260	75	72
		105	133	1.30	0.83	344.510	75	72
	10	107.5	135	1.60	0.89	345.850	76	73
		110	135	1.55	0.86	347.140	76	73
	11	112.5	136	1.60	0.89	348.440	76	74
		115	136	1.60	0.89	349.750	76	74
	12	117.5	131	1.60	0.89	351.080	76	74
		120	134	1.65	0.92	352.410	79	74

Calculations for: Northern Pulp Power Boiler PM
Test #2

Client: Northern Pulp
Job Number: 121413456

Plant: Power Boiler
Location: Pictou, NS
Test: PM-2
Date: 23-Jul-13
Personnel: TBH,SP

Calculated Parameters

Stack Gas Pressure, Ps (in Hg)	29.71
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	28.84
Volume of Water Vapour Collected, Vwc (cu ft)	12.374
Stack Gas Moisture Content (% as decimal)	0.177
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	27.09

Isokinetictity Checks

Check range	Within Criteria
Check average	Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	590	1.50	0.83	73.39	29.76	531	1 290	1 340	102.48
		5	587	1.60	0.88	75.86	29.76	532	1 310	1 358	100.67
	2	7.5	587	1.40	0.77	70.98	29.76	532	1 280	1 329	105.22
		10	587	1.50	0.83	73.45	29.76	532	1 299	1 346	95.32
	3	12.5	584	1.30	0.72	68.20	29.75	532	1 200	1 245	102.10
		15	584	1.30	0.72	68.20	29.75	532	1 210	1 256	102.95
	4	17.5	585	1.25	0.69	66.94	29.75	532	1 200	1 244	104.11
		20	584	1.25	0.69	66.89	29.75	532	1 110	1 152	96.31
	5	22.5	585	1.20	0.66	65.58	29.75	532	1 140	1 183	101.03
		25	586	1.20	0.66	65.64	29.75	532	1 130	1 173	100.22
	6	27.5	585	1.15	0.64	64.20	29.75	531	1 130	1 183	101.48
		30	587	1.20	0.66	65.69	29.75	533	1 150	1 191	101.89
	7	32.5	588	1.15	0.63	64.38	29.75	533	1 100	1 139	99.84
		35	585	1.10	0.61	62.78	29.74	533	1 100	1 138	101.61
	8	37.5	587	1.05	0.58	61.45	29.74	533	1 080	1 118	102.28
		40	587	1.05	0.58	61.45	29.74	533	1 050	1 086	99.34
	9	42.5	587	1.20	0.66	65.69	29.75	534	1 130	1 169	101.70
		45	585	1.15	0.64	64.20	29.75	534	1 110	1 147	100.10
	10	47.5	586	1.40	0.78	70.90	29.76	534	1 250	1 293	102.29
		50	584	1.30	0.72	68.20	29.75	534	1 170	1 210	99.18
	11	52.5	584	1.30	0.73	68.20	29.75	535	1 200	1 237	101.43
		55	584	1.50	0.84	73.29	29.76	535	1 270	1 310	99.97
	12	57.5	587	1.60	1.00	80.48	29.77	535	1 380	1 434	100.17
		60	585	1.75	0.98	79.20	29.77	535	1 380	1 424	100.68
Traverse 2	1	62.5	580	0.98	0.55	59.02	29.74	534	1 070	1 105	103.97
		65	582	0.94	0.53	57.90	29.74	534	1 020	1 053	101.38
	2	67.5	584	0.94	0.53	57.70	29.74	534	1 060	1 095	105.08
		70	587	0.92	0.52	57.04	29.74	534	1 010	1 044	101.12
	3	72.5	588	0.88	0.50	55.83	29.74	534	1 000	1 033	102.45
		75	582	0.85	0.47	55.08	29.73	533	0.970	1 003	101.55
	4	77.5	583	0.90	0.45	53.48	29.73	533	0.940	0.972	101.51
		80	586	0.82	0.45	54.28	29.73	533	0.970	1 003	103.75
	5	82.5	587	0.83	0.46	54.63	29.73	533	0.960	0.993	102.13
		85	581	0.84	0.47	54.69	29.73	533	0.960	1 024	104.17
	6	87.5	588	0.96	0.53	59.01	29.74	534	1 020	1 054	100.58
		90	580	0.97	0.54	58.72	29.74	534	1 040	1 075	101.67
	7	92.5	580	1.00	0.56	59.62	29.74	534	1 040	1 075	100.13
		95	582	1.20	0.67	65.42	29.75	534	1 100	1 137	99.87
	8	97.5	586	1.40	0.77	71.08	29.76	534	1 260	1 303	103.36
		100	587	1.40	0.78	70.98	29.76	534	1 230	1 272	100.74
	9	102.5	585	1.50	0.83	73.32	29.76	534	1 270	1 314	100.33
		105	585	1.50	0.83	73.32	29.76	534	1 250	1 293	99.75
	10	107.5	585	1.60	0.89	75.73	29.77	535	1 340	1 384	102.32
		110	585	1.55	0.86	74.54	29.76	535	1 290	1 332	100.07
	11	112.5	586	1.60	0.89	75.79	29.77	536	1 300	1 338	99.07
		115	586	1.60	0.89	75.79	29.77	536	1 310	1 349	99.84
	12	117.5	585	1.60	0.89	75.73	29.77	536	1 330	1 369	101.27
		120	584	1.65	0.92	76.84	29.77	537	1 330	1 368	99.56
		Total 120	Average 584	Average 1.25	Average 0.69	Average 66.45	Average 29.75	Average 533	Total 55 890	Total 57 587	Average 101.12

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Power Boiler
Location: Pictou, NS
Test: PM-2
Date: 23-Jul-15
Personnel: TBH/SF

Test Start: 2:00 PM
Test Finish: 2:30 PM

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	17.9	1.9	80	0	14
5	18.2	1.6	122	0	12
10	18.1	1.6	124	0	13
15	16.2	2.7	340	0	21
20	16.2	2.7	323	0	20
25	16.0	2.7	310	0	22
30	16.3	2.6	347	0	21
Average:	**17.0**	**2.2**	**235**	**0**	**18**

Raw Data for: Northern Pulp Power Boiler PM
Test #3

Client: Northern Pulp
Job Number: 121413466

Plant: Power Boiler
Location: Pictou, NS
Test: PM-3
Date: 24-Mar-13
Personnel: TBM

Test Start: 8:00 AM
Test Finish: 10:08 AM

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	778.1	694.3	183.8
2	100 mL H2O	671.7	637.9	33.8
3	Blank	672.2	665.6	6.6
4	200g Silica Gel	1050.8	1037.1	13.5
			Total Weight Gain (g)	237.7
			Moisture Volume (mL)	237.7

Particulate Collected from Filter (mg):	194.6		
Particulate Collected from Probe Wash (mg):	13.7		
Particulate Collected from Impinger Wash (mg):	3.7		
Total Particulate Collected (mg):	238.3		

Parameters

Barometric Pressure, Pbar (in. Hg)	29.99	O2, (%)	13.23	Stack Diameter, (in.)	72
Stack Static Pressure, Pstatic (in. H2O)	0.30	CO2, (%)	4.23	Stack Area, (sq. ft.)	28.27
Ambient Temp, (°F)	68	N2, (%)	82.55	Probe Length, (ft.)	8
H2O Volume Collected, Vw (mL)	237.70	CO(ppm)	358.1	Nozzle Diameter, (in.)	0.172
Total # Sampling Points,	24	NOx (ppm)	36.7	Pitot Coefficient, (Cp)	0.816
Sampling Time per Point, (min)	5	SO2 (ppm)	0.0	Gamma, meter constant	1.033
Readings Taken Every __ mins	2.5			Port length (in.)	6
Regulatory Agency	NSDOE				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						352.640		
Traverse 1	1	2.5	130	0.80	0.45	353.630	73	73
		5	131	0.82	0.46	354.580	74	73
	2	7.5	132	0.92	0.51	355.605	74	73
		10	133	0.92	0.51	356.610	74	73
	3	12.5	135	0.85	0.47	357.570	75	73
		15	134	0.86	0.48	358.550	75	73
	4	17.5	134	0.85	0.47	359.510	75	73
		20	134	0.84	0.47	360.490	75	73
	5	22.5	133	0.82	0.46	361.450	75	73
		25	133	0.80	0.45	362.380	75	73
	6	27.5	133	0.84	0.47	363.340	76	73
		30	136	0.82	0.46	364.260	76	73
	7	32.5	137	0.84	0.47	365.280	77	74
		35	137	0.86	0.48	366.250	77	74
	8	37.5	142	0.86	0.47	367.230	77	74
		40	140	0.85	0.47	368.190	77	74
	9	42.5	140	1.50	0.61	369.270	77	74
		45	140	1.10	0.61	370.370	77	74
	10	47.5	140	1.40	0.77	371.390	77	74
		50	142	1.45	0.80	372.850	79	73
	11	52.5	134	1.30	0.84	374.120	79	73
		55	134	1.70	0.95	375.480	79	73
	12	57.5	134	1.75	0.98	376.870	79	73
		60	134	1.70	0.95	378.23	80	73
						378.230		
Traverse 2	1	62.5	134	1.30	0.84	379.510	76	76
		65	132	1.30	0.84	380.790	76	76
	2	67.5	133	1.25	0.76	382.050	76	76
		70	134	1.45	0.81	383.270	78	73
	3	72.5	133	1.10	0.63	384.390	78	74
		75	136	1.20	0.67	385.540	78	76
	4	77.5	133	1.15	0.64	386.670	78	76
		80	134	1.10	0.62	387.780	78	76
	5	82.5	133	1.10	0.62	388.890	78	76
		85	133	1.15	0.64	390.020	78	76
	6	87.5	133	1.10	0.62	391.130	78	76
		90	133	1.10	0.62	392.270	78	76
	7	92.5	136	1.20	0.67	393.390	78	76
		95	136	1.20	0.67	394.580	78	76
	8	97.5	136	1.30	0.73	395.730	78	76
		100	133	1.25	0.70	396.870	78	76
	9	102.5	136	1.30	0.73	398.190	78	76
		105	135	1.40	0.78	399.400	78	76
	10	107.5	133	1.50	0.84	400.630	78	76
		110	133	1.50	0.84	401.970	78	76
	11	112.5	133	1.70	0.95	403.270	78	76
		115	133	1.80	1.01	404.690	78	73
	12	117.5	136	1.80	1.00	406.108	78	73
		120	133	1.85	1.03	407.488	78	73
			6498		32.29		7287	

Calculations for: Northern Pulp Power Boiler PM
Test #3

Client: Northern Pulp
Job Number: 121413498

Plant: Power Boiler
Location: Pictou, NS
Test: PM-3
Date: 04-Jul-13
Personnel: TBH

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	28.91
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	29.21
Volume of Water Vapour Collected, Vwc (cu ft)	11.410
Stack Gas Moisture Content (% as decimal)	0.167
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	27.33

Isokinetcity Checks

Check range	Within Criteria
Check average	Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	590	0.80	0.45	52.90	29.93	533	0.960	1.000	103.03
		5	591	0.82	0.46	53.81	29.93	534	0.960	0.999	101.78
	2	7.5	592	0.82	0.51	56.83	29.94	534	1.020	1.061	102.18
		10	595	0.82	0.51	56.97	29.94	534	1.019	1.061	101.43
	3	12.5	595	0.85	0.47	54.76	29.93	534	0.980	1.019	100.20
		15	594	0.86	0.48	55.04	29.94	534	0.980	1.019	101.60
	4	17.5	594	0.83	0.47	54.72	29.93	534	0.980	0.998	100.11
		20	594	0.84	0.47	54.39	29.93	534	0.980	1.019	102.80
	5	22.5	595	0.82	0.46	53.79	29.93	534	0.980	0.998	102.01
		25	595	0.80	0.45	53.13	29.93	534	0.970	0.988	100.04
	6	27.5	595	0.84	0.47	54.44	29.93	535	0.923	0.955	98.50
		30	596	0.82	0.46	53.83	29.93	535	0.960	0.997	102.00
	7	32.5	597	0.84	0.47	54.53	29.93	536	1.020	1.057	100.97
		35	597	0.86	0.48	55.18	29.94	536	0.970	1.005	100.34
	8	37.5	602	0.86	0.47	55.41	29.93	536	0.980	1.016	102.00
		40	600	0.85	0.47	54.99	29.93	536	0.960	0.995	100.33
	9	42.5	600	1.10	0.61	62.56	29.94	536	1.080	1.120	99.26
		45	600	1.10	0.61	62.56	29.94	536	1.100	1.140	101.08
	10	47.5	600	1.40	0.77	70.58	29.96	536	1.220	1.265	99.43
		50	602	1.45	0.80	71.85	29.96	537	1.260	1.303	100.79
	11	52.5	594	1.50	0.84	72.69	29.96	537	1.270	1.314	99.23
		55	594	1.70	0.95	77.36	29.97	537	1.370	1.416	100.58
	12	57.5	594	1.75	0.98	78.51	29.97	537	1.360	1.408	99.88
		60	594	1.70	0.95	77.36	29.97	538	1.360	1.408	99.79
Traverse 2	1	62.5	594	1.50	0.84	72.69	29.90	536	1.260	1.324	99.99
		65	592	1.50	0.84	72.57	29.96	536	1.260	1.327	100.03
	2	67.5	593	1.35	0.76	68.90	29.96	536	1.260	1.308	103.86
		70	594	1.45	0.81	71.47	29.96	537	1.220	1.283	97.02
	3	72.5	595	1.10	0.62	62.30	29.96	537	1.120	1.158	102.37
		75	596	1.20	0.67	65.12	29.95	537	1.150	1.189	100.57
	4	77.5	595	1.15	0.64	63.70	29.95	537	1.130	1.168	100.86
		80	594	1.10	0.62	62.25	29.95	537	1.110	1.148	101.23
	5	82.5	595	1.10	0.62	62.30	29.95	537	1.110	1.148	101.31
		85	595	1.15	0.64	63.70	29.95	537	1.130	1.168	100.86
	6	87.5	595	1.10	0.62	62.30	29.95	537	1.130	1.168	103.14
		90	595	1.10	0.62	62.30	29.95	537	1.120	1.158	102.22
	7	92.5	596	1.20	0.67	65.12	29.95	537	1.120	1.158	97.85
		95	596	1.20	0.67	65.12	29.95	537	1.180	1.230	104.08
	8	97.5	595	1.30	0.73	67.78	29.95	537	1.180	1.230	103.03
		100	595	1.25	0.70	66.41	29.95	537	1.200	1.241	102.77
	9	102.5	596	1.30	0.73	67.78	29.95	537	1.220	1.262	102.53
		105	595	1.40	0.78	70.28	29.95	537	1.210	1.251	97.81
	10	107.5	596	1.50	0.84	72.75	29.96	537	1.230	1.272	96.17
		110	596	1.50	0.84	72.75	29.96	537	1.340	1.386	104.79
	11	112.5	595	1.70	0.95	77.45	29.96	537	1.300	1.345	95.49
		115	595	1.80	1.01	79.89	29.97	537	1.429	1.471	101.49
	12	117.5	596	1.80	1.00	79.76	29.97	537	1.415	1.461	100.87
		120	595	1.85	1.03	80.79	29.97	537	1.390	1.429	97.90
		Total 120	Average 595	Average 1.21	Average 0.67	Average 64.85	Average 29.95	Average 536	Total 54.620	Total 56.787	Average 100.80

3103.43

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Power Boiler
Location: Pictou, NS
Test: PM-3
Date: 24-Jul-15
Personnel: TBH

Test Start: 8:10 AM
Test Finish: 8:40 AM

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	14.2	3.0	473	0	20
5	13.9	4.0	421	0	32
10	13.3	4.3	329	0	37
15	13.4	4.2	362	0	36
20	13.2	4.3	393	0	37
25	12.4	4.8	344	0	49
30	12.2	5.0	395	0	46
Average:	13.2	4.2	388	0	37

DATA ENTRY

Northern Pulp
Pictou, NS
Fuel: Natural Gas
Operating Conditions: low normal
Emission Control Equipment: scrubber
Stack Height from Grade: 51 m
Stack Diameter: 1.93 m

Reference Temperature, Tref (F):	77	
(K):	298	
Reference Pressure, Pref (in.Hg):	29.92	
(Bar):	1.0	

Parameter	Symbol	Units	Test 1	Test 2	Test 3	Average
Test ID	-	-	PM-1	PM-2	PM-3	-
Date	-	-	23-Jul-15	23-Jul-15	24-Jul-15	n/a
Start Time	-	-	9:42 AM	1:25 PM	8:00 AM	n/a
End Time	-	-	11:51 AM	3:40 PM	10:08 AM	n/a
Total Sampling Time	-	min	120	120	120	120
Stack Diameter	D	in.	72	72	72	72
Average Stack Gas Temperature	Ts	F	129	134	135	133
Average Dry Gas Meter Temperature	Tm	F	71	73	76	73
Barometric Pressure	Pbar	in.Hg	29.60	29.70	29.90	29.73
Stack Static Pressure	Pstatic	in.H2O	0.20	0.20	0.20	0.20
Average Pressure Drop (Head)	dP	in.H2O	1.21	1.25	1.21	1.22
Average deltaH Orifice	dH	in.H2O	0.68	0.69	0.67	0.68
Average Meter Temperature	Tm	F	71	73	76	73
Gas Sample Volume	Vm	cu.ft	55.22	55.69	54.82	55.24
Average Isokinetics	I	%	98.57	101.12	100.80	100.16
Nozzle Diameter	Dn	in.	0.172	0.172	0.172	0.172
Pitot Coefficient	Cp	-	0.816	0.816	0.816	0.816
Gamma, meter constant	y	-	1.033	1.033	1.033	1.033
Reference Temperature	Tref	R	537	537	537	537
Reference Pressure	Pref	in.Hg	29.92	29.92	29.92	29.92
Stack Gas Oxygen Content	Co2	%	16.1	17.0	13.2	15.4
Stack Gas Carbon Dioxide Content	Cco2	%	2.5	2.2	4.2	3.0
Stack Gas Nitrogen Content	Cn2	%	81.3	80.8	82.5	81.6
Stack Gas Sulphur Dioxide Content	Cso2	ppm	0.0	0.0	0.0	0.0
Stack Gas Nitrogen Oxides Content	Cnox	ppm	18.9	17.6	36.7	24.4
Stack Gas Carbon Monoxide Content	Cco	ppm	1037.4	235.1	388.1	553.6
Volume of Water Collected	Vw	mL	203.7	257.8	237.7	233.1
Particulate Collected from Filter	-	mg	70.9	77.9	194.6	114.5
Particulate Collected from Probe Wash	-	mg	26.3	19.4	13.7	19.8
Particulate Collected from Impinger Wash	-	mg	23.7	1.2	3.7	9.5
Total Particulate Collected (excluding impingers)	Mp	mg	97.2	97.3	208.3	134.2

Legend:
F - degrees Fahrenheit
K - degrees Kelvin
Bar - bars
in.Hg - inches of mercury
in. - inches
in.H2O - inches of water
cu.ft - cubic feet
R - degrees Rankin
NOx - as NO2

CALCULATIONS

Northern Pulp
Pictou, NS
Fuel: Natural Gas
Operating Conditions: low normal
Emission Control Equipment: scrubber
Stack Height from Grade: 51 m
Stack Diameter: 1 93 m

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Stack Area	As	sq ft sq m	As = Pi x ((D 12) ^ 2) / 4 As (sq m) = As (sq ft) x 0 0929	28 27 2 63	28 27 2 63	28 27 2 63	28 27 2 63
Barometric Pressure	Pbar	kPa	Pbar (kPa) = Pbar (in Hg) x 3 386	100 2	100 6	101 2	100 7
Stack Static Pressure	Pstatic	kPa	Pstatic (kPa) = Pstatic (in H2O) x 0 249	0 05	0 05	0 05	0 05
Avg. Stack Temperature	Ts	R	Ts (R) = Ts (F) + 460	589	594	595	593
Avg. Meter Temperature	Tm	R	Tm (R) = Tm (F) + 460	531	533	536	533 5
Nozzle Diameter	Dn	mm	Dn (mm) = Dn (in) x 25 4	4	4	4	4 4
Gas Meter Pressure	Pm	in Hg	Pm = Pbar + (dH / 13 6)	29 65	29 75	29 95	29 78
Sample Volume at Ref Cond	Vmc	cu ft	Vmc = Tref/Pref x (Vm x Pm x y) / Tm	57 15	57 60	56 80	57 2
		cu m	Vmc (cu m) = 0 02832 x Vmc (cu ft)	1 62	1 63	1 61	1 62
Volume of Water Vapour	Vwc	cu ft	Vwc = 0 0480 x Vlc	9 78	12 37	11 41	11 19
Water Fraction	Bwo	-	Bwo = Vwc / (Vwc + Vmc)	0 146	0 177	0 167	0 2
Molecular Weight, Dry	Md	lb/lb-mol	Md = 0 44 (Cco2) + 0 32 (Co2) + 0 28 (Cn2)	29 05	29 04	29 21	29 1
Molecular Weight, Wet	Ms	lb/lb-mol	Ms = Md (1 - Bwo) + (18 x Bwo)	27.44	27.09	27 33	27.3
Stack Pressure	Ps	in Hg	Ps = Pbar + (Pstatic / 13 6)	29.61	29 71	29 91	29 75
Stack Gas Velocity	Vs	ft/s	Vs = 85.33 x Cp x ((dP x Ts)/(Ps x Ms))^0.5	64 77	66 45	64 65	65 3
		m/s	Vs (m/s) = 0.3048 x Vs (ft/s)	19 74	20.25	19 71	19 9
Actual Stack Gas Flow Rate	Q	acfm	Q = 60 x Vs x As	109,874	112,729	109,684	110,762
Dry Stack Gas Flow Rate	Qs	Rcfm	Qs = Q x (1-Bwo) x (Tref/Ts) x (Ps/Pref)	84,872	83,270	82,367	83,436
		Rcms	Qs (Rcms) = 0 0004*2 x Qs (Rcfm)	39 97	39 30	38 88	39 4
Sulphur Dioxide - SO2							
SO2 Measured Concentration	Cso2	ppm	Measurement from Flue Gas Analyzer	0 00	0 00	0 00	0 00
Uncorrected @ Ref Cond	Cso2	mg/Rcm	Cso2 (mg/Rcm) = Cso2 (ppm) x 2.62	0 00	0 00	0 00	0 00
SO2 Emission Rate	ERso2	g/s	ERso2 = Cso2/1000 x Qs	0 00	0 00	0 00	0 00
		kg/hr	ERso2 (kg/hr) = 3.6 x ERso2 (g/s)	0 00	0 00	0 00	0 00
SO2 Concentration							
Corrected to 11% O2	Cso2	mg/Rcm	Cso2 (11% O2) = Cso2 (mg/Rcm) x (20.9-11) / (20.9-Co2)	0 00	0 00	0 00	0 00
Corrected to 3% O2	Cso2	mg/Rcm	Cso2 (3% O2) = Cso2 (mg/Rcm) x (20.9-3) / (20.9-Co2)	0 00	0 00	0 00	0 00
Corrected to 12% CO2	Cso2	mg/Rcm	Cso2 (12% CO2) = Cso2 (mg/Rcm) x (12/Cco2)	0 00	0 00	0 00	0 00
Nitrogen Oxides - NOx							
NOx Measured Concentration	Cnox	ppm	Measurement from Flue Gas Analyzer	18 86	17 57	36 71	24 38
Uncorrected @ Ref Cond	Cnox	mg/Rcm	Cnox (mg/Rcm) = Cnox (ppm) x 1.882	35 49	33 07	69.10	45 88
NOx Emission Rate	ERnox	g/s	ERnox = Cnox/1000 x Qs	1 42	1 30	2 69	1 80
		kg/hr	ERnox (kg/hr) = 3.6 x ERnox (g/s)	5 11	4 68	9 67	6 49
NOx Concentration							
Corrected to 11% O2	Cnox	mg/Rcm	Cnox (11% O2) = Cnox (mg/Rcm) x (20.9-11) / (20.9-Co2)	73.92	83 37	89 15	82 15
Corrected to 3% O2	Cnox	mg/Rcm	Cnox (3% O2) = Cnox (mg/Rcm) x (20.9-3) / (20.9-Co2)	133 66	150 73	161 19	148 53
Corrected to 12% CO2	Cnox	mg/Rcm	Cnox (12% CO2) = Cnox (mg/Rcm) x (12/Cco2)	168 52	177 27	196 22	180 67
Carbon Monoxide - CO							
CO Measured Concentration	Cco	ppm	Measurement from Flue Gas Analyzer	1037 43	235 14	388 14	553 57
Uncorrected @ Ref Cond	Cco	mg/Rcm	Cco (mg/Rcm) = Cco (ppm) x 1.145	1187 86	269.24	444 42	633 84
CO Emission Rate	ERco	g/s	ERco = Cco/1000 x Qs	47.47	10 58	17 28	25 11
		kg/hr	ERco (kg/hr) = 3.6 x ERco (g/s)	170 90	38.10	62.20	90 40
CO Concentration							
Corrected to 11% O2	Cco	mg/Rcm	Cco (11% O2) = Cco (mg/Rcm) x (20.9-11) / (20.9-Co2)	2474 25	678 73	573 42	1242 13
Corrected to 3% O2	Cco	mg/Rcm	Cco (3% O2) = Cco (mg/Rcm) x (20.9-3) / (20.9-Co2)	4473 65	1227.20	1036 80	2245 88
Corrected to 12% CO2	Cco	mg/Rcm	Cco (12% CO2) = Cco (mg/Rcm) x (12/Cco2)	5640 47	1443 27	1262 05	2781.93
Particulate Concentration	Cs	mg/Rcm	Cs = Mp / Vmc	60 04	59.63	129.48	83.05
Particulate Emission Rate	ERp	g/s	ERp = Cs/1000 x Qs	2 40	2 34	5 03	3 26
		kg/hr	ERp (kg/hr) = 3.6 x ERp (g/s)	8 64	8.44	18 12	11 73
Particulate Concentration							
Corrected to 11% O2	Cs	mg/Rcm	Cs (11% O2) = Cs x (20.9-11) / (20.9-Co2)	125 06	150 32	167 07	147 48
Corrected to 3% O2	Cs	mg/Rcm	Cs (3% O2) = Cs x (20.9-3) / (20.9-Co2)	226 11	271 78	302 07	266 65
Corrected to 12% CO2	Cs	mg/Rcm	Cs (12% CO2) = Cs x (12/Cco2)	285 09	319 64	367 70	324 14

Legend:
sq ft = square feet
sq m = square metres
Pi = 3 142
R = degrees Rankin
ppm = parts per million
in Hg = inches of mercury
cu ft = cubic feet
cu m = cubic metres
Ref Cond = reference temperature and pressure (25 C and 101 3 kPa)
Rcms = dry reference cubic metres per second
Rcfm = dry reference cubic feet per minute
mg/Rcm = milligrams per dry reference cubic metre
g/s = grams per second
NOx = as NO2
acfm = actual cubic feet per minute

OFFICIAL STACK TESTING RESULTS
Northern Pulp
Pictou, NS

Fuel: Natural Gas
Operating Conditions: low normal
Emission Control Equipment: scrubber
Stack Height from Grade: 51 m
Stack Diameter: 1.93 m

Parameter	Test 1	Test 2	Test 3	Average	NSDOE Limits
Test ID Test Date	PM-1 23-Jul-15	PM-2 23-Jul-15	PM-3 24-Jul-15	- -	- -
Stack Gas Temperature (C) Moisture Content (%) Velocity (m/s) Volumetric Flow (Rcms)	53.9 14.6 19.7 40.0	56.8 17.7 20.3 39.3	57.4 16.7 19.7 38.9	56.0 16.3 19.9 39.4	- - - -
Oxygen - O2 (%) Carbon Dioxide - CO2 (%)	16.1 2.53	17.0 2.24	13.2 4.23	15.4 3.00	- -
Sulphur Dioxide - SO2 SO2 Measured Concentration (ppm) Uncorrected at Ref Cond (mg/Rcm) Emission Rate (kg/hr)	0.0 0.0 0.00	0.0 0.0 0.00	0.0 0.0 0.00	0.0 0.0 0.00	- - -
Nitrogen Oxides - NOx NOx Measured Concentration (ppm) Uncorrected at Ref Cond (mg/Rcm) Emission Rate (kg/hr)	18.9 35.5 5.11	17.6 33.1 4.68	36.7 69.1 9.67	24.4 45.9 6.49	- - -
Carbon Monoxide - CO CO Measured Concentration (ppm) Uncorrected at Ref Cond (mg/Rcm) Emission Rate (kg/hr)	1037.4 1187.9 170.90	235.1 269.2 38.10	388.1 444.4 62.20	553.6 633.8 90.40	- - -
Particulate Matter - PM Particulate Concentration (mg/Rcm) Concentration, corrected to 11% O2 (mg/Rcm) Particulate Emission Rate (kg/hr)	60.0 125.1 8.64	59.6 150.3 8.44	129.5 167.1 18.12	83.0 147.5 11.73	- 150 -

Legend:
C - degrees Celsius
m/s - metres per second
Rcms - dry reference cubic metres per second
ppm - parts per million
Ref Cond - reference temperature and pressure (25 C and 101.3 kPa)
mg/Rcm - miligrams per dry reference cubic metre
NOx - as NO2
ND - non-detectable

Particulate Recovery: Impinger Catch, Probe Wash, Filter Catch

Client: Northern Pulp
Facility: Power Boiler
Location: Pictou, NS
Job Number: 121-013.0/01

IMPINGER CATCH

Container ID	Beaker Pre Weights (g)				Sample ID	Gravimetrics					Beaker Post Weights (g)				Uncorrected Particulate Weight (g)	Corrected Particulate Weight (g)
	Date					Jar + Sample + Rinse (g)	Jar Tare (g)	Sample Collected (g)	Rinse Water (g)	Total Rinse Water (g)	Date					
	Analysed by										Analysed by					
	Trial 1	Trial 2	Trial 3	Average							Trial 1	Trial 2	Trial 3	Average		
10	110.6664	110.6665		110.6665	Pkt 1	495.4	391.2	203.7	11.9	110.4	110.6648	110.6642		110.6644	0.0218	0.0271
12	112.1681	112.1681		112.1683	Pkt 2	797.4	394.0	207.8	10.5	146.1	112.1736	112.1733		112.1735	0.0052	0.0063
13	109.0748	109.0748		109.0747	Pkt 3	647.1	394.0	207.7	11.1	28.9	109.0792	109.0787		109.0790	0.0043	0.0053
11	109.1826	109.1824		109.1977	MR	464.2	394.0	68.7		94.2	109.1944	109.1947		109.1947	0.0029	Conc. (g/mL) 0.000035

PROBE WASH

Container ID	Beaker Pre Weights (g)				Sample ID	Gravimetrics					Beaker Post Weights (g)				Uncorrected Particulate Weight (g)	Corrected Particulate Weight (g)
	Date					Jar + Acetone (g)	Jar Tare (g)	Recovered Acetone (g)	Rinse Acetone	Total Acetone (g)	Date					
	Analysed by										Analysed by					
	Trial 1	Trial 2	Trial 3	Average							Trial 1	Trial 2	Trial 3	Average		
31	108.5887	108.5887		108.5887	Pkt 1	480.3	382.8	97.2	23.3	122.2	108.5284	108.5290		108.5287	0.0396	0.0263
32	120.1098	120.1102		120.1101	Pkt 2	481.8	381.2	95.5	14.7	104.7	120.1324	120.1320		120.1322	0.0222	0.0148
47	113.1929	113.1929		113.1929	Pkt 3	477.7	382.8	90.2	9.2	99.4	113.2092	113.2094		113.2093	0.0164	0.0109
12	113.2481	113.2481		113.2481	MR	777.2	777.2	0.0		0.0	113.2484	113.2483		113.2484	0.0004	Conc. (g/mL) 0.000027

Density of Acetone = 0.7880 g/mL

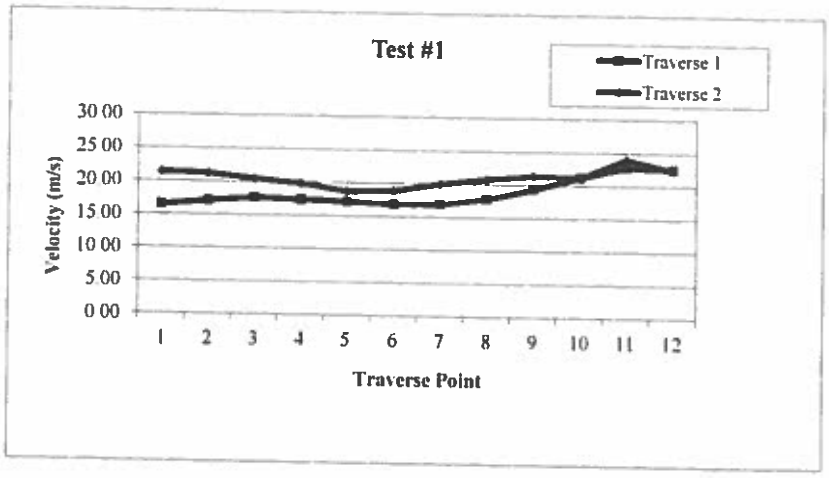
FILTER CATCH

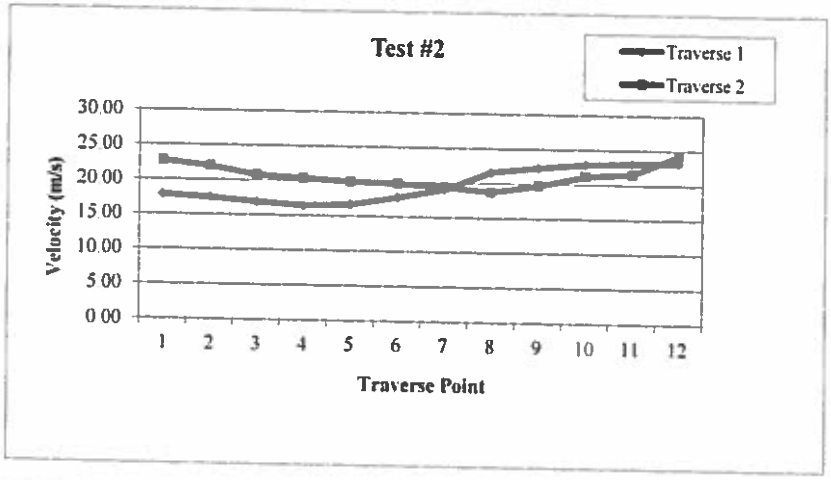
Filter ID	Pre Weights (g)				Sample ID	Post Weights (g)				Particulate Weight from Filter (g)
	Date					Date				
	Analysed by					Analysed by				
	Trial 1	Trial 2	Trial 3	Average		Trial 1	Trial 2	Trial 3	Average	
2716-16	0.1203	0.1204		0.1204	Pkt 1	0.1813	0.1813		0.1813	0.0739
2716-11	0.3611	0.3611		0.3611	Pkt 2	0.4297	0.4299		0.4298	0.0779
2716-19	0.1777	0.1777		0.1778	Pkt 3	0.2274	0.2271		0.2272	0.0494

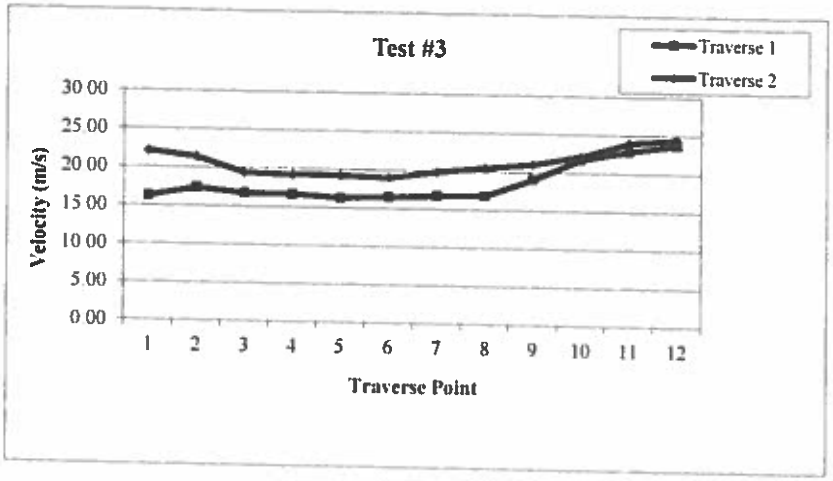
Northern Pulp
Power Boiler

121413456

Stack Gas Velocity Profiles
Pictou, NS







Raw Data for: Northern Pulp Dissolving Tank PM
Test #1

Client: Northern Pulp
Job Number: 121413456

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-1
Date: 31-Jul-13
Personnel: JB/TS

Test Start: 9:00 AM
Test Finish: 10:50 AM

Particulate Collected from Filter (mg):	391.9
Particulate Collected from Probe Wash (mg):	46.4
Particulate Collected from Impinger Wash (mg):	29.4
Total Particulate Collected (mg):	467.7

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	968.1	708.5	279.6
2	100 mL H2O	820.0	743.1	76.9
3	Blank	695.1	693.7	1.4
4	200g Silica Gel	953.9	947.1	6.8
5	Blank	995.1	995.0	330.1
			Total Weight Gain (g)	694.8
			Moisture Volume (mL)	694.8

Parameters	
Barometric Pressure, Pbar (in. Hg)	29.70
Stack Static Pressure, Pstatic (in. H2O)	-0.20
Ambient Temp, (°F)	63
H2O Volume Collected, Vw (mL)	694.8
Total # Sampling Points,	20
Sampling Time per Point, (min)	5
Readings Taken Every __ mins	2.5
Regulatory Agency	NSENV

O2, (%)	20.9
CO2, (%)	0.0
N2, (%)	79.1
CO(ppm)	0.0
NOx (ppm)	0.0
SO2 (ppm)	0.0

Stack Diameter, (in.)	48
Stack Area, (sq. ft.)	12.57
Probe Length, (ft.)	5
Nozzle Diameter, (in.)	0.306
Pitot Coefficient, (Cp)	0.836
Gamma, meter constant	1.117
Port length (in.)	6

Traverse	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						732.770		
Traverse 1	1	2.5	171	0.10	0.19	733.320	87	87
		5	182	0.10	0.19	733.900	87	87
	2	7.5	184	0.15	0.29	734.550	87	87
		10	184	0.15	0.29	735.250	87	87
	3	12.5	184	0.15	0.29	735.940	87	87
		15	183	0.15	0.29	736.660	87	87
	4	17.5	183	0.15	0.29	737.370	87	87
		20	180	0.15	0.29	738.070	87	87
	5	22.5	172	0.10	0.19	738.650	87	87
		25	181	0.15	0.29	739.370	87	87
	6	27.5	183	0.15	0.29	740.070	87	87
		30	183	0.15	0.29	740.780	88	87
	7	32.5	183	0.15	0.29	741.480	88	87
		35	183	0.10	0.15	742.080	88	87
	8	37.5	160	0.10	0.20	742.660	88	86
		40	174	0.10	0.20	743.260	88	86
	9	42.5	173	0.10	0.19	743.880	88	86
		45	175	0.10	0.19	744.450	88	86
	10	47.5	175	0.10	0.19	745.040	88	86
		50	174	0.10	0.19	745.610	88	86
						745.610		
Traverse 2	1	52.5	182	0.09	0.17	746.160	88	88
		55	172	0.06	0.19	746.690	88	88
	2	57.5	180	0.10	0.19	747.260	88	88
		60	180	0.10	0.19	747.830	88	88
	3	62.5	180	0.13	0.25	748.480	88	88
		65	181	0.13	0.25	749.150	88	88
	4	67.5	175	0.12	0.23	749.810	88	88
		70	176	0.12	0.23	750.440	88	88
	5	72.5	176	0.13	0.25	751.110	88	88
		75	155	0.14	0.28	751.800	88	88
	6	77.5	170	0.17	0.33	752.530	89	88
		80	172	0.23	0.48	753.450	89	88
	7	82.5	163	0.28	0.54	754.410	89	88
		85	141	0.30	0.61	755.430	89	88
	8	87.5	139	0.33	0.67	756.470	89	88
		90	142	0.33	0.67	757.340	90	89
	9	92.5	140	0.35	0.71	758.640	90	89
		95	137	0.50	1.01	759.990	90	89
	10	97.5	140	0.70	1.43	761.300	91	89
		100	141	0.70	1.43	762.790	91	89

Calculations for: Northern Pulp Dissolving Tank PM
Test #1

Client: Northern Pulp
Job Number: 121413458

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-1
Date: 21-Jul-15
Personnel: JJS/TS

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.69
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	28.84
Volume of Water Vapour Collected, Vwc (cu ft)	33.350
Stack Gas Moisture Content (% as decimal)	0.005
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	29.38

Isokineticity Checks

Check range	Outside of Criteria
Check average	Within Criteria

		Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu ft.)	Vol. @ Ref., Vmc (cu ft.)	Isokinetics (%)
Traverse 1	1	2.5	631	0.10	0.19	21.52	29.71	547	0.550	0.599	87.01
		5	642	0.10	0.19	21.71	29.71	547	0.580	0.632	92.55
	2	7.5	644	0.15	0.29	26.62	29.72	547	0.650	0.708	84.84
		10	644	0.15	0.29	26.62	29.72	547	0.700	0.763	91.37
	3	12.5	644	0.15	0.29	26.62	29.72	547	0.690	0.752	90.06
		15	643	0.15	0.29	26.60	29.72	547	0.720	0.784	93.90
	4	17.5	643	0.15	0.29	26.60	29.72	547	0.710	0.773	92.66
		20	640	0.15	0.29	26.54	29.72	547	0.700	0.763	91.08
	5	22.5	632	0.10	0.19	21.54	29.71	547	0.540	0.632	91.63
		25	641	0.15	0.29	26.56	29.72	547	0.720	0.784	93.79
	6	27.5	643	0.15	0.29	26.60	29.72	547	0.700	0.763	91.30
		30	643	0.15	0.29	26.60	29.72	548	0.710	0.773	92.52
	7	32.5	643	0.15	0.29	26.60	29.72	548	0.700	0.762	91.21
		35	643	0.10	0.19	21.72	29.71	548	0.600	0.653	98.73
	8	37.5	620	0.10	0.20	21.33	29.71	548	0.580	0.630	90.79
		40	634	0.10	0.20	21.97	29.71	548	0.600	0.652	94.97
	9	42.5	633	0.10	0.19	21.95	29.71	548	0.620	0.674	98.06
		45	635	0.10	0.19	21.99	29.71	548	0.570	0.620	90.29
	10	47.5	635	0.10	0.19	21.99	29.71	548	0.580	0.641	93.46
		50	634	0.10	0.19	21.97	29.71	548	0.570	0.620	90.22
Traverse 2	1	52.5	642	0.09	0.17	20.99	29.71	548	0.550	0.598	92.34
		55	632	0.08	0.15	19.26	29.71	548	0.530	0.578	93.63
	2	57.5	640	0.10	0.19	21.67	29.71	548	0.570	0.620	90.65
		60	640	0.10	0.19	21.67	29.71	548	0.570	0.620	90.65
	3	62.5	640	0.13	0.25	24.71	29.72	548	0.650	0.707	90.67
		65	641	0.13	0.25	24.73	29.72	548	0.670	0.729	93.54
	4	67.5	635	0.12	0.23	23.65	29.72	548	0.660	0.718	95.45
		70	636	0.12	0.23	23.67	29.72	548	0.630	0.685	91.18
	5	72.5	636	0.13	0.25	24.63	29.72	548	0.670	0.728	93.17
		75	615	0.14	0.26	25.14	29.72	548	0.690	0.750	90.93
	6	77.5	630	0.17	0.33	28.03	29.72	549	0.750	0.815	90.71
		80	632	0.25	0.48	34.05	29.74	549	0.900	0.978	89.94
	7	82.5	623	0.28	0.54	35.20	29.74	549	0.960	1.044	89.56
		85	621	0.30	0.61	36.37	29.74	549	1.020	1.109	90.77
	8	87.5	610	0.33	0.67	38.43	29.75	549	1.040	1.131	88.91
		90	602	0.33	0.67	38.18	29.75	550	1.070	1.161	90.71
	9	92.5	600	0.35	0.71	38.26	29.75	550	1.100	1.194	90.41
		95	597	0.50	1.01	46.80	29.77	550	1.250	1.358	85.80
	10	97.5	600	0.70	1.43	55.52	29.81	550	1.410	1.532	82.01
		100	601	0.70	1.43	55.56	29.81	550	1.490	1.619	85.74
			Total 100	Average 630	Average 0.19	Average 0.37	Average 27.97	Average 29.73	Average 548	Total 30.020	Total 32.645	Average 91.11

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-1
Date: 21-Jul-15
Personnel: JJB/FS

Test Start:
Test Finish:

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	20.9	0.0	0.0	0.0	0.0
5	20.9	0.0	0.0	0.0	0.0
10	20.9	0.0	0.0	0.0	0.0
15	20.9	0.0	0.0	0.0	0.0
20	20.9	0.0	0.0	0.0	0.0
25	20.9	0.0	0.0	0.0	0.0
30	20.9	0.0	0.0	0.0	0.0
Average:	20.9	0.0	0.0	0.0	0.0

Raw Data for: Northern Pulp Dissolving Tank PM
Test #2

Client: Northern Pulp
Job Number: 121413456

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-2
Date: 23-Jul-15
Personnel: JB/TS

Test Start: 12:45 PM
Test Finish: 2:25 PM

Particulate Collected from Filter (mg):	576.2
Particulate Collected from Probe Wash (mg):	184.3
Particulate Collected from Impinger Wash (mg):	21.6
Total Particulate Collected (mg):	782.2

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	919.7	706.9	213.8
2	100 mL H2O	736.8	728.7	7.9
3	Blank	885.9	884.3	1.6
4	200g Silica Gel	964.4	957.4	7.0
5	blank	1067.8	656.1	411.7
			Total Weight Gain (g)	642.0
			Moisture Volume (mL)	642.0

Parameters

Barometric Pressure, Pbar (in. Hg)	29.80
Stack Static Pressure, Pstatic (in. H2O)	-0.20
Ambient Temp, (°F)	59
H2O Volume Collected, Vw (mL)	642.0
Total # Sampling Points,	20
Sampling Time per Point, (min)	5
Readings Taken Every __ mins	2.5
Regulatory Agency	NSENV

O2, (%)	20.9
CO2, (%)	0.0
N2, (%)	79.1
CO(ppm)	0.0
NOx (ppm)	0.0
SO2 (ppm)	0.0

Stack Diameter, (in.)	48
Stack Area, (sq. ft.)	12.57
Probe Length, (ft.)	5
Nozzle Diameter, (in.)	0.305
Pitot Coefficient, (Cp)	0.836
Gamma, meter constant	1.117
Port length (in.)	6

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						776.990		
Traverse 1	1	2.5	183	0.13	0.31	777.730	91	83
		5	188	0.13	0.30	778.460	83	83
	2	7.5	183	0.27	0.34	779.190	83	83
		10	187	0.15	0.34	779.870	83	83
	3	12.5	188	0.12	0.24	780.470	83	83
		15	177	0.13	0.25	781.320	83	83
	4	17.5	177	0.16	0.33	782.050	86	83
		20	185	0.16	0.32	782.790	86	83
	5	22.5	185	0.12	0.24	783.470	86	86
		25	185	0.12	0.24	784.130	86	86
	6	27.5	183	0.12	0.24	784.770	87	86
		30	183	0.12	0.24	785.380	87	86
	7	32.5	186	0.10	0.20	786.020	87	86
		35	175	0.10	0.20	786.630	87	86
	8	37.5	182	0.10	0.20	787.210	87	86
		40	183	0.10	0.20	787.790	87	86
	9	42.5	182	0.11	0.22	788.400	87	86
		45	184	0.10	0.20	789.010	88	86
	10	47.5	179	0.12	0.24	789.630	87	86
		50	177	0.12	0.24	790.280	87	86
						790.280		
Traverse 2	1	52.5	181	0.12	0.24	790.920	88	87
		55	180	0.12	0.24	791.550	88	87
	2	57.5	179	0.13	0.24	792.180	88	87
		60	179	0.12	0.21	792.810	88	87
	3	62.5	180	0.13	0.27	793.500	88	87
		65	178	0.13	0.27	794.170	88	87
	4	67.5	179	0.13	0.27	794.840	88	87
		70	183	0.13	0.27	795.490	88	88
	5	72.5	182	0.13	0.21	796.170	88	88
		75	180	0.11	0.23	796.840	88	88
	6	77.5	180	0.11	0.23	797.490	88	88
		80	180	0.11	0.23	798.110	88	88
	7	82.5	180	0.11	0.23	798.740	88	88
		85	180	0.11	0.23	799.360	88	88
	8	87.5	179	0.10	0.21	799.970	88	88
		90	180	0.10	0.21	800.580	88	88
	9	92.5	181	0.10	0.21	801.180	88	88
		95	183	0.10	0.21	801.800	88	88
	10	97.5	172	0.13	0.27	802.500	88	88
		100	170	0.13	0.27	803.170	88	88

Calculations for: Northern Pulp Dissolving Tank PM
Test #2

Client: Northern Pulp
Job Number: 121413456

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-3
Date: 22-Jul-15
Personnel: JJB/PB

Calculated Parameters

Stack Gas Pressure, Ps (in Hg)	29.79
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	28.84
Volume of Water Vapour Collected, Vwc (cu ft)	30.816
Stack Gas Moisture Content (% as decimal)	0.018
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	28.22

Isokineticity Checks

Check range	Within Criteria
Check average	Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp. Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	643	0.15	0.31	28.64	29.82	545	0.740	0.812	99.38
	2	5	648	0.15	0.30	28.74	29.82	545	0.730	0.801	98.41
		7.5	645	0.17	0.34	28.41	29.83	545	0.730	0.801	92.24
	3	10	647	0.17	0.34	28.45	29.83	545	0.780	0.856	98.71
		12.5	646	0.12	0.24	23.92	29.82	545	0.700	0.768	105.49
	4	15	637	0.12	0.25	23.72	29.82	545	0.650	0.713	97.12
		17.5	637	0.16	0.33	27.39	29.82	546	0.730	0.800	94.39
	5	20	645	0.16	0.32	27.96	29.82	546	0.740	0.811	96.28
		22.5	645	0.12	0.24	23.87	29.82	546	0.660	0.744	102.05
	6	25	645	0.12	0.24	23.87	29.82	546	0.660	0.723	99.05
		27.5	645	0.12	0.24	23.87	29.82	547	0.640	0.700	95.96
	7	30	645	0.12	0.24	23.87	29.82	547	0.610	0.667	91.46
		32.5	646	0.10	0.20	21.80	29.81	547	0.640	0.700	105.19
	8	35	635	0.10	0.20	21.62	29.81	547	0.910	0.667	99.40
		37.5	642	0.10	0.20	21.74	29.81	547	0.580	0.634	95.03
	9	40	643	0.10	0.20	21.75	29.81	547	0.580	0.634	95.11
		42.5	642	0.11	0.22	22.60	29.82	547	0.610	0.667	95.30
	10	45	644	0.10	0.20	21.77	29.81	547	0.610	0.667	100.01
		47.5	639	0.12	0.24	23.75	29.82	547	0.640	0.700	95.51
		50	637	0.12	0.24	23.72	29.82	547	0.630	0.689	93.67
Traverse 2	1	52.5	641	0.12	0.24	23.79	29.82	548	0.640	0.699	95.49
		55	640	0.12	0.24	23.77	29.82	548	0.630	0.688	93.92
	2	57.5	633	0.12	0.24	23.68	29.82	548	0.630	0.688	93.35
		60	639	0.12	0.21	23.75	29.82	548	0.630	0.688	93.84
	3	62.5	640	0.13	0.27	24.74	29.82	548	0.690	0.753	98.84
		65	638	0.13	0.27	24.70	29.82	548	0.670	0.732	95.82
	4	67.5	639	0.13	0.27	24.72	29.82	548	0.670	0.732	95.80
		70	643	0.13	0.27	24.80	29.82	548	0.650	0.709	93.24
	5	72.5	642	0.13	0.21	24.78	29.82	548	0.680	0.742	97.45
		75	640	0.11	0.23	22.78	29.82	548	0.670	0.731	104.23
	6	77.5	629	0.11	0.23	22.56	29.82	548	0.650	0.709	100.25
		80	640	0.11	0.23	22.78	29.82	548	0.620	0.676	96.45
	7	82.5	640	0.11	0.23	22.78	29.82	548	0.620	0.667	96.01
		85	640	0.11	0.23	22.78	29.82	548	0.620	0.676	96.45
	8	87.5	638	0.10	0.21	21.68	29.82	548	0.610	0.665	99.44
		90	640	0.10	0.21	21.70	29.82	548	0.610	0.665	99.52
	9	92.5	641	0.10	0.21	21.72	29.82	548	0.600	0.654	97.67
		95	643	0.10	0.21	21.75	29.82	548	0.620	0.676	101.39
	10	97.5	632	0.13	0.27	24.59	29.82	548	0.700	0.764	99.55
		100	630	0.13	0.27	24.55	29.82	548	0.670	0.731	95.13
		Total 100	Average 641	Average 0.12	Average 0.25	Average 23.69	Average 29.82	Average 547	Total 28.160	Total 28.620	Average 97.41

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-2
Date: 22-Jul-15
Personnel: JJB/FS

Test Start: 1:00 PM
Test Finish: 1:30 PM

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	20.9	0.0	0.0	0.0	0.0
5	20.9	0.0	0.0	0.0	0.0
10	20.9	0.0	0.0	0.0	0.0
15	20.9	0.0	0.0	0.0	0.0
20	20.9	0.0	0.0	0.0	0.0
25	20.9	0.0	0.0	0.0	0.0
30	20.9	0.0	0.0	0.0	0.0
Average:	20.9	0.0	0.0	0.0	0.0

Raw Data for: Northern Pulp Dissolving Tank PM
Test #3

Client: Northern Pulp
Job Number: 121413486

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-3
Date: 23-Mar-13
Personnel: JB/TS

Test Start: 3:53 PM
Test Finish: 5:40 PM

Particulate Collected from Filter (mg):	372.4
Particulate Collected from Probe Wash (mg):	160.9
Particulate Collected from Impinger Wash (mg):	13.7
Total Particulate Collected (mg):	547.0

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	881.8	703.0	166.0
2	100 mL H2O	740.0	733.5	6.5
3	Blank	595.0	594.1	0.9
4	200g Silica Gel	981.1	975.5	5.6
5	blank	1064.8	655.4	409.2
			Total Weight Gain (g)	610.2
			Moisture Volume (mL)	610.2

Parameters

Barometric Pressure, Pbar (in. Hg)	29.30	O2, (%)	20.9	Stack Diameter, (in.)	48
Stack Static Pressure, Pstatic (in. H2O)	-0.20	CO2, (%)	0.0	Stack Area, (sq. ft.)	12.57
Ambient Temp, (°F)	61.00	N2, (%)	79.1	Probe Length, (ft.)	5
H2O Volume Collected, Vw (mL)	610.20	CO(ppm)	0.0	Nozzle Diameter, (in.)	0.305
Total # Sampling Points,	20	NOx (ppm)	0.0	Pitot Coefficient, (Cp)	0.839
Sampling Time per Point, (min)	3	SO2 (ppm)	0.0	Gamma, meter constant	1.117
Readings Taken Every __ mins	2.5			Port length (in.)	8
Regulatory Agency	NSENV				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp Inlet (°F)	Gas Meter Temp Outlet (°F)
						803.660		
Traverse 1	1	2.5	170	0.10	0.21	804.260	86	86
		5	169	0.10	0.21	804.950	86	86
	2	7.5	170	0.10	0.21	805.440	86	86
		10	170	0.10	0.21	806.030	86	86
	3	12.5	171	0.12	0.25	806.670	86	86
		15	168	0.12	0.25	807.320	86	86
	4	17.5	170	0.12	0.25	807.980	87	86
		20	171	0.13	0.27	808.670	87	86
	5	22.5	170	0.13	0.27	809.350	87	87
		25	171	0.13	0.27	810.040	87	87
	6	27.5	172	0.13	0.27	810.720	87	87
		30	170	0.13	0.27	811.420	87	87
	7	32.5	170	0.13	0.27	812.110	87	87
		35	170	0.13	0.27	812.808	87	87
	8	37.5	172	0.15	0.31	813.548	88	87
		40	171	0.15	0.31	814.298	88	87
	9	42.5	171	0.15	0.31	815.040	88	87
		45	172	0.15	0.31	815.789	88	87
	10	47.5	172	0.15	0.31	816.539	88	87
		50	172	0.13	0.27	817.240	88	87
						817.240		
Traverse 2	1	52.5	173	0.13	0.27	817.960	88	87
		55	173	0.13	0.27	818.660	88	87
	2	57.5	172	0.13	0.27	819.345	88	88
		60	171	0.13	0.27	820.050	89	88
	3	62.5	172	0.14	0.29	820.760	89	88
		65	172	0.14	0.29	821.470	89	88
	4	67.5	173	0.14	0.29	822.170	89	88
		70	172	0.13	0.31	822.930	89	88
	5	72.5	171	0.13	0.31	823.680	89	88
		75	173	0.15	0.31	824.428	89	88
	6	77.5	173	0.15	0.31	825.180	89	88
		80	177	0.15	0.31	825.910	89	88
	7	82.5	177	0.15	0.31	826.640	89	88
		85	178	0.15	0.31	827.370	89	88
	8	87.5	173	0.15	0.31	828.098	89	89
		90	176	0.13	0.31	828.820	89	89
	9	92.5	174	0.13	0.27	829.550	90	89
		95	173	0.13	0.27	830.260	90	89
	10	97.5	174	0.13	0.27	830.970	90	89
		100	174	0.13	0.27	831.670	90	89

Calculations for: Northern Pulp Dissolving Tank PM
Test #3

Client: Northern Pulp
Job Number: 121413456

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-3
Date: 22-Jul-15
Personnel: JJB/FB

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	28.49
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	28.84
Volume of Water Vapour Collected, Vwc (cu.ft)	29.290
Stack Gas Moisture Content (% as decimal)	0.492
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	23.51

Isokineticity Checks

Check range	Within Criteria
Check average	Within Criteria

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Std., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	2.5	630	0.10	0.21	21.51	29.52	548	0.600	0.650	92.47
		5	629	0.10	0.21	21.49	29.52	548	0.590	0.639	90.86
	2	7.5	630	0.10	0.21	21.51	29.52	548	0.590	0.639	90.93
		10	630	0.10	0.21	21.51	29.52	548	0.590	0.639	90.93
	3	12.5	631	0.12	0.25	23.58	29.52	548	0.590	0.639	90.93
		15	628	0.12	0.25	23.52	29.52	548	0.640	0.694	90.12
	4	17.5	630	0.12	0.25	23.58	29.52	548	0.650	0.704	91.31
		20	631	0.13	0.27	24.54	29.52	547	0.660	0.715	92.76
	5	22.5	630	0.13	0.27	24.52	29.52	547	0.690	0.747	93.27
		25	631	0.13	0.27	24.54	29.52	547	0.680	0.736	91.76
	6	27.5	631	0.13	0.27	24.54	29.52	547	0.690	0.747	93.19
		30	630	0.13	0.27	24.52	29.52	547	0.680	0.736	91.84
	7	32.5	630	0.13	0.27	24.52	29.52	547	0.700	0.757	94.46
		35	630	0.13	0.27	24.52	29.52	547	0.690	0.747	93.11
	8	37.5	632	0.15	0.31	26.38	29.52	547	0.690	0.747	93.11
		40	631	0.15	0.31	26.36	29.52	548	0.740	0.800	93.04
	9	42.5	631	0.15	0.31	26.36	29.52	548	0.750	0.811	94.22
		45	632	0.15	0.31	26.38	29.52	548	0.750	0.811	94.22
	10	47.5	632	0.15	0.31	26.38	29.52	548	0.740	0.800	93.04
		50	632	0.13	0.27	24.56	29.52	548	0.740	0.800	93.04
									0.720	0.778	97.23
Traverse 2	1	52.5	633	0.13	0.27	24.58	29.50	548	0.720	0.778	97.24
		55	633	0.13	0.27	24.58	29.52	548	0.700	0.757	94.60
	2	57.5	632	0.13	0.27	24.56	29.52	548	0.685	0.740	92.42
		60	631	0.13	0.27	24.54	29.52	548	0.705	0.761	94.95
	3	62.5	632	0.14	0.29	25.49	29.52	548	0.710	0.766	92.22
		65	632	0.14	0.29	25.49	29.52	548	0.710	0.766	92.22
	4	67.5	633	0.14	0.29	25.51	29.52	549	0.700	0.755	91.00
		70	632	0.15	0.31	26.38	29.52	549	0.760	0.820	95.37
	5	72.5	631	0.15	0.31	26.36	29.52	549	0.750	0.809	94.05
		75	631	0.15	0.31	26.36	29.52	549	0.740	0.799	92.79
	6	77.5	635	0.15	0.31	26.45	29.52	549	0.740	0.799	93.09
		80	637	0.15	0.31	26.49	29.52	549	0.750	0.809	94.49
	7	82.5	637	0.15	0.31	26.49	29.52	549	0.730	0.788	91.97
		85	638	0.15	0.31	26.51	29.52	549	0.730	0.788	92.05
	8	87.5	635	0.15	0.31	26.45	29.52	549	0.720	0.778	90.48
		90	636	0.15	0.31	26.47	29.52	549	0.730	0.787	91.82
	9	92.5	634	0.13	0.27	24.60	29.52	550	0.730	0.786	90.38
		95	633	0.13	0.27	24.58	29.52	550	0.710	0.765	95.60
	10	97.5	634	0.13	0.27	24.60	29.52	550	0.710	0.765	95.68
		100	634	0.13	0.27	24.60	29.52	550	0.700	0.754	94.33
		Total 100	Average 632	Average 0.13	Average 0.26	Average 24.90	Average 29.52	Average 548	Total 28.010	Total 30.263	Average 93.24

Combustion Gas Data for: Northern Pulp

Client: Northern Pulp
Job Number: 121413456

Plant: Dissolving Tank
Location: Pictou, NS
Test: PM-3
Date: 22-Jul-15
Personnel: JJB/FS

Test Start: 4:00 PM
Test Finish: 4:30 PM

Time (min)	O2 (%)	CO2 (%)	CO (ppm)	SO2 (ppm)	NOx (ppm)
0	20.9	0.0	0.0	0.0	0.0
5	20.9	0.0	0.0	0.0	0.0
10	20.9	0.0	0.0	0.0	0.0
15	20.9	0.0	0.0	0.0	0.0
20	20.9	0.0	0.0	0.0	0.0
25	20.9	0.0	0.0	0.0	0.0
30	20.9	0.0	0.0	0.0	0.0
Average:	20.9	0.0	0.0	0.0	0.0

DATA ENTRY

Northern Pulp
Pictou, NS
Fuel: NA
Operating Conditions: normal
Emission Control Equipment: NA
Stack Height from Grade: 51 m
Stack Diameter: 1.22 m

Reference Temperature, Tref (F):	77	
(K):	298	
Reference Pressure, Pref (in.Hg):	29.92	
(Bar):	1.0	

Parameter	Symbol	Units	Test 1	Test 2	Test 3	Average
Test ID	-	-	PM-1	PM-2	PM-3	-
Date	-	-	21-Jul-15	22-Jul-15	22-Jul-15	n/a
Start Time	-	-	9:00 AM	12:45 PM	3:55 PM	n/a
End Time	-	-	10:50 AM	2:25 PM	5:40 PM	n/a
Total Sampling Time	-	min	100	100	100	100
Stack Diameter	D	in.	48	48	48	48
Average Stack Gas Temperature	Ts	F	170	181	172	174
Average Dry Gas Meter Temperature	Tm	F	88	87	88	88
Barometric Pressure	Pbar	in.Hg	29.70	29.80	29.50	29.67
Stack Static Pressure	Pstatic	in.H2O	-0.20	-0.20	-0.20	-0.20
Average Pressure Drop (Head)	dP	in.H2O	0.19	0.12	0.13	0.15
Average deltaH Orifice	dH	in.H2O	0.37	0.25	0.28	0.30
Average Meter Temperature	Tm	F	88	87	88	88
Gas Sample Volume	Vm	cu.ft	30.02	26.18	28.01	28.07
Average Isokinetics	I	%	91.11	97.41	93.24	93.92
Nozzle Diameter	Dn	in.	0.306	0.306	0.306	0.306
Pitot Coefficient	Cp	-	0.836	0.836	0.836	0.836
Gamma, meter constant	y	-	1.117	1.117	1.117	1.117
Reference Temperature	Tref	R	537	537	537	537
Reference Pressure	Pref	in.Hg	29.92	29.92	29.92	29.92
Stack Gas Oxygen Content	Co2	%	20.9	20.9	20.9	20.9
Stack Gas Carbon Dioxide Content	Cco2	%	0.0	0.0	0.0	0.0
Stack Gas Nitrogen Content	Cn2	%	79.1	79.1	79.1	79.1
Stack Gas Sulphur Dioxide Content	Cso2	ppm	0.0	0.0	0.0	0.0
Stack Gas Nitrogen Oxides Content	Cnox	ppm	0.0	0.0	0.0	0.0
Stack Gas Carbon Monoxide Content	Cco	ppm	0.0	0.0	0.0	0.0
Volume of Water Collected	Vw	mL	694.8	642.0	610.2	649.0
Particulate Collected from Filter	-	mg	391.9	576.2	372.4	446.8
Particulate Collected from Probe Wash	-	mg	46.4	194.3	160.9	133.8
Particulate Collected from Impinger Wash	-	mg	29.4	21.8	13.7	21.7
Total Particulate Collected (excluding impingers)	Mp	mg	438.3	770.4	533.2	580.6
Pulp production		adubmt/day	596	701	701	666.0

Legend:
F - degrees Fahrenheit
K - degrees Kelvin
Bar - bars
in Hg - inches of mercury
in. - inches
in H2O - inches of water
cu ft - cubic feet
R - degrees Rankin
NOx - as NO2

CALCULATIONS

Northern Pulp
Pictou, NS
Fuel: NA
Operating Conditions: normal
Emission Control Equipment: NA
Stack Height from Grade: 51 m
Stack Diameter: 1.22 m

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Stack Area	As	sq ft	As = Pi x ((D/12)^2) / 4	12.57	12.57	12.57	12.57
		sq m	As (sq m) = As (sq ft) x 0.0929	1.17	1.17	1.17	1.17
Barometric Pressure	Pbar	kPa	Pbar (kPa) = Pbar (in.Hg) x 3.386	100.6	100.9	99.9	100.5
Stack Static Pressure	Pstatic	kPa	Pstatic (kPa) = Pstatic (in.H2O) x 0.249	-0.05	-0.05	-0.05	-0.05
Avg. Stack Temperature	Ts	R	Ts (R) = Ts (F) + 460	630	641	632	634
Avg. Meter Temperature	Tm	R	Tm (R) = Tm (F) + 460	548	547	548	547.5
Nozzle Diameter	Dn	mm	Dn (mm) = Dn (in.) x 25.4	8	8	8	7.8
Gas Meter Pressure	Pm	in.Hg	Pm = Pbar + (dH / 13.6)	29.73	29.82	29.52	29.69
Sample Volume at Ref Cond	Vmc	cu.ft	Vmc = Tref/Pref x (Vm x Pm x y) / Tm	32.65	28.62	30.27	30.5
		cu.m	Vmc (cu.m) = 0.02832 x Vmc (cu.ft)	0.92	0.81	0.86	0.86
Volume of Water Vapour	Vwc	cu.ft	Vwc = 0.0480 x Vlc	33.35	30.82	29.29	31.15
Water Fraction	Bwo	-	Bwo = Vwc / (Vwc + Vmc)	0.505	0.518	0.492	0.5
Molecular Weight, Dry	Md	lb/lb-mol	Md = 0.44 (Co2) + 0.32 (O2) + 0.28 (Co2)	28.84	28.84	28.84	28.8
Molecular Weight, Wet	Ms	lb/lb-mol	Ms = Md (1 - Bwo) + (18 x Bwo)	23.36	23.22	23.51	23.4
Stack Pressure	Ps	in.Hg	Ps = Pbar + (Pstatic / 13.6)	29.69	29.79	29.49	29.65
Stack Gas Velocity	Us	ft/s	Us = 85.33 x Cp x ((dP x Ts)/(Ps x Ms))^0.5	27.97	23.89	24.90	25.6
		m/s	Us (m/s) = 0.3048 x Us (ft/s)	8.53	7.28	7.59	7.8
Actual Stack Gas Flow Rate	Q	acfm	Q = 60 x Us x As	21,089	18,012	18,772	19,291
Dry Stack Gas Flow Rate	Qs	Rcfm	Qs = Q x (1-Bwo) x (Tref/Ts) x (Ps/Pref)	8,823	7,238	7,987	8,015
		Rcms	Qs (Rcms) = 0.000472 x Qs (Rcfm)	4.16	3.42	3.77	3.8
Sulphur Dioxide - SO2							
SO2 Measured Concentration	Cso2	ppm	Measurement from Flue Gas Analyzer	0.00	0.00	0.00	0.00
Uncorrected @ Ref Cond	Cso2	mg/Rcm	Cso2 (mg/Rcm) = Cso2 (ppm) x 2.62	0.00	0.00	0.00	0.00
SO2 Emission Rate	ERso2	g/s	ERso2 = Cso2/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERso2 (kg/hr) = 3.6 x ERso2 (g/s)	0.00	0.00	0.00	0.00
SO2 Concentration							
Corrected to 11% O2	Cso2	mg/Rcm	Cso2 (11% O2) = Cso2 (mg/Rcm) x (20.9-11) / (20.9-Co2)	#DIV/0!	#DIV/0!	0.00	#DIV/0!
Corrected to 3% O2	Cso2	mg/Rcm	Cso2 (3% O2) = Cso2 (mg/Rcm) x (20.9-3) / (20.9-Co2)	#DIV/0!	#DIV/0!	0.00	#DIV/0!
Corrected to 12% CO2	Cso2	mg/Rcm	Cso2 (12% CO2) = Cso2 (mg/Rcm) x (12/Cco2)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Nitrogen Oxides - NOx							
NOx Measured Concentration	Cnox	ppm	Measurement from Flue Gas Analyzer	0.00	0.00	0.00	0.00
Uncorrected @ Ref Cond	Cnox	mg/Rcm	Cnox (mg/Rcm) = Cnox (ppm) x 1.882	0.00	0.00	0.00	0.00
NOx Emission Rate	ERnox	g/s	ERnox = Cnox/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERnox (kg/hr) = 3.6 x ERnox (g/s)	0.00	0.00	0.00	0.00
NOx Concentration							
Corrected to 11% O2	Cnox	mg/Rcm	Cnox (11% O2) = Cnox (mg/Rcm) x (20.9-11) / (20.9-Co2)	0.00	0.00	0.00	0.00
Corrected to 3% O2	Cnox	mg/Rcm	Cnox (3% O2) = Cnox (mg/Rcm) x (20.9-3) / (20.9-Co2)	0.00	0.00	0.00	0.00
Corrected to 12% CO2	Cnox	mg/Rcm	Cnox (12% CO2) = Cnox (mg/Rcm) x (12/Cco2)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Carbon Monoxide - CO							
CO Measured Concentration	Cco	ppm	Measurement from Flue Gas Analyzer	0.00	0.00	0.00	0.00
Uncorrected @ Ref Cond	Cco	mg/Rcm	Cco (mg/Rcm) = Cco (ppm) x 1.145	0.00	0.00	0.00	0.00
CO Emission Rate	ERco	g/s	ERco = Cco/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERco (kg/hr) = 3.6 x ERco (g/s)	0.00	0.00	0.00	0.00
CO Concentration							
Corrected to 11% O2	Cco	mg/Rcm	Cco (11% O2) = Cco (mg/Rcm) x (20.9-11) / (20.9-Co2)	0.00	0.00	0.00	0.00
Corrected to 3% O2	Cco	mg/Rcm	Cco (3% O2) = Cco (mg/Rcm) x (20.9-3) / (20.9-Co2)	0.00	0.00	0.00	0.00
Corrected to 12% CO2	Cco	mg/Rcm	Cco (12% CO2) = Cco (mg/Rcm) x (12/Cco2)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Particulate Concentration	Cs	mg/Rcm	Cs = Mp / Vmc	473.99	950.60	622.10	682.23
Particulate Emission Rate	ERp	g/s	ERp = Cs/1000 x Qs	1.97	3.25	2.35	2.52
		kg/hr	ERp (kg/hr) = 3.6 x ERp (g/s)	7.11	11.69	8.44	9.08
		kg/mlubmit		0.29	0.40	0.29	0.33
Particulate Concentration							
Corrected to 11% O2	Cs	mg/Rcm	Cs (11% O2) = Cs x (20.9-11) / (20.9-Co2)	##########	##########	##########	##########
Corrected to 3% O2	Cs	mg/Rcm	Cs (3% O2) = Cs x (20.9-3) / (20.9-Co2)	##########	##########	##########	##########
Corrected to 12% CO2	Cs	mg/Rcm	Cs (12% CO2) = Cs x (12/Cco2)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Legend:
sq ft = square feet
sq m = square metres
Pi = 3.142
R = degrees Rankin
ppm = parts per million
in.Hg = inches of mercury
cu ft = cubic feet
cu m = cubic metres
Ref Cond = reference temperature and pressure (25 C and 101.3 kPa)
Rcms = dry reference cubic metres per second
Rcfm = dry reference cubic feet per minute
mg/Rcm = milligrams per dry reference cubic metre
g/s = grams per second
NOx = as NO2
acfm = actual cubic feet per minute

OFFICIAL STACK TESTING RESULTS
Northern Pulp
Pictou, NS

Fuel: NA
Operating Conditions: normal
Emission Control Equipment: NA
Stack Height from Grade: 51 m
Stack Diameter: 1.22 m

Parameter	Test 1	Test 2	Test 3	Average	NSENV Limits
Test ID	PM-1	PM-2	PM-3	-	-
Test Date	21-Jul-15	22-Jul-15	22-Jul-15	-	-
Stack Gas Temperature (C)	77	83	78	79	-
Moisture Content (%)	50.5	51.8	49.2	50.5	-
Velocity (m/s)	8.53	7.28	7.59	7.80	-
Volumetric Flow (Rcms)	4.16	3.42	3.77	3.78	-
Oxygen - O2 (%)	20.9	20.9	20.9	20.9	-
Carbon Dioxide - CO2 (%)	0.0	0.0	0.0	0.0	-
Sulphur Dioxide - SO2					
SO2 Measured Concentration (ppm)	0.0	0.0	0.0	0.0	-
Uncorrected at Ref Cond (mg/Rcm)	0.0	0.0	0.0	0.0	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-
Nitrogen Oxides - NOx					
NOx Measured Concentration (ppm)	0.0	0.0	0.0	0.0	-
Uncorrected at Ref Cond (mg/Rcm)	0.0	0.0	0.0	0.0	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-
Carbon Monoxide - CO					
CO Measured Concentration (ppm)	0.0	0.0	0.0	0.0	-
Uncorrected at Ref Cond (mg/Rcm)	0.0	0.0	0.0	0.0	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-
Particulate Matter - PM					
Particulate Concentration (mg/Rcm)	474.0	950.6	622.1	682.2	-
Particulate Emission Rate (kg/hr)	7.11	11.69	8.44	9.08	-
Particulate Emission Rate (kg/adubmt)	0.29	0.40	0.29	0.33	0.5

Legend:
C - degrees Celsius
m/s - metres per second
Rcms - dry reference cubic metres per second
ppm - parts per million
Ref Cond - reference temperature and pressure (25 C and 101.3 kPa)
mg/Rcm - miligrams per dry reference cubic metre
NOx - as NO2
ND - non-detectable

Particulate Recoveries: Impinger Catch, Probe Wash, Filter Catch

Client: Northern Pulp
Facility: Deepburn Tarp
Location: Pictou, NS
Job Number: 121413-06

IMPINGER CATCH

Container ID	Beaker Pre Weights (g)				Sample ID	Recoveries					Beaker Post Weights (g)				Uncorrected Particulate Weight (g)	Corrected Particulate Weight (g)
	Data Analyzed by					Jar + Sample + Rinse (g)	Jar Tare (g)	Recovered Sample Collected (g)	Rinse Water (g)	Total Rinse Water (g)	Data Analyzed by					
	Trial 1	Trial 2	Trial 3	Average							Trial 1	Trial 2	Trial 3	Average		
I1	111.9817	111.9812		111.9815	FM 1	1208.3	394.2	814.0	0.1	27.1	111.9830	111.9813		111.9835	0.0352	0.0294
C2	109.8953	109.8953		109.8953	FM 2	1139.5	393.4	842.0	8.6	42.2	109.8982	109.8982		109.8982	0.0241	0.0218
C3	109.0329	109.0324		109.0326	FM 3	1127.2	381.8	810.2	8.8	44.4	109.0484	109.0484		109.0484	0.0161	0.0117
I7	109.1975	109.1974		109.1972	MR	464.2	394.3	58.7		58.7	109.1982	109.1982		109.1982	0.0010	Conc. (g/mL) 0.000170

PROBE WASH

Container ID	Beaker Pre Weights (g)				Sample ID	Recoveries					Beaker Post Weights (g)				Uncorrected Particulate Weight (g)	Corrected Particulate Weight (g)
	Data Analyzed by					Jar + Acetone (g)	Jar Tare (g)	Recovered Acetone (g)	Rinse Acetone	Total Acetone (g)	Data Analyzed by					
	Trial 1	Trial 2	Trial 3	Average							Trial 1	Trial 2	Trial 3	Average		
A5	107.9077	107.9074		107.9076	FM 1	465.2	381.5	68.4	15.5	83.9	107.9562	107.9562		107.9562	0.0486	0.0464
A3	109.2343	109.2342		109.2341	FM 2	445.3	380.7	54.6	30.6	84.4	109.4307	109.4307		109.4309	0.1968	0.1943
A7	111.9019	111.9017		111.9018	FM 3	444.8	381.5	53.4	26.2	79.6	111.7648	111.7648		111.7648	0.1630	0.1609
I2	111.7481	111.7481		111.7481	MR	777.2	777.2	0.0		0.0	111.7484	111.7483		111.7484	0.0004	Conc. (g/mL) 0.000021

Density of Acetone: 0.7890 g/mL

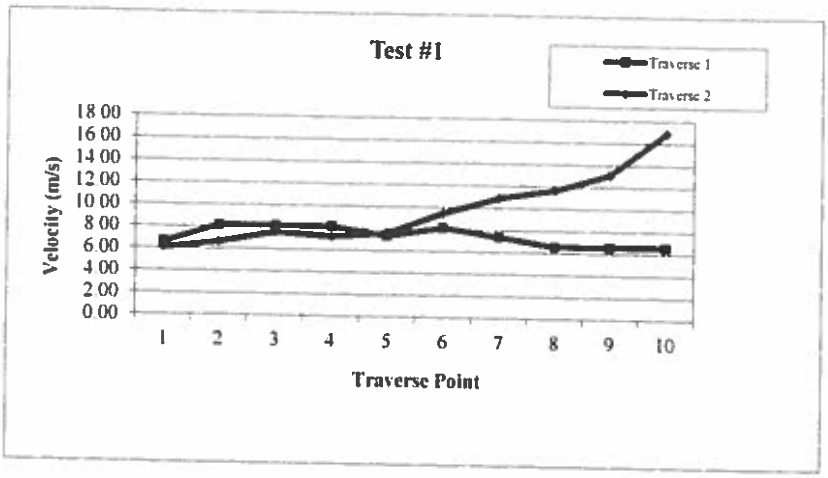
FILTER CATCH

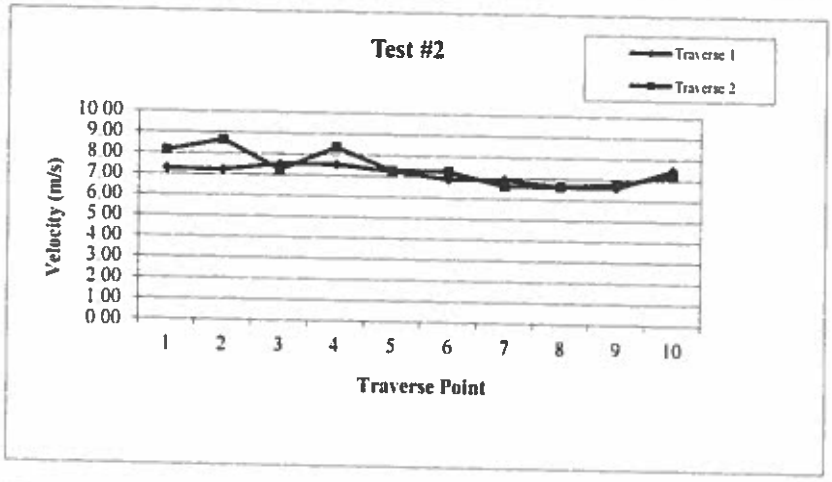
Filter ID	Pre Weights (g)				Sample ID	Post Weights (g)				Particulate Weight Rinse Filter (g)
	Data Analyzed by					Data Analyzed by				
	Trial 1	Trial 2	Trial 3	Average		Trial 1	Trial 2	Trial 3	Average	
07181-13	0.3179	0.3178		0.3179	FM 1	0.7308	0.7310		0.7309	0.3919
07181-40	0.2838	0.2831		0.2834	FM 2	0.6487	0.6721		0.6604	0.3762
07181-36	0.2954	0.2951		0.2953	FM 3	0.6678	0.6674		0.6677	0.3724

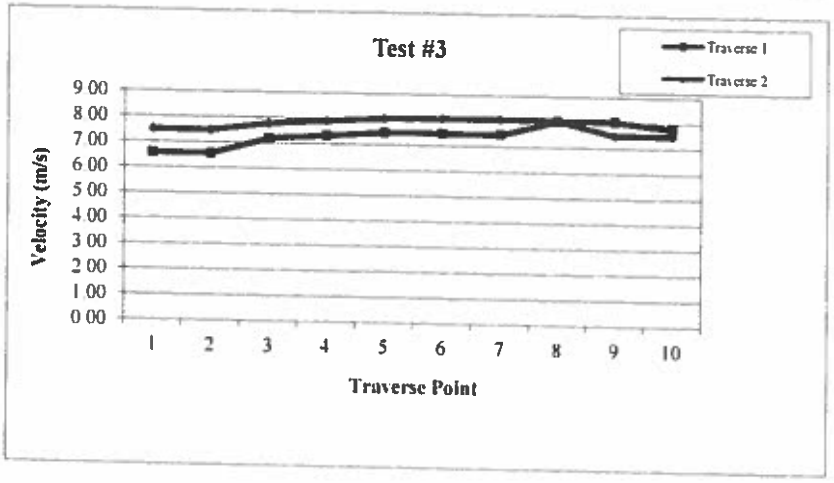
Northern Pulp
Dissolving Tank

########

Stack Gas Velocity Profiles
Pictou, NS







Project: 121413456
Test: Power Boiler PM-3
Date: Aug 13, 2015
Analyst: TBH

Absolute stack gas pressure (Ps) in in.Hg is:

$$Ps = P_{bar} + \frac{P_{static}\ in.H_2O}{13.6\ in.H_2O/in.Hg}$$

$$Ps = 29.90 + \frac{0.20}{13.6}$$

$$Ps = 29.91\ in.Hg$$

The molecular weight of the stack gas on a dry basis (Md) in lb/lb-mole is:

$$Md = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ [(\%N_2)]$$

$$Md = 0.44 \times 4.23 + 0.32 \times 13.23 + 0.28\ (82.55 + \ /\ ) + 0.40\ (\ /\ + \ /\ )$$

$$Md = 1.8612 + 4.2656 + 23.114 + \ /$$

$$Md = 29.2408\ lb/lb\text{-}mole$$

The volume of water vapour collected at reference conditions (Vwc) in ft^3 is:

$$Vwc = 0.0480\ ft^3/mL \times \text{volume of moisture collected mL.}$$

$$Vwc = 0.0480 \times 237.70$$

$$Vwc = 11.41\ ft^3$$

The average _H orifice in in.H_2O is:

$$\Delta H_{orifice\ avg.} = \frac{\Sigma\ H orifice}{\#\ points}$$

$$\Delta H_{orifice\ avg.} = \frac{32.92}{48}$$

$$\Delta H_{orifice\ avg.} = 0.686\ in.H_2O$$

The pressure at the gas meter (Pm) in in.Hg is:

$$Pm = P_{bar} + \frac{\Delta H\ orifice_{avg.}\ in.H_2O}{13.6\ in.H_2O/in.Hg}$$

$$Pm = 29.90 + \frac{0.686}{13.6}$$

$$Pm = 29.90 + 0.05$$

$$Pm = 29.95\ in.Hg$$

The temperature of the gas meter (Tm) in °R is:

$$Tm = \frac{\Sigma\ meter\ temp.\ °F}{\#\ points} + 460$$

$$Tm = \frac{7187}{96} + 460$$

$$Tm = 749 + 460$$

$$Tm = 539\frac{1}{4}\ °R$$

The total volume of gas metered (Vm) in ft^3 is:

$Vm = Vf\ ft^3 - Vi\ ft^3$

$Vm = 407.48 - 352.66$

$Vm = 54.82\ ft^3$

The dry gas volume at reference conditions (Vmc) in ft^3 is:

$$Vmc = \frac{T_{ref}\ °R}{P_{ref}\ in.Hg} \times \frac{Pm\ in.Hg \times Vm\ ft^3 \times y}{Tm\ °R}$$

$$Vmc = \frac{537}{29.92} \times \frac{29.95 \times 54.82 \times 1.033}{535.91}$$

$Vmc = 56.80\ ft^3 \times 1\ m^3 / 35.31\ ft^3 = 1.61\ m^3$

The stack gas moisture content, i.e. the proportion by volume of water vapour in the gas stream (Bwo) is:

$$Bwo = \frac{Vwc\ ft^3}{Vwc\ ft^3 + Vmc\ ft^3}$$

$$Bwo = \frac{11.41}{11.41 + 56.80}$$

$$Bwo = \frac{11.411}{68.21}$$

$Bwo = 0.167$

The Molecular weight of the stack gas on a wet basis (Ms) in lb/lb-mole is:

Ms = Md lb/lb-mole (1-Bwo) + 18 lb/lb-mole x Bwo

Ms = 29.24 x (1 - 0.167) + 18 x 0.167

Ms = 29.24 x 0.833 + 3006

Ms = 27.33 lb/lb-mole

The average temperature of the stack ($Ts_{avg.}$) in °R is:

$$Ts_{avg.} = \frac{\Sigma Ts\ °F}{\#\ points} + 460$$

$$Ts_{avg.} = \frac{6498}{48} + 460$$

$Ts_{avg.}$ = 135.38 + 460

$Ts_{avg.}$ = 595.38 °R

The average velocity ($Us_{avg.}$) of the stack in ft/s is:

$$Us_{avg.} = \frac{\Sigma V}{\#\ points}$$

$Us_{avg.}$ = 3103.43 / 48

$Us_{avg.}$ = 64.65 ft/s x 1 m / 3.281 ft = _____ m/s

2-12-2

$$U_{S1} = 85.33 C_P \sqrt{\frac{\Delta P_1 \cdot T_{S1}}{P_S \cdot M_S}} = (85.33)(.816)\sqrt{\frac{(1.05)695}{(29.91)(27.33)}}$$

U_{S1} = 80.79 ft/s ✓

The cross-sectional area of the stack (As) in ft^2 is:

$As = \frac{\Pi (D\ ft)^2}{4}$

$As = \frac{\Pi}{4} \times (\frac{72/12}{})^2$

$As = 0.7854 \times 36$

$As = 2827\ ft^2$

The volumetric stack gas flowrate on a dry basis at reference conditions (Qs) in ft^3/hr is:

$Qs = 3600\ s/hr \times Us\ ft/s \times As\ ft^2 \times (1\text{-}Bwo) \times \frac{T_{ref}\ °R}{Ts_{avg}\ °R} \times \frac{Ps\ in.Hg}{P_{ref}\ in.Hg}$

$Qs = 3600 \times 64.65 \times 28.27 \times (1 - 0.167) \times \frac{537}{595.38} \times \frac{29.91}{29.92}$

$Qs = 3600 \times 64.65 \times 28.27 \times 0.833 \times 0.902 \times 0.9997$

$Qs = 41,942,005\ ft^3/hr \times 1\ hr / 60\ min = 82,367\ ft^3/min$

$Qs = 82,367\ ft^3/min \times 1\ m^3 / 35.31\ ft^3 \times 1\ min / 60\ s = 38.88\ m^3/s$

The total amount of particulate matter collected (Mp) in mg is:

Mp = 208.3 mg

The concentration of the particulate matter in the stack gas on a dry basis at reference conditions (Cp) in lb/ft^3 is:

$$Cp = 2.205 \times 10^{-6} \text{ lb/mg} \times \frac{Mp \text{ mg}}{Vmc \text{ ft}^3}$$

$$Cp = 2.205 \times 10^{-6} \text{ lb/mg} \times \frac{208.3}{56.30}$$

Cp = 8.08×10^{-6} lb/ft^3 x 453,590 mg / lb x 35.31 ft^3 / m^3 = 129.5 mg/m^3

The emission rate of the particulate matter from the stack on a dry basis at reference conditions (ERp) in lb/hr is:

Erp = Cp lb/ft^3 x Qs ft^3/hr

ERp = 8.08×10^{-6} x 4 942 005

ERp = 39.93 lb/hr x 1 kg / 2.20 lb = 18.1 kg/hr

GAS CALCULATIONS

Client: Northern Pulp
Plant: Lime Kiln
Location: Pictou, NS

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
Gas 1	4.6	22.1	6.9	1.7	116.9
Gas 2	4.6	22.5	6.8	1.7	131.4
Gas 3	4.2	23.0	6.6	1.7	47.9

GAS CALCULATIONS
Northern Pulp
Lime Kiln
Pictou, NS

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Corresponding PM Test				PM-1	PM-2	PM-3	n/a
Dry Stack Gas Flow Rate	Qs	dscfm	(Entered from PM Test Data)	16,190	15,244	15,723	15719 1
		dscms	Qs (dscms) = 0.000472 x Qs (dscfm)	7 64	7 20	7 42	7 42
Stack Gas Oxygen Content	Co2	%	Measurement from Flue Gas Analyzer	4 6	4 6	4 2	4 5
Stack Gas Carbon Dioxide Content	Cco2	%	Measurement from Flue Gas Analyzer	22 1	22 5	23 0	22 5
Sulphur Dioxide - SO2							
SO2 Measured Concentration	Cso2	ppm	Measurement from Flue Gas Analyzer	1 7	1 7	1 7	1 67
Uncorrected @ STP	Cso2	mg/dscm	Cso2 (mg/dscm) = Cso2 (ppm) x 2.62	4 41	4 37	4 37	4 38
SO2 Emission Rate	ERso2	g/s	ERso2 = Cso2/1000 x Qs	0 03	0 03	0 03	0 03
		kg/hr	ERso2 (kg/hr) = 3.6 x ERso2 (g/s)	0 12	0 11	0 12	0 12
SO2 Concentration							
Corrected to 11% O2	Cso2	mg/dscm	Cso2 (11% O2) = Cso2 (mg/dscm) x (20.9-11) / (20.9-Co2)	2 68	2 65	2 58	2 64
Corrected to 3% O2	Cso2	mg/dscm	Cso2 (3% O2) = Cso2 (mg/dscm) x (20.9-3) / (20.9-Co2)	4 65	4 79	4 67	4 77
Corrected to 12% CO2	Cso2	mg/dscm	Cso2 (12% CO2) = Cso2 (mg/dscm) x (12/Cco2)	2 39	2 33	2 28	2 33
Nitrogen Oxides - NOx							
NOx Measured Concentration	Cnox	ppm	Measurement from Flue Gas Analyzer	116 9	131 4	47 9	98 71
Uncorrected @ STP	Cnox	mg/dscm	Cnox (mg/dscm) = Cnox (ppm) x 1.882	219 93	247 35	90 07	185 78
NOx Emission Rate	ERnox	g/s	ERnox = Cnox/1000 x Qs	1 68	1 78	0 67	1 38
		kg/hr	ERnox (kg/hr) = 3.6 x ERnox (g/s)	6 05	6 41	2 41	4 95
NOx Concentration							
Corrected to 11% O2	Cnox	mg/dscm	Cnox (11% O2) = Cnox (mg/dscm) x (20.9-11) / (20.9-Co2)	133 94	150 14	53 29	112 46
Corrected to 3% O2	Cnox	mg/dscm	Cnox (3% O2) = Cnox (mg/dscm) x (20.9-3) / (20.9-Co2)	242 17	271 47	96 35	203 33
Corrected to 12% CO2	Cnox	mg/dscm	Cnox (12% CO2) = Cnox (mg/dscm) x (12/Cco2)	119 31	131 72	47 08	99 37
Carbon Monoxide - CO							
CO Measured Concentration	Cco	ppm	Measurement from Flue Gas Analyzer	6 9	6 8	6 6	6 76
Uncorrected @ STP	Cco	mg/dscm	Cco (mg/dscm) = Cco (ppm) x 1.145	7 94	7 76	7 52	7 74
CO Emission Rate	ERco	g/s	ERco = Cco/1000 x Qs	0 06	0 06	0 06	0 06
		kg/hr	ERco (kg/hr) = 3.6 x ERco (g/s)	0 22	0 20	0 20	0 21
CO Concentration							
Corrected to 11% O2	Cco	mg/dscm	Cco (11% O2) = Cco (mg/dscm) x (20.9-11) / (20.9-Co2)	4 84	4 71	4 45	4 67
Corrected to 3% O2	Cco	mg/dscm	Cco (3% O2) = Cco (mg/dscm) x (20.9-3) / (20.9-Co2)	8 74	8 52	8 04	8 44
Corrected to 12% CO2	Cco	mg/dscm	Cco (12% CO2) = Cco (mg/dscm) x (12/Cco2)	4 31	4 13	3 93	4 12

Legend:
sq ft - square feet
sq m - square metres
PI - 3.142
R - degrees Rankin
ppm - parts per million
in Hg - inches of mercury
cu ft - cubic feet
cu m - cubic metres
STP - standard temperature and pressure (25 C and 101.3 kPa)
dscms - dry standard cubic metres per second
dscfm - dry standard cubic feet per minute
mg/dscm - miligrams per dry standard cubic metre
g/s - grams per second
NOx - as NO2
acfm - actual cubic feet per minute

STACK TESTING RESULTS
GAS CALCULATIONS
Northern Pulp
Lime Kiln
Pictou, NS

Parameter	Test 1	Test 2	Test 3	Average	Limits
Oxygen - O2 (%)	4.64	4.59	4.17	4.47	-
Carbon Dioxide - CO2 (%)	22.1	22.5	23.0	22.5	-
Sulphur Dioxide - SO2					
SO2 Measured Concentration (ppm)	1.68	1.67	1.67	1.67	-
Uncorrected at STP (mg/dscm)	4.41	4.37	4.37	4.38	-
Emission Rate (kg/hr)	0.12	0.11	0.12	0.12	-
Nitrogen Oxides - NOx					
NOx Measured Concentration (ppm)	117	131	47.9	98.7	-
Uncorrected at STP (mg/dscm)	220	247	90.1	186	-
Emission Rate (kg/hr)	6.05	6.41	2.41	4.95	-
Carbon Monoxide - CO					
CO Measured Concentration (ppm)	6.93	6.78	6.57	6.76	-
Uncorrected at STP (mg/dscm)	7.94	7.76	7.52	7.74	-
Emission Rate (kg/hr)	0.22	0.20	0.20	0.21	-

Legend:
C - degrees Celsius
m/s - metres per second
dscms - dry standard cubic metres per second
ppm - parts per million
STP - standard temperature and pressure (25 C and 101.3 kPa)
mg/dscm - miligrams per dry standard cubic metre
NOx - as NO2
ND - non-detectable