Combustion Gas Concentrations for Vidir Gasifier with Straw Feed Stock

Final Report

June 2005

Source Testing for
Vidir Gasifier Air Emissions
with Straw Feed Stock

04-4075-1000

Chris Kozak - Project Manager

Submitted by
Dillon Consulting Limited

O:\PROJECTS\FINAL\044075\text\Reports.05\Vidir Gasifier source testing.doc

TABLE OF CONTENTS

		Page No.
1	BACKGROUND	1
	1.1 Disclaimer	1
2	EMISSION SOURCE	2
3	SAMPLING METHODOLOGIES	3
4	RESULTS	4
5	DISCUSSIONS OF RESULTS	6
6	CLOSURE	7

LIST OF TABLES

Table 4.1: Combustion Gas Emission Concentrations from Vidir Gasifier Exhaust Stack 5

LIST OF APPENDICES

Appendix A Combustion Gas Concentration Measurements

1 BACKGROUND

Dillon Consulting Limited (Dillon) was retained by Vidir BioMass Inc.(Vidir) to conduct source testing on the Vidir Gasifier using straw feed stock. These measured emission rates were conducted with the Gasifier operating at the maximum system design production rate of approximately 500 pounds (227 kg) of straw per hour.

Source testing was conducted on November 8, 2004.

1.1 Disclaimer

This report was prepared by Dillon for the sole benefit of our client. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

2 EMISSION SOURCE

In November 2004, Dillon performed source testing on the Vidir Gasifier exhaust stack to quantify combustion gas emission rates. Gasification is a two-step, endothermic (heat absorbing) process in which a solid fuel (i.e., biomass) is thermochemically converted into a low or medium Btu gas. In the first reaction, pyrolysis, the volatile components of the fuel are vaporized at temperatures below 600°C by a set of complex reactions. Char (fixed carbon) and ash are the pyrolysis by-products which are not vaporized. In the second step, the char is gasified through reactions with oxygen, steam, and hydrogen. Some unburned char is combusted to release the heat needed for the endothermic gasification reactions. The Vidir Gasifier as tested was equipped with a heat exchanger which reduced the exhaust gas outlet temperatures to approximately 400°F.

Because of existing equipment and building configurations, a single sample port was located on a vertical run of process piping between the heat exchanger and the exhaust blower inside of the process building. The single three-inch diameter sample port was ideally located (8 and 2 diameter criteria) on the 12-inch diameter process line.

3 SAMPLING METHODOLOGIES

Dillon measured the concentration of combustion gases from the exhaust gas stream during steady state conditions with a straw feed rate of 500 pounds (227 kg) per hour. Combustion gas emission concentrations were measured with a Madur GA-40T Plus Portable Combustion Gas Analyzer. This instrument allows the following gases to be measured simultaneously:

- Oxygen (O_2);
- Carbon Monoxide (CO);
- Sulphur Dioxide (SO_2);
- Oxides of Nitrogen (NO, NO_2, NO_x); and
- Carbon Dioxide (CO_2) by calculation.

The Madur GA-40T Plus analyzer sampling unit includes a stainless steel sample probe, a condensate trap, a filter trap, and a housing unit, which contains a series of electrochemical cells. Gas concentrations were recorded at one-minute intervals.

4 RESULTS

Table 4.1 summarizes the results of the combustion gas concentrations in the Vidir Gasifier exhaust stream. Appendix A contains the combustion gas summary sheets for each of the test periods.

Table 4.1: Combustion Gas Emission Concentrations from Vidir Gasifier Exhaust Stack

Location	Date (m/d/y)	Sample Time	Combustion Gas Concentration									
			O_2		CO_2		CO		NO_x		SO_2	
			%	mg/m^3	%	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
Vidir Gasifier Exhaust Stack	11/08/04	1114-1206	9.4	123,026	10.9	196,155	153	175	327	615	20	52
	11/08/04	1256-1350	10.2	133,497	10.4	187,157	146	167	289	544	23	60
	11/08/04	1434-1540	10.3	134,806	10.7	192,556	164	188	321	604	23	60
	Average		10.0	130,443	10.7	191,956	154	177	312	588	22	57

Notes:

Combustion Gas concentrations are the average concentrations from each test period.
Feed Rate = 227 kg (500 lbs) of straw per hour.

Example Calculation: $$\text{Conc. } CO_2 \text{ (mg/m3)} = \frac{\text{ppm} \times MW_{CO2}}{24.45} \quad \text{where } MW_{CO2} = 44 \text{ g/g mole}$$

5 DISCUSSIONS OF RESULTS

The results of Combustion Gas emissions testing performed on the Vidir Gasifier exhaust stack indicate that the CO concentrations in this stream range between 167 mg/m^3 and 188 mg/m^3. The corresponding average concentration for CO is 177 mg/m^3.

6 CLOSURE

This report was prepared exclusively for the purposes, project, and site location outlined in the report. The report is based on information provided to, or obtained by Dillon as indicated in the report, and applies solely to site conditions existing at the time of the site investigation. Although a reasonable investigation was conducted by Dillon, Dillon's investigation was by no means exhaustive and cannot be construed as a certification of the absence of any contaminants from the site. Rather, Dillon's report represents a reasonable review of available information within an agreed work scope, schedule, and budget. It is, therefore, possible that currently unrecognized contamination or potentially hazardous materials may exist at the site, and that the levels of contamination or hazardous materials may vary across the site. Further review and updating of the report may be required as local and site conditions, and the regulatory and planning frameworks, change over time.

This report was prepared by Dillon for the sole benefit of our client. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Respectfully submitted,
Dillon Consulting Limited

Chris Kozak
Project Manager