

INCINERATOR EFFICIENCY SURVEY

**QUESTOR TECHNOLOGIES INC.
MOBIL LONE PINE 06-03-030-27-W4M**

INCINERATOR EXHAUST STACK

November 5, 1998

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SUMMARY

On November 5, 1998, the Edmonton office of Maxxam Analytics Inc. conducted a source emission survey and efficiency test on the Incinerator Exhaust Stack that was operating on a Mobil well site (06-03-030-27-W4M) near the Mobil Lone Pine Creek Gas Plant. Sampling was carried out on the separator inlet to determine concentrations of organic compounds and water content. Sampling was carried out on the separator outlet to determine concentrations of organic compounds, total reduced sulphur compounds and water content. Sampling was carried out on the incinerator exhaust stack to determine concentrations of sulphur dioxide, oxides of nitrogen, carbon monoxide, total reduced sulphur compounds and organic compounds. Furthermore, destruction efficiencies were determined for total reduced sulphur compounds and organic compounds.

The summary of results is as follows:

RUN:	<u>SEP. INLET</u>	<u>SEP. OUTLET</u>	<u>STACK</u>	<u>AVERAGE</u>
DATE:	Nov. 5, 1998	Nov. 5, 1998	Nov. 5, 1998	
TIME:	12:06 - 13:06	12:06 - 13:06	12:06 - 13:06	

WATER CONTENT

<i>(lb. water/million ft³ of wet gas)</i>	6.4	4.3	-	-
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SULPHUR DIOXIDE

<i>(ppmv wet)</i>	-	-	547	-
<i>(ppmv dry)</i>	-	-	610	-
<i>(kg/hr)</i>	-	-	-	-

OXIDES OF NITROGEN (as NO₂)

<i>(ppmv wet)</i>	-	-	67	-
<i>(ppmv dry)</i>	-	-	75	-
<i>(kg/hr)</i>	-	-	-	-

CARBON MONOXIDE

<i>(ppmv wet)</i>	-	-	226	-
<i>(ppmv dry)</i>	-	-	252	-
<i>(kg/hr)</i>	-	-	-	-

TOTAL REDUCED SULPHUR COMPOUNDS

<i>Hydrogen Sulphide (H₂S)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	-	10400	<1.0	-
	<i>(g/hr)</i>	-	-	-	-
<i>Carbonyl Sulphide (COS)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	-	6	<1.0	-
	<i>(g/hr)</i>	-	-	-	-
<i>Carbon Disulphide (CS₂)</i>	<i>(ppmv wet)</i>	-	-	<0.4	-
	<i>(ppmv dry)</i>	-	<0.5	<0.5	-
	<i>(g/hr)</i>	-	-	-	-

ORGANIC COMPOUNDS

<i>Methane (CH₄)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	825000	816900	<1.0	-
	<i>(g/hr)</i>	-	-	-	-
<i>Ethane (C₂H₆)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	44100	44800	<1.0	-
	<i>(g/hr)</i>	-	-	-	-
<i>Propane (C₃H₈)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	13700	14800	<1.0	-
	<i>(g/hr)</i>	-	-	-	-
<i>Butane (C₄H₁₀)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	7040	9420	<1.0	-
	<i>(g/hr)</i>	-	-	-	-
<i>Pentane (C₅H₁₂)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	3520	5880	<1.0	-
	<i>(g/hr)</i>	-	-	-	-
<i>Hexane (C₆H₁₄)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	1960	3510	<1.0	-
	<i>(g/hr)</i>	-	-	-	-

<i>Heptane + (C₇H₁₆)</i>	<i>(ppmv wet)</i>	-	-	<0.9	-
	<i>(ppmv dry)</i>	4680	3690	<1.0	-
	<i>(g/hr)</i>	-	-	-	-

Components heavier than heptane are presented in Appendix II of this report

DESTRUCTION EFFICIENCIES - TRS (as Sulphur)					
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<i>(total in - ppmv as Sulphur)</i>	10420	-	-	-	-
<i>(total out - ppmv as Sulphur)</i>	1.50	-	-	-	-
<i>(% efficiency)</i>	>99.99	-	-	-	-

DESTRUCTION EFFICIENCIES - GASEOUS ORGANICS (as CH₄)					
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<i>(total in - ppmv as Methane)</i>	851328	-	-	-	-
<i>(total out - ppmv as Methane)</i>	1.37	-	-	-	-
<i>(% efficiency)</i>	>99.99	-	-	-	-

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1.0 DISCUSSION

There were no operational or analytical problems encountered during the field sampling or sample analysis. The values reported are considered to be representative of the conditions that existed during the testing period.

Due to the fact that there were no existing ports available and ports could not be placed through the firebrick of the stack, velocity profiles were not performed during this project. Therefore, mass emissions from the exhaust stack have not been calculated.

2.0 PROJECT PERSONNEL/ SAMPLING TEAM

Mr. Dwight Jenkinson was the project coordinator for Mobil Oil Canada. Mr. Dan Motyka was the project coordinator for Questor Technologies. The Maxxam sampling team consisted of Walter Book, Dwayne Duddy and Casey Kelley, who conducted all field sampling.

3.0 PLANT OPERATING PARAMETERS

Maxxam sampling team members were not made aware of any plant operating variances or upsets during the time of sampling. All sampling was conducted during steady plant operating conditions. If a plant upset were to occur, the sampling team would halt sampling, remove the probe from the stack and seal the inlet with an inert plug until the plant process was back at normal operating conditions. At this time the probe would be unsealed and placed back into the stack and sampling would resume.

4.0 TEST METHODS

760 mm Hg and 25°C are used as reference pressure and temperature for this report.

WATER CONTENT (Separator Inlet & Outlet Only)

Water content was determined following the protocols in the Standard Test Method for Water Vapor Content of Gaseous Fuels by Measurement of Dew-Point Temperature as outlined in the ASTM Book of Standards¹. Samples were collected at both the separator inlet and outlet and water content was then determined using a Dew-Point apparatus.

SULPHUR DIOXIDE

Sulphur dioxide samples were collected following the protocols in Method #8 - Determination of Sulphuric Acid Mist and Sulphur Dioxide Emissions from Stationary Sources as outlined in the Alberta Stack Sampling Code (Ref. 89)². The samples were collected through a quartz glass lined stainless steel sampling probe and passed through a series of four impingers. The first two impingers contained 250 mLs of 5% hydrogen peroxide (H₂O₂) absorbing solution, the third was left empty and the fourth contained approximately 150 grams of silica gel. The stack gas was then passed through a sample pump and dry gas meter.

OXIDES OF NITROGEN

Oxides of nitrogen samples were collected following the protocols Method #7A - Determination of Nitrogen Oxide Emissions from Stationary Sources (Ion Chromatographic Method) as outlined in the Alberta Stack Sampling Code (Ref. 89)². Grab samples were collected twice per run in evacuated 2 litre round bottom flasks. Each flask contained 25 mLs of dilute sulphuric acid - hydrogen peroxide absorbing solution. All flasks were evacuated to within 3.0 inches Hg (absolute pressure) or less prior to sample collection. Minimum holding time before sample recovery was 16 hours.

CARBON MONOXIDE

Carbon monoxide samples were collected following the protocols in Method #10 - Determination of Carbon Monoxide Emissions from Stationary Sources as outlined in the Alberta Stack Sampling Code (Ref. 89)². The samples were collected through a Teflon™ lined stainless steel sample probe and captured in 5L Tedlar™ air bags, which in turn were housed in an air tight lung sampler. An empty impinger in an ice bath was placed in front of the Tedlar™ bag to remove moisture present in the sample gas stream. Samples were collected using the integrated bag sampling technique.

¹ ANNUAL BOOK OF ASTM STANDARDS, American Society for Testing and Materials, Philadelphia, PA, 1995.

² ALBERTA STACK SAMPLING CODE, (Publication Ref. 89), Alberta Environmental Protection, Air and Water Approvals Division, 1996.

TOTAL REDUCED SULPHUR COMPOUNDS

Total reduced sulphur compounds were collected following the protocols in the Reference Method for Source Testing - Measurement of Emissions of Total Reduced Sulphur Compounds From Sour Gas Plants as outlined in the Alberta Stack Sampling Code (Ref.89)¹. The samples were collected through a quartz glass lined stainless steel sampling probe, which in turn was connected, to a series of three impingers. The first impinger contained 100 mLs of 85% phosphoric acid (H₃PO₄) to remove moisture from the stack gas, and the second and third impingers each contained 250 mLs of a citrate buffer solution to remove sulphur dioxide interference. The stack gas was then collected in a 5L Tedlar™ air bag, which was housed in an evacuated air tight lung sampler. All sample lines on the collection train were Teflon™ and were thoroughly purged prior to collection of the TRS samples. All bag samples were collected in five minutes or less.

ORGANIC COMPOUNDS

Organic compounds were collected following the protocols in Method #18 - Measurement of Gaseous Organic Compound Emissions by Gas Chromatography as outlined in the Alberta Stack Sampling Code (Ref.89)¹. The samples were collected through a quartz glass lined sample probe and captured in 5L Tedlar™ air bags, which in turn were housed in an air tight lung sampler. An empty impinger in an ice bath was placed in front of the lung sampler to remove moisture present in the sample gas stream. Samples were collected using the integrated bag sampling technique over a one-hour period.

FLUE GAS MOISTURE CONTENT (Exhaust Stack Only)

Flue gas moisture content was determined simultaneously with the target parameter sample runs following the protocols in Method #4 - Determination of Moisture Content in Stack Gases as outlined in the Alberta Stack Sampling Code (Ref. 89)¹. Moisture was measured volumetrically for each sample run.

FIXED GAS COMPOSITION (CO₂, O₂, N₂ & CO) AND MOLECULAR WEIGHTS

Fixed gas composition and molecular weights were determined following the protocols in Method #3 - Gas Analysis for the Determination of Molecular Weights as outlined in the Alberta Stack Sampling Code (Ref. 89)¹. Flue gas samples were collected once per run in 5 litre Tedlar™ air bags. All bags were analyzed by gas chromatograph upon return to Maxxam's Edmonton laboratory.

STACK TEMPERATURES

Stack temperatures were determined using a calibrated type "K" thermocouple and digital pyrometer.

¹ ALBERTA STACK SAMPLING CODE, (Publication Ref. 89), Alberta Environmental Protection, Air and Water Approvals Division, 1996.

5.0 ANALYTICAL METHODS

SULPHUR DIOXIDE

Sulphur dioxide samples were analyzed following the protocols in Method #8 - Determination of Sulphuric Acid Mist and Sulphur Dioxide Emissions from Stationary Sources as outlined in the Alberta Stack Sampling Code (Ref. 89)¹. Sulphate concentration is measured by titrating samples against a standardized barium perchlorate trihydrate solution using thiorin as an indicator.

OXIDES OF NITROGEN

Oxides of nitrogen samples were analyzed following the protocols in Method #7A - Determination of Nitrogen Oxide Emissions from Stationary Sources (Ion Chromatographic Method) as outlined in the Alberta Stack Sampling Code (Ref. 89)¹. The nitrogen oxides, excluding nitrous oxide, were oxidized to nitrate and measured using ion chromatography.

CARBON MONOXIDE

Carbon monoxide samples were analyzed following the protocols in Method #10 - Determination of Carbon Monoxide Emissions from Stationary Sources as outlined in the Alberta Stack Sampling Code (Ref. 89)¹. The samples were analyzed using a non-dispersive infrared analyzer or equivalent. Maxxam used a Bacharach™ Model CA300NSX Combustion Analyzer. The analyzer was calibrated using an EPA Protocol 1 gas in purified grade nitrogen.

TOTAL REDUCED SULPHUR COMPOUNDS

Total reduced sulphur compounds were analyzed following the protocols in Reference Method for Source Testing - Measurement of Emissions of Total Reduced Sulphur Compounds From Sour Gas Plants as outlined in the Alberta Stack Sampling Code (Ref.89)¹. Analysis was performed using a gas chromatograph. The gas chromatograph was calibrated as per the applicable protocols. All TRS analysis was performed on site, within approximately one hour of sample collection.

ORGANIC COMPOUNDS

Organic compounds were analyzed following the protocols in Method #18 - Measurement of Gaseous Organic Compound Emissions by Gas Chromatography as outlined in the Alberta Stack Sampling Code (Ref.89)¹. A calibrated Shimadzu™ Gas Chromatograph 14A-GC4 with a Flame Ionization Detector (FID) was used for all sample analysis.

¹ ALBERTA STACK SAMPLING CODE, (Publication Ref. 89), Alberta Environmental Protection, Air and Water Approvals Division, 1996.

FLUE GAS MOISTURE CONTENT

Flue gas moisture content was determined following the protocols as outlined in Method #4 - Determination of Moisture Content in Stack Gases as outlined in the Alberta Stack Sampling Code (Ref. 89)¹. This reference method was conducted simultaneously with the target parameter sample runs. Moisture was determined volumetrically for each run.

FIXED GAS COMPOSITION (CO₂, O₂, N₂ & CO) AND MOLECULAR WEIGHTS

Fixed gas analysis was performed following the protocols in Method #3 - Gas Analysis for the Determination of Molecular Weights as outlined in the Alberta Stack Sampling Code (Ref. 89)¹. Gas chromatography was used for fixed gas composition analysis. The sample was injected automatically, via a Valco™ valve to an Altec™ mole sieve dual column, 36" long, operating at 35°C. The components of interest are eluted on a thermal conductivity detector (TCD) and the responses measured. Prior to and after sample analysis, a Matheson Cal-Mat1™ standard was analyzed to certify the gas chromatograph accuracy. The Cal-Mat1™ standard has an individual component accuracy of 0.02% absolute and is NIST traceable. The gas chromatograph uses helium as a carrier gas and each run is programmed for 10 minutes.

¹ ALBERTA STACK SAMPLING CODE, (Publication Ref. 89), Alberta Environmental Protection, Air and Water Approvals Division, 1996

6.0 EQUIPMENT CALIBRATION METHODS

DRY GAS METERS, DRY GAS METER/ORIFICE ASSEMBLIES

Units are calibrated and calibration data is documented as per the protocols outlined in Section 5.3 of Method #5 of the Alberta Stack Sampling Code (Ref. 89)¹ and 40 CFR 60 Appendix 1².

THERMOCOUPLES

Thermocouples were calibrated and calibration data is documented as per the protocols outlined in Section 4.3 of Method #2 of the Alberta Stack Sampling Code (Ref. 89)¹ and 40 CFR 60 Appendix 1². All thermocouples have been previously calibrated against ASTM mercury-in-glass thermometers at three temperatures: in an ice bath, at the boiling point of water, and at an elevated temperature of peanut oil.

SAMPLE PROBE - PITOT TUBE ASSEMBLY

Sample probes - pitot tube assemblies were calibrated and calibration data is documented as per the protocols outlined in Section 4 of Method #2 of the Alberta Stack Sampling Code (Ref. 89)¹ and 40 CFR 60 Appendix 1². All sample probe and pitot tube assemblies have been previously calibrated against a standard pitot tube with a NIST traceable coefficient. Calibration data and pitot tube coefficients are based on multiple flow rate measurements obtained at the Southern Alberta Institute of Technology (S.A.I.T.) wind tunnel.

SAMPLE COLLECTION GLASSWARE & PROBE LINERS

All glassware and probe liners used for the collection of flue gas samples were cleaned using laboratory grade glassware detergent and thoroughly rinsed with de-ionized water.

FIELD BAROMETER

All field barometers were calibrated as per the protocols as outlined in Section 5.7 of Method #5 of the Alberta Stack Sampling Code (Ref. 89)¹ and 40 CFR 60 Appendix 1². Field barometers are calibrated weekly against an in house mercury barometer which has been previously calibrated by Environment Canada.

CALIBRATION DATES

Pitot tubes were calibrated on January 7, 1998. Dry gas meters were calibrated on March 20, 1998 and the thermocouples were last calibrated on January 6, 1998. The orifices were calibrated on January 7 and 8, 1998.

All calibration data is presented in Appendix V of this report.

¹ ALBERTA STACK SAMPLING CODE, (Publication Ref. 89), Alberta Environmental Protection, Air and Water Approvals Division, 1996.

² CODE OF FEDERAL REGULATIONS, (40 CFR 60 App. A), U.S. Environmental Protection Agency, 7-1-96 Edition.)

7.0 QUALITY ASSURANCE/ QUALITY CONTROL

Maxxam Analytics Inc. is registered and certified by both the Standard Council of Canada (SCC) and the Canadian Association of Environmental Analytical Laboratories (CAEAL) for specific tests as registered with the Council and Association. Our Quality System complies with ISO Guide 25-1990 and CAN/CSA Z753-95. Maxxam Analytics is ISO 9002 registered and our quality system complies with all ISO requirements.

MAXXAM SOURCE TESTING DEPARTMENT

Maxxam's source testing department QA/QC protocols include, but are not limited to the following:

- regular maintenance and calibration of all field sampling equipment as per the applicable sampling method protocols. All calibration records are retained on site for inspection.
- sample glassware cleaning and proofing.
- on site leak checks (sample systems & pitot tubes), flow checks, moisture verifications and % isokinetic determinations.
- proper sealing, labeling, storing, transport and chain of custody/log in procedures upon return to the laboratory.
- submission of field blank sampling absorbing solution for analysis to determine if background contamination has occurred.

MAXXAM ANALYTICAL DEPARTMENTS

Maxxam's analytical departments QA/QC protocols include, but are not limited to the following:

- Canadian Association of Environmental Analytical Laboratories (CAEAL) performance evaluation samples on a quarterly basis.
- Canadian Association of Environmental Analytical Laboratories (CAEAL) yearly laboratory audits.
- Standard Council of Canada (SCC) yearly laboratory audits.
- analytical instrument calibration curves based on five (5) varying standards.
- minimum of one spike sample is run with each set of stack samples.
- minimum of one (1) QC blank sample is analyzed with each set of stack samples, routinely blank samples are run between each individual stack sample.
- all stack samples are analyzed in duplicate.

8.0 REVIEW

All sampling, analysis, and QA/QC for this project was performed by Maxxam Analytics Inc. and complies with the applicable protocols. The results are therefore considered to be representative of the source during the testing period. Any deviations or modifications made to the sampling or analytical methods are outlined in the discussion of this report. On this basis, Maxxam is issuing this completed report to Questor Technologies Inc., Calgary, Alberta.

We trust that this report meets your requirements. If you have any questions regarding this project, please do not hesitate to contact the undersigned at (403) 468-3500 or fax (403) 466-3332.

Yours truly,

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