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DATE: 19 November 2001

TO: JoAnn Camacho, U.S. EPA/ERTC Work Assignment Manager

THROUGH: Dennis Miller, REAC Analytical Section Leader

FROM: Miguel Trespalacios, REAC Task Leader Miguel Trespalacios

SUBJECT: ECONOMY PRODUCTS SITE. SHENANDOAH, IOWA. WORK ASSIGNMENT #0-215 - FINAL TRIP REPORT

BACKGROUND

Response Engineering and Analytical Contract (REAC) personnel provided technical assistance to the United States Environmental Protection Agency/Environmental Response Team Center (U.S.EPA/ERTC) as they supported the U.S. EPA Region VII in evaluating the performance of Midwest Soil Remediation, Inc. full scale GEM-1000 low temperature thermal desorption unit (TDU) in treating pesticide contaminated soils. **This project involves the treatment of approximately 6000 tons of pesticide contaminated soil at the Economy Products superfund site in Shenandoah, Iowa.**

The GEM-1000 TDU is a two part treatment system designed to first vaporize contaminants from the soil through the application of heat in a counter-current rotary desorber (primary system) and then destroy the vaporized compounds in downstream air pollution control devices (secondary system). The contaminated soil is conveyed over a weigh scale to the cold end side of the rotary desorber. The rotary desorber is equipped with speed, slope and temperature controls to provide a variable soil retention time of 6 to 12 minutes and a soil temperature in the range of 600-800°F. As the soil travels through the desorber and come in contact with hot combustion gases flowing in the opposite direction, the contaminants in the soil are volatilized and enter the gas stream. The contaminated dust laden air stream exiting the desorber is routed to a pulse jet baghouse for the removal of dust.

The dust free gases from the baghouse are then routed to an air pollution control system where virtually all of the organic contaminants are converted to carbon dioxide, water vapor and inorganic acids (HCL). Any inorganic acid that is generated is neutralized in a packed-bed scrubber. The exhaust gases are quenched to reduce the temperature before they are discharged to the atmosphere.

The former Economy Products facility formulated pesticides from 1961 to 1973. Many of the pesticides formulated at the site are now banned or their use is restricted. These pesticides include aldrin, dieldrin, endrin, 4,4-DDE, 4,4-DDD, 4,4-DDT, lindane gamma-BHC, chlordane, heptachlor, and toxaphene.

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In 1973, a fire destroyed the Economy Product's main packaging area, a warehouse where chemicals were stored, and another building adjacent to the warehouse. As a result of the fire, pesticides were deposited around the facility, both on-site and onto property adjacent to the facility.

Following the fire, debris and refuse from the site were disposed of in three different locations. These locations included a limestone quarry in Stennett, Iowa, Shenandoah's municipal landfill, and the Economy site itself. The Iowa National Guard subsequently spread one foot of clay fill over the areas where debris had been removed. The site was zoned industrial and is currently unoccupied.

In 1988, the Iowa Department of Natural Resources (IDNR) conducted a preliminary assessment (PA) of the Economy Products site. Contractors for IDNR and the U.S. EPA performed a site inspection (SI) and a site reconnaissance in 1993 and 1995, respectively. In 1997 and 1998, the U.S. EPA and Superfund Technical and Response Team (START) conducted further investigations of soil and groundwater at the site. The investigations found that the soil was contaminated with pesticides at three locations: on-site, on a railway access area adjacent to the site, and in residential areas adjacent to the site. The on-site pesticide contamination was determined to be from the ground surface to twelve feet below the ground surface.

OBSERVATIONS AND ACTIVITIES

Site Visit and Shakedown Operations

REAC personnel visited the Economy Products site on 11 June 2001 to observe the TDU's shakedown operations and ensure that all efforts and process activities carried out to operate the TDU at safe and efficient operation levels were performed according to an approved Work Plan. The Work Plan was specifically developed for the test demonstration to establish that the TDU would operate at optimum levels and to document any deviations from the Work Plan.

During the shakedown period, the TDU was operated for a 24-hour period while feeding clean soil, followed by a limited period of operation while feeding contaminated soil. The shakedown period was necessary to demonstrate the TDU's systems operation. Some of these systems included the continuous emission monitoring (CEM), the continuous process monitoring (CPM) and the automatic waste feed cutoff (AWFCO) systems.

There were several problems encountered during the shakedown period of the TDU. Some of the problems included the operation of the CEM and AWFCO systems. The CEM system was not working properly during the shakedown period and needed repair and certification before performing the POP test. New carbon monoxide (CO) and oxygen (O_2) monitors needed to be installed to continue with the test demonstration. The AWFCO system could not be demonstrated to be functionally operative during the shakedown operations and set points were not properly established until the last week of July after the POP test was performed.

Proof of Performance (POP) Test Evaluation

REAC personnel visited the Economy Products site on 26 June 2001 to observe the setup and operation of the POP test and ensure that the sampling and testing operations, including the equipment and relevant calibrations, test procedures, test completion, and sample documentation were in compliance with the approved POP test plan. The POP test plan required three stack emission tests to be performed to establish

the TDU compliance for efficiently treating the pesticide contaminated soil from the site.

The stack emission tests included U.S. EPA Methods 5 and 26A for the determination of particulate, HCl, and chlorine emissions; U.S. EPA Method 9 for the determination of visible emissions; U.S. EPA Method 10 for the determination of CO emissions; U.S. EPA Method 23 for the determination of polychlorinated dibenzo-p-dioxins and furans (PCDDs/PCDFs) emissions; U.S. EPA Method 25A for the determination of total hydrocarbon emissions by CEM; and SW-846 Methods 10/8270 for the determination of organochlorine pesticides. Entropy, Inc. of Raleigh, North Carolina performed the stack emission tests.

Several sampling difficulties were encountered during the performance of the POP tests that caused one Method 5 test run, one Method 26A test run and two Method 23 test runs to be aborted. Replacement test runs were performed. The additional test runs were necessary to produce the three valid test runs as required in the performance specification for the Economy Products site project. Additional problems were encountered with the CEM system which caused test delays and required CEM repairs and replacement parts. Ultimately, the majority of the CEM problems were resolved and the CEM certification testing was performed.

Continuous Emission Monitoring (CEM) System Evaluation

The CEM system installed in the TDU for the POP test evaluation consists of extractive monitors for measuring the effluent gas concentration of CO, O_2, and THC emissions during TDU operation. Because of excessive moisture, the THC emissions (U.S. EPA Method 25A) could not be reliably measured. This condition was communicated to the U.S. EPA On-Scene Coordinator (OSC) and a decision was made not to conduct the THC emissions testing.

The problems encountered with the TDU's CEM system resulted in POP test delays to repair and replace equipment parts. The delays required the use of Entropy's CEMs to complete the emissions testing. Ultimately, the majority of the TDU's CEM problems were resolved and a relative accuracy test audit (RATA) to establish the CEM performance certification was scheduled to commence on 30 July 2001. During certification testing, the TDU's CEM system was not able to continually record data. It was necessary for an Entropy technician to manually record the CEM data for comparison to Entropy's reference method data.

Entropy reference method procedures and calibration records complied with the specifications in U.S. EPA Methods 3A and 10. During field observations, it was noted that during the certification of the TDU's CEMs, the calibration gases were not protocol calibration gases as required by the reference methods and that calibration gas certificates were never provided. Although the TDU's CEMs appeared to be calibrated using non-protocol gases, the CEMs met all of the performance specification test parameter requirements.

RESULTS

A summary of the stack emissions test results is provided in Table 1. A total of three qualified test runs were performed. All the results were reported on a dry weight basis and were corrected to 7% O_2. All results were below the established limit standards. The CO concentration averaged 1.64 parts per million by volume (ppmv). Chlorine as Cl_2 averaged 0.0871 ppmv. The HCl concentration averaged 0.186 ppmv. The concentration of filterable particulate matter averaged 0.00455 grains per standard dry cubic foot (gr/dscf).

TABLE 1
Summary of Stack Emissions Test Results
Economy Products Superfund Site
Shenandoah, Iowa
November 2001

TARGET COMPOUND	TEST 1	TEST 2	TEST 3	AVERAGE
Plume Opacity (%)	2.3	1.3	0.8	1.5
CO (ppmv)	0.00	2.08	2.85	1.64
O_2 (%)	5.7	6.1	7.4	6.40
Total Particulates (gr/dscf)	0.00741	0.00377	0.00247	0.004556
HCl (ppmv)	0.193	0.207	0.158	0.186
Cl_2 (ppmv)	0.0744	0.106	0.081	0.087
Aldrin (%DRE)	99.999	99.999	>99.999	>99.999
4,4-DDT (%DRE)	>99.996	>99.999	>99.996	>99.998
Dieldrin (%DRE)	99.999	99.999	99.999	>99.999
Heptachlor (%DRE)	**99.993**	**99.994**	**99.992**	**>99.993**
Total PCDDs (ng/dscm)	**0.252**	**0.222**	**0.185**	**0.220**
Total PCDFs (ng/dscm)	0.577	0.465	0.459	0.500
PCDDs/PCDFs (TEQ)	0.0183	0.0180	0.0179	0.0181

ppmv = parts per million by volume
gr/dscf = grains per dry standard cubic foot
%DRE = percent destruction and removal efficiency
ng/dscm = nanograms per dry standard cubic meter
TEQ = toxicity equivalency

The concentration of PCDDs/PCDFs averaged 0.0181 nanograms per dry standard cubic meter on a toxicity equivalency (TEQ) basis. Emissions reported in TEQ were calculated using the 1989 U.S. EPA toxic equivalency factors (TEFs). The mass of each tetra through octa-chlorinated PCDD/PCDF congener was adjusted for the corresponding TEFs and the adjusted congener masses were added together to determine PCDDs/PCDFs concentration in ng/dscm TEQ.

Six-minute average plume opacity averaged 0.8%. Destruction and removal efficiencies (DREs) for aldrin, 4,4-DDT, dieldrin, and heptachlor as principal organic hydrocarbons (POHCs) were 99.99% or higher. A detailed account of the emission test results is provided in the Stationary Source Sampling Report. This report without the appendices is provided in Appendix A. The CEM Performance Specification Test Report is provided in Appendix B.

DISCUSSION OF RESULTS

In summary, the stack emission tests were performed in compliance with the established reference methodology and the results of the tested parameters were below the limit standards established for the Economy Products site.

Quality assurance and quality control (QA/QC) procedures associated with the analysis of the particulate matter, HCl, Cl_2, and PCDD/PCDF samples are summarized in the final test report; all QA/QC results were within the accepted criteria for duplicates, blanks, matrix spikes, internal and surrogate spikes. Therefore, the laboratory results are considered acceptable. QA/QC procedures associated with the pesticide sample analysis were not summarized in the final test report; a laboratory data validation report was not prepared even though very poor surrogate recoveries were reported during the analysis of the pesticide samples. **The pesticide results should be considered estimated unless data validation is performed.**

Independent calculations using Entropy field data and laboratory reports indicate that the procedures used to calculate emission test results and DREs are acceptable and accurately portray the POP test results. It is important to note that a DRE is typically demonstrated for a POHC that is chosen prior to the POP test. Midwest Soil Remediation, Inc. was unable to adequately quantify the POHC in the feed soil. This resulted in the selection of POHCs selection for DRE demonstration to be determined after the POP test was performed, stack samples analyzed and later re-analyzed and the results were reported.

Appendix A

APPENDIX A

Stationary Source Sampling Report
Economy Products Superfund Site
Shenandoah, Iowa
November 2001

ENTROPY, INC.

Specialists in Air Emissions Technology

P.O. BOX 90067 • RALEIGH, NORTH CAROLINA 27675-0067
(919) 781-3550 • (800) 486-3550 • FAX (919) 787-8442

STATIONARY SOURCE SAMPLING REPORT
REFERENCE NO. 17546

MIDWEST SOIL REMEDIATION, INC.
SHENANDOAH, IOWA

EMISSIONS TESTING FOR:
PARTICULATE,
CHLORINE,
HYDROGEN CHLORIDE,
4-8 PCDD/PCDF,
POHC,
CARBON MONOXIDE,
AND
VISIBLE EMISSIONS

INCINERATOR STACK

PERFORMED FOR: MIDWEST SOIL REMEDIATION, INC.

JUNE 2001

REPORT CERTIFICATION

EI Reference Number 17546

The sampling and analysis performed for this report were carried out under my direction and supervision, and I hereby certify that, to the best of my knowledge, the test report is authentic and accurate.

Signature: Jeff Kunstling

Date: 9-04-01

Jeff Kunstling
Project Director
Client Services Division

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PCDD/PCDF Summaries

EPA 1989 Toxic Equivalencies

Run-By-Run Tests Summaries

1.0. INTRODUCTION

1.1. Background

A sampling and analytical program was conducted on the Midwest Soil Remediation Inc. GEM1000 Unit 1 soil treatment system at the Economy Products site in Shenandoah, Iowa.

1.2. Outline of Test Program

Table 1-1 is a test log that presents the sampling objectives, sampling methods, test dates, and run numbers for the test program. Several runs utilized volumetric air flow rates and/or flue gas composition data from other runs; refer to **Table 1-1**.

1.3. Test Participants

Table 1-2 lists the personnel involved in the test program.

TABLE 1-1
TEST LOG
INCINERATOR STACK
JUNE 2001

Sampling Objective	Test Method	Test Date	Run Numbers	Flue Gas Composition	Volumetric Air Flow Rate
Particulate, Cl_2, and HCl [(1)]	EPA 5 and 26A	6/27/01, 6/27/01, 6/28/01	S-M5/26A-1, S-M5/26A-2, S-M5/26A-4	S-M3/23-1, S-M3/23-1, S-M3/23-4	S-M5/26A-1, S-M5/26A-2, S-M5/26A-4
PCDD/PCDF and POHC [(2)]	EPA M23	6/27/01, 6/28/01, 6/29/01	S-M23-1, S-M23-4, S-M23-5	S-M3/23-1, S-M3/23-4, S-M3/23-5	S-M23-1, S-M23-4, S-M23-5
Carbon Monoxide	EPA 10	6/27/01, 6/28/01, 6/29/01	S-CEM-1, S-CEM-3, S-CEM-4	S-CEM-1, S-CEM-3, S-CEM-4	S-M23-1, S-M23-4, S-M23-5
Visible Plume Opacity	EPA 9	6/27/01, 6/28/01, 6/29/01	S-M9-1, S-M9-4, S-M9-5	Not Applicable	Not Applicable

(1) Cl_2 = chlorine and HCl = hydrogen chloride.

(2) POHC included adrin; dieldrin; 4,4-DDT; heptachlor; alpha chlordane; endrin; gamma chlordane; lindane gamma-BHC; and toxaphene.

TABLE 2-1
TEST RESULTS VERSUS PERMITTED LIMITS
INCINERATOR STACK
JUNE 2001

	Rep 1	Rep 2	Rep 3	Average	Permit Limit
Concentration, ppmvd @ 7% O_2					
Carbon Monoxide	0.00	2.08	2.85	1.64	100
Chlorine as Cl_2	0.0744	0.106	0.0810	0.0871	77
Hydrogen Chloride	0.193	0.207	0.158	0.186	77
Concentration, gr/dscf @ 7% O_2					
Filterable Particulate	0.00741	0.00377	0.00247	0.00455	0.015
Concentration, ng/dscm @ 7% O_2					
PCDD/PCDF 1989 EPA Toxic Equivalency	0.0183	0.0180	0.0179	0.0181	0.2
Destruction and Removal Efficiency, %					
Aldrin	99.99	99.99	> 99.99	> 99.99	99.99
Dieldrin	99.99	99.99	99.99	99.99	99.99
Highest Six Minute Average, %					
Plume Opacity	2.3	1.3	0.8	1.5	5

TABLE 2-5

EPA 1989 PCDD/PCDF TOXIC EQUIVALENCIES SUMMARY

Scrubber Outlet

	Concentration, ng/DSCM @ 7% O2 *-			1989 EPA Equiv.	-------Toxic Equivalencies------- Concentration, ng/DSCM @ 7% O2 *-		
	S-M23-1	S-M23-4	S-M23-5	Factor	S-M23-1	S-M23-4	S-M23-5
PCDD							
2378-TCDD	1.54E-003 -	2.98E-003	2.26E-003	1.00000	1.54E-003 -	2.98E-003	2.26E-003
Other TCDD	1.61E-002 -	2.02E-002	2.37E-002	0.00000	0.00E+000 -	0.00E+000	0.00E+000
12378-PeCDD	3.46E-003	3.70E-003	3.37E-003	0.50000	1.73E-003	1.85E-003	1.69E-003
Other PeCDD	3.30E-002	3.08E-002	2.85E-002	0.00000	0.00E+000	0.00E+000	0.00E+000
123478-HxCDD	2.94E-003	2.47E-003	1.98E-003	0.10000	2.94E-004	2.47E-004	1.98E-004
123678-HxCDD	4.67E-003	4.10E-003	4.79E-003	0.10000	4.67E-004	4.10E-004	4.79E-004
123789-HxCDD	3.62E-003	3.02E-003	2.60E-003	0.10000	3.62E-004	3.02E-004	2.60E-004
Other HxCDD	3.57E-002	3.42E-002	3.34E-002	0.00000	0.00E+000	0.00E+000	0.00E+000
1234678-HpCDD	3.17E-002	2.63E-002	2.47E-002	0.01000	3.17E-004	2.63E-004	2.47E-004
Other HpCDD	2.83E-002	2.25E-002	1.93E-002	0.00000	0.00E+000	0.00E+000	0.00E+000
OCDD	9.05E-002	7.21E-002	4.00E-002	0.00100	9.05E-005	7.21E-005	4.00E-005
Total PCDD	2.52E-001	2.22E-001	1.85E-001		4.80E-003	6.12E-003	5.17E-003
PCDF							
2378-TCDF	8.94E-003	6.31E-003	7.22E-003	0.10000	8.94E-004	6.31E-004	7.22E-004
Other TCDF	2.09E-001	1.58E-001	1.53E-001	0.00000	0.00E+000	0.00E+000	0.00E+000
12378-PeCDF	1.38E-002	9.98E-003	1.10E-002	0.05000	6.90E-004	4.99E-004	5.50E-004
23478-PeCDF	1.44E-002	1.30E-002	1.43E-002	0.50000	7.20E-003	6.50E-003	7.15E-003
Other PeCDF	1.59E-001	1.23E-001	1.21E-001	0.00000	0.00E+000	0.00E+000	0.00E+000
123478-HxCDF	1.42E-002	1.26E-002	1.30E-002	0.10000	1.42E-003	1.26E-003	1.30E-003
123678-HxCDF	1.38E-002	1.15E-002	1.12E-002	0.10000	1.38E-003	1.15E-003	1.12E-003
123789-HxCDF	3.67E-003	3.51E-003	5.04E-003	0.10000	3.67E-004	3.51E-004	5.04E-004
234678-HxCDF	1.09E-002	1.10E-002	1.03E-002	0.10000	1.09E-003	1.10E-003	1.03E-003
Other HxCDF	5.84E-002	5.31E-002	5.40E-002	0.00000	0.00E+000	0.00E+000	0.00E+000
1234678-HpCDF	3.70E-002	3.11E-002	2.53E-002	0.01000	3.70E-004	3.11E-004	2.53E-004
1234789-HpCDF	4.77E-003	5.01E-003	6.13E-003	0.01000	4.77E-005	5.01E-005	6.13E-005
Other HpCDF	1.23E-002	1.18E-002	1.26E-002	0.00000	0.00E+000	0.00E+000	0.00E+000
OCDF	1.65E-002	1.53E-002	1.52E-002	0.00100	1.65E-005	1.53E-005	1.52E-005
Total PCDF	5.77E-001	4.65E-001	4.59E-001		1.35E-002	1.19E-002	1.27E-002
Total PCDD/PCDF	8.29E-001	6.87E-001	6.44E-001		1.83E-002	1.80E-002	1.79E-002

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg)

\- Estimated maximum possible concentrations for analytes found above the detection limit, but not meeting all the qualitative identification criteria.

TABLE 2-7

PARTICULATE, CL2, AND HCL TEST RESULTS SUMMARY

Scrubber Outlet

	S-M26A-1	S-M26A-2	S-M26A-4	Average
Run Date	6/27/01	6/27/01	6/28/01	
Run Start Time	1115	1715	1707	
Run Finish Time	1430	2006	1916	
Test Train Parameters:				
Volume Of Dry Gas Sample, SCF *	44.179	41.222	40.053	
Percent Isokinetic:	102.8	100.2	96.4	
Flue Gas Parameters:				
CO_2, Percent By Volume, Dry	10.4	10.4	10.8	10.5
O_2, Percent By Volume, Dry	5.7	5.7	5.5	5.6
Temperature, °F	187	184	182	184
Air Flow Rate, Dry SCFM *	4,821	4,952	4,965	4,913
Air Flow Rate, Wet ACFM	14,103	14,110	13,804	14,006
Filterable Particulate:				
Concentration, grains/DSCF *	0.00810	0.00412	0.00274	0.00499
Concentration, gr/DSCF @ 7% O2	0.00741	0.00377	0.00247	0.00455
Emission Rate, lb/hr	0.335	0.175	0.116	0.209
Chlorine as Cl2:				
Concentration, ppmvd	0.0814	0.116	0.0897	0.0957
Concentration, ppmvd @ 7% O2	0.0744	0.106	0.0810	0.0871
Emission Rate, lb/hr	0.00433	0.00636	0.00492	0.00520

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg)

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TABLE 2-7 (Continued)

PARTICULATE, CL2, AND HCL TEST RESULTS SUMMARY

Scrubber Outlet

	S-M26A-1	S-M26A-2	S-M26A-4	Average
Hydrogen Chloride:				
Concentration, ppmvd	0.211	0.226	0.175	0.204
Concentration, ppmvd @ 7% O2	0.193	0.207	0.158	0.186
Emission Rate, lb/hr	0.00577	0.00636	0.00492	0.00568

TABLE 2-8

POHC TEST RESULTS SUMMARY

Scrubber Outlet

	S-M23-1	S-M23-4	S-M23-5	Average
Run Date	6/27/01	6/28/01	6/29/01	
Run Start Time	1000	1415	0845	
Run Finish Time	1555	1828	1252	
Test Train Parameters:				
Volume Of Dry Gas Sample, SCF *	123.128	102.511	112.342	
Percent Isokinetic:	96.9	104.5	96.8	
Flue Gas Parameters:				
CO_2, Percent By Volume, Dry	10.4	10.8	9.2	10.1
O_2, Percent By Volume, Dry	5.7	5.5	6.5	5.9
Temperature, °F	186	183	182	184
Air Flow Rate, Dry SCFM *	4,900	5,085	5,095	5,027
Air Flow Rate, Wet ACFM	14,309	14,237	14,216	14,254
Aldrin:				
Concentration, ng/DSCM *	9.75	9.30	< 0.943	< 6.66
Concentration, ng/DSCM @ 7% O2	8.92	8.39	< 0.910	< 6.07
Emission Rate, lb/hr	1.79E-007	1.77E-007	< 1.80E-008	< 1.25E-007
α-BHC (lindane-a):				
Concentration, ng/DSCM *	< 2,868	< 3,445	< 3,143	< 3,152
Concentration, ng/DSCM @ 7% O2	< 2,623	< 3,109	< 3,034	< 2,922
Emission Rate, lb/hr	< 5.26E-005	< 6.56E-005	< 6.00E-005	< 5.94E-005

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg)
< Indicates the value is below the detection limit.

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TABLE 2-8 (Continued)

POHC TEST RESULTS SUMMARY

Scrubber Outlet

	S-M23-1	S-M23-4	S-M23-5	Average
B-BHC (lindane-b):				
Concentration, ng/DSCM *	< 5,736	< 6,889	< 6,286	< 6,304
Concentration, ng/DSCM @ 7% O2	< 5,245	< 6,218	< 6,068	< 5,844
Emission Rate, lb/hr	< 1.05E-004	< 1.31E-004	< 1.20E-004	< 1.19E-004
delta-BHC (lindane-c):				
Concentration, ng/DSCM *	< 5,736	< 6,889	< 6,286	< 6,304
Concentration, ng/DSCM @ 7% O2	< 5,245	< 6,218	< 6,068	< 5,844
Emission Rate, lb/hr	< 1.05E-004	< 1.31E-004	< 1.20E-004	< 1.19E-004
cis-chlordane:				
Concentration, ng/DSCM *	< 5,736	< 6,889	< 6,286	< 6,304
Concentration, ng/DSCM @ 7% O2	< 5,245	< 6,218	< 6,068	< 5,844
Emission Rate, lb/hr	< 1.05E-004	< 1.31E-004	< 1.20E-004	< 1.19E-004
trans-chlordane:				
Concentration, ng/DSCM *	< 8,603	< 10,334	< 9,429	< 9,455
Concentration, ng/DSCM @ 7% O2	< 7,868	< 9,327	< 9,102	< 8,766
Emission Rate, lb/hr	< 1.58E-004	< 1.97E-004	< 1.80E-004	< 1.78E-004
p,p'-DDE:				
Concentration, ng/DSCM *	< 1,721	< 2,067	< 1,886	< 1,891
Concentration, ng/DSCM @ 7% O2	< 1,574	< 1,865	< 1,820	< 1,753
Emission Rate, lb/hr	< 3.16E-005	< 3.94E-005	< 3.60E-005	< 3.57E-005

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg)
< Indicates the value is below the detection limit.

(Continued next page)

TABLE 2-8 (Continued)

POHC TEST RESULTS SUMMARY

Scrubber Outlet

	S-M23-1	S-M23-4	S-M23-5	Average
o,p-DDT:				
Concentration, ng/DSCM *	< 4,015	< 4,822	< 4,400	< 4,412
Concentration, ng/DSCM @ 7% O2	< 3,672	< 4,353	< 4,248	< 4,091
Emission Rate, lb/hr	< 7.37E-005	< 9.19E-005	< 8.40E-005	< 8.32E-005
p,p'-DDT:				
Concentration, ng/DSCM *	< 2,868	< 3,445	< 3,143	< 3,152
Concentration, ng/DSCM @ 7% O2	< 2,623	< 3,109	< 3,034	< 2,922
Emission Rate, lb/hr	< 5.26E-005	< 6.56E-005	< 6.00E-005	< 5.94E-005
Dieldrin:				
Concentration, ng/DSCM *	32.1	26.9	5.66	21.6
Concentration, ng/DSCM @ 7% O2	29.4	24.3	5.46	19.7
Emission Rate, lb/hr	5.90E-007	5.12E-007	1.08E-007	4.03E-007
Endosulfan Sulfate:				
Concentration, ng/DSCM *	< 11,471	< 13,778	< 12,573	< 12,607
Concentration, ng/DSCM @ 7% O2	< 10,490	< 12,436	< 12,136	< 11,687
Emission Rate, lb/hr	< 2.11E-004	< 2.62E-004	< 2.40E-004	< 2.38E-004
Endrin:				
Concentration, ng/DSCM *	< 11,471	< 13,778	< 12,573	< 12,607
Concentration, ng/DSCM @ 7% O2	< 10,490	< 12,436	< 12,136	< 11,687
Emission Rate, lb/hr	< 2.11E-004	< 2.62E-004	< 2.40E-004	< 2.38E-004

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg)
< Indicates the value is below the detection limit.

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TABLE 2-8 (Continued)

POHC TEST RESULTS SUMMARY

Scrubber Outlet

		S-M23-1		S-M23-4		S-M23-5		Average
Heptachlor:								
Concentration, ng/DSCM *	<	5,736	<	6,889	<	6,286	<	6,304
Concentration, ng/DSCM @ 7% O2	<	5,245	<	6,218	<	6,068	<	5,844
Emission Rate, lb/hr	<	1.05E-004	<	1.31E-004	<	1.20E-004	<	1.19E-004
Heptachlor Epoxide:								
Concentration, ng/DSCM *	<	5,736	<	6,889	<	6,286	<	6,304
Concentration, ng/DSCM @ 7% O2	<	5,245	<	6,218	<	6,068	<	5,844
Emission Rate, lb/hr	<	1.05E-004	<	1.31E-004	<	1.20E-004	<	1.19E-004
Lindane (gamma-BHC isomer):								
Concentration, ng/DSCM *	<	5,736	<	6,889	<	6,286	<	6,304
Concentration, ng/DSCM @ 7% O2	<	5,245	<	6,218	<	6,068	<	5,844
Emission Rate, lb/hr	<	1.05E-004	<	1.31E-004	<	1.20E-004	<	1.19E-004
Methoxychlor:								
Concentration, ng/DSCM *	<	2,868	<	3,445	<	3,143	<	3,152
Concentration, ng/DSCM @ 7% O2	<	2,623	<	3,109	<	3,034	<	2,922
Emission Rate, lb/hr	<	5.26E-005	<	6.56E-005	<	6.00E-005	<	5.94E-005

* 68° F (20° C) -- 29.92 Inches of Mercury (Hg)
< Indicates the value is below the detection limit.

TABLE 2-9
CARBON MONOXIDE TEST RESULTS SUMMARY
INCINERATOR STACK

	Run 1	Run 3	Run 4	Average
Test Date	6/27/01	6/28/01	6/29/01	
Run Start Time	1145	845	842	
Run Finish Time	1610	1916	1333	
Flue Gas Parameters				
CO2, percent by volume, dry	5.716	6.119	7.481	6.439
O2, percent by volume, dry	10.387	10.079	9.052	9.839
Air Flow Rate, dry SCFM *	4,900	5,085	5,095	5,027
Carbon Monoxide				
Concentration, ppmvd	0.00	2.08	2.85	1.64
Emission Rate, lb/hr	0.00	0.0461	0.0633	0.0365

TABLE 2-10
SIX-MINUTE AVERAGE PLUME OPACITY OBSERVATIONS SUMMARY
INCINERATOR STACK

Run Number:	S-M9-1	S-M9-4	S-M9-5
Date:	6/27/01	6/28/01	6/29/01
Highest Single Opacity Reading, %	10	5	5
Highest 6-minute Average Block Opacity, %	2.3	1.3	0.8

S-M9-1

Set	Time		Average
No.	Start	Finish	% Opacity
1	1156	1202	1.3
2	1202	1208	1.3
3	1208	1214	1.7
4	1214	1220	0.8
5	1220	1226	0.4
6	1226	1232	1.7
7	1232	1238	0.4
8	1238	1244	0.4
9	1244	1250	2.3
10	1250	1256	2.1

S-M9-4

Set	Time		Average
No.	Start	Finish	% Opacity
1	1516	1522	0.6
2	1522	1528	0.4
3	1528	1534	1.0
4	1534	1540	0.0
5	1540	1603	1.3
6	1603	1609	0.2
7	1609	1615	0.4
8	1615	1621	0.8
9	1621	1627	0.4
10	1627	1633	0.8

S-M9-5

Set	Time		Average
No.	Start	Finish	% Opacity
1	1006	1012	0.4
2	1012	1018	0.6
3	1018	1024	0.4
4	1024	1030	0.6
5	1030	1036	0.8
6	1036	1042	0.6
7	1042	1048	0.6
8	1048	1054	0.0
9	1054	1060	0.6
10	1060	1106	0.2

3.0. PROCESS DESCRIPTION AND OPERATION

3.1. General

Midwest Soil Remediation, Inc. operates a mobile incineration unit in Shenandoah, Iowa, North Carolina. This unit is used to decontaminate soils at sites around the United States. The testing covered in this report was performed at the stack to this incineration unit.

3.2. Source Air Flow

Figure 3-1 is an air flow schematic which shows the passage of flue gases exhausted from the Incinerator Stack.

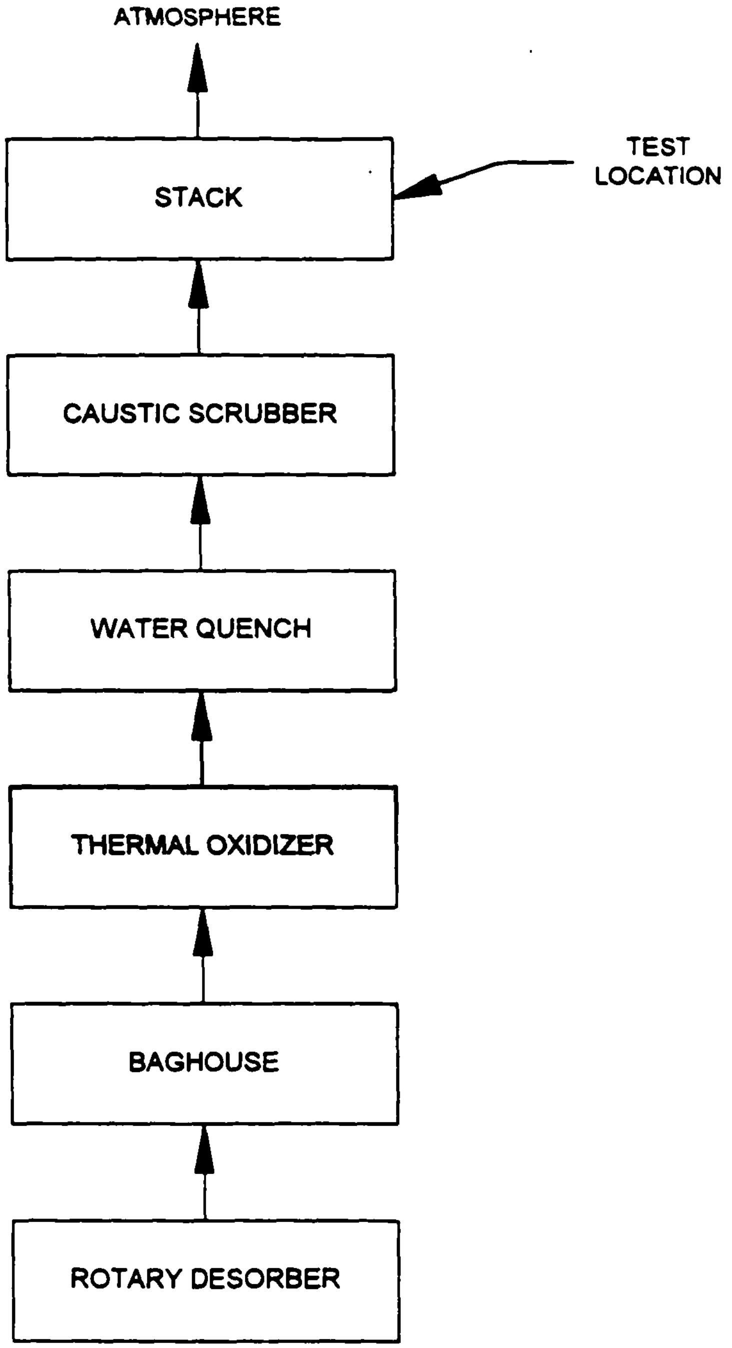

FIGURE 3-1. INCINERATOR AIR FLOW SCHEMATIC


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4.0. SAMPLING AND ANALYTICAL PROCEDURES

4.1. General

All sampling and analytical procedures were those recommended by the United States Environmental Protection Agency and the Iowa Department of Environmental Quality. This section provides brief descriptions of the sampling and analytical procedures.

4.2. Sampling Points

The number and location of the sampling points were determined according to the procedures outlined in EPA Method 1. As shown in **Figure 4-1** the stack cross section was divided into 24 equal areas with 12 sampling points on each of two axes.

4.3. Cyclonic Flow Check

A Type S Pitot tube assembly, Magnehelic gauges, and a universal protractor (angle finder) were used to determine the flow angles at each of the sampling or velocity traverse points. At each point, the Pitot tube was positioned at a right angle to the air flow. The angles were determined by rotating the Pitot tube until a null reading was obtained on the Magnehelic gauges. When the null reading was obtained, the angle of the Pitot tube was recorded.

4.4. Volumetric Air Flow Rates

4.4.1. Flue Gas Velocity

The flue gas velocity and volumetric flow rate were determined according to the procedures outlined in EPA Method 2. Velocity head measurements (delta P) were made using Type S Pitot tubes conforming to the geometric specifications outlined in EPA Method 2. Accordingly, each has been assigned a coefficient of 0.84. Differential pressures were measured with Magnehelic gauges of appropriate range. Flue gas temperatures were measured with chromel-alumel thermocouples equipped with hand-held digital readouts.

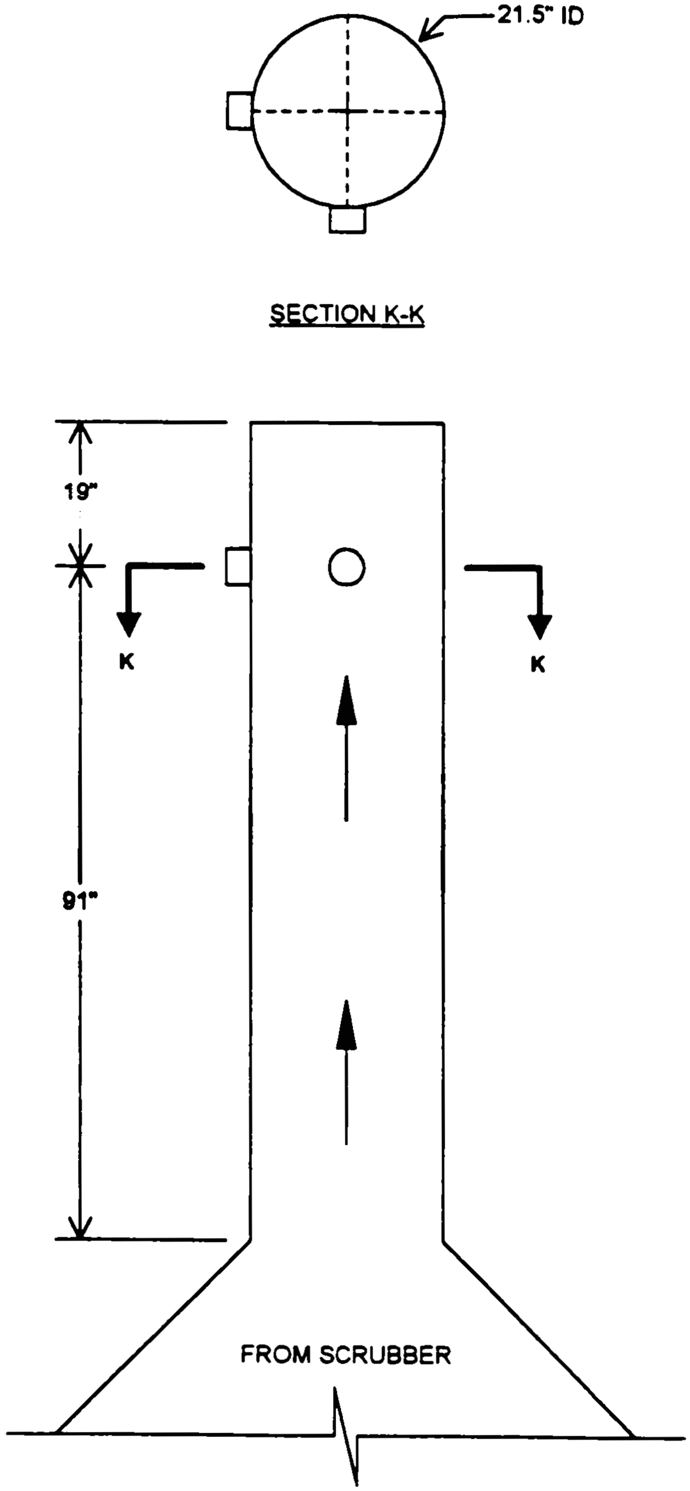

FIGURE 4-1. INCINERATOR STACK TEST LOCATION

4.4.2. Flue Gas Composition

The flue gas composition was determined using both EPA Methods 3 and 3A. Method is discussed in the following paragraphs and Method 3A is discussed further in **Section 4.5.1**.

Sample Collection: Flue gas samples were collected using the multipoint, integrated sampling technique outlined in EPA Method 3. A stainless steel probe and a peristaltic pump delivering 500 to 750 mL/min of flue gas were used to fill a Tedlar bag. Moisture was removed by means of a knockout jar located prior to the pump. Sampling was of the same duration (except purges following port changes) as the pollutant emissions runs.

Sample Analysis: Analysis for carbon dioxide and oxygen was performed using an Orsat apparatus. The analytical results were used to determine the flue gas composition, molecular weight, excess air, and emissions correction factor.

4.4.3. Flue Gas Moisture Content

The moisture content was determined in conjunction with the appropriate pollutant emissions methods discussed in the following sections.

4.5. Emissions Determinations

4.5.1. Carbon Dioxide, Oxygen, and Carbon Monoxide

Continuous emissions monitoring (CEM) was conducted for carbon dioxide (CO_2) and oxygen (O_2) concentrations and carbon monoxide (CO) emissions. The sampling and analytical procedures for CO_2/O_2 and CO were in accordance with EPA Methods 3A and 10, respectively.

The extractive monitors require that the effluent gas sample be conditioned to eliminate any possible interference (water vapor and particulate matter), before being transported and injected into each analyzer. All components of the sampling system that contact the sample are stainless steel, glass, or Teflon. The sampling system consisted of a heated probe with a heated out-of-stack particulate filter, heated sample lines, moisture removal trap, sample pump, and distribution manifold board. All samples were routed through a distribution manifold board for delivery to the analyzers.

The sampling probe was constructed of Type 316 stainless steel and was heated electrically to maintain the sample temperature above the dew point. An 8-foot length of heated 3/8-inch O.D. Teflon tubing connected the probe to the ice bath condenser. The probe used by Entropy was located at the centroid of the sampling location. Calibration gas was injected at the probe exit prior to any conditioning or filtering.

The condenser consisted of a 30-foot coil of Teflon tubing followed by two knockout jars, all immersed in an ice bath to remove any moisture from the sample. The system was designed

to minimize contact between the sample and the condensate. As the sample gas flowed through the condenser, the condensate was collected in the knockout jars. The sample exiting the condenser passed through a heated Balston particulate filter and was then transported through unheated 3/8-inch O.D. Teflon tubing by way of a Teflon-lined sample pump to the flow distribution manifold board, where the flow to the analyzers was monitored and controlled.

Each sample acquisition/sample conditioning system also included two calibration gas injection ports: (1) immediately upstream of the analyzers for analyzer linearity checks, and (2) at the outlet of the probe for the sampling system bias and calibration drift checks. This arrangement provided both ease in checking the analyzer performance and a means of evaluating the entire monitoring system.

Carbon Dioxide: An ACS (Fuji) Model 3300 nondispersive infrared (NDIR) analyzer was used to continuously monitor the CO_2 concentration in the flue gas stream. The theory of operation for this analyzer is based on the principle that CO_2 gas has a unique absorption line spectrum in the infrared region. The instrument consists of an infrared light source, a chopper, a measuring cell, and a detector. The infrared light beam emitted by the source passes through the measuring cell filled with a continuously flowing gas sample. The light beam is partially absorbed or attenuated by the gas species of interest in this cell before reaching the front chamber of the detector. Both the front and rear chambers of the sealed detector are filled with a reference gas. The difference in the amount of light absorbed between the front and rear chambers is dependent on the concentration of the gas species of interest within the sample measuring cell and creates a pressure differential between the two chambers. This pressure difference is then observed as gas flow by the micro-flow sensor located in a channel communicating the two chambers. The resulting AC signal from the micro-flow sensor is rectified, amplified, and linearized into a DC voltage signal for output. The analyzer full scale measurement is 0 to 20% for CO_2.

Oxygen: The oxygen content in the effluent was determined by a Teledyne Model 320P-4 analyzer, which use Teledyne's patented micro-fuel cell to consume O_2 from the atmosphere surrounding the measurement probe. The consumption of O_2 generates a proportional electrical current. This current is then amplified and provides a signal output of 0 to 1.0 V DC which corresponds to a full scale range of 0 to 25 percent O_2.

Carbon Monoxide: A Thermo Environmental Model 48 Gas Filter Correlation (GFC) analyzer was used to continuously sample the carbon monoxide (CO) concentrations in the gas stream. GFC spectroscopy is based on the comparison of the infrared (IR) absorption spectrum of the measured gas to that of other gases in the sample being analyzed. This technique is implemented by using a high concentration sample of the measured gas (i.e., CO) as a filter for the infrared radiation transmitted through the analyzer. Radiation from an IR source is chopped

and passed through a gas filter alternating between CO and N_2 due to rotation of the filter wheel. The radiation then passes through an interference filter and on to an absorption cell. The IR radiation then exits the sample cell and falls on to an IR detector.

The CO gas filter produces a reference beam that cannot be further attenuated by CO in the sample cell. The N_2 side of the filter wheel is transparent to the IR radiation and thus produces a measure beam that is partially absorbed by CO in the cell. The chopped detector signal is modulated by the alternation between the two gas filters with an amplitude related to the concentration of CO in the sample cell. Other gases, which absorb the reference and measure beams equally, do not cause modulation of the detector signal leaving the GFC responding specifically to CO.

Data Acquisition System: Entropy's data acquisition system (DAS) uses a PC based system with a 16-channel external analog-to-digital converter. In addition to providing an instantaneous display of analyzer responses, the DAS compiles the analyzer data collected once each second and averages them, calculates emission rates, and documents analyzer calibrations. The test data and calibrations are stored on hard disk and printed on a laser printer.

4.5.2. Particulate, Chlorine, and Hydrogen Chloride

Sample Collection. Samples were withdrawn isokinetically from the source using a **combined EPA Method 5 and EPA Method 26 sampling train. The sampling train consisted of a glass nozzle, a heated glass probe with a Type S Pitot tube attached, a filter, five chilled impingers, and a metering console. The particulate sample was collected on a Pallflex** 2500QAT-UP quartz filter maintained at a temperature of 248°F ± 25°F. The first two impingers each contained 100 mL of 0.1N sulfuric acid (H_2SO_4), the third and fourth impingers each contained 100 mL of 0.1N sodium hydroxide (NaOH), and the fifth contained preweighed silica gel. Each of the 24 points was sampled for 2.5 minutes, resulting in net run times of 60 minutes.

The filter was removed from the filter holder and placed in a 250 mL glass jar. The H_2SO_4 and NaOH reagents were returned to the original 1000 mL and 500 mL glass jars, weighed, the weight recorded on the labels, and the liquid levels marked. The silica gel was returned to the original tared container, weighed, and the weight recorded on the label. The volume of water vapor condensed in the impingers and the volume of water vapor collected in the silica gel were summed and entered into moisture content calculations.

The nozzle, probe, and fronthalf of the filter holder were rinsed with acetone into a 500 mL glass jar. The backhalf of the filter holder and the first and second impingers along with the connecting glassware were rinsed with DI water into a 500 mL glass jar. The third and fourth impingers were rinsed with DI water into a separate 500 mL glass jar.

Sample Analysis. EPA Method 5 analytical procedures were used to analyze the filter

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and fronthalf acetone rinse for particulate. The H_2SO_4 reagent and associated DI water rinse were analyzed for HCl using ion chromatography as outlined in EPA Method 26. The NaOH reagent and associated DI water rinse were analyzed for Cl_2 using ion chromatography as outlined in EPA Method 26.

4.5.3. PCDD/PCDF and POHC

Sample Collection: Samples for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDF) and POHC were withdrawn isokinetically from the source using an EPA Method 23 sampling train. The sampling train consisted of a glass nozzle, a heated glass probe with a Type S Pitot tube attached, a Whatman EPM2000 glass fiber filter maintained at a temperature of 248°F ± 25°F, a water-cooled condenser, a sorbent trap containing XAD-2 resin, five chilled impingers, and a metering console. Each of the 24 points were sampled for 7.5 minutes, resulting in net run times of 180 minutes.

The water-cooled condenser and sorbent trap were arranged in a manner that allowed the condensate to drain vertically through the trap. Gas entering the trap was maintained at or below 68°F.

The first impinger (optional knockout) remained empty, the second and third impingers each contained 100 mL of DI water, the fourth remained empty, and the fifth contained approximately 400 grams of preweighed silica gel. Sealing greases were not used on any portion of the sample train.

Sample Train Component Preparation:

Glassware. All glass parts of the sample train including the sorbent trap, were precleaned prior to sampling according to the following procedures.

1. Soaked in hot soapy water (Alconox) at 50°C or higher
2. Rinsed three times with tap H_2O
3. Rinsed three times with DI H_2O
4. Baked at 450°F for two hours
5. Rinsed three times with pesticide grade acetone
6. Rinsed three times with pesticide grade methylene chloride
7. Capped with pretreated aluminum foil

Following sample recovery, the glassware was reused at the same sampling location.

XAD-2 Traps. The XAD-2 traps were provided and spiked by the analytical laboratory. Each sorbent trap was charged with 20 to 30 grams of XAD-2 resin. Care was taken to ensure that the resin was kept at temperatures below 120°F before and after sample collection to prevent resin decomposition. The period of time between charging the trap and use in the field was minimized and was not allowed to exceed 14 days.

Sample Recovery. Recovery of the samples and assembly of the sample trains for reuse was conducted in the laboratory located at the job site. The DI water reagent was returned to the original 1000 mL amber glass jar, weighed, the weight recorded on the label, and the liquid level marked. The silica gel was returned to the original tared container, weighed, and the weight recorded on the label. The volume of water vapor condensed in the impingers and the volume of water vapor collected in the XAD resin and silica gel were summed and entered into moisture content calculations.

The filter was removed from the holder and folded in half with the particulate catch on the inside. It was again folded in half and then placed in a glass petri dish. The dish was sealed with Teflon tape and wrapped in aluminum treated foil.

The probe and front-half of the filter holder were rinsed three times into a 500 mL amber jar with pesticide-grade acetone, then three times with pesticide-grade methylene chloride. The back-half of the filter holder, the Teflon transfer line, and the condenser were rinsed three times with acetone then three times with methylene chloride into a separate amber jar. Then all train components, from the nozzle to the XAD, were rinsed with toulene into a third amber jar. All samples were stored at 40°F until analyzed. Blanks of each solvent lot used at the test site were also saved for potential analysis. All sample containers containing water were extracted for analysis by the designated lab within 14 days after sample collection.

One field blank was recovered. A field blank consists of a complete sampling train that is assembled as though to collect a sample, but flue gas was not pulled through the train. The field blank train was leak checked the same number of times as a sampling train used during a run. The train was placed at the sampling location for the duration of one run. The train was then returned to the laboratory and disassembled for recovery using the same procedure used to recover actual samples. The field blank was obtained using a train that has previously been used to collect at least one actual sample from the test site.

Sample Analysis. The filter(s), XAD-2 resin, impinger reagents, and rinses were analyzed for PCDD/PCDF according to EPA Method 23. All extracts from one run were combined and volume reduced to 1 mL resulting in one extract per run from which an aliquot was taken for analysis. SW-846 Method 8081 (GC/ECD) for pesticide analysis was not applicable to air samples as it is non-compatible with the XAD resin. SW-846 Method 8270 (GC/MS) was expected to provide much better identification of the pesticides and lower detection limits. The lab prepared a lab method blank (MB) and a lab control spike (LCS) with resin from the same batch used for the field samples. The LCS sample was fortified with the traditional mixture of native PCDD/PCDFs but also contained the pesticides present in a commercially available standard pesticide mixture. All sampling modules and the MB/LCS were pre-spiked with the EPA Method 23 surrogate standards

4.5.4. Visible Plume Opacity

The procedures outlined in EPA Method 9 were used for the determination of the plume opacity. A certified, experienced visible emissions (VE) observer was on site to record plume opacity. Each run consisted of the VE observer reading the plume opacity every 15 seconds for 60 minutes.

4.6. Equipment Calibration

Pertinent calibration data are provided in **Appendix D**.

TABLE 5-1
IN-HOUSE EQUIPMENT CALIBRATION

Apparatus	Calibration Method And Frequency	Specifications	Corrective Action
Type S Pitot Tubes	Standards contained in EPA Method 2	Coefficient of 0.84 ± 0.02	Refurbish or recalibrate
	Visual inspection prior to shipment to test site and again prior to each day of testing		
Manometers	Leak checked before and after each field use		Adjust or replace
Magnehelic Gauges	Initially calibrate over full range	0-10" water column	
	After each field use, checked against inclined manometer at average settings encountered during testing	Within ± 5%	Repair and Recalibrate
Thermometers - Impinger - Dry Gas Meter - Filter Box	After purchase and prior to each field use, using ASTM Hg-in-glass thermometer	Impinger = ± 2°F DGM = ± 5.4°F FB = ± 5.4°F	Adjust, determine correction factor, or reject
	After purchase and prior to each field use, using ASTM mercury-in-glass thermometer		
Thermocouple/ Potentiometer	After purchase. 3-point (ice bath, boiling water, and hot oil) using ASTM Hg-in-glass thermometer	± 1.5% of absolute temperature	Adjust, determine correction factor, or reject
	Before and after each field use, compared to ASTM Hg-in-glass thermometer at ambient conditions		
Dry Gas Meter and Orifice	**Full calibration (every 6 months) over wide range of orifice settings to obtain calibration factor (isokinetic meter box) as per EPA Method 5**	**DGM = ± 0.02 from avg.coeff. for each run** Orifice = ± 0.15" H_2O over delta H range of 0.4"-4.0"	**Adjust or replace**
	10-minute quick calibration before sending to test site and again prior to first day of field use (isokinetic)	± 3% of full calibration Υ ± 5% of full calibration Υ	Use if no backup Do not use
	Calculate Υqa* on-site for each test run to determine if the meter gamma (Υ) has changed (EPA Method 5 Section 5.3.2 Alternate Procedures as approved by Administrator)	Average Yqa must be within ±5% of full calibration Υ	Perform post test calibration at average delta H and highest vacuum encountered during testing to determine if meter gamma has changed (isokinetic)
	A post test isokinetic meter box calibration is performed after every job at the approximate average delta H to determine if meter gamma has changed (isokinetic) as per EPA Method 5	±5% of full calibration Gamma (initial or recalibration) that yields the lowest sample volume for the testing is used for calculations	Recalibrate or replace
Critical Orifice	Dry gas meter transfer standard (EPA Method 5 Alternate)	Calibrated to obtain K factor	Replace/repair and Recalibrate

* See Appendix D for EMTIC guideline document

TABLE 5-1 (Continued)
IN-HOUSE EQUIPMENT CALIBRATION

Apparatus	Calibration Method And Frequency	Specifications	Corrective Action
Barometer	Before and after each field use against an aneroid barometer	± 0.1" mercury	Adjust to agree
	Reference barometer adjusted for elevation differences		
Probe Nozzle	Average of 5 I.D. measurements using a micrometer. Visual inspection before and after each field use	Difference between high and low measurement ≤ 0.004"	Repair and recalibrate

5.3. Sample Processing

Entropy, Inc. employs systems that ensure the integrity of an environmental sample from the time of acquisition, through analysis, and ultimately to proper disposal. These systems are necessary to allow valid conclusions to be drawn from analytical results separated in time and space from the sampling operation. In addition, these systems recognize that samples are occasionally of value even after analytical results have been reported.

Samples are collected, transported, and stored in clean containers that are constructed of materials inert to the analytical matrix. Containers are used which allow airtight seals. When necessary, containers are employed which prevent photochemical reactions. All sample containers are labeled with the following information:

- Unique source identifier
- Sample run identifier
- Analyte identifier
- Sample matrix identifier
- Sample analyst identifier

Additional information relating to the sample is recorded on the data sheet for the sampling run that afforded the subject sample. Accordingly, the sampling data sheet contains all the information listed above, plus the date and time the sample was acquired and supplemental information such as observations pertinent to the quality of the sample. For condensed samples, e.g., samples in liquid media, the sample levels are marked on the outside of the container; this mark is used to indicate sample loss, and as such, may serve as a reference in adjusting results accordingly.

For transport from the field to the laboratory, samples are stored in sealed containers and secured in a fashion that minimizes movement and thus prevents breakage of containers. Containers used for transporting glass are packed with foam. Samples that require chilling are kept cold until analyzed.

Samples remain in the custody of the sampler, from acquisition until conveyance to the sample custodian. All custody transfers are signed and documented on a record of custody form, which remains with the sample until turned over to the custodian.

Analytical data are identified in a manner identical to that of the sampling data. Accordingly, all data generated from the analysis of samples are documented with the following information:

- Source identifier
- Sample run identifier
- Analyte identifier
- Sample matrix identifier
- Analyst identifier
- Analysis date

Portions of samples remaining after analysis are returned to their original sample containers. These samples are stored in designated storage areas until their destruction is authorized.

5.4. Instrument Calibration

Instrument calibration is one of the most important functions in generating precise and accurate quality data. All of the contract laboratories involved in the analytical testing for the test program maintain rigorous QA programs for instrument calibration.

5.5. Blanks and Spikes

Field blanks, method blanks, trip blanks, lab-proof blanks and filter blanks are obtained, digested, and analyzed when applicable. The blanks reflect the background contamination obtained from the various sources during the sampling and analysis. Thus, data adjustment or correction can be made accordingly.

In most cases, it is not necessary to digest and analyze the method blanks, reagent blanks or the lab-proof blanks unless the field blank shows a high level of contamination. If a high level of contamination is present, it is imperative to individually analyze the above blanks to help determine the cause of contamination.

Spiked samples are used to check on the performance of a routine analysis or the recovery efficiency of a method. During spiking, a known amount of stock solutions of the substance of interest is added to the sample prior to sample extraction, digestion, and analysis.

5.6. Internal/External System Audit Checks

System and performance audits are routine elements of all Entropy QA/QC programs.

Internal Systems Audit: The following sampling equipment checks were conducted prior to sample collection.

- All sampling equipment was thoroughly checked to ensure clean and operable components.
- Equipment was inspected for possible damage from shipment.
- The oil manometers or Magnehelic gauges were leveled and zeroed.
- The temperature measurement systems were checked for damage and operability by measuring the ambient temperature.

Performance Audits: Performance audits of the laboratory are conducted prior to the processing of any compliance samples for analysis. Audit materials typically include samples available from the EPA prior to new source testing. Also, samples of known concentration are prepared in-house or obtained from the EPA for Internal QA checks.

External Systems Audits: Entropy is subject to a system audit each time a test is conducted for any Air Pollution Control agency. This procedure entails an EPA observer on-site to do qualitative evaluation of performance to demonstrate compliance with the applicable regulations.

5.7. Data Reduction and Validation

The test team leader is responsible for reviewing and validating data as they are acquired. Each team leader has extensive knowledge of sampling methodology and the characteristics of the process being measured and is capable of evaluating the accuracy, representativeness, and completeness of raw data on-site. Action to replace inadequate data can be taken immediately.

Data obtained during calibrations and test runs are recorded on standardized forms that are checked twice for completeness and accuracy by the QA Director or his designated representative. Data reduction and consistency are achieved by using the standardized forms and Entropy's in-house computer facilities.

5.8. QA/QC Summary

All chemicals used were American Chemical Society (ACS), High Performance Liquid Chromatography (HPLC), or pesticide grade. The deionized, distilled water utilized met or exceeded the American Society for Testing and Materials (ASTM) specifications for Type-I reagent water. Pretest and posttest leak checks were conducted on each sampling train. **Table 5-2** presents a summary of quality assurance/quality control requirements for each test method

used in this test program.

TABLE 5-2
QUALITY ASSURANCE/QUALITY CONTROL CRITERIA
INCINERATOR STACK
JUNE 2001

Test Method	Parameter	QA/QC Criteria	QA/QC Status
EPA 3A and 10	Calibration Error	± 2%	≤ 2 %
	Zero Drift	± 3%	≤ 3 %
	Calibration Drift	± 3%	≤ 3 %
	Sampling System Bias	± 5%	≤ 5%
EPA 5 (Particulate)	Constant weight	0.5 mg or 1% of the total weight less the tare weight; whichever is greater	≤ 0.5 mg
	Acetone blank	≤ 0.001% by weight	0.3 mg/125.6 g
EPA 26A modified (HCl and Cl_2)	Matrix spike recovery	N/A	101.8 – 111.6 %
	Duplicate analyses	≤ 5 % from mean	≤ 2.50 %
	Reagent blank, HCl	N/A	ND (0.2 mg)
	Reagent blank, Cl_2	N/A	ND (0.1 mg)
EPA 23 (PCDD/PCDF)	Tetra-hexa internal standards recovery	40 -130 %	90.1 - 112%
	Hepta-octa internal standards recovery	25 - 130%	72.8 – 101%
	Surrogate standards recovery	70 - 130%	90.4 - 102%
	Alternate standards recovery	40 - 130%	88.5 - 101%

TABLE 5-3
FLUE GAS PCDD/PCDF INTERNAL STANDARDS
PERCENT RECOVERIES
INCINERATOR STACK
JUNE 2001

	M23 Blank	S-M23-FB	S-M23-1	S-M23-4	S-M23-5
2,3,7,8-TCDD	96.9	102	112	109	107
1,2,3,7,8-PeCDD	93.7	98.2	108	101	96
1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD	99.1	104	112	107	104
1,2,3,4,6,7,8-HpCDD	85.2	93.1	101	94.3	93.2
OCDD	73.7	80	87	77	75
2,3,7,8-TCDF	94.3	99.4	111	104	101
1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF	91	96.6	105	97.6	91.9
1,2,3,4,7,8-HxCDF 1,2,3,6,7,8-HxCDF 2,3,4,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF	90.1	95.4	98.2	96.8	91.8
1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	82.2	88.5	95.1	89.4	85.8
OCDF	72.8	77.2	84	76	75.1

TABLE 5-4
FLUE GAS PCDD/PCDF SURROGATE AND ALTERNATE STANDARDS PERCENT RECOVERIES INCINERATOR STACK JUNE 2001

	M23 Blank	S-M23-FB	S-M23-1	S-M23-4	S-M23-5
Surrogate Standards					
2,3,7,8-TCDD	91.5	96.9	90.9	92.7	92
1,2,3,7,8-PeCDD	95.2	102	96.1	97.3	98.9
1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD	93.6	99.9	93	96.3	97.3
1,2,3,4,6,7,8-HpCDD	93.4	98	90.4	93.3	99.6
OCDD	93.4	98	90.4	93.3	99.6
2,3,7,8-TCDF	91.5	96.9	90.9	92.7	92
1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF	95.2	102	96.1	97.3	98.9
1,2,3,4,7,8-HxCDF 1,2,3,6,7,8-HxCDF 2,3,4,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF	95.4	99.4	95.1	96.9	99.1
1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	93.4	98	90.4	93.3	99.6
OCDF	93.4	98	90.4	93.3	99.6
Alternative Standard					
	88.5	92.6	101	92.4	89.4

Appendix B

APPENDIX B
CEM Performance Specification Test Report
Economy Products Superfund Site
Shenandoah, Iowa
November 2001

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PERFORMANCE SPECIFICATION TEST REPORT
REFERENCE NO. 17600

MIDWEST SOIL REMEDIATION, INC. - ECONOMY PRODUCTS SITE
SHENANDOAH, IOWA

MSA ULTIMA O_2 AND MONITOR LABS CO CONTINUOUS EMISSION MONITORING SYSTEMS

INCINERATOR STACK

PERFORMED FOR: MIDWEST SOIL REMEDIATION, INC.

JULY 2001

REPORT CERTIFICATION

EI Reference Number 17600

The sampling and analysis performed for this report were carried out under my direction and supervision, and I hereby certify that, to the best of my knowledge, the test report is authentic and accurate.

Signature: Jeff Kunstling

Date: September 14, 2001

Jeff Kunstling
Project Director
Client Services Division

TABLE OF CONTENTS

1.0. PROJECT SUMMARY

1.1. Source Information

Plant Name and Address:	Midwest Soil Remediation, Inc. Economy Products Site Shenandoah, Iowa
Unit Tested:	Incinerator Stack

1.2. Testing Firm Information

Firm Name and Address:	Entropy, Inc. P. O. Box 90067 Raleigh, North Carolina 27675-0067
Firm Contact:	Jeff Kunstling
Telephone Number:	(800) 486-3550, extension 217

1.3. Test Information

Test Requested By:	**Midwest Soil Remediation, Inc.**
Firm Contact:	Mike Fetherling - Midwest Soil Remediation, Inc
Telephone Number:	847-742-4331
Test Objective:	Performance Specification Testing on the MSA Ultima oxygen and Monitor Labs carbon monoxide CEMSs installed on the incinerator stack in accordance with BIF Regulations (40 CFR 266, Appendix IX).
Test Methods:	EPA Methods 3A and 10
Test Dates:	July 30, 2001
Test Coordinators:	Mike Fetherling - Midwest Soil Remediation, Inc.
Test Personnel:	Jeff Kunstling, Entropy Project Director Derek Brewster, Entropy Project Manager Jon Thomas, Entropy Engineering Technician

2.0. SUMMARY AND DISCUSSION OF RESULTS

The performance specification test results and the regulatory specifications for the Midwest Soil Remediation, Inc. CO and O_2 monitors are summarized in **Table 2-1**. All data pertaining to the performance test are included in the appendices to this report.

2.1. Relative Accuracy Test Results

The relative accuracy test result for the MSA Ultima oxygen and Monitor Labs carbon monoxide CEMS is summarized in **Table 2-1.** Summaries of the comparative data Entropy used to compute the CEMS relative accuracy results are presented in **Appendix A**. Boilers and Industrial Furnace regulations according to Part 266 Appendix IX require a nine-run minimum CO relative accuracy result of 10 percent of the mean reference value or ±10 ppm difference, whichever is less restrictive. BIF regulations specify expression of the CO emission standard as ppm CO corrected to 7 percent O_2 for the relative accuracy calculation. The reference and plant CEMS CO monitors both measured no CO during the entire RATA. The CO monitor, therefore, met the ±10 ppm difference guidelines. All reference measurement system calibration bias and drift checks for each test run used in the relative accuracy determinations were within the specifications in EPA Methods 3A and 10.

2.2. Calibration Error Test Results

The calibration error test results for the plant monitors were within the applicable specifications (see **Table 2-2**). Each monitor was challenged with zero and two upscale EPA Protocol 1 gases for three non-consecutive times at each measurement point. Entropy personnel collected the data used to determine calibration error. **Appendix D** includes the calibration error test data.

2.3. Response Time Test Results

The response time results for the O_2 and CO monitor were within the applicable specifications (see **Table 2-3**). Entropy personnel recorded the response times for both low-level and high-level calibration gas injections. **Appendix E** includes the response time test data.

2.4. Calibration Drift Test Results

The 7-day calibration drift tests were conducted according to the procedures in Performance Specification 4 and the Methods Manual for Compliance with the BIF Regulations. The data obtained during the daily automatic zero and span calibrations were collected by plant personnel and used to calculate the calibration drift results. **Table 2-4** summarizes the calibration drift data obtained during the routine daily calibration checks. **Appendix F** includes the CEMS calibration drift test data.

2.5. Plant Data Acquisition System (DAS)

The plant was unable to record CEMS data for the purpose of the RATA, therefore an Entropy Inc. person recorded the twenty one-minute readings that are necessary. The numbers were recorded from the monitor LCD screens on the top of the minute as a representation of the previous minute data.

TABLE 2-1
RELATIVE ACCURACY TEST AUDIT RESULTS

Test Parameter	Result	Specification
CO, ppmvd @ 7% O_2	0.0 ppm	±10 ppm difference

TABLE 2-2
CALIBRATION ERROR TEST RESULTS

Parameter	Mean Difference (% of Span)	Specification
ppm CO	1.04% low 0.17% mid 0.37% high	≤ 5.0% of span value of 200 ppm
$\%O_2$	0.13% low 0.097% mid 0.17% high	± 0.5% O_2

TABLE 2-3
RESPONSE TIME TEST RESULTS

Parameter	Response Time in Seconds	Specification
ppm CO	59.7	≤ 2 minutes
$\%O_2$	60.11	≤ 2 minutes

TABLE 2-4
CALIBRATION DRIFT TEST RESULTS

Parameter	Maximum Drift	Specification
CO zero CO span	0.62 ppm (0.31%) 0.72 ppm (0.36%)	± 6.0 ppm (3.0% of span value of 200 ppm CO) for 7 days
O_2 zero O_2 span	0.0% O_2 0.2% O_2	± 0.5% O_2

4.0. TEST EQUIPMENT AND PROCEDURES

4.1. Relative Accuracy Test Equipment

Entropy's extractive measurement system and all sampling and data reduction procedures conform to the requirements of the BIF Regulations (40 CFR Part 266 App. IX) and EPA Methods 3A and 10 (40 CFR 60).

Table 4-1 lists the gas analyzers that were used during this test program. **Figure 4-1** is a simplified schematic of the reference extractive measurement system.

The extractive monitors require that the effluent gas sample be conditioned to eliminate any possible interference (water vapor and particulate matter) before being transported and injected into each analyzer. All components of the sampling system that contact the sample are glass, stainless steel, or Teflon. A heated probe, a heated out-of-stack secondary particulate filter, heated sample lines, moisture removal trap, sample pump, and distribution manifold board are used to deliver a representative sample of flue gas to the analyzers.

The sampling probe is constructed of Type 316 stainless steel and is heated electrically to maintain the sample temperature above the dew point. An 8-foot length of heated Teflon tubing connects the probe to an ice bath condenser. The probe used by Entropy allows the integrated sampling of all three of the required probe traverse points. Calibration gas is injected into the exit of the probe tip prior to any conditioning or filtering.

The condenser consists of a 30-foot coil of Teflon tubing followed by two condensate traps, all immersed in an ice bath to remove any moisture from the sample. The condensate is continuously removed from both traps via a condensate discharge pump. The sample is split before the condenser to allow the hydrocarbon analyzer to receive a wet sample. The system is designed to minimize contact between the sample and the condensate.

TABLE 4-1.
GAS ANALYZERS USED FOR THE PERFORMANCE SPECIFICATION TEST
JULY 2001

Parameter	Analyzer	Model No.	Range	Operational Principle
CO	Thermo Environmental	48	0-100 ppm	GFC/IR
O_2	Teledyne	320P-4	0-25%	Fuel Cell

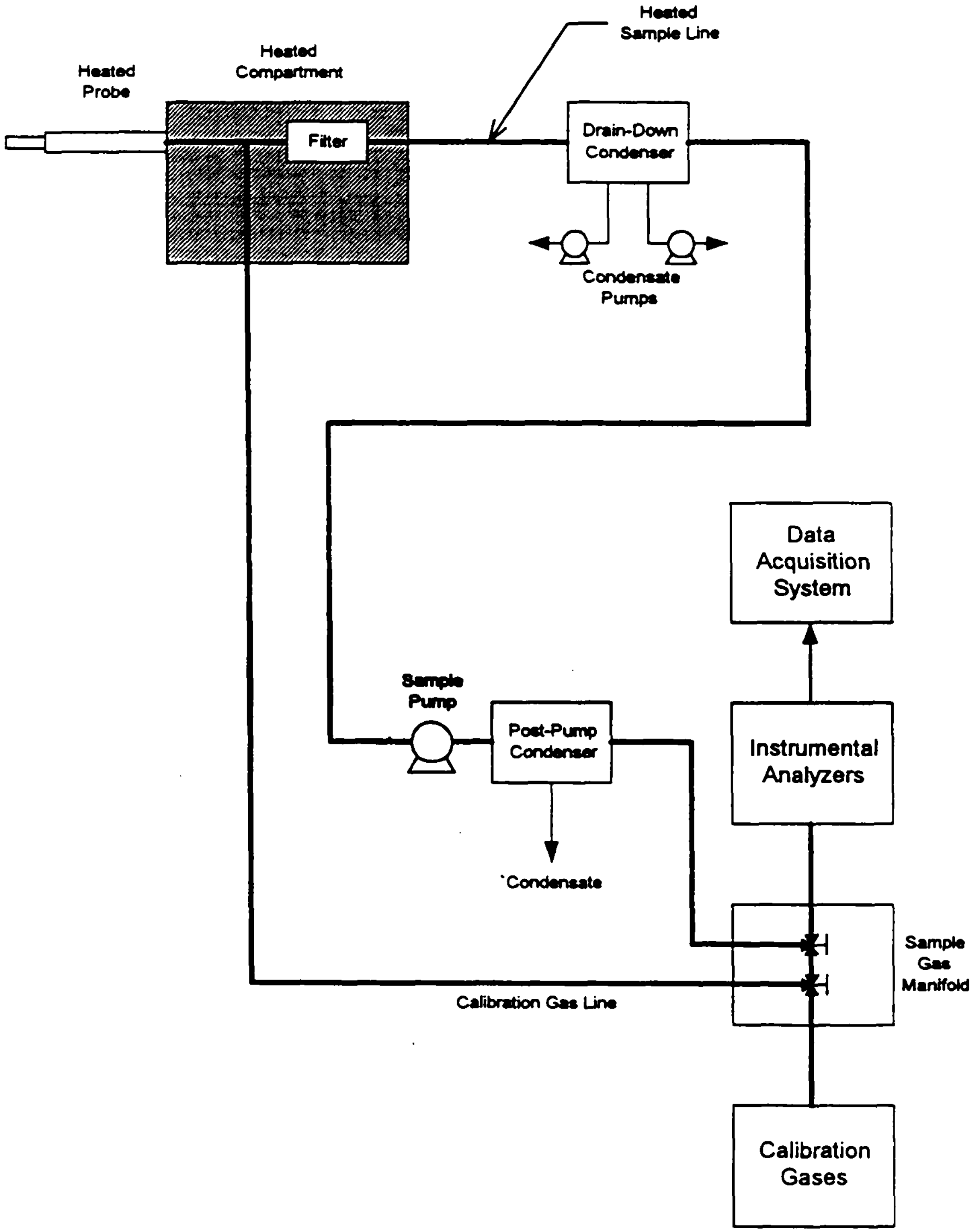

FIGURE 4-1. REFERENCE CEM SYSTEM SETUP.

The condenser consists of a 30-foot coil of Teflon tubing followed by two condensate traps, all immersed in an ice bath to remove any moisture from the sample. The condensate is continuously removed from both traps via a condensate discharge pump. The system is designed to minimize contact between the sample and the condensate.

The sample exiting the condenser is transported through unheated 3/8-inch O.D. Teflon tubing by way of a Teflon-lined sample pump to the flow distribution manifold board, where the flow to the analyzers is monitored and controlled.

The sample acquisition/sample conditioning system also includes two calibration gas injection port locations: (1) immediately upstream of the analyzers for analyzer linearity checks, and (2) at the outlet of the probe for the sampling system bias and calibration drift checks. This arrangement provides both ease in checking the analyzer performance and a means of evaluating the entire monitoring system.

4.2. Test Procedures

4.2.1. Relative Accuracy Test Audits

Concentration measurements were made according to the applicable EPA methods that require the tester to: (1) select apparatus meeting the applicable equipment specifications of the methods, (2) conduct an interference response test prior to the testing program, and (3) conduct various measurements during the testing program to demonstrate conformance with the measurement system performance specifications. All pre-test and field checks of the CEMS, as well as all measurements made throughout the test program, were conducted according to the procedures specified in the EPA methods.

A minimum of nine 21-minute comparative test runs was performed for the relative accuracy test. During each 21-minute sample run, the required three (3) points were sampled continuously. The sample traverse points were located at 16.7, 50.0, and 83.3 percent of the inside diameter. **Figure 4-2** is a schematic of the boiler test location.

In accordance with EPA methods, analyzer calibration error checks were conducted on the reference analyzer before initiating the relative accuracy testing. This check is conducted (after final calibration adjustments are made) by injecting the calibration gases directly into each gas analyzer and recording the responses.

Zero and upscale calibration checks are conducted before and after each test run in order to quantify measurement system calibration drift and sampling system bias. Upscale is either the mid- or high-range gas, whichever most closely approximates the flue gas level. During these checks, the calibration gases are introduced into the sampling system at the probe outlet so that the calibration gases are analyzed in the same manner as the flue gas samples.

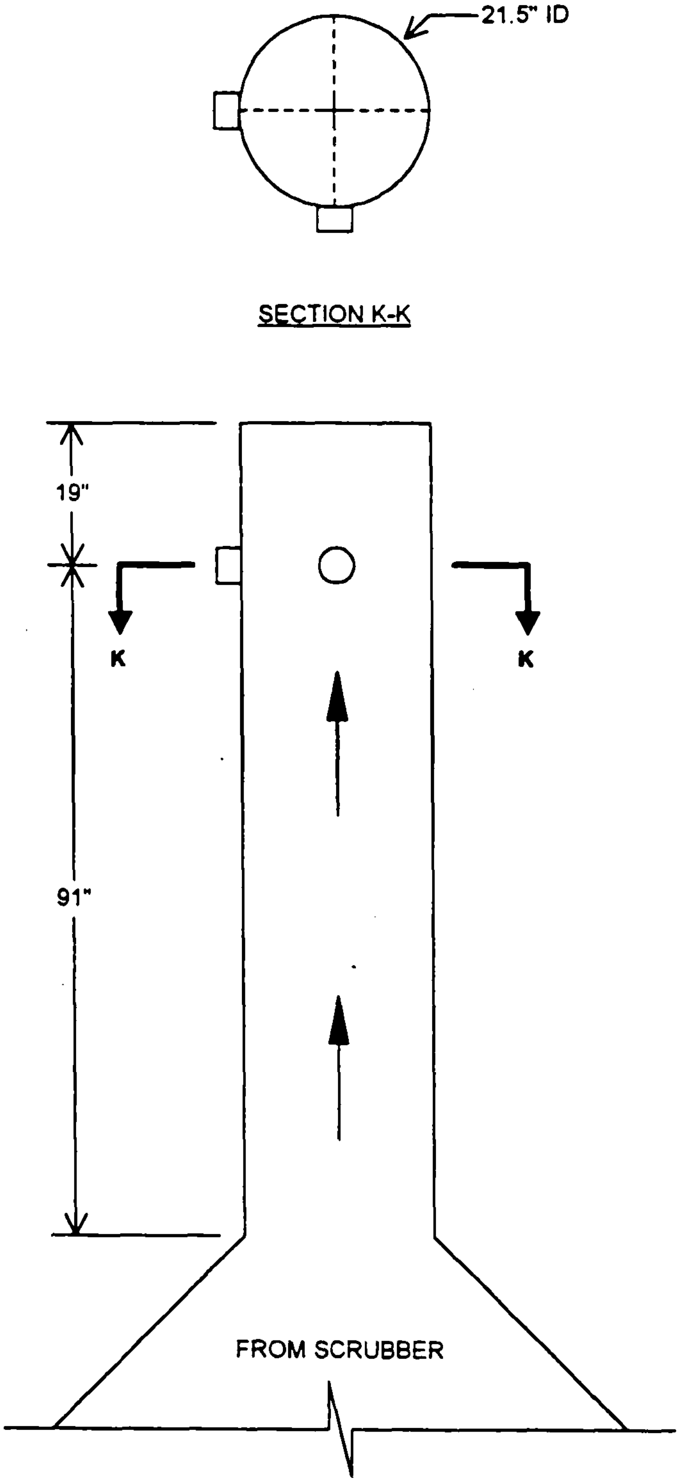

FIGURE 3-2. STACK TEST LOCATION.

Drift is defined as the difference between the pre- and post-test run calibration check responses. Sampling system bias is the difference between the test run calibration check responses (system calibration) and the initial calibration error responses (direct analyzer calibration) to the zero and upscale calibration gases. If an acceptable post-test bias check result is obtained but the zero or upscale drift result exceeds the drift limit, the test run result is valid; however, the analyzer calibration error and bias check procedures must be repeated before conducting the next test run.

A run is considered invalid and must be repeated if the post-test zero or upscale calibration checks results exceeds the bias specification. The calibration error and bias checks must be repeated and acceptable results obtained before testing can resume.

The reference analyzer measurements were recorded as both 1- and 21-minute averages on Entropy's DAS. All test run concentration results were determined from the average gas concentrations measured during the run and adjusted based on the zero and upscale sampling system bias check results (Equation 6C-1 presented in Method 6C, Section 8). The reference CO emission rate values in units of ppm at 7% O_2 were computed from each test run average of CO and O_2 (each adjusted for zero and upscale sampling system bias).

4.2.2. Calibration Error Tests

The calibration error tests conducted on the CO and O_2 analyzers were performed according to the procedures in the BIF specifications to verify analyzer linearity. The calibration error test requires that three non-sequential gas injections be performed using each of three calibration gases. The calibration error test was performed using audit points for the cylinder gas audit within the low- and mid- ranges specified in Appendix F, Procedure 1 (40 CFR 60). A high-range gas was injected to show complete linearity of the scale to comply with the BIF specifications. Entropy provided the calibration gases for this test. The calibration gases used were protocol gases with a ±1% tolerance.

The gas injections were made at the sample probe outlet and passed through all CEMS components used in normal operation. The BIF performance specification states that the mean difference between the CEMS and reference value at all three gas values shall be less than or equal to 5 percent of the span value.

4.2.3. Response Time Test

The response time test consists of three injections each of a low-range and a high-range calibration gas into the sampling system at the sample probe outlet. After each injection a stable response to the calibration gas is observed, the gas flow is stopped and the amount of time required for the CEMS response to reach 95 percent of the stable flue gas concentration is

recorded. The mean upscale and downscale response times are determined, with the slower of the two reported as the response time. BIF Regulations require a 2-minute response time.