BTEC Inc.

VOC Destruction Efficiency Emissions Test Report

Prepared for:

Valassis Manufacturing Company

Livonia, Michigan

Anderson Printing Division
35955 Schoolcraft Road
Livonia, Michigan

Project No. 15-4716.00
September 2, 2015

BT Environmental Consulting, Inc.
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EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Valassis Manufacturing Company (Valassis) to evaluate the volatile organic compound (VOC) destruction efficiency (DE) of a single regenerative thermal oxidizer (RTO). The RTO DE evaluation was conducted on July 7, 2015. The purpose of this document is to summarize the results of the required emissions test program.

Michigan Department of Environmental Quality Air Quality Division Permit No. 249-06A requires that the RTO maintain a VOC destruction efficiency of at least 98%. The results of the emissions test program are summarized by Table I.

Table I
RTO DE Emissions Test Result Sumamry
Sampling Date: July 7, 2015

Run	Time	Inlet VOC Emission Rate (lbs/hr)	Outlet VOC Emission Rate (lbs/hr)*	VOC Destruction Efficiency (%)
1	10:57-12:38	84.8	0.47	99.4
2	13:13-14:18	60.6	0.65	98.9
3	16:02-17:05	89.2	1.02	98.9
	Averages:	78.2	0.7	99.1

*Outlet VOC emission rate corrected for methane

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Valassis Manufacturing Company (Valassis) to evaluate the volatile organic compound (VOC) destruction efficiency (DE) of a single regenerative thermal oxidizer (RTO). The purpose of this document is to summarize the results of the required emissions test program.

The Air Quality Division (AQD) of Michigan's Department of Environmental Quality has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

The RTO unit is operated at the Valassis Manufacturing Company (Valassis) facility located at 35955 Schoolcraft Road in Livonia, Michigan. VOC DE Testing of the RTO was conducted on July 7, 2015

1.b Purpose of Testing

The purpose of the test program was to verify the RTO VOC DE as required by Michigan Department of Environmental Quality Air Quality Division (AQD) Permit No. 249-06A.

1.c Source Description

The Valassis facility in Livonia prints a wide variety of direct mail, insert, and other advertisements and marketing tools using a series of heat set web offset lithographic printing presses. VOC emissions from the heat set web offset lithographic printing presses are routed to a single, common RTO.

1.d Test Program Contact

The contact for information regarding the test program as well as the test report is:

Ms. Kalena Dunham
Materials Supervisor/ Plant Engineer
Valassis Manufacturing Company
Richard N. Anderson Printing Division
35955 Schoolcraft Road
Livonia, MI 48150

1.e Test Personnel

Names and affiliations for personnel who were present during the test program are summarized by Table 1.

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions test program.

2.a Operating Data

Operating data is available in Appendix E.

2.b Applicable Permit

The RTO at the Valassis facility is regulated by Michigan Department of Environmental Quality Air Quality Division (AQD) Permit No. 249-06A.

2.c Results

The results of the emissions test program are summarized by Table 2.

2.d Emission Regulation Comparison

Permit No. 249-06A requires a minimum VOC destruction efficiency of 98%. As summarized by Table 2, the RTO DE is above 98%.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

The type of industrial process is heat set web offset lithographic printing presses. Five presses operate continuously with the exception of maintenance and print job change overs, and all five presses exhaust to a common RTO.

3.b Process Flow Diagram

The RTO controls VOC emissions from the corresponding equipment by oxidizing organics present in the exhaust gas at elevated temperatures. Due to the simplicity of the RTO unit, a process flow diagram is not necessary.

3.c Raw and Finished Materials

Production data for the five presses are summarized in Appendix E.

3.d Process Capacity

The target production rate is over 2.8 million pages per hour.

3.e Process Instrumentation

Process instrumentation relevant to the emissions test program includes combustion temperature and differential pressure.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used to verify the DE of the RTO.

4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content was conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Molecular Weight of Dry Stack Gas"(Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. An S-type or standard pitot tube with a thermocouple assembly, calibrated in accordance with Method 2, Section 4.1.1, was used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

A cyclonic flow check was performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

Molecular weight was determined according to USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using Method 4 (with a single moisture run conducted at the RTO inlet and at the RTO outlet). Exhaust gas was extracted and passed through (i) two impingers, each with 100 ml deionized water, (ii) an empty impinger, and (iii) an impinger filled with silica gel. Exhaust gas moisture content was then determined volumetrically (liquid impingers) and gravimetrically (silica gel impinger). A schematic drawing of the Method 4 sampling train is provided as Figure 4.

VOC concentrations were measured at the inlet and outlet of the RTO using the procedures of 40 CFR 60, Appendix A, Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer." Triplicate 60-minute test runs were conducted on the RTO.

RTO inlet VOC concentrations were measured using a VIG Industries Model 20 THC gas analyzer and a J.U.M. Model 109A gas analyzer. RTO outlet VOC concentrations were measured using a J.U.M. Model 109A methane/non-methane THC gas analyzer. For each sampling location, a sample of the gas stream was drawn through a stainless-steel probe with an in-line glass fiber filter to remove any particulate and a heated Teflon® sample line to prevent the condensation of any moisture from the sample before it enters the analyzer. Data was recorded at 4-second intervals on a Laptop PC equipped with data acquisition software.

For analyzer calibrations, calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United States National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11 point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A field quality assurance check of the system was performed pursuant to Method 205 by setting the diluted concentration to a value identical to a Protocol 1 calibration gas and then verifying that the analyzer response is the same with the diluted gas as with the Protocol 1 gas. The results of the Method 205 verification test are provided in Appendix B.

A drawing of the Method 25A sampling train used for the testing program is presented as Figure 3.

4.b Recovery and Analytical Procedures

Because all measurements were conducted using on-line analyzers, no samples were recovered during the test program.

4.c Sampling Ports

Sampling ports are located at the RTO inlet and at the RTO outlet that meet the minimum criteria of Method 1.

4.d Traverse Points

Traverse points for each exhaust flowrate sampling location are illustrated by Figures 1 and 2.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The results of the emissions test program are summarized by Table 2. Exhaust gas flowrates measured at each sampling location are summarized in Appendix A. Equipment calibration data is summarized in Appendix B.

5.b Discussion of Results

Permit No. 249-06 requires a minimum VOC destruction efficiency of 98%. As summarized by Table 2, the RTO DE is well above 98%.

5.c Sampling Procedure Variations

The inlet sampling location had an oily residue that caused the sample line to have a high bias at the completion of each run. BTEC used two separate inlet sampling systems during the test program to save time. The sample line from system 1 was pulled from the duct following run 1 and allowed to draw ambient air to clear residue before the inlet post test calibration was conducted. During this time testing resumed using system 2. After completion of the second run, system 2 was removed and allowed to draw ambient air before the post test calibration was performed, and system 1 was reinserted for run 3.

5.d Process or Control Device Upsets

Prior to the start of run 3(approximately 14:23), a power surge caused the plant to shut down. All processes and the RTO shut down. Once all the processes came back online, run 3 was started at 16:02.

5.e Control Device Maintenance

Routine maintenance of the RTO has been conducted as recommended by the manufacturer.

5.f Audit Sample Analyses

No samples were collected as part of the test program.

5.g Calibration Sheets

Calibration data relevant to the emissions test program is provided in Appendix B.

5.h Sample Calculations

Sample calculations are provided in Appendix C.

5.i Field Data Sheets

Copies of the relevant field data sheets and field notes are provided in Appendix A.

5.j Laboratory Data

No laboratory analysis was included in this test program.

Table 1
Testing Personnel

Name	Affiliation
Kalena Dunham	Valassis
Jeff Gilmour	Valassis
Matt Young	BTEC
Paul Molenda	BTEC
Shane Rabideau	BTEC
Mark Dziadosz	MDEQ

Table 2
RTO VOC Destruction Efficiency Testing
Valassis
Livonia, MI

Parameter	Run 1	Run 2	Run 3	Average
Sampling Time	7/7/2015 10:57-12:38	7/7/2015 13:13-14:18	7/7/2015 16:02-17:05	
Inlet Flowrate (scfm)	15,506	19,015	21,802	18,774
Outlet Flowrate (scfm)	17,382	21,303	21,399	20,028
Inlet THC Concentration (ppmv propane)	806.3	478.8	614.2	633.1
Inlet 1 VOC Concentration (ppmv, corrected as per USEPA 7E)	799.1	465.9	597.7	
Inlet THC Mass Flowrate (lb/hr)	84.8	60.6	89.2	78.2
Outlet THC Concentration (ppmv propane)	4.50	5.29	10.76	6.9
Outlet THC Concentration (ppmv, corrected as per USEPA 7E)	4.14	4.59	9.77	
Outlet CH4 Concentration (ppmv methane)	0.49	0.54	6.66	2.6
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	0.4	0.4	6.6	
Outlet THC Concentration (- methane)	3.99	4.43	6.96	5.1
Outlet THC Mass Emission Rate (lb/hr)	0.47	0.65	1.02	0.7
THC Destruction Efficiency (%)	99.4	98.9	98.9	99.1

scfm: standard cubic feet per minute
ppmv: parts per million on a volume to volume basis
lb/hr: pounds per hour
THC: total hydrocarbons
MW: molecular weight
24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31: ft^3 per m^3
453600: mg per lb

Equations

lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

Inlet VOC Correction			
Co	10.85	9.38	23.77
Cma	498	498	498
Cm	506.54	511.22	515.75

Outlet VOC Correction			
Co	0.46	0.76	0.93
Cma	29.9	29.9	29.9
Cm	29.67	30.29	31.02

Outlet CH4 Correction			
Co	0.14	0.19	0.24
Cma	19.9	19.9	19.9
Cm	19.39	19.21	19.60

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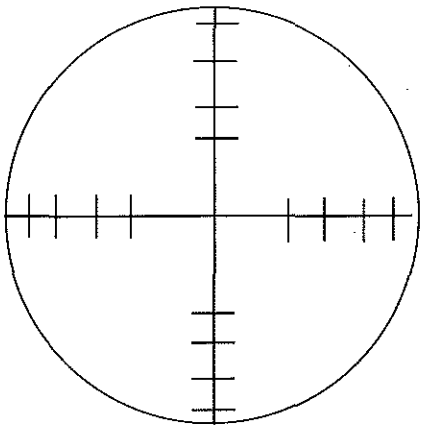
Stack Diameter : 48 inches

Points	Distance "
1	1.5
2	5.0
3	9.3
4	15.5
5	32.5
6	38.7
7	43.0
8	46.5



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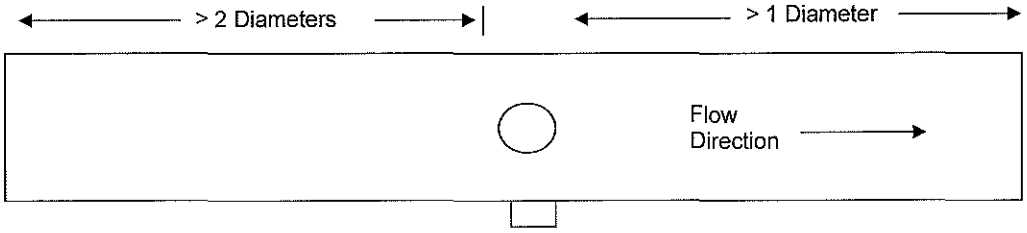
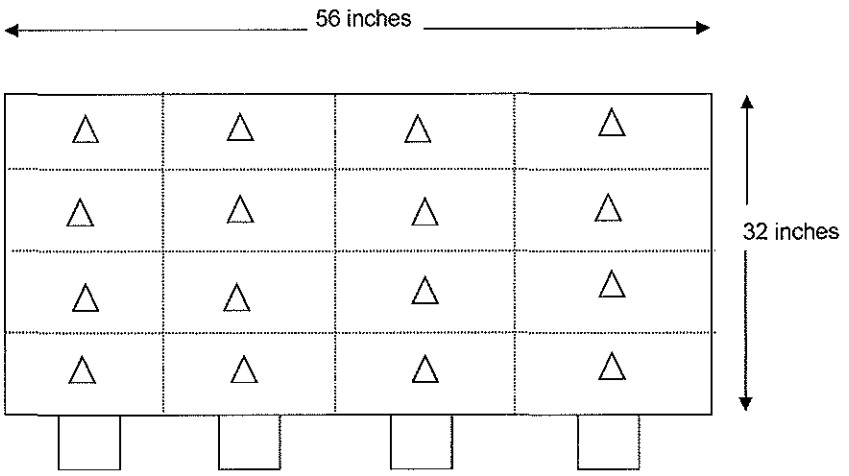


Figure 1

Site: **Valassis Manufacturing Company** **RTO Inlet Traverse Point Diagram**	**Sampling Date:** **July 7, 2015**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

BTEC Inc.



△ = sampling point

Not to Scale

Points	Distance "
1	4.0
2	12.0
3	20.0
4	28.0

Figure 2

Site: **Valassis Manufacturing Company** **RTO Outlet Traverse Point Diagram**	**Sampling Date:** **July 7, 2015**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

BTEC Inc.

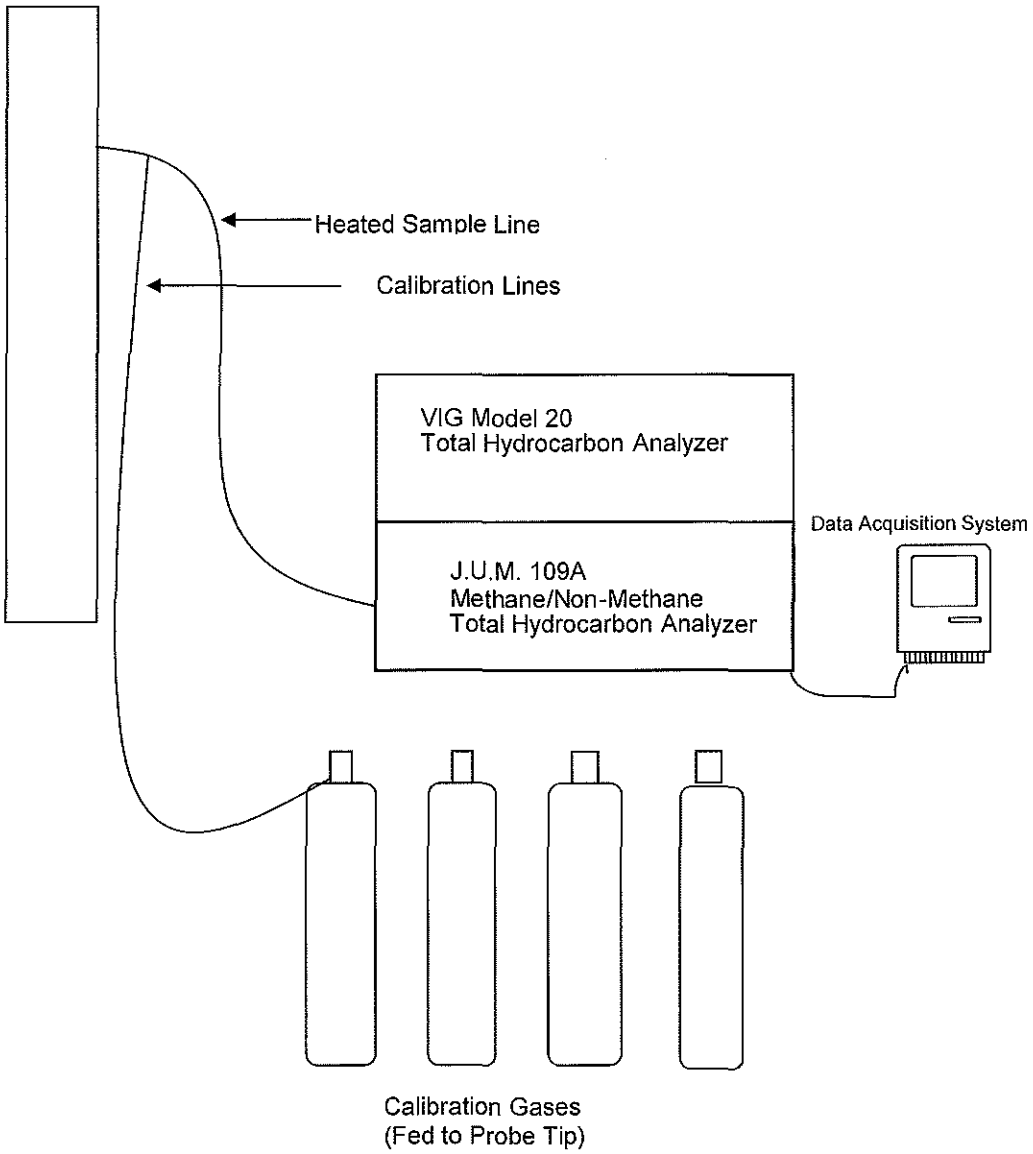


Figure 3

Site: **Sampling Date:** **USEPA Method 25A** **July 7, 2015** **Valassis Manufacturing Company** **Livonia, Michigan**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

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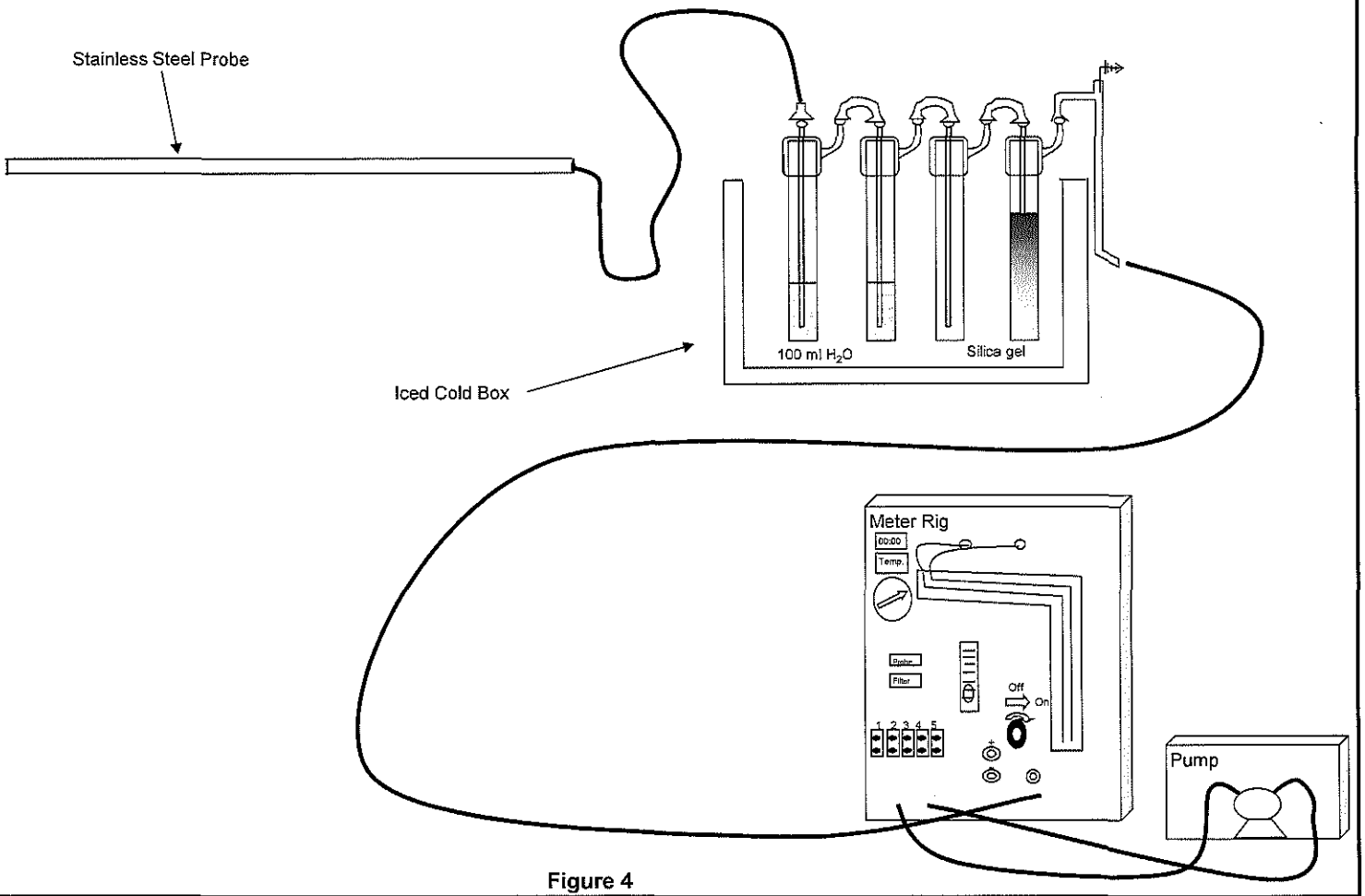

Figure 4

Site:	Sampling Date:	
USEPA Method 4 Valassis Manufacturing Company Livonia, Michigan	July 7, 2015	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073