

**PILOT-SCALE INCINERATION OF CONTAMINATED
SOIL FROM THE CHEMICAL INSECTICIDE
CORPORATION SUPERFUND SITE**

By

A. Siag, D. J. Fournier, Jr., and L. R. Waterland
Acurex Environmental Corporation
Incineration Research Facility
Jefferson, Arkansas 72079

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EPA Project Officer: R. C. Thurnau
Technical Task Manager: H. O. Wall
Waste Minimization, Destruction, and Disposal Research Division
Risk Reduction Engineering Laboratory
Cincinnati, Ohio 45268

RISK REDUCTION ENGINEERING LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

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FOREWORD

Today's rapidly developing and changing technologies and industrial products and practices frequently carry with them the increased generation of materials that, if improperly dealt with, can threaten both public health and the environment. The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. These laws direct the EPA to perform research to define our environmental problems, measure the impacts, and search for solutions.

The Risk Reduction Engineering Laboratory is responsible for planning, implementing, and managing research, development, and demonstration programs to provide an authoritative, defensible, engineering basis in support of the policies, programs, and regulations of the EPA with respect to drinking water, wastewater, pesticides, toxic substances, solid and hazardous wastes, and Superfund-related activities. This publication is one of the products of that research and provides a vital communications link between the researcher and the user community.

This report describes a series of tests conducted at the EPA's Incineration Research Facility to evaluate the incinerability of pesticide- and toxic-trace-metals-contaminated soil from the Chemical Insecticide Corporation Harbor Superfund site. The evaluation focused on the ability of rotary kiln incineration to achieve effective destruction of the pesticide contaminants, and on the fate of the contaminant trace metals. Specific attention was paid to evaluating whether a conventional rotary kiln incinerator equipped with a state-of-the-art air pollution control system could achieve 99.96 percent removal efficiency of the arsenic contaminant.

For further information, please contact the Waste Minimization, Destruction and Disposal Research Division of the Risk Reduction Engineering Laboratory.

E. Timothy Oppelt, Director
Risk Reduction Engineering Laboratory

ABSTRACT

A detailed test program was performed at the EPA's Incineration Research Facility (IRF) to define the incineration characteristics of contaminated soil from the Chemical Insecticide Corporation (CIC) Superfund site, in Edison Township, New Jersey. The soils at the site are highly contaminated by organochlorine pesticides and trace metals. The major metal contaminant is arsenic, present in site soils at levels up to 8,000 mg/kg. The purpose of these tests was to evaluate the incinerability of these soils in terms of the destruction and removal efficiency (DRE) for organochlorine pesticides (chlordane and p,p'-DDT), the fate of arsenic in terms of the system removal efficiency (RE), and the fate of other contaminant trace metals. The test program consisted of a set of four incineration tests in the IRF rotary kiln incineration system (RKS), equipped with a high-efficiency scrubber system consisting of a Calvert Flux Force/Condensation scrubber. In three of the four tests, soil alone was fed to the kiln of the RKS. In the fourth test, lime, in the ratio of 0.5 kg of lime to 10 kg of soil, was blended with the soil to evaluate whether arsenic RE was affected. All tests were performed at a kiln exit gas temperature of approximately 982°C (1,800°F) and an afterburner exit gas temperature of 1,204°C (2,200°F). The Calvert scrubber was operated at a pressure drop of approximately 12 kPa (50 in WC).

Test results show that incineration under the conditions tested resulted in the elimination of the soil pesticide contaminants. No pesticide contaminants were present in the scrubber exit flue gas, with corresponding DREs of at least 99.9916 percent for p,p'-DDT. Arsenic REs of 99.99 percent can be achieved with the Calvert scrubber under the conditions tested feeding soil alone. Adding lime to the soil did not measurably improve arsenic RE. Trace metal concentrations in the toxicity characteristic leaching procedure (TCLP) leachates of both untreated soil and kiln ash (treated soil) were significantly below corresponding TC regulatory levels for all metals except arsenic. Soil leachate arsenic concentrations were 40 to 50 percent of the regulatory level. Kiln ash leachate arsenic concentrations were near or above arsenic's TC regulatory level. Adding lime to the soil significantly reduced both the soil and the resulting kiln ash TCLP leachate arsenic concentrations. Nominally 70 percent of the arsenic measured in the incinerator discharges was in the kiln ash in all of the tests in which soil alone was fed; about 30 percent was accounted for in the scrubber liquor. The kiln ash arsenic fraction increased to about 90 percent in the test in which lime was added to the soil; about 10 percent of the arsenic measured was in the scrubber liquor in this test. Scrubber exit flue gas accounted for a negligible fraction of the arsenic discharged in all tests. Particulate levels at the Calvert scrubber exit were nominally 10 to 20 mg/dscm at 7 percent O₂, well below the hazardous waste incinerator performance standard of 180 mg/dscm at 7 percent O₂. Calvert scrubber apparent HCl collection efficiencies were 99.95 percent or greater, above the hazardous waste incinerator performance standard of 99.9 percent.

Test results suggest that conventional rotary kiln incineration in a unit equipped with a high-efficiency scrubber system such as the Calvert system tested would be an appropriate treatment technology for site soils, because elimination of the contaminant organochlorine pesticides and greater than 99.99-percent organic contaminant DREs were achieved; arsenic REs of greater than 99.96 percent were achieved; and the hazardous waste incinerator particulate and HCl performance standards were easily achieved. The treated soil may be a TC hazardous waste for soils with arsenic concentrations in the range of those of the soil tested. However, adding lime to the soil prior to incineration can significantly reduce the leachability of the kiln ash arsenic in the TCLP test.

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SECTION 1

INTRODUCTION

One of the primary missions of the Environmental Protection Agency's (EPA's) Incineration Research Facility (IRF) is to support Regional Offices in evaluations of the potential of incineration as a treatment option for contaminated soils at Superfund sites. One priority site is the Chemical Insecticide Corporation (CIC) site, in Edison Township, New Jersey. EPA Region 2 requested that test burns be conducted at the IRF to support an evaluation of the suitability of incineration as a treatment technology for the contaminated soils at the CIC site. Region 2 was specifically interested in whether flue gas emissions of arsenic could be limited to less than 0.04 percent of the amount of arsenic in the highly arsenic-contaminated site soil fed to the incinerator.

The CIC site was formerly used to manufacture pesticide products. The results of the remedial investigation and feasibility study (RI/FS) show that the soils at the site are highly contaminated by organochlorine pesticides and arsenic. Dioxin (i.e., 2,3,7,8-tetrachlorodibenzo-p-dioxin) has also been found at concentrations up to 1.8 $\mu\text{g/kg}$ (ppb) in some soil samples collected during the RI/FS. Thermal treatment has previously been demonstrated to be an effective means of destroying pesticides, dioxin, and other organic compounds. The finding of high concentrations of arsenic in the soils at the CIC site has raised the question of whether a thermal treatment unit treating soil from the site, and operating under conditions capable of attaining a 99.9999-percent destruction and removal efficiency (DRE) for dioxin and a 99.99-percent DRE for other organic contaminants, can also reduce arsenic concentrations to acceptable levels in the stack emissions. Therefore, this incineration test program focused on the ability of an incineration system to control the arsenic emissions to levels acceptable to the EPA, while operating at incineration conditions sufficient to destroy dioxin and other organic materials to the prescribed DRE.

The test program was designed to develop the data to support feasibility study (FS) efforts in evaluating incineration as a possible remedial alternative. The specific objectives of the test program were:

- To maintain critical operating parameters in the effective range associated with a dioxin DRE of 99.9999 percent while minimizing arsenic air emissions
- To determine whether the incinerator can attain a 99.96-percent removal efficiency (RE) for arsenic, where RE is defined as:

$$RE = 100 \left(1 - \frac{\text{flue gas emission rate}}{\text{feedrate}} \right) \quad (1-1)$$

- To determine the characteristics and arsenic content (at a minimum) of all effluent streams resulting from the thermal treatment process based on the test equipment employed
- To serve as a model for determining important operating parameters to be used for projecting comparable full-scale performance and operational costs

A series of four incineration tests was performed, using the IRF's rotary kiln incineration system (RKS). Throughout the tests, the incinerator operating conditions were held constant. The kiln exit gas temperature was held at an average of approximately 982°C (1,800°F), while the afterburner exit gas temperature was held at an average of approximately 1,204°C (2,200°F). In three of the tests, raw soil alone was packaged into 1.5-gal fiberpacks and fed to the RKS kiln via the system's ram feeder. In the fourth test, raw soil was mixed with lime, at a blend ratio of 0.5 kg of lime per 10 kg of soil, before being packaged.

This report discusses the results of the test program. Section 2 describes the IRF's RKS, equipped with the Calvert scrubber system, in which the tests were performed; the composition of the soil incinerated in the tests; and the test incinerator operating conditions. Section 3 discusses the sampling and analysis procedures employed during the tests. Section 4 presents the test results. Section 5 discusses test program conclusions. Finally, Section 6 discusses the quality assurance (QA) aspects of the test program. The appendices provide the complete test program backup data.

SECTION 2

FACILITY DESCRIPTION, WASTE SOIL CHARACTERISTICS, AND TEST CONDITIONS

The IRF's RKS, equipped with a high-efficiency particulate wet scrubber system, was used in this test program. A description of the system is presented in Section 2.1. Section 2.2 describes characteristics of the tested soil. The test matrix and incinerator operating conditions are discussed in Section 2.3.

2.1 TEST EQUIPMENT

All tests in this test program were performed in the IRF RKS. A schematic of the RKS is provided in Figure 1; the design characteristics of the system are summarized in Table 1. As shown, the RKS consists of a rotary kiln primary combustor followed by an afterburner chamber. Downstream of the afterburner, the combustion gas is quenched, then the gas flows through a primary air pollution control system (APCS). For this test program, a high-efficiency particulate wet scrubber system, consisting of the Calvert Flux Force/Condensation scrubber pilot plant, was used. The flue gas then passes through a secondary APCS consisting of a carbon bed absorber and a high-efficiency particulate air (HEPA) filter. The treated flue gas is then discharged to the atmosphere via an induced-draft (ID) fan and the stack.

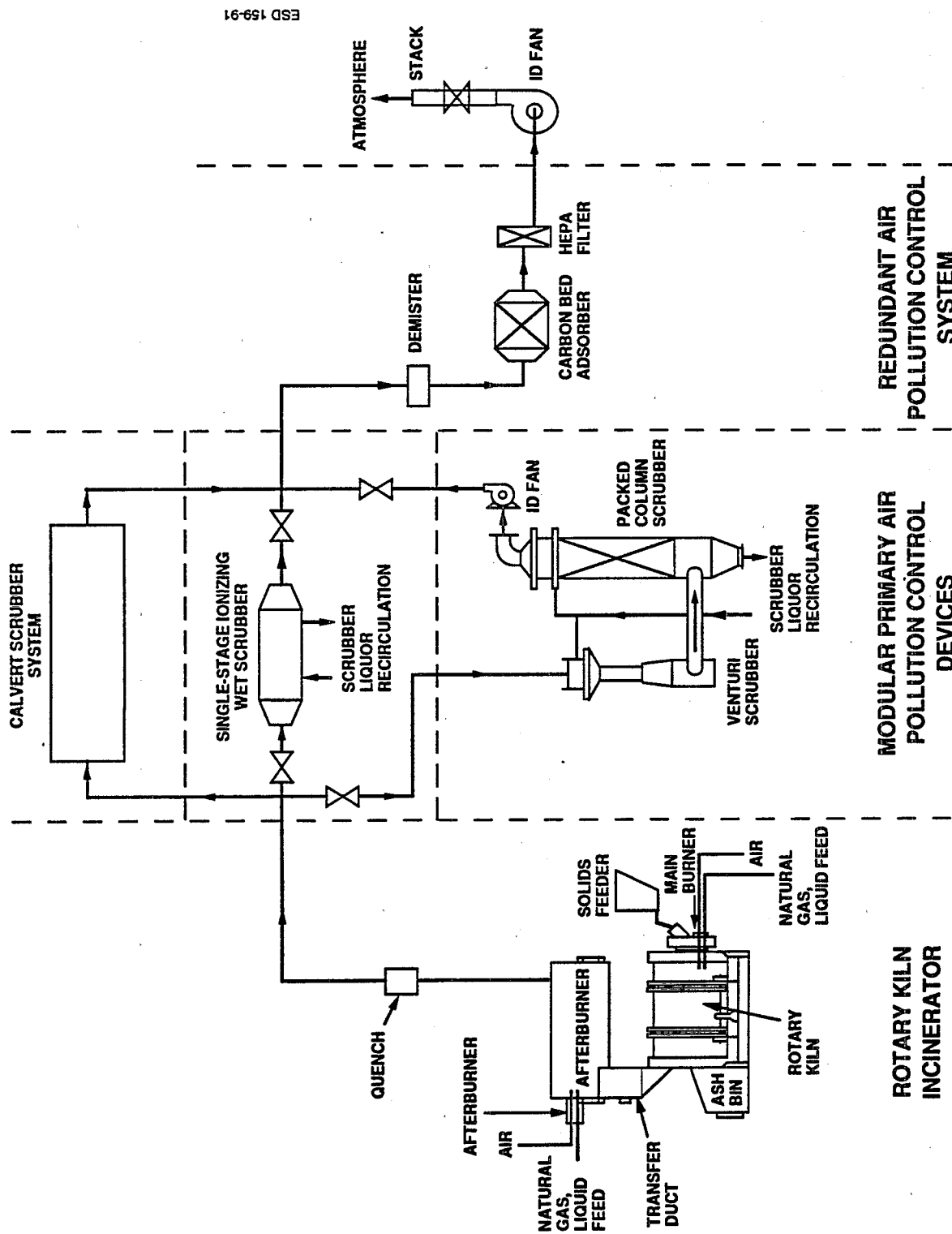
2.1.1 Incinerator Characteristics

The rotary kiln combustion chamber has an inside diameter of 1.04 m (40.75 in) and is 2.26 m (7 ft 5 in) long. The chamber is lined with refractory formed into a frustroconical shape to an average thickness of 18.7 cm (7.375 in). The refractory is encased in a 0.95-cm (0.375-in) thick steel shell. Total volume of the kiln chamber, including the transition section, is 1.90 m³ (67.2 ft³). Four steel rollers support the kiln barrel. A variable-speed DC motor, coupled to a reducing gear transmission, turns the kiln. Rotation speed can be varied from 0.2 to 1.5 rpm.

The afterburner chamber has a 0.91-m (3-ft) inside diameter, and is 3.05 m (10 ft) long. The afterburner chamber wall is constructed of a 15.2-cm (6-in) thick layer of refractory encased in a 0.63-cm (0.25-in) thick steel shell. The volume of the afterburner chamber is 1.8 m³ (63.6 ft³).

2.1.2 Air Pollution Control System

For this test program, the APCS was a high-efficiency scrubber system consisting of a condenser/absorber section, a Calvert Collision scrubber and entrainment separator, a wet electrostatic precipitator (designed to provide the final stage of particulate removal), a caustic



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Figure 1. Schematic of the IRF rotary kiln incineration system.

TABLE 1. DESIGN CHARACTERISTICS OF THE IRF ROTARY KILN INCINERATION SYSTEM

Characteristics of the Kiln Main Chamber	
Length	2.26 m (7 ft-5 in)
Diameter, outside	1.37 m (4 ft-6 in)
Diameter, inside	Nominal 1.04 m (3 ft-4.75 in)
Chamber volume	1.90 m ³ (67.2 ft ³)
Construction	0.95 cm (0.375 in) thick cold-rolled steel
Refractory	18.7 cm (7.375 in) thick high alumina castable refractory, variable depth to produce a frustroconical effect for moving solids
Rotation	Clockwise or counterclockwise, 0.2 to 1.5 rpm
Solids retention time	1 hr (at 0.2 rpm)
Burner	North American burner rated at 800 kW (2.7 MMBtu/hr) with liquid feed capability
Primary fuel	Natural gas
Feed system:	
Liquids	Positive displacement pump via water-cooled lance
Sludges	Moyno pump via front face, water-cooled lance
Solids	Metered twin-auger screw feeder or fiberpack ram feeder
Temperature (max)	1,010°C (1,850°F)
Characteristics of the Afterburner Chamber	
Length	3.05 m (10 ft)
Diameter, outside	1.22 m (4 ft)
Diameter, inside	0.91 m (3 ft)
Chamber volume	1.80 m ³ (63.6 ft ³)
Construction	0.63 cm (0.25 in) thick cold-rolled steel
Refractory	15.2 cm (6 in) thick high alumina castable refractory
Gas residence time	0.8 to 2.5 s depending on temperature and excess air
Burner	North American Burner rated at 800 kW (2.7 MMBtu/hr) with liquid feed capability
Primary fuel	Natural gas
Temperature (max)	1,204°C (2,200°F)
Characteristics of the Ionizing Wet Scrubber APCS	
System capacity, inlet gas flow	85 m ³ /min (3,000 acfm) at 78°C (172°F) and 101 kPa (14.7 psia)
Pressure drop	1.5 kPa (6 in WC)
Liquid flow	230 L/min (60 gpm) at 345 kPa (50 psig)
pH control	Feedback control by NaOH solution addition
Characteristics of the Venturi/Packed-Column Scrubber APCS	
System capacity, inlet gas flow	107 m ³ /min (3,773 acfm) at 1,204°C (2,200°F) and 101 kPa (14.7 psia)
Pressure Drop	
Venturi scrubber	7.5 kPa (30 in WC)
Packed column	1.0 kPa (4 in WC)
Liquid flow	
Venturi scrubber	77.2 L/min (20.4 gpm) at 60 kPa (10 psig)
Packed column	116 L/min (30.6 gpm) at 69 kPa (10 psig)
pH control	Feedback control by NaOH solution addition

injection system, and an ID fan. Figure 2 is diagram of the scrubber system. The quench chamber and cooling tower usually installed with the Calvert pilot unit were not used in these tests; the IRF RKS quench chamber and heat exchanger systems were used instead. The Calvert scrubber liquor was recirculated through the facility heat exchanger for scrubber liquor cooling. The key operating parameter of the scrubber system, pressure drop, was maintained at 12 kPa (50 in of water column [in WC]). This was the operating pressure drop recommended by Calvert Environmental, the scrubber's vendor. Pressure drop was controlled by a variable-speed drive on the ID fan.

At the exit of the Calvert scrubber, a demister removes the bulk of the suspended liquid droplets. In a typical commercial incinerator system, the flue gas would be vented to the atmosphere, downstream of this unit. However, at the IRF, a backup APCS is in place to further clean up the flue gas. The flue gas exiting the demister is passed through a bed of activated carbon, to allow the vapor-phase organic compounds to be adsorbed. A set of HEPA filters designed to remove suspended particulate from the flue gas is located downstream of the carbon bed.

2.2 TEST SOIL DESCRIPTION

The CIC site was formerly used to manufacture a variety of pesticides for commercial and military applications. The CIC product list included a wide range of insecticides, fungicides, rodenticides, and herbicides. One specific product was 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), which might have contained dioxin as a byproduct.

Pesticide manufacturing activities, with associated process-water storage lagoons, and poor housekeeping, led to the widespread chemical contamination of this site. Samples from the site were collected for analysis as part of the RI/FS. Analytical results for these samples indicate that the major site contaminants are pesticides and trace metals.

For pesticide constituents, the analytical results indicate that the following contaminants were detected at elevated levels in soil samples:

- p,p'-DDT, at up to 6,900 mg/kg
- p,p'-DDD, at up to 2,200 mg/kg
- p,p'-DDE, at up to 122 mg/kg
- α -BHC, at up to 45,000 mg/kg
- γ -BHC (Lindane), at up to 23,000 mg/kg
- Chlordane, at up to 61 mg/kg

For herbicide and dioxin/furan constituents, the analytical results indicate that the following contaminants were detected at elevated levels in soil samples:

- 2,4-D, at up to 2.5 mg/kg

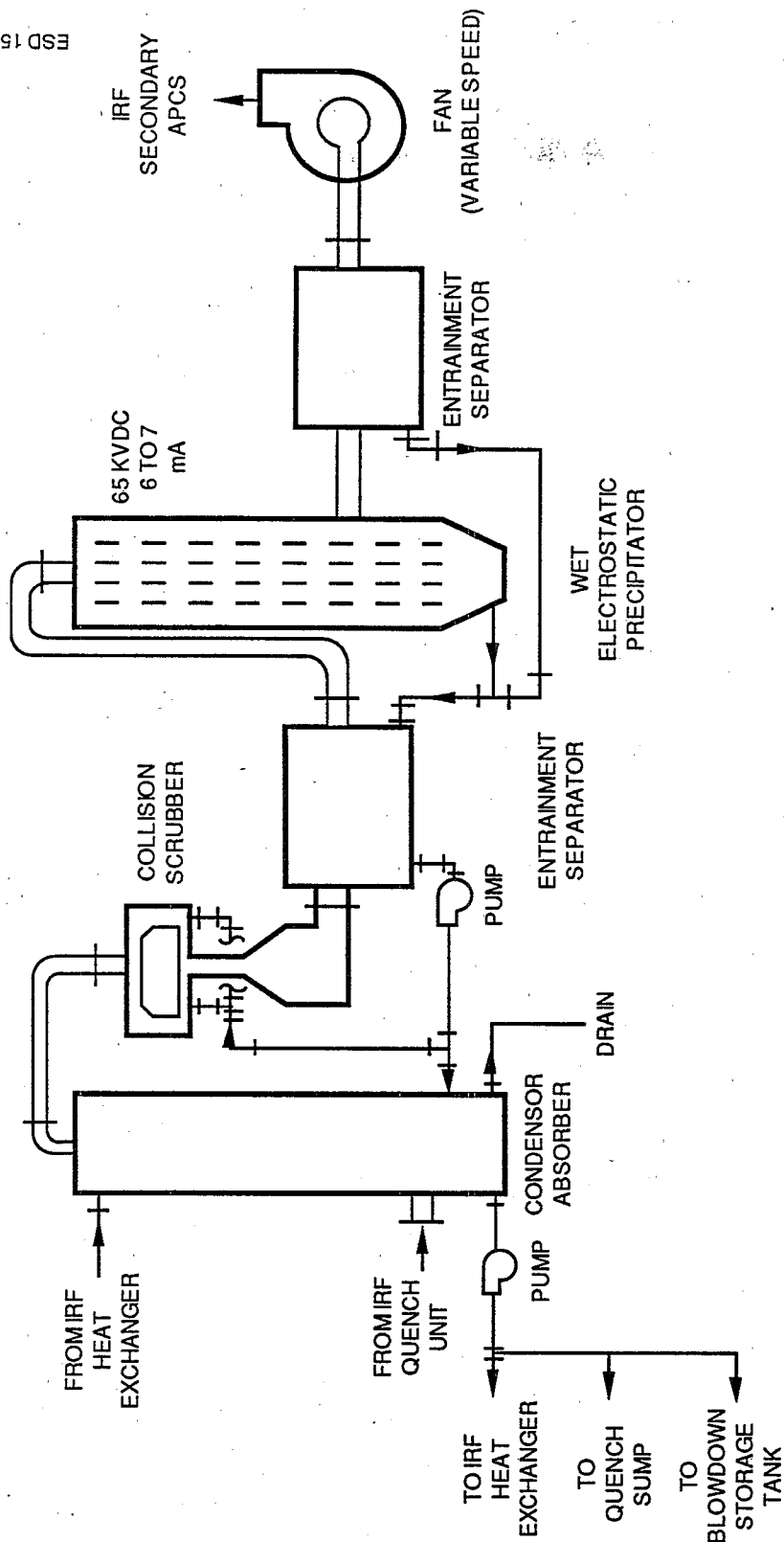


Figure 2. Schematic of the Calvert scrubber system.

- 2,4,5-T, at up to 3.3 mg/kg
- Silvex, at up to 3.1 mg/kg

Dioxin data indicate maximum concentrations of 7.3 $\mu\text{g/kg}$ for total tetrachlorodibenzo-p-dioxin (TCDD) and 1.8 $\mu\text{g/kg}$ for the 2,3,7,8-TCDD isomer.

For inorganic constituents, the analytical results indicate that the following contaminants were detected at elevated levels in soil samples:

- Arsenic, at up to 8,010 mg/kg
- Cadmium, at up to 177 mg/kg
- Chromium, at up to 196 mg/kg
- Lead, at up to 1,980 mg/kg
- Mercury, at up to 72 mg/kg
- Zinc, at up to 1,040 mg/kg

Four drums of soil were excavated from the CIC site in February 1991 for use in this test program. Composite characterization samples were taken for pretest analysis. Each sample was analyzed for eight toxicity characteristic leaching procedure (TCLP) trace metals; for antimony, beryllium, and thallium; and for the organochlorine pesticides and chlorinated herbicides noted above as being site contaminants. In addition, TCLP leachates of each sample were prepared and analyzed for trace metals and organochlorine pesticides. The results of these analyses are tabulated in Table 2. The table also shows that soil with an arsenic content of about 900 mg/kg was available for testing. This same soil was also contaminated with an average of 2 mg/kg of p,p'-DDD; 3 mg/kg of p,p'-DDE; 26 mg/kg of p,p'-DDT; and 9 mg/kg of chlordane.

Despite having arsenic, barium, chromium, and lead contamination levels of several tens to over 1,000 mg/kg, the soils were not toxicity characteristic (TC) hazardous wastes based on the TCLP leachate analysis results, which are also summarized in Table 2. In addition, there was no indication that the site soils were contaminated with listed hazardous wastes. Therefore, the test soils were considered solid, not hazardous, wastes, and therefore not subject to regulation under the Resource Conservation and Recovery Act (RCRA) or the Toxic Substances Control Act (TSCA).

A composite of the four characterization samples received was also subjected to proximate (ash, moisture, and heating value) analysis, the results of which are given in Table 3.

Prior to testing, the test soil was packaged into 1.5-gal plastic-bag-lined fiberpack containers for feeding to the RKS via the ram feeder in place on the system. Each fiberpack was

TABLE 2. SOIL CHARACTERIZATION AND TCLP LEACHATE SAMPLE ANALYSIS RESULTS

Constituent	Soil sample concentration, mg/kg					TCLP leachate concentration, mg/L				TC regulatory level, mg/L
	Drum 1	Drum 2	Drum 3	Drum-4	Avg.	Drum 1	Drum 2	Drum 3	Drum 4	
Trace metals										
Antimony	12	10	24	33	20	0.175	0.058	0.077	0.113	— ^a
Arsenic	1,260	771	875	784	922	3	2.1	1.5	1.2	5
Barium	63	52	59	60	59	0.92	0.48	0.03	0.08	100
Beryllium	0.25	0.25	0.35	0.35	0.33	0.002	0.002	<0.001	<0.001	—
Cadmium	2.3	1.5	2.1	1.9	2	0.015	0.014	0.012	0.014	1
Chromium	17	17	18	18	18	0.051	0.078	0.072	0.216	5
Lead	55	80	104	103	86	0.062	0.052	0.051	0.051	5
Mercury	7.8	8.9	10.5	8.6	9	<0.002	<0.002	<0.002	<0.002	0.2
Selenium	<4.4	<4.7	<4.5	<6.6	<6	<0.08	<0.08	<0.08	<0.08	1
Silver	<0.33	<0.35	<0.34	<0.45	<0.5	<0.01	<0.01	<0.01	0.01	5
Thallium	18	16	19	22	19	NA ^b	NA	NA	NA	—
Organochlorine pesticides										
α-BHC	<0.8	<0.8	<0.8	<0.8	<0.8	<0.001	<0.001	<0.001	<0.001	—
γ-BHC	<0.8	<0.8	<0.8	<0.8	<0.8	<0.001	<0.001	<0.001	<0.001	0.4
p,p'-DDD	3	1.9	1.5	1.8	2.1	<0.001	<0.001	<0.001	<0.001	—
p,p'-DDE	4.3	2.8	2.3	3.1	3.1	<0.001	<0.001	<0.001	<0.001	—
p,p'-DDT	33	32	21	19	26	<0.001	<0.001	0.0025	<0.001	—
Chlordane	11	<8	<8	<8	9	<0.01	<0.01	<0.01	<0.01	0.03
Four-drum composite sample										
Chlorinated herbicides										
2,4-D	<5									
2,4,5-T	<5									
Silvex	<5									

^a — = No TCLP regulatory level established.^b NA = Not analyzed.

TABLE 3. PROXIMATE ANALYSIS RESULTS

Ash content	87%
Moisture content	13%
Heating value	Will not burn
pH	6.1

filled with 4.5 kg (10 lb) of soil, its plastic bag was secured with a wire tie, then the fiberpack's lid was secured.

2.3 TEST CONDITIONS

The test series was designed specifically to determine whether incineration can attain a 99.96-percent RE for arsenic, under operating parameters associated with a 99.9999-percent dioxin DRE. The kiln chamber, afterburner chamber, and APCS operating parameters were held nominally constant throughout the test program. The target incinerator test and operating conditions for each test are given in Table 4.

Three tests were planned for the test program, with a possible fourth in the event that the arsenic RE was measured to be less than 99.96 percent. The arsenic RE, based on rapid-turnaround analysis data from the first test, was calculated to be 99.89 percent. It was therefore decided to conduct the fourth test, in which 0.5 kg of lime was mixed with every 10 kg of test soil. The lime used was chemical grade hydrated lime obtained from the Arkansas Lime Company in Batesville, Arkansas. It contained 73 percent available CaO, 24 percent chemically combined moisture, and 0.7 percent MgO.

Table 5 summarizes the actual incinerator exit gas temperatures and flue gas O₂ levels, including their ranges and averages, for each test over the period of flue gas sampling, compared with the respective target conditions. For all tests, the average kiln exit gas temperature was within 7°C (12°F) of the target temperature, while the average afterburner exit gas temperature was within 5°C (8°F) of the target.

The actual O₂ levels in the kiln were generally higher than the target concentration. The higher O₂ levels resulted from higher than expected air leakage into the kiln chamber. This leakage was due to the inability to tightly secure the kiln rotating seal, and to the higher kiln draft induced by the Calvert fan to maintain a scrubber pressure drop of 12 kPa (50 in WC). The average kiln exit O₂ level achieved for all tests was 12 percent. The average afterburner O₂ level was within 0.7 percent of the targeted level for all tests.

The actual kiln and afterburner operating conditions achieved for each test are summarized in Tables 6 and 7, respectively. Table 8 provides a similar summary of the APCS operating conditions for each test. Continuous emission monitor (CEM) data are summarized in Table 9. The ranges and averages of the temperature, CEM, and scrubber pH data presented

TABLE 4. TARGET INCINERATOR TEST AND OPERATING CONDITIONS

Kiln exit gas temperature	982°C (1,800°F)
Afterburner exit gas temperature	1,204°C (2,200°F)
Kiln exit O ₂ level	10%
Afterburner exit O ₂ level	7.9%
Kiln solids residence time	0.5 hr
Total waste soil feedrate	55 kg (120 lb)
Calvert scrubber pressure drop	12.4 kPa (50 in WC)
Scrubber liquor temperature	66°C (150°F)
Scrubber liquor blowdown rate	0 to 2 L/min (0 to 0.5 gpm)

in Tables 5 through 9 were developed for the periods of the flue gas sampling, using the data automatically recorded by a personal computer (PC) based data acquisition system. The values given for the remaining parameters were derived from the control room logbook data. During the second day of testing, the NO_x instrument electronic output failed, forcing the operator to manually record the data, from the instrument meter, in the control room logbook for this and subsequent tests.

Transcribed data from the control room logs of the operating parameters, recorded at 15-min intervals, are given in Appendix A. Appendix B contains graphic presentations of the flue gas temperature and gas emission monitor readings for the kiln and afterburner. Appendix B also contains graphical presentations of the scrubber and stack exit flue gas emission monitor readings. These data plots were based on incinerator system conditions recorded at 35-s intervals on the data acquisition system. In addition, durations of flue gas sampling periods, major events, cumulative amounts of waste fed into the incinerator, and cumulative amounts of ash removed from the incinerator are included on some of the plots. These data provide the basis for assembling a complete picture of the actual incinerator operating conditions.

TABLE 5. ACTUAL VERSUS TARGET OPERATING CONDITIONS

TABLE 3. ACTUAL VERSUS TARGET TEMPERATURES AND FLUE GAS O ₂ CONCENTRATIONS								
Test	Date	Temperature, °C (°F)			Flue gas O ₂ , %			
		Target	Minimum	Maximum	Average	Target	Range	Average
Kiln exit								
1	8/6/91	982 (1,800)	895 (1,644)	1,031 (1,888)	975 (1,788)	10	10.8-16.5	12.3
2	8/8/91	982 (1,800)	900 (1,653)	1,023 (1,874)	983 (1,802)	10	10.5-14.9	12.7
3	8/13/91	982 (1,800)	946 (1,736)	1,060 (1,940)	984 (1,803)	10	8.9-19.0	10.9
4	8/15/91	982 (1,800)	920 (1,688)	1,024 (1,876)	979 (1,794)	10	9.2-14.5	12.1
Afterburner exit								
1	8/6/91	1,204 (2,200)	1,201 (2,193)	1,219 (2,226)	1,208 (2,207)	7.9	5.8-9.4	7.2
2	8/8/91	1,204 (2,200)	1,196 (2,185)	1,227 (2,241)	1,208 (2,207)	7.9	6.4-8.8	7.6
3	8/13/91	1,204 (2,200)	1,204 (2,200)	1,214 (2,218)	1,209 (2,208)	7.9	6.4-9.1	7.8
4	8/15/91	1,204 (2,200)	1,204 (2,200)	1,214 (2,218)	1,209 (2,208)	7.9	7.1-12.6	8.1

TABLE 6. KILN OPERATING CONDITIONS

Parameter		Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Average natural gas feedrate	scm/hr	35.4	38.5	39.4	40.8
	(scfh)	(1,250)	(1,360)	(1,390)	(1,440)
	kW	366	399	408	423
	(kBtu/hr)	(1,250)	(1,360)	(1,390)	(1,440)
Average combustion air flowrate through burner	scm/hr	204	198	210	205
	(scfh)	(7,210)	(7,010)	(7,410)	(7,240)
Average combustion air flowrate calculated by O ₂	scm/hr	804	912	771	900
	(scfh)	(28,380)	(32,200)	(27,230)	(31,770)
Average draft	Pa	10.0	7.5	7.5	7.5
	(in WC)	(0.04)	(0.03)	(0.03)	(0.03)
Exit gas temperature	Range, °C	896-1,031	901-1,023	947-1,060	920-1,024
	(°F)	(1,644-1,888)	(1,653-1,874)	(1,736-1,940)	(1,688-1,876)
	Average, °C	976	983	984	979
	(°F)	(1,788)	(1,802)	(1,803)	(1,794)
Exit gas O ₂	Range, %	10.8-16.5	10.5-14.9	8.9-19.0	9.2-14.5
	Average, %	12.3	12.7	10.9	12.1
Average waste feedrate	kg/hr	55.7	55.5	54.2	57.0
	(lb/hr)	(123)	(122)	(119)	(125)
Average kiln ash discharge rate	kg/hr	37.3	38.7	34.3	38.1
	(lb/hr)	(82)	(85)	(75)	(84)
Calculated residence time	s	2.1	1.8	2.2	1.9

TABLE 7. AFTERBURNER OPERATING CONDITIONS

Parameter		Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Average natural gas feedrate					
	scm/hr	65.4	71.1	74.4	66.8
	(scfh)	(2,310)	(2,510)	(2,630)	(2,360)
	kW	677	737	770	691
	(kBtu/hr)	(2,310)	(2,510)	(2,630)	(2,360)
Average combustion air flowrate					
	scm/hr	218	215	218	221
	(scfh)	(7,710)	(7,580)	(7,700)	(7,810)
Exit gas temperature	Range, °C	1,201-1,219	1,196-1,227	1,204-1,214	1,204-1,214
	(°F)	(2,193-2,226)	(2,185-2,241)	(2,200-2,218)	(2,199-2,218)
	Average, °C	1,208	1,208	1,209	1,209
	(°F)	(2,207)	(2,207)	(2,208)	(2,208)
Exit gas O ₂	Range, %	5.8-9.4	6.4-8.8	6.8-9.1	7.1-12.6
	Average, %	7.2	7.6	7.8	8.1
Calculated residence time	s	1.0	1.0	1.0	1.0

TABLE 8. APCS OPERATING CONDITIONS

Parameter		Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Average quench chamber liquor flowrate	L/min (gpm)	114 (30)	114 (30)	140 (37)	114 (30)
Quench liquor pH	Range	8.1-8.6	6.3-7.2	7.4-7.5	7.7-7.9
	Average	8.5	6.9	7.4	7.7
Average quench exit gas temperature	°C (°F)	83 (182)	83 (182)	83 (182)	83 (182)
Average blowdown flowrate	L/min (gpm)	1.4 (0.38)	3.8 (0.75)	2.3 (0.62)	2.9 (0.77)
Average Calvert scrubber liquid flowrate, Condenser absorber	L/min (gpm)	598 (158)	628 (166)	617 (163)	625 (165)
Scrubber liquor pH					
Condenser adsorber	average	7.9	6.1	6.7	6.2
Collision scrubber	average	7.6	7.2	7.7	7.3
Calvert Collision scrubber pressure drop	kPa (in WC)	11.9 (48)	12.2 (49)	12.4 (50)	12.4 (50)
Average scrubber liquor temperature	°C (°F)	52 (126)	54 (129)	52 (126)	52 (126)
Average scrubber flue gas temperature					
Scrubber inlet	°C (°F)	84 (184)	84 (184)	84 (184)	85 (185)
Scrubber exit	°C (°F)	63 (145)	68 (155)	69 (156)	67 (153)
Average stack gas temperature	°C (°F)	59 (138)	61 (142)	58 (137)	59 (139)
Average stack gas flowrate	dscm/min (dscfm)	67.4 (2,380)	65.2 (2,300)	63.6 (2,240)	63.2 (2,230)

TABLE 9. CEM DATA

Parameter		Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Kiln exit					
O ₂	Range, %	10.8-16.5	10.5-14.9	8.9-19.0	9.2-14.5
	Average, %	12.3	12.7	10.9	12.1
	Target, %	10.0	10.0	10.0	10.0
Afterburner exit					
O ₂	Range, %	5.8-9.4	6.4-8.8	6.8-9.1	7.1-12.6
	Average, %	7.2	7.6	7.8	8.1
	Target, %	7.9	7.9	7.9	7.9
Scrubber exit					
O ₂	Range, %	14.8-16.1	14.1-15.7	14.5-15.3	14.4-15.4
	Average, %	15.2	14.8	14.9	14.9
CO	Range, ppm	<1-3	<1	<1	<1-1
	Average, ppm	<1	<1	<1	<1
CO ₂	Range, %	0.1-3.7	2.9-4.0	3.2-3.9	3.2-4.0
	Average, %	3.3	3.5	3.5	3.5
NO _x	Range, ppm	<1-47	2-40	<1-40	40-50
	Average, ppm	36	30	35	45
Stack					
O ₂	Range, %	14.2-15.4	15.6-16.8	15.9-16.6	15.4-16.3
	Average, %	14.6	16.1	16.2	15.8
CO	Range, ppm	3-5	3-4	3-4	3-4
	Average, ppm	4	4	3	4
CO ₂	Range, %	2.8-3.9	3.1-4.0	3.3-3.8	3.3-3.9
	Average, %	3.4	3.6	3.5	3.8

SECTION 3

SAMPLING AND ANALYSIS PROCEDURES

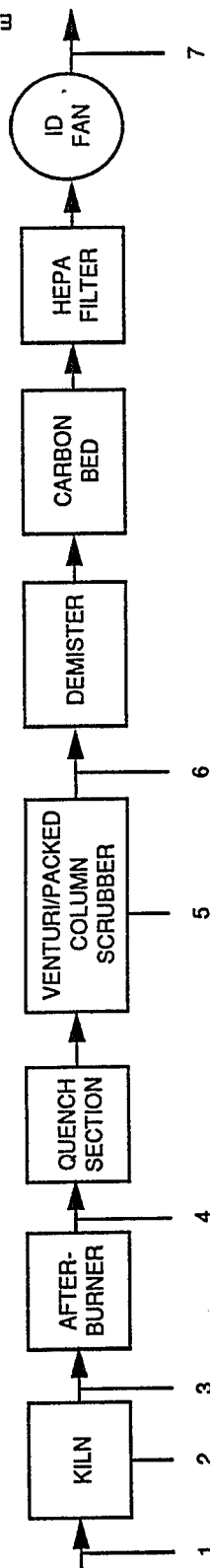
The sampling and analysis efforts were designed to meet the test objectives and to satisfy the IRF permit compliance requirements. The scope of the sampling efforts undertaken during this test program is illustrated in Figure 3, in which the sampling locations are identified. Table 10 summarizes the sampling and analysis matrix. Specifically, the sampling effort completed during each test consisted of:

- Obtaining a composite sample of the soil feed from each drum before the soil was packaged into the fiberpack containers
- Collecting a composite sample of the kiln ash
- Collecting a composite sample of the scrubber liquor
- Continuously measuring O₂ levels in the kiln exit and afterburner exit flue gases; O₂, CO, CO₂, and NO_x at the scrubber exit; and O₂, CO, and CO₂ levels at the stack
- Sampling flue gas at the scrubber system exit for organochlorine pesticides, arsenic, and particulate and HCl
- Sampling at the stack downstream of the secondary APCS for arsenic, and particulate and HCl

3.1 SAMPLING PROCEDURES

The soil was received in four 55-gal drums. The composite soil sample for each test was obtained by taking thief samples from each shipment drum at three locations in the drum cross section just prior to packaging the soil into the fiberpack containers. These three samples were combined to form one composite soil feed sample per test. Each composite soil sample was preserved in an appropriate container, according to the specific analysis procedure requirements noted in Table 10, and given to the onsite Sample Custodian.

On each test day, the incinerator was brought to nominally steady operation at test conditions while firing auxiliary fuel (natural gas) alone. Soil feed was then initiated. Flue gas sampling was started about 0.5 hour after waste feed was initiated.



Sampling point	Soil feed	Kiln ash	Calvert scrubber liquor	Continuous flue gas monitoring	Method 0010 (organochlorine pesticides)	Method 108 (arsenic)	Method 5 (particulate and HCl)
1	X						
2		X					
3				X			
4				X			
5			X				
6				X	X	X	X
7				X		X	X

Figure 3. Sampling matrix.

TABLE 10. SAMPLING AND ANALYSIS MATRIX SUMMARY

Sample	Location	Sampling procedure	Analysis		
			Parameter	Method	Frequency
Soil feed	Soil drum during fiberpack drum packaging	Thief/composite	Proximate analysis:		
			Ash content	ASTM D-3174	1 composite
			Moisture	ASTM D-3173	
			Heating value	ASTM D-3286	
			Ultimate analysis: (C, H, O, N, S, Cl)	ASTM D-3176	1 composite
			Specific gravity	ASTM D-854	1 composite
			Organochlorine pesticides	Method 3540 extraction with Method 8080 analysis ^a	1 composite/test
			As, Ba, Cd, Cr, Pb, Se, Ag	Method 3050 digestion with Method 6010 analysis ^a	1 composite/test
			Hg	Digestion and analysis by Method 7471 ^a	1 composite/test
			TCLP extraction	Method 1311 ^b	1 composite/test
Soil feed TCLP leachate			As, Ba, Cd, Cr, Pb, Se, Ag	Method 3010 digestion with Method 6010 analysis ^a	1/test
			Hg	Digestion and analysis by Method 7470 ^a	1/test
			Organochlorine pesticides	Method 3510 extraction with Method 8080 analysis ^a	1/test
			Organochlorine pesticides	Method 3040 extraction with Method 8080 analysis ^a	1 composite/test
Kiln ash	Kiln ash pit	Thief/composite	As, Ba, Cd, Cr, Pb, Se, Ag	Method 3050 digestion with Method 6010 analysis ^a	1 composite/test
			Hg	Digestion and analysis by Method 7471 ^a	1 composite/test
			Specific gravity	ASTM D-854	1 composite/test
			TCLP extraction	Method 1311 ^b	1 composite/test

^aReference 1, SW-846.

^bReference 2, 40 CFR 261, Appendix II.

(continued)

TABLE 10. (continued)

Sample	Location	Sampling procedure	Parameter	Analysis	
				Method	Frequency
Kiln ash TCLP leachate			As, Ba, Cd, Cr, Pb, Se, Ag	Method 3010 digestion with Method 6010 analysis ^a	1/test
			Hg	Digestion and analysis by Method 7470 ^a	1/test
Scrubber liquor	Scrubber system drain	Tap	Organochlorine pesticides	Method 3510 extraction with Method 8080 analysis ^a	1 composite/test
			As, Ba, Cd, Cr, Pb, Se, Ag	Method 3010 digestion with Method 6010 analysis ^a	1 composite/test
			Hg	Digestion and analysis by Method 7470 ^a	1 composite/test
			pH	Method 9040 ^a	1 composite/test
Flue gas	Scrubber exit	Method 5 ^c	Particulate	Method 5 ^c	1/test
			HCl	Analysis of impinger solution for Cl by specific ion electrode	1/test
		Method 108 ^d	As	Method 108 ^d with GFAA analysis	1/test
		Method 0010 ^a	Organochlorine pesticides	Method 3540 extraction and analysis by Method 8080 ^a	1/test
Stack gas	Stack, downstream of carbon bed/HEPA filter	Method 5 ^c	Particulate	Method 5 ^c	1/test
			HCl	Analysis of impinger solution for Cl by specific ion electrode	1/test
		Method 108 ^d	As	Method 108 ^d with GFAA analysis	1/test

^aReference 1, SW-846.^cReference 3, 40 CFR 60, Appendix A.^dReference 4, 40 CFR 61, Appendix B.

The kiln ash was continuously removed from the catch bin by a steel auger and conveyed into an initially clean 55-gallon steel drum. The entire ash transfer system was sealed to prevent sample loss and contamination. A representative sample was collected from the ash collection drum at the conclusion of each test.

Each test was run with the scrubber system operating at minimum blowdown. Any blowdown discharged was directed to an initially clean collection tank. At the conclusion of each test day, the incinerator was operated on natural gas for a minimum of 2 hours after waste feed cessation. After the 2-hour cleanout time, the scrubber system contents were drained to the blowdown collection tank. The contents of the tank were continuously recirculated and mechanically stirred to ensure good mixing and homogeneity. The composite scrubber liquor sample for each test was collected from this collection tank.

The flue gas, at four locations (kiln exit, afterburner exit, Calvert scrubber system exit, and the stack), was continuously monitored for location-specific combinations of O_2 , CO, CO_2 , and NO_x . The CEMs available at the IRF, and the locations they monitored during these tests, are summarized in Table 11.

The scrubber exit flue gas and the stack gas were sampled for particulate and HCl, using an EPA Method 5 train. These gases were also sampled for arsenic, using EPA Method 108. In addition, the scrubber exit flue gas was sampled for organochlorine pesticides, using an EPA Method 0010 train. These sampling operations were conducted in strict adherence to the respective method guidelines.

3.2 LABORATORY ANALYSIS PROCEDURES

The numbers and types of samples collected for analysis during this test program are summarized in Table 12. The sample collection procedures resulted in four individual soil feed samples and one composite soil feed sample. One set of kiln ash samples was taken for each test. One set of flue gas characterization samples was collected for each test. Scrubber liquor samples were also collected for each test.

Soil feed samples, kiln ash samples, and scrubber liquor samples were analyzed separately for:

- Trace metals, including arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver
- Organochlorine pesticides

An aliquot of each soil feed and kiln ash sample was also subjected to the TCLP, and the leachate analyzed for the above trace metals. Soil feed TCLP leachate samples were also analyzed for organochlorine pesticides.

Organochloride pesticides were determined by Method 8080. Solid samples (i.e., soil feed, kiln ash, and Method 0010 train samples) were Soxhlet-extracted (Method 3540) prior to analysis; liquid samples (i.e., scrubber liquor and TCLP leachates) were liquid/liquid-extracted (Method 3510). Solid samples were digested and analyzed for mercury by Method 7471; liquid

TABLE 11. CEMs USED IN THE TESTS

Location	Monitor				Range
	Constituent	Manufacturer	Model	Principle	
Kiln exit	O ₂	Beckman	755	Paramagnetic	0-10 percent 0-25 percent 0-100 percent
Afterburner exit	O ₂	Beckman	755	Paramagnetic	0-10 percent 0-25 percent 0-100 percent
Scrubber exit	O ₂	Teledyne	326 A	Fuel cell	0-5 percent 0-10 percent 0-25 percent
	CO	Horiba	VIA 500	NDIR	0-50 ppm 0-500 ppm
	CO ₂	Horiba	PIR 2000	NDIR	0-20 percent 0-80 percent
	NO _x	Thermo Electron	10 AR	Chemiluminescent	0-75 ppm to 0-10,000 ppm in multiples of 2
Stack	O ₂	Teledyne	326 A	Fuel cell	0-5 percent 0-10 percent 0-25 percent
	CO	Horiba	VIA 500	NDIR	0-50 ppm 0-500 ppm
	CO ₂	Horiba	PIR 2000	NDIR	0-20 percent 0-80 percent

TABLE 12. SUMMARY OF TEST SAMPLES

Sample type	Analyte/procedure	Number of samples	
		Each test	Total
Soil feed	Proximate, ultimate, specific gravity		1
	Organochlorine pesticides	1	4
	Trace metals	1	4
	TCLP extraction	1	4
Soil feed TCLP leachate	Organochlorine pesticides	1	4
	Trace metals	1	4
Kiln ash	Organochlorine pesticides	1	4
	Trace metals	1	4
	TCLP extraction	1	4
	Specific gravity	1	4
Kiln ash TCLP leachate	Trace metals	1	4
Composite scrubber liquor	Organochlorine pesticides	1	4
	Trace metals	1	4
	pH	1	4
Calvert scrubber exit flue gas			
Method 108 train			
Probe wash	Arsenic	1	4
Filter	Arsenic	1	4
Impingers (1, 2, 3, and 4 combined)	Arsenic	1	4
Method 0010 train	Organochlorine pesticides	1	4
Method 5 particulate/HCl train			
Probe wash/filter	Particulate	1	4
Impingers (1, 2, 3, and 4 combined)	Chloride	1	4
Stack gas			
Method 5 particulate/HCl train			
Probe wash/filter	Particulate	1	4
Impingers (1, 2, 3, and 4 combined)	Chloride	1	4
Method 108 train			
Probe wash	Arsenic	1	4
Filter	Arsenic	1	4
Impingers (1, 2, 3, and 4 combined)	Arsenic	1	4

samples were digested and analyzed for mercury by Method 7470. The remaining trace metal analyses were performed by inductively coupled argon plasma (ICAP) spectrometry (Method 6010). Solid samples were digested by Method 3050 for analysis; liquid samples were digested by Method 3010.

Flue gas particulate load was determined by desiccating the filter and probe wash of the Calvert scrubber system exit and the stack Method 5/HCl train. HCl at the scrubber exit and the stack was determined by analyzing the combined impinger solution from the respective Method 5/HCl trains for chloride, using a chloride specific ion electrode.

The scrubber exit and stack flue gases were sampled for arsenic by Method 108. Sampling train samples were analyzed by the Method 108 procedure, using graphite furnace atomic absorption (GFAA) spectroscopy. The scrubber exit flue gas was also sampled for organochloride pesticides by Method 0010. Method 0010 train samples were extracted by Method 3540, and analyzed by Method 8080 for organochlorine pesticides.

The composite soil feed sample was subjected to proximate (moisture, ash content, and heat content) analysis, ultimate (C, H, O, N, S, Cl) analysis, and specific gravity using ASTM methods.

Proximate, ultimate, and mercury analyses were performed by Galbraith Laboratories, in Knoxville, Tennessee. Organochlorine pesticides, specific gravity, and HCl analyses were performed at the IRF onsite analytical laboratory. Arsenic and other trace metals analyses were performed by the Environmental Monitoring Systems Laboratory (EMSL), in Cincinnati, Ohio, operated by Technology Applications, Inc.

SECTION 4

TEST RESULTS

Results from the test program performed are discussed in this section. Test results are grouped by analyte class. Thus, Section 4.1 presents the contaminated soil proximate and ultimate analysis results. Section 4.2 discusses the organochlorine pesticides measurements, including the effectiveness of incineration in decontaminating the test soil. Section 4.3 discusses the trace metal measurements, including arsenic removal efficiencies (REs), and the distribution of contaminant metals among the incinerator discharge streams. Finally, Section 4.4 presents the results of the flue gas particulate and HCl measurements.

4.1 PROXIMATE AND ULTIMATE ANALYSIS RESULTS

The proximate and ultimate analysis results for the composite soil sample analyzed are presented in Table 13. Comparing the data in Table 13 with those in Table 3 shows that the composite soil prepared for testing had a slightly higher moisture content, and slightly lower ash content, than the characterization samples taken for pretest analysis.

Table 14 summarizes the cumulative soil weight fed for each test and the total amount of kiln ash collected. As indicated in the table, between 73 and 81 percent of the soil weight fed for a given test was collected as kiln bottom ash. This fraction agrees quite well with the ash content of the soil obtained by proximate analysis, as shown in Table 13.

4.2 ORGANOCHLORINE PESTICIDES ANALYSIS RESULTS

Table 15 summarizes the results of the organochlorine pesticide analyses of the soil feed, soil feed TCLP leachate, kiln ash, scrubber liquor and flue gas samples analyzed. The data in Table 15 indicate that the soil feed contained between < 10 and 17 mg/kg of chlordane; between 3.4 and 6.7 mg/kg of p,p'-DDE; between 4.3 and 7.3 mg/kg of p,p'-DDD; and between 41 and 92 mg/kg of p,p'-DDT. However, none of these soil contaminants was found in any of the feed TCLP leachate, kiln ash, or scrubber liquor samples. Low levels of p,p'-DDT were found in the scrubber exit flue gas in two of the four tests, although no other pesticide analyte was found.

Interestingly, α -BHC was found in three of the four soil feed TCLP leachate samples at levels ranging from 3.5 to 8.3 $\mu\text{g/L}$; and γ -BHC was found in one soil feed TCLP leachate sample at 2.3 $\mu\text{g/L}$. Neither compound was detected in the corresponding soil feed sample. However, this is most likely the result of the relatively high method PQL for these compounds in the soil analyses. The high level soil purge and trap sample introduction method was required for soil feed sample analyses so that the p,p'-DDT levels approaching 100 mg/kg could be quantitated. Use of this introduction method resulted in α -BHC and γ -BHC PQLs of 2 mg/kg.

**TABLE 13. PROXIMATE AND ULTIMATE
ANALYSIS RESULTS FOR THE
COMPOSITE SOIL FEED SAMPLE**

Proximate analysis (as received)	
Moisture, %	16.3
Ash, %	78.7
Volatile matter, %	5.0
Higher heating value, kJ/kg (Btu/lb)	903 (389)
Bulk density, g/mL	1.47
Ultimate analysis, %	
C	2.2
H	<0.4
N	0.08
S	0.04
Cl	0.04

TABLE 14. SOIL FEED AND ASH COLLECTED

Drum	Test	Ash collected				
		Total soil feed		Weight		Fraction of Feed
		kg	lb	kg	lb	%
3	1 (8/6/91)	214	470	165	362	77
4	2 (8/8/91)	217	477	175	385	81
2	3 (8/13/91)	212	466	155	342	73
1	4 (8/15/91)	222	489	172	378	77

TABLE 15. ORGANOCHLORINE PESTICIDE ANALYSIS RESULTS

Sample	Chlordane	Concentration				
		α -BHC	γ -BHC	p,p'-DDE	p,p'-DDD	p,p'-DDT
Test 1 (8/6/91)						
Soil feed, mg/kg	14	<2.0	<2.0	5.5	7.3	65
Soil feed TCLP leachate, $\mu\text{g/L}$	<10	8.3	2.3	<2.0	<2.0	<2.0
Kiln ash, mg/kg	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02
Scrubber liquor, $\mu\text{g/L}$	<1.0	<0.20	<0.20	<0.20	<0.20	<0.02
Scrubber exit flue gas, $\mu\text{g/dscm}$	<0.33	<0.066	<0.066	<0.066	<0.066	0.10
Test 2 (8/8/91)						
Soil feed, mg/kg	17	<2.0	<2.0	6.7	7.3	92
Soil feed TCLP leachate, $\mu\text{g/L}$	<10	4.4	<2.0	<2.0	2.6	<2.0
Kiln ash, mg/kg	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02
Scrubber liquor, $\mu\text{g/L}$	<1.0	<0.20	<0.20	<0.20	<0.20	<0.20
Scrubber exit flue gas, $\mu\text{g/dscm}$	<0.30	<0.060	<0.060	<0.060	<0.060	<0.060
Test 3 (8/13/91)						
Soil feed, mg/kg	<10	<2.0	<2.0	3.4	4.3	41
Soil feed TCLP leachate, $\mu\text{g/L}$	<10	3.6	<2.0	<2.0	<2.0	<2.0
Kiln ash, mg/kg	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02
Scrubber liquor, $\mu\text{g/L}$	<1.0	<0.20	<0.20	<0.20	<0.20	<0.20
Scrubber exit flue gas, $\mu\text{g/dscm}$	<0.31	<0.061	<0.061	<0.061	<0.061	<0.061
Test 4 (8/15/91)						
Soil feed, mg/kg	13	<2.0	<2.0	4.8	6.4	46
Soil feed TCLP leachate, $\mu\text{g/L}$	<10	<2.0	<2.0	<2.0	<2.0	<2.0
Kiln ash, mg/kg	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02
Scrubber liquor, $\mu\text{g/L}$	<1.0	<0.20	<0.20	<0.20	<0.20	<0.20
Scrubber exit flue gas, $\mu\text{g/dscm}$	<0.31	<0.062	<0.062	<0.062	<0.062	0.077
TCLP regulatory level, $\mu\text{g/L}$	30	^a	400	—	—	—

^a — = Has no TCLP regulatory level.

The TCLP test involves producing 20 g of leachate/g of solid leached. Thus, if α -BHC or γ -BHC were present in the soil feed samples at just below the PQL of 2 mg/kg, and all this quantity of each compound leached in the procedure, then resulting leachate concentrations would be just below 100 μ g/L. Measuring TCLP leachate concentrations in the 2 to 8 μ g/L range, therefore, is not inconsistent with having nondetectable levels in corresponding soil samples at a PQL of 2 mg/kg.

Table 15 also notes the TCLP regulatory level that defines a TC hazardous waste for the two pesticides having a regulatory level. The low level of γ -BHC found in the one soil feed TCLP leachate sample was far below the regulatory level.

As noted above, the data in Table 15 show that none of the four pesticides present in the soil feed was detected in the corresponding incineration-treatment kiln ash residue. Table 16 summarizes the lower bound degree of pesticide decontamination achieved corresponding to the kiln ash PQLs. Identified in Table 16 is the upper bound fraction of the amount of each pesticide introduced in the incinerator feed that could have been present in the kiln ash discharge in each test.

The data in Table 16 show that no more than 0.62 percent of the chlordane, 0.44 percent of the p,p'-DDE, 0.34 percent of the p,p'-DDD, or 0.04 percent of the p,p'-DDT fed to the incinerator could have been discharged in the kiln ash. The decontamination effectiveness of incineration under the conditions tested was, thus, at least 99.38 percent for chlordane; 99.56 percent for p,p'-DDE; 99.66 percent for p,p'-DDD; and 99.96 percent for p,p'-DDT.

Comparing the data in Table 15 with the characterization sample analysis data in Table 2 shows that most samples taken from the drums delivered to the IRF contained generally higher levels of all four pesticide contaminants listed found in test samples (chlordane; p,p'-DDD; p,p'-DDE; and p,p'-DDT) than did the characterization samples analyzed prior to soil shipment.

Table 17 combines the scrubber exit flue gas organochlorine pesticide compound concentrations noted in Table 15 with soil feedrate and flue gas flowrate data to yield the organochlorine pesticide DREs achieved for the tests. DRE is defined as:

$$DRE = 100 \left(1 - \frac{\text{flue gas emission rate}}{\text{feedrate}} \right) \quad (4-2)$$

As shown in Table 17, for the two tests in which p,p'-DDT was detected in the scrubber exit flue gas (Tests 1 and 4), the DRE achieved was 99.9916 percent. This exceeds the 99.99-percent POHC DRE requirement in the hazardous waste incinerator performance standard. The lower bound DREs achieved for p,p'-DDT in Tests 2 and 3, based on the flue gas emission stream PQL, were also greater than 99.99 percent. Lower bound DREs based on the flue gas emission stream measurement PQLs were greater than 99.87 percent for chlordane, 99.901 percent for p,p'-DDE, and 99.923 percent for p,p'-DDD. The expectation is that all three of these compounds were destroyed at greater than 99.99 percent DRE; however, method PQLs were too

TABLE 16. ORGANOCHLORINE PESTICIDE DECONTAMINATION EFFECTIVENESS

Parameter	Chlordane	p,p'-DDE	p,p'-DDD	p,p'-DDT
Test 1 (8/6/91)				
Soil feed				
Concentration, mg/kg	14	5.5	7.3	65
Amount fed, g	3.03	1.17	1.55	14.0
Kiln ash				
Concentration, mg/kg	<0.1	<0.02	<0.02	<0.02
Amount discharged, mg	<16	<3.3	<3.3	<3.3
Fraction of amount fed, %	<0.54	<0.28	<0.21	<0.02
Test 2 (8/8/91)				
Soil feed				
Concentration, mg/kg	17	6.7	7.3	92
Amount fed, g	3.73	1.45	1.59	19.9
Kiln ash				
Concentration, mg/kg	<0.1	<0.02	<0.02	<0.02
Amount discharged, mg	<17	<3.5	<3.5	<3.5
Fraction of amount fed, %	<0.47	<0.24	<0.22	<0.02
Test 3 (8/13/91)				
Soil feed				
Concentration, mg/kg	<10	3.4	4.3	41
Amount fed, g	<2.1	0.71	0.92	8.77
Kiln ash				
Concentration, mg/kg	<0.1	<0.02	<0.02	<0.02
Amount discharged, mg	<16	<3.1	<3.1	<3.1
Fraction of amount fed, %	— ^a	<0.44	<0.34	<0.04
Test 4 (8/15/91)				
Soil feed				
Concentration, mg/kg	13	4.8	6.4	46
Amount fed, g	2.78	1.07	1.42	10.1
Kiln ash				
Concentration, mg/kg	<0.1	<0.02	<0.02	<0.02
Amount discharged, mg	<17	<3.4	<3.4	<3.4
Fraction of amount fed, %	<0.62	<0.32	<0.24	<0.03

^a— = Not applicable because not detected in the feed.

TABLE 17. ORGANOCHLORINE PESTICIDE DREs

Parameter	Chlordane	p,p'-DDE	p,p'-DDD	p,p'-DDT
Test 1 (8/6/91)				
Pesticide feedrate, mg/hr	791	305	405	3,640
Scrubber exit flue gas emission rate, $\mu\text{g/hr}$	<990	<200	<200	306
DRE, %	>99.87	>99.934	>99.951	99.9916
Test 2 (8/8/91)				
Pesticide feedrate, mg/hr	951	371	405	5,100
Scrubber exit flue gas emission rate, $\mu\text{g/hr}$	<860	<170	<170	<170
DRE, %	>99.910	>99.954	>99.958	>99.9967
Test 3 (8/13/91)				
Pesticide feedrate, mg/hr	<540	183	234	2,240
Scrubber exit flue gas emission rate, $\mu\text{g/hr}$	<890	<180	<180	<180
DRE, %	— ^a	>99.901	>99.923	>99.9920
Test 4 (8/15/91)				
Pesticide feedrate, mg/hr	712	275	366	2,600
Scrubber exit flue gas emission rate, $\mu\text{g/hr}$	<880	<180	<180	219
DRE, %	>99.88	>99.935	>99.951	99.9916

^a— = Not applicable because not detected in the feed.

high to unambiguously establish this when these compounds were present at the lower concentrations in the soil feed.

The data in Tables 16 and 17 confirm that incineration under the conditions tested was sufficient to eliminate the contaminant organochlorine pesticide compounds from the soil, and that the DREs attained were in compliance with the hazardous waste incinerator performance standards in the two cases in which a clear DRE could be established. The data in Tables 16 and 17 also show that the addition of lime to the test soil in Test 4 had no effect on the effectiveness of incineration in decontaminating the soil, or on the DREs for the organochlorine pesticide compounds.

4.3 ARSENIC AND OTHER TRACE METAL DISTRIBUTIONS

As noted in Section 1, one of the primary objectives of the test program was to evaluate arsenic's fate and its RE in a rotary kiln incinerator under operating conditions associated with a 99.9999-percent dioxin DRE. Concentrations of arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury were measured in the soil feed, kiln ash, scrubber liquor, soil feed TCLP leachate, and kiln ash TCLP leachate samples. Only arsenic concentrations were measured in the scrubber exit and stack flue gases. Based on these concentrations, the trace metals distributions among the discharge streams and the arsenic REs were determined. The results of these evaluations are discussed in the following subsections.

4.3.1 Arsenic Removal Efficiency

The primary test program objective was to evaluate whether a 99.96-percent arsenic RE could be achieved during the incineration treatment of the site soils under conditions associated with a 99.9999-percent dioxin DRE in an incinerator equipped with a state-of-the-art APCS. As noted in Section 1, arsenic RE is defined as:

$$RE = 100 \left(1 - \frac{\text{flue gas emission rate}}{\text{feedrate}} \right) \quad (4-3)$$

Table 18 summarizes the arsenic concentrations measured, and the resulting feedrates and flue gas emission rates, for the four tests performed. As shown in the table, the arsenic RE achieved for Test 1 at the scrubber exit, 99.89 percent, was less than the target of 99.96 percent. This result was obtained on a quick-turnaround laboratory analysis. Based on this result, it was decided to perform Test 4, with lime blended with the soil to evaluate whether lime addition affected arsenic RE.

In contrast to the Test 1 experience, the arsenic REs measured at the scrubber exit in Tests 2 and 3 were 99.990 and 99.991 percent, respectively, greater than the target 99.96 percent. Tests 2 and 3 were performed with soil feed alone (no lime addition), and at the same nominal incinerator and scrubber system operating conditions. The authors have no explanation for the order of magnitude higher scrubber exit arsenic emission rate experienced in Test 1 compared to Tests 2 and 3. The 99.991-percent scrubber exit arsenic RE in Test 4, in which lime was added to the soil, was comparable to the REs in Tests 2 and 3.

Arsenic REs corresponding to the stack gas emission rates were uniformly 99.990 to 99.994 percent. Comparing stack arsenic emission rates to scrubber exit discharge rates shows that no additional arsenic removal in the carbon bed/HEPA filter secondary APCS was achieved for any test except Test 1.

4.3.2 Test Sample Trace Metals Concentrations

Table 19 summarizes the concentrations of all eight of the test metals in the soil feed and in each of the incinerator discharge streams analyzed (complete analysis results are given in Appendix C). The table also notes the soil feed and kiln ash TCLP leachate metal concentrations for each test, and the TCLP regulatory levels for each TCLP metal determined. Comparing feed soil leachate, kiln ash leachate, and scrubber liquor metals concentrations to the TCLP regulatory levels shows that no regulatory level was exceeded for any metal except arsenic. No feed soil would be an arsenic TC hazardous waste. However, the Test 1 kiln ash was a TC hazardous waste for arsenic, and the Tests 2 and 3 kiln ash leachates contained arsenic levels near the regulatory limit. The arsenic concentrations in TCLP leachates of both the feed soil and the kiln ash for Test 4 were reduced from the levels measured in the other three tests. This suggests that adding lime, as was done in Test 4, renders the arsenic less leachable from both the soil and the resulting kiln ash.

TABLE 18. ARSENIC REMOVAL EFFICIENCIES

Parameter	Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Soil				
Feedrate, kg/hr	55.7	55.5	54.2	57.0
Arsenic concentration, mg/kg	1,040	1,040	794	803
Arsenic feedrate, g/hr	57.9	57.7	43.0	45.8
Scrubber exit flue gas				
Flowrate, dscm/min	49.8	47.6	48.6	48.4
Arsenic concentration, $\mu\text{g}/\text{dscm}$	22.1	2.04	1.38	1.43
Arsenic emission rate, mg/hr	66.0	5.82	4.02	4.15
RE, %	99.89	99.9899	99.9907	99.9909
Stack gas				
Flowrate, dscm/min	67.4	65.2	63.6	63.2
Arsenic concentration, $\mu\text{g}/\text{dscm}$	1.14	0.93	1.12	1.16
Arsenic emission rate, mg/hr	4.61	3.64	4.27	4.40
RE, %	99.9920	99.9937	99.9900	99.9903

The data in Table 19 suggest that the scrubber liquor discharge might be a TC hazardous waste for arsenic based on the total sample analysis results shown. However, the scrubber liquor metal concentrations shown in Table 19 are for bulk scrubber liquor samples, which contain suspended solids. A true TCLP leachate of the full test program composite scrubber liquor was prepared by filtering the liquor and using the resulting filtrate as the leachate. Arsenic was not detected in this composite scrubber liquor TCLP leachate at a PQL of 0.5 mg/L.

Because the TCLP test involved producing 20 g of leachate per gram of solid leached, the TCLP leachate concentration in mg/L can be used to calculate the fraction of metals in each matrix that is "mobile," or leachable, in the procedure. For example, if all the metals in a solid sample leached in the procedure (was 100-percent leachable), the resulting TCLP leachate metals concentration in mg/L would be 1/20th of the solid sample concentration in mg/kg. Thus the ratio of:

$$20 \left(\frac{\text{leachate concentration (mg/L)}}{\text{solid concentration (mg/kg)}} \right) \quad (4-4)$$

represents the fraction of metals leachable in the procedure.

TABLE 19. TRACE METALS ANALYSIS RESULTS

Sample	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
Test 1 (8/6/91)								
Soil feed, mg/kg	1,040	56	1.7	16	120	10	<11	<0.44
Soil feed TCLP leachate, mg/L	2.2	0.89	0.009	<0.007	0.086	<0.002	0.066	<0.005
Kiln ash, mg/kg	653	60	0.50	9.7	74	<1.0	<12	<0.45
Kiln ash TCLP leachate, mg/L	5.8	0.76	0.005	<0.007	0.28	<0.002	0.059	<0.005
Scrubber liquor, mg/L	8.5	0.16	0.054	0.15	0.23	0.007	<0.13	0.01
Test 2 (8/8/91)								
Soil feed, mg/kg	1,040	66	1.1	19	118	5.8	<11	<0.44
Soil feed TCLP leachate, mg/L	2.2	0.57	0.012	<0.007	0.079	<0.002	0.057	<0.005
Kiln ash, mg/kg	619	60	0.42	11	58	<1.0	16	<0.45
Kiln ash TCLP leachate, mg/L	3.8	0.70	0.005	<0.007	0.088	<0.002	0.065	<0.005
Scrubber liquor, mg/L	12	0.23	0.023	0.089	0.27	<0.002	<0.13	<0.005
Test 3 (8/13/91)								
Soil feed, mg/kg	794	48	0.86	17	104	5.4	<11	<0.43
Soil feed TCLP leachate, mg/L	2.5	0.80	0.012	<0.007	0.083	<0.002	0.063	<0.005
Kiln ash, mg/kg	619	64	0.68	11	61	<1.0	15	<0.46
Kiln ash TCLP leachate, mg/L	4.1	0.78	0.005	<0.007	0.095	<0.002	0.062	<0.005
Scrubber liquor, mg/L	10	0.21	0.017	0.064	0.29	<0.002	0.14	<0.005
Test 4 (8/15/91)								
Soil feed, mg/kg	803	43	0.97	13	86	6.2	15	<0.48
Soil feed TCLP leachate, mg/L	0.11	0.18	<0.005	<0.007	0.049	<0.002	0.058	<0.005
Kiln ash, mg/kg	1,100	74	0.85	14	83	<1.0	<11	<0.44
Kiln ash TCLP leachate, mg/L	1.2	0.12	<0.005	<0.007	0.036	<0.002	0.083	<0.005
Scrubber liquor, mg/L	6.0	0.26	0.011	0.057	0.23	<0.002	<0.13	<0.005
TCLP regulatory level, mg/L	5.0	100	1.0	5.0	5.0	0.2	1.0	5.0

Table 20 shows these fractions leachable for each metal in each soil and kiln ash. Silver is not shown in Table 20 because no soil or kiln ash sample contained silver. The "less than" leachabilities in the table arose when the leachate contained no detectable metal; the "less than" level corresponds to the PQL of the metal in the leachate. The "greater than" leachabilities in the table arose when the leachate contained detectable levels of a metal not detected in the solid sample. No fractional leachability was calculated when both the solid sample and the resulting leachate concentrations were less than detectable.

The data in Table 20 show that chromium and mercury were sparingly leachable (leachabilities of 2 percent or less) from all test soil samples, and that chromium was sparingly leachable from kiln ash samples. Lead was also sparingly leachable from feed soil samples. Its leachability from corresponding kiln ash samples apparently increased in the tests with raw soil

TABLE 20. TCLP LEACHABLE TRACE METAL CONTENTS

Sample	Fraction leachable, %			
	Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Feed Soil				
Arsenic	4.2	4.2	6.4	0.3
Barium	31	17	33	8.4
Cadmium	11	22	28	<10
Chromium	<0.8	<0.7	<0.8	<1.1
Lead	1.4	1.3	1.6	1.1
Mercury	<0.4	<0.7	<0.7	<0.7
Selenium	>12	>10	>11	7.8
Kiln ash				
Arsenic	18	12	13	2.1
Barium	25	23	24	3.2
Cadmium	20	24	15	<12
Chromium	<1.4	<1.2	<1.3	<1.0
Lead	7.7	3.0	3.1	0.9
Mercury	— ^a	—	—	—
Selenium	>9.6	7.9	8.3	>15

^a— = Not detected in the solid sample.

feed only (Tests 1, 2, and 3). For the test with lime added (Test 4), lead's leachability from kiln ash was unchanged from its leachability from the corresponding soil.

Arsenic, barium, cadmium, and selenium were measurably (4 to 10 percent) to moderately (10 to 30 percent) leachable from both soil feed and kiln ash samples in the tests with raw soil feed alone (Tests 1, 2, and 3). Arsenic and barium leachabilities from both soil and corresponding kiln ash were significantly reduced with lime addition (Test 4). Cadmium and selenium leachabilities from the soil with lime added were also apparently reduced; and cadmium leachability from the kiln ash resulting from the incineration of the soil mixed with lime was apparently reduced as well.

4.3.3 Discharge Distributions

Table 19 shows measured concentrations of the trace metals in the discharge streams analyzed. These concentrations can be combined with feed soil and discharge stream mass flowrate information to better show how the metals distribute among the discharge streams. These distributions are discussed in the following paragraphs.

Table 21 summarizes the trace metal distributions among the incinerator discharge streams, expressed as fractions (in percent) of the amount of each metal fed to the incinerator for each test for all metals analyzed, except arsenic which will be discussed separately. Thus, the value in the table represents the fraction of the metal fed to the kiln accounted for by the noted discharge. The rows labeled "Total" represent the total amount of metal fed accounted for by the sum of the discharges analyzed. Silver is also not listed in Table 21 because silver was not found in any test sample analyzed, with the exception of one scrubber liquor sample. Selenium is not listed because it was not found in three of four soil feed samples.

The data in Table 21 show that the kiln ash discharge accounted for most of the barium and lead fed in all tests. The scrubber liquor accounted for about a factor of 10 less (i.e., 10 percent) of the amount of barium and lead fed than the kiln ash. The kiln ash also accounted for the predominant fraction of chromium fed in all tests, although the scrubber liquor accounted for higher relative fractions of chromium. The behavior of cadmium was apparently inconsistent from test to test. However, cadmium was only present in test soils at 1 to 2 mg/kg levels, so small changes in kiln ash/scrubber liquor cadmium concentrations could cause large changes in calculated kiln ash/scrubber liquor relative fractions. The addition of lime to the soil, as done in Test 4, apparently did not affect metals distributions to kiln ash or scrubber liquor within the variability of the data in Table 21.

No mercury was found in any kiln ash or scrubber liquor sample. The "less than" fractions noted in Table 21 correspond to sample analysis PQLs. Ostensibly, most or all of the mercury fed escaped the incineration system via the scrubber exit flue gas.

Arsenic distributions are summarized in Table 22. Arsenic was also measured in the scrubber exit flue gas and in the RKS stack gas. The scrubber exit flue gas discharge fractions are shown in Table 22; stack gas fractions are not shown. The scrubber exit flue gas would be the typical atmospheric discharge from an actual incinerator treating CIC site soils. Further, conclusions based on stack gas fractions do not differ from those based on scrubber exit flue gas fractions. As arsenic was measured in all incinerator discharge streams, the "Total" row represents the degree of mass balance achieved for arsenic in each test.

The data in Table 22 show that the arsenic distributions were quite similar in the three tests in which raw soil alone was fed (Tests 1 through 3). Between 42 and 49 percent of the arsenic fed was accounted for in the kiln ash (treated soil) discharge. About 20 percent was collected in the scrubber liquor. With lime added to the soil (Test 4), the scrubber liquor fraction decreased to 13 percent of the amount fed, and the kiln ash fraction increased to 91 percent of the amount fed. The scrubber exit flue gas arsenic fraction was low, 0.1 percent or less, in all four tests.

TABLE 21. TRACE METAL DISTRIBUTIONS

Sample	Metal distribution, % of metal fed				
	Ba	Cd	Cr	Pb	Hg
Test 1 (8/6/91)					
Kiln ash	90	22	68	91	<7
Scrubber liquor	6	69	19	4	<1
Total	77	89	59	45	<8
Test 2 (8/8/91)					
Kiln ash	91	43	84	89	<12
Scrubber liquor	6	36	8	4	<1
Total	69	63	50	38	<13
Test 3 (8/13/91)					
Kiln ash	92	60	85	88	<12
Scrubber liquor	7	34	7	5	<1
Total	91	84	47	42	<13
Test 4 (8/15/91)					
Kiln ash	92	76	91	93	<11
Scrubber liquor	10	19	7	5	<1
Total	125	78	76	69	<12

TABLE 22. ARSENIC DISTRIBUTIONS

Sample	Arsenic distribution, % of arsenic fed			
	Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Kiln ash	42	42	49	91
Scrubber liquor	18	19	22	13
Scrubber exit flue gas	0.1	0.01	0.01	0.01
Total	60	61	71	104

Overall mass balance closure for arsenic was improved in Test 4 compared to Tests 1 through 3. Mass balance closure for arsenic was in the 60- to 71-percent range in Tests 1, 2, and 3, improving to 104 percent in Test 4. Nevertheless, all mass balance closure results achieved in these tests are considered quite good when viewed in light of past experience in achieving trace metal mass balance closures from a variety of combustion sources, incinerators included. Typical mass balance closure results from this past experience have been, at best, in the 30- to 200-percent range. The fact that three of four closures achieved were less than 100 percent is expected, as some loss of arsenic via particulate dropout in the afterburner, or slagging with holdup in the afterburner, is not unlikely.

A clearer picture of the variation in relative metal distributions with incinerator operation is possible when the data in Table 22 are normalized by the total mass balance closure achieved. Table 23 summarizes the test arsenic distribution data in this form. The distribution fractions in Table 23 have been normalized to the total amount of arsenic measured in all the discharge streams analyzed. Thus, these normalized values represent fractions that would have resulted had mass balance closure in each test been 100 percent. Note that the sum of the normalized values, as shown in Table 23, is indeed 100 percent. Use of distribution fractions normalized in this manner allows clearer data interpretation, because variable mass balance closure is eliminated as a source of test-to-test data variability. In other words, given that variable and less than perfect mass balance closure is invariably experienced, the use of normalized distributions is a best attempt to quantify metal partitioning phenomena.

The normalized distributions in Table 23 clearly show that about 70 percent of the arsenic accounted for was discharged in the kiln ash, or treated soil, in the three tests feeding soil alone (Tests 1 through 3). About 30 percent of the arsenic measured was accounted for in the scrubber system liquor. A small fraction of the arsenic measured was accounted for by the scrubber exit flue gas. However, with lime added, in Test 4, the kiln ash arsenic fraction increased to 88 percent and the scrubber liquor arsenic fraction decreased to about 12 percent. The scrubber exit flue gas arsenic fraction remained negligible. Clearly, the addition of lime to the soil stabilized the arsenic, tending to keep it in the kiln ash.

TABLE 23. NORMALIZED ARSENIC DISTRIBUTIONS

Sample	Arsenic distribution, % of arsenic measured			
	Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Kiln ash	70.2	68.3	69.3	87.8
Scrubber liquor	29.6	31.7	30.7	12.2
Scrubber exit flue gas	0.17	0.01	0.01	0.01
Total	100	100	100	100
Apparent scrubber collection efficiency	99.44	99.953	99.963	99.937

Trace metals can leave the kiln of a rotary kiln incinerator via two pathways: (1) in entrained flyash carried in the combustion flue gas into the afterburner; and (2) in the combustion flue gas as volatilized, vapor-phase metal. The data in Table 23 suggest that both of these mechanisms were at work in Tests 1 through 3, in which soil alone was fed. Lime addition would not be expected to affect the amount of soil entrained in the combustion flue gas; thus, it would not be expected to affect the amount of arsenic lost from the kiln via the entrainment mechanism. Therefore, it appears that the addition of lime in Test 4 caused the arsenic in the soil to become less volatile, i.e., allowed the formation of arsenic compounds less volatile than those present in the soil alone, and thereby decreased the arsenic loss from the kiln through volatilization.

Arsenic concentrations were not measured in the scrubber inlet flue gas, so a direct calculation of scrubber system collection efficiency is not possible. However, an estimate of the flowrate of arsenic at the scrubber inlet can be obtained by summing the flows in the two scrubber discharge streams: the scrubber exit flue gas and the scrubber liquor. This permits an apparent scrubber collection efficiency to be calculated as:

$$\frac{\text{Scrubber liquor fraction}}{\text{Scrubber liquor fraction} + \text{scrubber exit flue gas fraction}} \quad (4-5)$$

The apparent scrubber collection efficiencies for these tests are also given in Table 23. The apparent-scrubber-collection-efficiency data in Table 23 show that the Calvert scrubber system achieved an average of 99.95 percent arsenic collection in Tests 2, 3, and 4. The apparent collection efficiency in Test 1 was lower, at 99.44 percent. However, the Test 1 result is suspected to be an outlier.

4.4 PARTICULATE AND HCl EMISSION DATA

Particulate levels at the Calvert scrubber exit and at the stack were measured by Method 5 trains. Each Method 5 train was fitted with an impinger train to collect HCl to determine HCl emissions. The results obtained are discussed in the following subsections.

4.4.1 Particulate load

Table 24 gives the particulate levels measured at the scrubber exit and at the stack in the four tests. Flue gas particulate levels at the scrubber exit ranged from 9 to 19 mg/dscm (corrected to 7 percent O₂). These levels would represent the stack emissions of a typical incinerator equipped with a Calvert scrubber. At the RKS stack, after further passage of the flue gas through a carbon bed absorber and HEPA filter, particulate levels ranged from 2 to 29 mg/dscm (at 7 percent O₂). Particulate levels in the stack were decreased from levels measured at the scrubber exit, in three of the four tests. For reasons unexplained, in Test 3 the level in the scrubber exit was lower than in the stack. All particulate levels measured at both sample locations, however, were substantially below the 180 mg/dscm (at 7 percent O₂) hazardous waste incinerator performance standard.

TABLE 24. FLUE GAS PARTICULATE LEVELS

Parameter	Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Scrubber exit				
Particulate loading at 7% O ₂ , mg/dscm	12	12	19	9
Flue gas flowrate, dscm/hr	2,990	2,870	2,900	2,870
Particulate emission rate, g/hr	15	15	24	12
Stack				
Particulate load at 7% O ₂ , mg/dscm	5	4	29	2
Flue gas flowrate, dscm/hr	4,050	3,890	3,780	3,800
Particulate emission rate, g/hr	8	5	35	3

4.4.2 HCl Emissions

The soil incinerated during this test program contained 0.042 percent chlorine. Table 25 summarizes the levels of HCl measured in the scrubber exit flue gas and at the stack. As a reminder, HCl concentrations were determined by chloride analysis of the combined Method 5 impinger solutions. This procedure provides an estimate of maximum HCl concentration by assuming that all measured chloride exists in the form of HCl.

Measured HCl concentrations at the scrubber exit ranged from less than 0.15 to 0.25 mg/dscm, with corresponding emission rates ranging from less than 7.23 to 12 mg/hr. Measured levels at the stack were about the same as the corresponding scrubber exit levels. No significance is given to the fact that stack levels were uniformly higher than scrubber exit levels. All measurements were low, near the method PQL, and approximately the same.

Apparent scrubber system collection efficiencies are also noted in Table 25. These were calculated using the chlorine feedrates and measured emission rates shown in the table. As shown, apparent scrubber collection efficiencies were 99.95 percent, or slightly higher, in all tests. These levels exceed the 99-percent collection efficiency required by the hazardous waste incineration performance standards.

TABLE 25. FLUE GAS HCl LEVELS

Parameter	Test 1 (8/6/91)	Test 2 (8/8/91)	Test 3 (8/13/91)	Test 4 (8/15/91)
Cl Feedrate, g/hr	23.4	23.3	22.8	23.9
Scrubber exit				
Flue gas HCl concentration, mg/dscm	<0.15	0.25	0.23	<0.17
Flue gas HCl emission rate, mg/hr	<7.3	12.0	11.2	<8.4
Scrubber system collection efficiency, %	>99.969	99.949	99.951	>99.965
Stack				
Flue gas HCl concentration, mg/dscm	0.28	0.38	0.29	0.18
Flue gas HCl emission rate, mg/hr	18.9	24.6	18.1	11.6
System collection efficiency, %	99.926	99.904	99.927	99.956

SECTION 5

CONCLUSIONS

A detailed test program was performed at the EPA's IRF to define the incineration characteristics of contaminated soil from the CIC Superfund site, in Edison Township, New Jersey. The soils at the site are highly contaminated by organochlorine pesticides and trace metals. Dioxin (i.e., 2,3,7,8-TCDD) has been found in some soil samples at concentrations up to 1.8 $\mu\text{g/kg}$ (ppb). The major metal contaminant is arsenic, present in site soils at levels up to 8,000 mg/kg. Cadmium, lead, chromium, mercury, and zinc have also been found at levels up to several hundred to a few thousand mg/kg. The purpose of these tests was to evaluate the incinerability of these soils in terms of the DRE for organochlorine pesticides (i.e., chlordane and p,p'-DDT), the fate of arsenic in terms of the system RE, and the fate of other contaminant trace metals. The specific test objectives were:

- To confirm the ability of conventional rotary kiln incineration to destroy organochlorine pesticide contaminants in the soil, as measured by their absence in the treated soil (kiln ash) discharge
- To confirm the ability of a conventional rotary kiln incinerator, with a high-efficiency scrubber, to achieve an arsenic RE of 99.96 percent under operating conditions associated with a 99.9999-percent dioxin DRE

The test program consisted of a set of four incineration tests in the IRF RKS equipped with a high-efficiency scrubber system consisting of a Calvert Flux Force/Condensation scrubber.

The soil excavated for testing contained an average of 13 mg/kg of chlordane, 5 mg/kg of p,p'-DDE, 6 mg/kg of p,p'-DDD, and 61 mg/kg of p,p'-DDT. It was also contaminated with an average of 920 mg/kg of arsenic, 53 mg/kg of barium, 1 mg/kg of cadmium, 16 mg/kg of chromium, 107 mg/kg of lead, and 7 mg/kg of mercury. In three of the four tests, raw soil alone was fed to the kiln of the RKS. In the fourth test, lime was blended with the soil, in the ratio of 0.5 kg of lime to 10 kg of soil, to evaluate whether arsenic RE was affected. All tests were performed at a kiln exit gas temperature of approximately 982°C (1,800°F), and an afterburner exit gas temperature of 1,204°C (2,200°F). The Calvert scrubber was operated at a pressure drop of approximately 12 kPa (50 in WC).

Test conclusions are as follows:

- Incineration under the conditions tested resulted in the elimination of the soil pesticide contaminants. No pesticide was detected in any kiln ash (treated soil) sample. Based on method PQLs, the decontamination effectiveness demonstrated

was at least 99.38 percent for chlordane, 99.56 percent for p,p'-DDE, 99.66 percent for p,p'-DDD, and 99.96 percent for p,p'-DDT.

- Pesticide DREs of at least 99.9916 percent were achieved for p,p'-DDT under the conditions tested. None of the other pesticide contaminants was detected in the scrubber exit flue gas, with lower bound DREs, corresponding to method PQLs, ranging from at least 99.87 percent for chlordane to at least 99.92 percent for p,p'-DDD.
- Arsenic REs of 99.99 percent can be achieved under the conditions tested, with the Calvert scrubber, feeding soil alone. Adding lime to the soil does not measurably improve arsenic RE.
- Chromium, mercury, and lead were sparingly leachable (with fractional leachabilities of 2 percent or less) from the site soil in the TCLP test. Chromium was also sparingly leachable from the incineration treatment kiln ash. Arsenic, barium, cadmium, and selenium were measurably (4 to 10 percent) to moderately (10 to 30 percent) leachable from both soil and resulting kiln ash samples.
- The addition of lime to the soil significantly reduced arsenic and barium fractional leachabilities from both soil and resulting kiln ash. The fraction of arsenic leachable from the soil was decreased from the 4- to 6-percent range to 0.3 percent with lime addition, the kiln ash fractional arsenic leachability decreased from the 12- to 18-percent range to 2.1 percent when lime was added to the incinerator feed soil. Corresponding barium leachability from the soil decreased from the 17- to 33-percent range to 8.4 percent, and from the incineration kiln ash from the 23- to 25-percent range to 3.2 percent. Cadmium leachability from both soil and kiln ash was also apparently reduced with lime addition, as was lead leachability from kiln ash. Cadmium fractional leachability from the soil decreased from the 11- to 28-percent range to less than 10 percent, and from the kiln ash from the 15- to 24-percent range to less than 12 percent. Kiln ash lead leachability was decreased from the 3- to 8-percent range to 0.9 percent with lime added to the soil feed. Lime addition had no apparent effect on the leachability of selenium from both soil and kiln ash, or on the leachability of lead from soil.
- Trace metal concentrations in TCLP leachates of both untreated soil and kiln ash (treated soil) were significantly below corresponding TC regulatory levels for all metals except arsenic. Soil leachate arsenic concentrations were 40 to 50 percent of the regulatory level. Adding lime to the soil can significantly lower the corresponding leachate arsenic concentration.
- Kiln ash leachate arsenic concentrations were near or above arsenic's TC regulatory level, suggesting that treated soil could or would be a TC hazardous waste. Lime addition can be used to decrease kiln ash leachate arsenic concentrations.

- The kiln ash discharge accounted for most of the barium introduced in the soil feed and a greater fraction of the arsenic, chromium, and lead than accounted for by the scrubber liquor discharge. The scrubber liquor accounted for a factor of about 10 less of the barium and lead accounted for by the kiln ash; this stream accounted for higher relative fractions of arsenic and chromium. No mercury was detected in the kiln ash or scrubber liquor discharge; presumably, all mercury introduced in the soil feed was discharged in the scrubber exit flue gas.
- Nominally 70 percent of the arsenic measured in the incinerator discharge was in the kiln ash of all tests in which soil alone was fed; about 30 percent was accounted for in the scrubber liquor. A negligible fraction was accounted for in the scrubber exit flue gas.
- In the test in which lime was added to the soil, the kiln ash arsenic fraction increased to about 90 percent; about 10 percent of the arsenic measured was in the scrubber liquor of this test. Scrubber exit flue gas continued to account for a negligible fraction of the arsenic discharged. It appears that lime addition reduced the volatility of arsenic in the kiln, removing the vapor-phase arsenic escape pathway.
- Within the variability of the data, lime addition had no apparent effect on the partitioning of the other trace metal soil contaminants between the kiln ash and scrubber liquor discharge streams
- The Calvert scrubber apparent arsenic collection efficiency was nominally 99.95 percent, and was not affected by lime addition
- Particulate levels at the Calvert scrubber exit were nominally 10 to 20 mg/dscm at 7 percent O₂, well below the hazardous waste incinerator performance standard of 180 mg/dscm at 7 percent O₂
- Calvert scrubber apparent HCl collection efficiencies were 99.95 percent or greater, above the hazardous waste incinerator performance standard of 99 percent

Test results suggest that conventional rotary kiln incineration in a unit equipped with a high-efficiency scrubber system, such as the Calvert system tested, would be an appropriate treatment. Elimination of contaminant organochlorine pesticides from the soil, and destruction of the contaminants at a DRE of 99.99 percent, was achieved. Arsenic REs of greater than 99.96 percent were achieved in the system with the Calvert scrubber in normal operation. The hazardous waste incinerator particulate and HCl performance standards were easily achieved.

Incineration treatment of soils with arsenic concentrations in the range of the concentrations of the soil tested may result in the treated soil being a TC hazardous waste. However, adding lime to soil prior to incineration can significantly reduce the leachability of the kiln ash arsenic in the TCLP test.

As discussed in Section 6, almost all test program QA objectives were achieved. Three PQL objectives were not met:

- For chlordane in flue gas (0.33 $\mu\text{g}/\text{dscm}$ achieved versus a 0.2 $\mu\text{g}/\text{dscm}$ objective)
- For α -BHC and γ -BHC in soil feed (2 mg/kg achieved versus a 1 mg/kg objective)
- For mercury in kiln ash (1 mg/kg achieved versus a 0.2 mg/kg objective)

None of the analytes was found in any corresponding test program sample. Failure to achieve the PQL objectives for those analytes/matrices means that the level to which it can be stated that the analyte was absent is higher than originally intended.

In addition, the mercury analysis accuracy objective was not met. Mercury was found only in soil feed samples. No other test sample matrix, with the exception of one scrubber liquor sample, contained mercury above the PQL. Failure to meet this objective means only that feed mercury concentrations were likely known only to within a factor of 1.7 (± 40 percent), instead of to within a factor of 1.3 (± 25 percent) as originally desired.

SECTION 6

QUALITY ASSURANCE

This test program was carried out as outlined in the test plan for the program⁵. The QA aspects of the program were carried out in accordance with the quality assurance project plan (QAPP)⁶ for the program. All tests were performed in accordance with the procedures documented in the test plan and QAPP.

All samples analyzed to obtain the data reported in this report were taken at the IRF by members of the IRF operating staff. All samples were collected and/or recovered in accordance with the methods appropriate to their eventual analysis. After appropriate preservation, the samples were relinquished to the custody of the onsite Sample Custodian. The Sample Custodian subsequently directed the splitting and transport of samples to the appropriate laboratories for analysis.

Sample organic extractions and extract analyses for organochlorine pesticides were performed in the IRF's onsite laboratories. Sample digestions and digestate analyses for trace metals were performed by EPA's EMSL, in Cincinnati, Ohio, which is operated under contract by Technology Applications, Inc. TCLP extractions were performed at the IRF; the extracts were analyzed for organochlorine pesticides, at the IRF, and for trace metals, at EMSL. Analysis of Method 5 train impinger contents for chloride ion was performed at the IRF.

The sample chain-of-custody procedures described in the QAPP for these tests were followed without deviation. No compromise in sample integrity occurred.

The QA efforts performed to ensure that data quality is known for particulate and CEM measurements involved adherence to Reference Method procedures and CEM manufacturers' specifications. No deviations from the QAPP occurred in these measurements.

Numerous QA procedures were followed to assess the data quality of the laboratory analytical measurements performed in the test program. These included blank sample analyses, duplicate analyses, and matrix spike (MS) and matrix spike duplicate (MSD) sample analyses. Method blank samples were analyzed for all sample matrices for which logical matrix blanks could be prepared.

Results of QA procedures performed for the critical laboratory analytical measurements are discussed, by analyte group, in the following subsections. The critical measurements identified in the QAPP for the program were the organochlorine pesticide, trace metal, and flue gas HCl measurements. Other analyses performed in the program (e.g., proximate and ultimate

analyses of composite soil feed samples) were identified in the QAPP as not critical. Accordingly, these analyses are not discussed in this section.

6.1 ORGANOCHLORINE PESTICIDE CONSTITUENT ANALYSES

A total of 27 test program samples was analyzed for the organochlorine pesticide constituents chlordane; α -BHC; γ -BHC; p,p'-DDD; p,p'-DDE; and p,p'-DDT. Included in this number were three method blank samples and four MS/MSD sample pairs. Table 26 summarizes the sample collection, extraction, and extract analysis dates for all samples except the TCLP leachate samples analyzed. Table 27 summarizes the sample collection, TCLP extraction, organic extraction, and organochlorine pesticide analysis dates for the TCLP leachates analyzed. All TCLP leachates were prepared within method hold time limits. All kiln ash and Method 0010 train samples were extracted within method hold time limits. Two soil feed, three soil, and the TCLP extraction blank were extracted 1 day after method hold time expiration. Only the scrubber liquor matrix spike sample was extracted within the hold time limit. The other scrubber liquor samples were extracted between 1 and 9 days after the 7 days method hold time had expired. These hold times exceedances are not believed to have affected the test results. All organic extracts were analyzed within method hold time limits.

Table 28 summarizes the precision, accuracy, completeness, and practical quantitation limit (PQL) data quality objectives (DQOs) for the organochlorine pesticide target analytes. Table 29 lists the measurement PQLs achieved for each sample matrix and compares them with the PQL DQOs. The target DQO levels were met for all sample matrices, with the exception of chlordane in the flue gas and all analytes in the soil feed. Although the achieved PQL of 0.33 $\mu\text{g}/\text{dscm}$ is slightly higher than the target value of 0.2 $\mu\text{g}/\text{dscm}$, the test objective for characterizing the flue gas for chlordane was not significantly compromised. In the case of the soil feed, p,p'-DDD, p,p'-DDE, and p,p'-DDT were quantitated at levels above the PQL in all feed samples, and chlordane was quantitated in three of four feed samples. Thus, failure to achieve the PQL objective for these compounds does not affect test results. The PQL achieved for α -BHC and γ -BHC, at 2 mg/kg, was only twice the PQL objective of 1 mg/kg. The effect of not achieving the PQL DQO in the soil feed for these analytes is that the detection limit at which it can be stated that these compounds do not exist in the feed is slightly higher than originally intended.

The six target organochlorine pesticide constituents were not detected above PQLs in any laboratory or method blank.

Organochlorine pesticide constituent measurement precision and accuracy were assessed by preparing one MS/MSD sample set for each of the soil feed, kiln ash, scrubber liquor, and flue gas Method 0010 train sample matrices, and measuring spike recovery. Table 30 summarizes the spike recovery data obtained. The data in Table 30 show that 38 of 44 individual spike recovery measurements, or 86 percent, were within compound-specific recovery ranges. As the completeness DQO for this measurement was 70 percent, the measurement accuracy DQO, as measured by the spike recovery from MS/MSD samples, was met. The data in Table 30 also show that 20 of 22 duplicate sample spike recovery RPDs, or 91 percent, were within the RPD DQO of 50 percent. Thus, the measurement precision DQO, as measured by spike recovery from MS/MSD samples, was also met.

TABLE 26. ORGANOCHLORINE PESTICIDE SAMPLE HOLD TIMES

Sample	Collection/ preparation date	Extraction date	Extraction hold time, days	Analysis date	Analysis hold time, days
Soil feed:					
Test 1	8/5/91	8/20/91	15	9/3/91	14
Test 2	8/5/91	8/13/91	8	9/4/91	22
Duplicate analysis	8/5/91	8/13/91	8	9/4/91	22
Test 3	8/5/91	8/20/91	15	9/3/91	14
Test 4	8/14/91	8/21/91	7	9/4/91	14
Matrix spike	8/20/91	8/20/91	0	9/3/91	14
Kiln ash					
Test 1	8/6/91	8/12/91	6	8/16/91	4
Test 2	8/8/91	8/12/91	6	8/16/91	4
Duplicate analysis	8/8/91	8/12/91	6	8/16/91	4
Test 3	8/13/91	8/20/91	7	9/6/91	17
Test 4	8/15/91	8/21/91	6	9/6/91	16
Matrix spike	8/21/91	8/21/91	0	9/6/91	16
Method requirement			14		40
Scrubber liquor					
Test 1	8/6/91	8/22/91	16	8/26/91	4
Test 2	8/8/91	8/22/91	14	9/16/91	25
Duplicate analysis	8/8/91	8/22/91	14	9/16/91	25
Test 3	8/13/91	8/23/91	10	9/16/91	24
Test 4	8/15/91	8/23/91	8	9/6/91	14
Method blank	8/13/91	8/23/91	10	9/16/91	24
Matrix spike	8/23/91	8/23/91	0	9/13/91	21
Scrubber exit flue gas Method 0010 trains					
Test 1	8/6/91	8/6/91	0	8/15/91	9
Test 2	8/8/91	8/8/91	0	8/16/91	8
Duplicate analysis	8/8/91	8/8/91	0	9/16/91	39
Test 3	8/13/91	8/13/91	0	8/26/91	13
Test 4	8/15/91	8/15/91	0	9/13/91	29
Method blank	8/6/91	8/6/91	0	8/15/91	9
Matrix spike	8/13/91	8/13/91	0	8/15/91	2
Method requirement			7		40

TABLE 27. ORGANOCHLORINE PESTICIDE SAMPLE HOLD TIMES FOR TCLP LEACHATE SAMPLES

Sample	Collection/ preparation date	TCLP extraction date	TCLP extraction hold time, days	Organic extraction date	Organic extraction hold time, days	Analysis date	Analysis hold time, days
Soil feed TCLP leachate							
Test 1	8/5/91	8/20/91	15	8/28/91	8	9/13/91	16
Test 2	8/5/91	8/20/91	15	8/28/91	8	9/13/91	16
Test 3	8/5/91	8/20/91	15	8/28/91	8	9/13/91	16
Test 4	8/14/91	8/26/91	12	8/28/91	8	9/13/91	16
Method blank	8/20/91	— ^a	—	8/28/91	8	9/13/91	16
Method requirement			28		7		40

^aSample is TCLP extraction fluid.

TABLE 28. ORGANOCHLORINE PESTICIDE MEASUREMENT DQOs

Measurement parameter	Measurement/analytical method	Reference	Conditions	DQO			
				Precision, % RSD or RPD	Accuracy, ^a %	Completeness, %	PQL
Organochlorine pesticides in soil feed and kiln ash samples	Soxhlet extraction, concentration, and direct injection GC/ECD	SW-846, Method 8080 ^b	Soxhlet extraction by Method 3540 ^b	50	25 to 160	70	1 mg/kg
Organochlorine pesticides in scrubber liquor and TCLP leachate samples	Liquid-liquid extraction, concentration, and direct injection GC/ECD	SW-846 Method 8080 ^b	Extraction by Method 3510 ^b	50	25 to 160	70	10 µg/L
Organochlorine pesticides in flue gas samples	Method 0010 sampling, Soxhlet extraction, concentration, and direct injection GC/ECD	SW-846 Method 8080 ^b	Soxhlet extraction by Method 3540 ^b	50	25 to 160	70	0.2 µg/dscm

^aCompound-specific acceptance criteria taken from Table 3 of Method 8080.^bReference 1, SW-846.

TABLE 29. ORGANOCHLORINE PESTICIDE PQLs: OBJECTIVES AND ACHIEVED

Sample type	PQL		
	DQO	Chlordane	Achieved
			α -BHC, γ -BHC, p,p'-DDD, p,p'-DDE, p,p'-DDT
Soil feed, mg/kg	1	10	2
Kiln ash, mg/kg	1	0.1	0.02
TCLP leachate, μ g/L	10	10	2
Scrubber liquor, μ g/L	10	1	0.2
Flue gas, μ g/dscm	0.2	0.33	0.06

TABLE 30. ORGANOCHLORINE PESTICIDE RECOVERIES FROM MATRIX SPIKE SAMPLES

Compound	Spike recovery, %												DQO
	Soil feed			Kiln ash			Scrubber liquor			Method 0010 train			
	MS	MSD	RPD, %	MS	MSD	RPD, %	MS	MSD	RPD, %	MS	MSD	RPD, %	
Chlordane	176	124	35	106	108	2	117	95	21	132	105	23	45-119
α-BHC	— ^a	—		115	121	5	61	45	30	105	99	6	37-134
γ-BHC	—	—		115	125	8	65	50	26	106	97	9	32-127
p,p'-DDD	205	111	59	138	144	4	97	80	19	107	107	0	31-141
p,p'-DDE	187	104	57	112	122	9	89	73	20	102	101	1	30-145
p,p'-DDT	107	119	11	196	174	12	93	77	19	127	125	1	25-160
DQO			50			50			50			50	

^a— = Sample dilution factor prohibited quantitation.

As a further measurement of precision, one sample each of the soil feed, kiln ash, scrubber liquor, and Method 0010 train was analyzed in duplicate for the six target organochlorine pesticide constituents. Neither the original nor duplicate analyses of the kiln ash, scrubber liquor, and Method 0010 train samples showed the presence of any of the six constituents above PQLs. As previously noted, α -BHC and γ -BHC were also not detected in the soil feed samples. The RPDs of the duplicate analyses for the remaining four constituents in the soil feed ranged from 11 to 30 percent; all of these RPDs were within the DQO for measurement precision of 50 percent. Thus, the measurement precision objective was met as also measured by duplicate feed soil analyses.

6.2 TRACE METAL ANALYSES (MERCURY EXCLUDED)

A total of 58 samples was analyzed for trace metals in the test program. Included in this total were five method blank samples and seven MS/MSD sample pairs. Table 31 lists the sample collection dates and analysis dates for all samples except the TCLP leachates. Table 32 summarizes the sample collection, TCLP extraction, and TCLP extract analysis dates for the TCLP leachate samples analyzed. The information in Table 32 shows that all TCLP leachates were prepared within method hold time limits. The information in Tables 31 and 32 shows that all metals analyses were completed within method hold time limits.

Table 33 summarizes the method blank trace metal analysis results. Also shown in Table 33 are the results for five sets of laboratory digestion blanks analyzed. The test sample data in Section 4 were not blank-corrected, with the exception of arsenic in the Method 108 sampling trains. For the Method 108 sampling trains, the laboratory analysis results for arsenic in the filters and impinger solutions were blank-corrected as part of the data analysis.

Table 34 summarizes the trace metal measurement precision, accuracy, and completeness DQOs. Table 35 lists the PQLs achieved for each sample matrix. As shown, all PQL DQOs were met, except for arsenic concentrations in the flue gas. The inability to meet this PQL did not compromise the test objectives, however, because arsenic was detected in all flue gas samples at concentrations above the PQL.

Trace metal measurement precision was assessed via duplicate sample analyses. Two types of duplicate sample analyses were performed. First, eight samples were analyzed in duplicate and two samples in triplicate, including separate digestions. Second, the IRF prepared one set of MS/MSD samples for each sample matrix analyzed and submitted these samples for analysis. Table 36 summarizes the duplicate sample analysis results, noting the RPD or percent relative standard deviation (%RSD) for each sample/analyte pair. In Table 36, the set of duplicate analysis results labeled "Test samples" corresponds to the sample duplicate analyses. The set of results labeled "MS/MSD samples" corresponds to the MS/MSD sample sets prepared at the IRF and submitted for analysis.

The data in Table 36 show that, of 62 unambiguous metal analysis RPD and %RSD determinations, 55, or 89 percent, met the precision DQO of 25 percent RPD (30 percent in flue gas train samples). As the completeness DQO for the trace metal measurements was 80 percent, the precision DQO, as measured by duplicate sample analyses, was met.

TABLE 31. TRACE METAL SAMPLE HOLD TIMES

Sample	Collection/ preparation date	Analysis date	Analysis hold time, days
Soil feed			
Test 1	8/5/91	10/22/91	78
Test 2	8/5/91	10/22/91	78
Duplicate analysis	8/5/91	10/22/91	78
Test 3	8/5/91	10/22/91	78
Test 4	8/14/91	10/22/91	69
Test 3 external matrix spike	1/8/92	2/6/92	29
Kiln ash			
Test 1	8/6/91	10/22/91	77
Test 2	8/8/91	10/24/91	77
Duplicate analysis	8/8/91	10/24/91	77
Test 3	8/13/91	10/22/91	70
Test 4	8/15/91	10/22/91	68
Test 3 external matrix spike	1/8/92	2/6/92	29
Scrubber liquor			
Test 1	8/6/91	10/24/91	79
Test 2	8/8/91	10/24/91	77
Duplicate analysis	8/8/91	10/24/91	77
Test 3	8/13/91	10/24/91	72
Test 4	8/15/91	10/24/91	70
Test 3 external matrix spike	9/11/91	10/24/91	43
Test 3 scrubber liquor pretest blank	8/13/91	10/24/91	72
Flue gas Method 108 train			
Scrubber exit			
Test 1 filter	8/6/91	10/21/91	76
Test 1 probe wash	8/6/91	10/21/91	76
Test 1 impingers	8/6/91	10/21/91	76
Test 2 filter	8/8/91	10/18/91	71
Duplicate analysis	8/8/91	1/9/92	154
Test 2 probe wash	8/8/91	10/18/91	71
Duplicate analysis	8/8/91	10/18/91	71
Repeat duplicate analysis	8/8/91	1/9/92	154
Test 2 impingers	8/8/91	10/18/91	71
Duplicate analysis	8/8/91	1/9/92	154
Test 3 filter	8/13/91	10/18/91	66
Test 3 probe wash	8/13/91	10/18/91	66
Test 3 impingers	8/13/91	10/18/91	66
Test 4 filter	8/15/91	10/21/91	67
Test 4 probe wash	8/15/91	10/18/91	64
Test 4 impingers	8/15/91	10/18/91	64
Method requirement			180

(continued)

TABLE 31. (continued)

Sample	Collection/ preparation date	Analysis date	Analysis hold time, days
Flue gas Method 108 train (continued)			
Stack			
Test 1 filter	8/6/91	10/21/91	76
Test 1 probe wash	8/6/91	10/21/91	76
Test 1 impingers	8/6/91	10/18/91	73
Test 2 filter	8/8/91	10/18/91	71
Test 2 probe wash	8/8/91	10/18/91	71
Test 2 impingers	8/8/91	10/18/91	71
Test 3 filter	8/13/91	10/18/91	66
Test 3 probe wash	8/13/91	10/18/91	66
Test 3 impingers	8/13/91	10/18/91	66
Duplicate analysis	8/13/91	10/18/91	66
Test 4 filter	8/15/91	10/21/91	67
Test 4 probe wash	8/15/91	10/21/91	67
Test 4 impingers	8/15/91	10/21/91	67
Method blank			
Filter	8/21/91	10/18/91	58
Probe wash	8/21/91	10/18/91	58
Impinger solution	8/21/91	10/18/91	58
Matrix spike			
Filter	9/6/91	10/21/91	45
Probe wash	9/6/91	10/21/91	45
Impinger solution	9/6/91	10/18/91	42
Method requirement			180

TABLE 32. TRACE METAL SAMPLE HOLD TIMES FOR TCLP LEACHATE SAMPLES

Sample	Collection/ preparation date	TCLP extraction date	TCLP extraction hold time, days	Analysis date	Analysis hold time, days
Soil feed TCLP leachate					
Test 1	8/5/91	8/20/91	15	12/31/91	133
Duplicate analysis	8/5/91	8/20/91	15	12/31/91	133
Test 2	8/5/91	8/20/91	15	12/31/91	133
Test 3	8/5/91	8/20/91	15	12/31/91	133
Duplicate analysis	8/5/91	8/20/91	15	12/31/91	133
Test 4	8/14/91	8/26/91	12	12/31/91	127
Kiln ash TCLP leachate					
Test 1	8/6/91	8/21/91	15	12/31/91	120
Test 2	8/8/91	8/22/91	14	12/31/91	119
Test 3	8/13/91	8/22/91	9	12/31/91	119
Duplicate analysis	8/13/91	8/22/91	9	12/31/91	119
Triplicate analysis	8/13/91	8/22/91	9	12/31/91	119
Test 4	8/15/91	8/26/91	11	12/31/91	115
Test 3 external matrix spike	8/22/91	9/11/91	22	12/31/91	111
Method blank	8/27/92	— ^a	—	12/31/91	126
Method requirement			28		180

^aSample is TCLP extraction fluid.

TABLE 33. TRACE METAL ANALYSES OF BLANK SAMPLES

Blank sample	Concentration						
	Ag	As	Ba	Cd	Cr	Pb	Se
Laboratory blanks							
3010 digestion blank, 100191-1, mg/L	<0.005	<0.026	0.002	<0.005	<0.007	0.051	0.053
3010 digestion blank, 100291-1, mg/L	<0.005	<0.027	0.002	<0.005	<0.007	0.037	0.053
3050 digestion blank, 101091-1, mg/L	0.018	<0.096	<0.001	<0.002	<0.029	<0.066	<0.130
3050 digestion blank, 101591-1, mg/L	<0.005	<0.096	0.003	0.003	<0.029	<0.066	<0.143
3010 digestion blank, 093091-1, mg/L	<0.005	<0.096	0.002	<0.002	<0.029	0.216	<0.130
3010 digestion blank, 13092-1, mg/L	0.011	<0.027	0.007	<0.005	<0.007	0.041	0.030
Method blanks							
Scrubber liquor, mg/L	<0.005	<0.096	0.30	0.004	<0.029	0.118	<0.130
TCLP extraction blank, mg/L	0.006	<0.027	0.028	<0.005	<0.007	0.041	0.051
Flue gas Method 108 train filter, mg/filter		0.0011					
Flue gas Method 108 train impinger solution, mg/L		0.0073					
Flue gas Method 108 train probe wash solution, mg/L		<0.005					

TABLE 34. TRACE METAL MEASUREMENT DQOs

Measurement parameter	Measurement/analytical method	Reference	Conditions	DQO		
				Precision, % RSD or RPD	Accuracy, %	Completeness, %
Trace metals in soil feed and kiln ash samples	ICAP	SW-846 Method 6010 ^a	Acid digestion by Method 3050 ^a	25	75 to 125	80
Trace metals in scrubber liquor and TCLP leachate samples	ICAP	SW-846 Method 6010 ^a	Digestion by Method 3010 ^a	25	75 to 125	80
Arsenic in flue gas	Method 108 sampling, GFAA analysis	SW-846 Method 6010 ^a	Method 108 ^b	30	75 to 125	80

^aReference 1, SW-846.^bReference 4, 40 CFR 61, Appendix B.

TABLE 35. TRACE METAL MEASUREMENT PQLs: OBJECTIVES AND ACHIEVED

Sample type	PQL	
	DQO	Achieved
Soil feed and kiln ash, mg/kg		
As	25	9.6
Ba	1	0.1
Cd	2	0.2
Cr	8	2.9
Pb	20	6.6
Scrubber liquor and TCLP leachates, µg/L		
As	250	96
Ba	10	2
Cd	20	5
Cr	80	29
Pb	200	51
Flue gas, µg/dscm		
As	0.5	0.75

TABLE 36. METALS ANALYSIS PRECISION

Sample	Concentration							DQO
	Ag	As	Ba	Cd	Cr	Pb	Se	
Test samples								
Soil feed, Test 2								
Analysis, mg/kg	<0.005	1,040	65.6	1.10	19.0	118	<0.130	
Duplicate analysis, mg/kg	0.093	808	54.9	0.96	18.1	94.7	<0.130	
RPD, %	— ^a	25	18	14	5	22	—	25
Soil feed TCLP leachate, Test 1								
Analysis, mg/L	<0.005	2.16	0.885	0.009	<0.007	0.086	0.066	
Duplicate analysis, mg/L	<0.005	2.32	0.815	0.012	<0.007	0.081	0.058	
RPD, %	—	7	8	29	—	6	13	25
Soil feed TCLP leachate, Test 3								
Analysis, mg/L	<0.005	2.52	0.798	0.012	<0.007	0.083	0.063	
Duplicate sample, mg/L	<0.005	2.13	0.670	0.009	<0.007	0.070	0.059	
RPD, %	—	17	17	29	—	17	7	25
Kiln ash, Test 2								
Analysis, mg/kg	<0.449	619	59.6	0.422	11.3	57.8	16.4	
Duplicate analysis, mg/kg	<0.460	608	56.8	0.672	11.8	53.5	<10.7	
RPD, %	—	2	5	46	4	8	—	25
Kiln ash TCLP leachate, Test 3								
Analysis, mg/L	<0.005	4.13	0.779	0.005	<0.007	0.095	0.062	
Duplicate sample, mg/L	<0.005	4.58	0.807	<0.005	<0.007	0.091	0.068	
Triplicate analysis, mg/L	<0.005	4.51	0.800	<0.005	<0.007	0.124	0.071	
% RSD	—	6	2	—	—	17	7	25
Scrubber liquor, Test 2								
Analysis, mg/L	<0.005	11.5	0.227	0.023	0.089	0.265	<0.130	
Duplicate analysis, mg/L	<0.005	11.4	0.227	0.024	0.096	0.285	0.183	
RPD, %	—	1	0	1	8	7	—	25

^a— Not appropriate for calculation.

(continued)

TABLE 36. (continued)

Sample	Concentration								DQO
	Ag	As	Ba	Cd	Cr	Pb	Se		
Test samples (continued)									
Scrubber exit flue gas Method 108 train filter, Test 2									
Analysis, µg/filter		71.6							
Duplicate analysis, µg/filter		58.8							
RPD, %		20							25
Scrubber exit flue gas Method 108 train probe wash solution, Test 2									
Analysis, µg/L		30.7							
Duplicate analysis, µg/L		32.4							
Repeat duplicate analysis, µg/L		32.9							
%RSD		4							25
Scrubber exit flue gas Method 108 train impinger solution, Test 2									
Analysis, µg/L		<5							
Duplicate analysis, µg/L		<5							
RPD, %		—							
Stack flue gas Method 108 train impinger solution, Test 3									
Analysis, µg/L		<5							
Duplicate analysis, µg/L		<5							
RPD, %		—							
MS/MSD samples									
Soil feed, Test 3									
MS, mg/kg	6.86	1,953	143	11.7	51.3	229	31.9		
MSD, mg/kg	7.03	1,844	143	14.1	72.1	249	28.1		
RPD, %	2	6	0	19	34	8	13		25
Kiln ash, Test 3									
MS, mg/kg	7.33	1,339	172	13.9	55.0	230	26.2		
MSD, mg/kg	7.13	1,232	179	14.5	55.0	220	25.0		
RPD, %	3	8	4	4	0	4	5		25

(continued)

TABLE 36. (continued)

Sample	Concentration							DQO
	Ag	As	Ba	Cd	Cr	Pb	Se	
MS/MSD samples (continued)								
Kiln ash TCLP leachate, Test 3								
MS, mg/L	0.049	14.8	2.06	0.042	0.391	0.285	0.193	
MSD, mg/L	0.057	14.8	2.06	0.050	0.382	0.241	0.193	
RPD, %	15	0	0	17	2	17	0	25
Scrubber liquor, Test 3								
MS, mg/L	0.025	26.2	0.262	0.117	0.430	1.27	0.477	
MSD, mg/L	0.032	22.1	0.257	0.113	0.439	1.27	0.467	
RPD, %	24	17	2	3	2	0	2	25
Method 108 train filter								
MS, µg/filter		207						
MSD, µg/filter		148						
RPD, %		33						25
Method 108 train probe wash solution								
MS, µg/L		85.6						
MSD, µg/L		136						
RPD, %		45						25
Method 108 train impinger solution								
MS, µg/L		107						
MSD, µg/L		53.2						
RPD, %		67						25

Trace metal measurement accuracy was assessed by preparing MS and MSD samples and measuring spike recovery. Two types of MS samples were analyzed. First, as part of its own laboratory QC program, EMSL spiked and analyzed five test samples. Second, as noted above, the IRF prepared and submitted MS/MSD samples for analysis. Table 37 summarizes the spike recovery data obtained. In the table, the internal matrix spikes were those prepared in the EMSL laboratory as part of its internal QC program. The external MS/MSD samples were those prepared at the IRF and submitted for separate analysis.

The data in Table 37 show that 68 of 85 spike recovery measurements, or 80 percent, met the accuracy DQO of 75 to 125 percent recovery. As the completeness DQO for the trace metal analyses was 80 percent, the accuracy objective for these measurements was met.

63 MERCURY ANALYSES

A total of 26 test program samples was analyzed for mercury. This total included two method blank samples and four MS/MSD sample pairs. Table 38 summarizes the sample collection and analysis dates. The TCLP leachate samples analyzed for mercury were aliquots of the samples analyzed for the other trace metals. Sample collection and TCLP extraction dates are as noted in Table 32. The mercury analysis dates for these samples are given in Table 38. As shown, all samples, TCLP leachates included, were analyzed within the mercury analysis method hold time limit of 28 days.

Mercury was not detected above the PQL of 2 $\mu\text{g/L}$ in either blank sample, a scrubber liquor blank collected before the start of Test 3 and a TCLP method blank.

Table 39 summarizes the mercury measurement precision, accuracy, and completeness DQOs. Table 40 lists the mercury PQL DQOs and notes the PQLs achieved. As shown, the PQL DQO for mercury in the scrubber liquor and TCLP leachate samples was met. The achieved PQL of 1 mg/kg of mercury in the soil feed and kiln ash samples was higher than the PQL DQO of 0.2 mg/kg. Mercury was detected above the PQL in all feed samples, and below the achieved PQL in all kiln ash samples. The effect of not achieving the PQL DQO for mercury in the kiln ash is that the detection limit at which it can be stated that mercury is not present in the kiln ash is higher than originally intended.

Mercury measurement precision was assessed via duplicate sample analyses. Two types of duplicate analyses were performed. First, one sample from each sample matrix was analyzed in duplicate, including separate digestions. Second, one set of MS/MSD samples for each sample matrix was prepared and analyzed. Table 41 summarizes the duplicate sample analysis results, noting the RPD for each sample pair. In Table 41, the set of duplicate analysis results labeled "Test samples" corresponds to the sample duplicate analyses. The set of results labeled "MS/MSD samples" corresponds to the MS/MSD sample sets.

In the case of the test samples, only the soil feed showed concentrations above the PQL. Of the five unambiguous metal analysis RPD determinations, three met the precision DQO of 25 percent. Thus, the completeness for mercury measurement precision, as measured by duplicate sample analyses, was 60 percent, lower than the precision completeness DQO of

TABLE 37. METALS SPIKE RECOVERIES FROM MATRIX SPIKE SAMPLES

Sample	Spike recovery, %						
	Ag	As	Ba	Cd	Cr	Pb	Se
Internal matrix spikes							
Soil feed, Test 1	88	79	94	91	89	80	98
Kiln ash TCLP leachate, Test 3 duplicate sample	14	90	91	94	89	94	94
Scrubber liquor, Test 1	11	90	92	92	89	91	96
Method 108 train impinger solution, Test 2		105					
Method 108 train probe wash solution, Test 3		105					
External MS/MSD samples							
Soil feed, Test 3							
MS	171	85	90	73	78	84	80
MSD	176	80	90	89	109	91	70
Kiln ash, Test 3							
MS	183	83	109	87	83	84	66
MSD	178	76	113	91	83	80	63
Kiln ash TCLP leachate, Test 3							
MS	245	103	76	105	89	119	85
MSD	285	103	76	125	87	100	85
Scrubber liquor, Test 3							
MS	63	104	102	100	93	99	88
MSD	80	88	100	97	95	99	87
Method 108 train filter							
MS		103					
MSD		74					
Method 108 train probe wash							
MS		29					
MSD		45					
Method 108 train impinger solution							
MS		178					
MSD		113					

TABLE 38. MERCURY SAMPLE HOLD TIMES

Sample	Collection/ preparation date	Analysis date	Analysis hold time, days
Soil feed:			
Test 1	8/5/91	8/29/91	24
Test 2	8/5/91	9/29/91	24
Duplicate analysis	8/5/91	8/29/91	24
Test 3	8/5/91	8/29/91	24
Test 4	8/14/91	8/29/91	15
Test 3 matrix spike	8/5/91	8/29/91	24
Soil feed TCLP leachate			
Test 1	8/20/91	9/13/91	24
Test 2	8/20/91	9/13/91	24
Duplicate analysis	8/20/91	9/13/91	24
Test 3	8/20/91	9/13/91	24
Test 4	8/26/91	9/13/91	18
Kiln ash			
Test 1	8/6/91	8/29/91	23
Test 2	8/8/91	8/29/91	21
Duplicate analysis	8/8/91	8/29/91	21
Test 3	8/13/91	8/29/91	16
Test 4	8/15/91	8/29/91	14
Test 3 matrix spike	8/13/91	8/29/91	16
Kiln ash TCLP leachate			
Test 1	8/21/91	9/13/91	23
Test 2	8/22/91	9/13/91	22
Duplicate analysis	8/22/91	9/13/91	22
Test 3	8/22/91	9/13/91	22
Test 4	8/26/91	9/13/91	18
Test 3 matrix spike	8/22/91	9/13/91	22
Method blank	8/27/91	9/13/91	17
Scrubber liquor			
Test 1	8/6/91	8/29/91	23
Test 2	8/8/91	8/29/91	21
Duplicate analysis	8/8/91	8/29/91	21
Test 3	8/13/91	8/29/91	16
Test 4	8/15/91	8/29/91	14
Test 3 matrix spike	8/13/91	8/29/91	16
Test 3 scrubber liquor pretest blank	8/13/91	8/29/91	16
Method requirement			28

TABLE 39. MERCURY MEASUREMENT DQOs

Measurement parameter	Measurement/ analytical method	Reference	Conditions	Precision, %RSD or RPD	Accuracy, %	Completeness, %
Mercury in soil feed and kiln ash samples	Cold vapor AA analysis	SW-846 ^a Method 7471	Preparation by Method 7471	25	75 to 125	80
Mercury in scrubber liquor and TCLP leachate samples	Cold vapor AA analysis	SW-846 ^a Method 7470	Preparation by Method 7470	25	75 to 125	80

^aReference 1, SW-846.

TABLE 40. MERCURY MEASUREMENT PQLs: OBJECTIVES AND ACHIEVED

Sample matrix	PQL	
	DQO	Achieved
Soil feed and kiln ash, mg/kg	0.2	1
Scrubber liquor and TCLP leachates, $\mu\text{g/L}$	2	2

80 percent. Table 41 shows that one RPD was 26 percent, exceeding the precision DQO by only 1 percent. This observation, together with the small sample population, suggest that failure to meet the precision DQO did not compromise the test conclusions based on the mercury data.

Mercury measurement accuracy was assessed by preparing MS and MSD samples and measuring spike recovery. Table 41 summarizes the spike recovery data obtained.

The data in Table 41 show that only one of eight spike recovery measurements, or 13 percent, met the accuracy DQO of 75 to 125 percent recovery. As the completeness DQO for the trace metal analyses was 80 percent, the accuracy objective for these measurements was not met. Had the spike recovery DQO been 60 to 140 percent recovery, however, the objective would have been met because seven of the eight spike recovery measurements, or 88 percent, met this less accurate recovery DQO.

The failure to meet the mercury analysis accuracy objective means that the sample trace metal contents were only generally known to within ± 40 percent. This is less accurate than the ± 25 percent originally desired. The test conclusions, however, are still valid and defensible, although some conclusions are slightly less certain than would have otherwise been the case.

6.4 CHLORIDE ANALYSES

The impinger contents from the Method 5 particulate/HCl sampling trains were analyzed for chloride to determine flue gas HCl concentrations at the locations sampled. The test plan and QAPP specified that analyses be performed by ion chromatography, Method 300.0.⁷ During the analysis period, however, several problems were experienced with the ion chromatograph used, which resulted in an inability to attain acceptable instrument performance because of an interfering ion. It was therefore decided to complete the impinger solution chloride analyses via chloride specific ion electrode analysis so that sample hold time limits could be met. All chloride samples were so analyzed, within the 28-day hold time limit.

As part of the chloride analyses, an impinger solution blank sample was analyzed and found to contain chloride ion at 1.1 mg/L. Conversion of the chloride ion data to HCl emissions showed that the HCl flue gas concentrations were very low without blank-correcting. Thus, blank-correcting would have had no significant impact on the HCl emissions data, so it was not performed.

TABLE 41. MERCURY DUPLICATE ANALYSIS AND SPIKE RECOVERY RESULTS

Sample	Mercury concentration, mg/kg	Spike recovery, %	RPD, %
Test samples^a			
Soil feed, Test 2			
Analysis	5.8		38
Duplicate analysis	8.5		
MS/MSD samples			
Soil feed, Test 3			
MS		113	16
MSD		133	
Kiln ash, Test 3			
MS		50	26
MSD		65	
Kiln ash TCLP leachate, Test 3			
MS		63	16
MSD		74	
Scrubber liquor, Test 3			
MS		67	7
MSD		72	
DQO		75-125	25

^aAll other matrix analyses for mercury performed in duplicate were below the PQL.

Table 42 summarizes the flue gas HCl measurement precision, accuracy, and completeness DQOs. The HCl PQL achieved, 175 $\mu\text{g}/\text{dscm}$, was sufficient to show compliance with the hazardous waste incinerator performance standard for HCl.

One impinger test sample was analyzed in duplicate, with an RPD of 2 percent. A MS/MSD sample set was also prepared and analyzed. The RPD of the MS/MSD analyses was 0.4 percent. Thus, the precision DQO of 30 percent was met by both sets of duplicate analyses. Spike recoveries were 113 percent for both analyses, which met the accuracy DQO of 75 to 130 percent recovery. The ability to meet the measurement precision and accuracy DQOs suggests that the use of an alternative analytical method to that specified in the test plan and QAPP did not adversely affect the test results.

TABLE 42. HCl MEASUREMENT DQOs

Measurement parameter	Measurement/analytical method	Conditions	DQO		
			Precision, % RSD or RPD	Accuracy, %	Completeness, %
HCl in flue gas	Method 5 sampling with specific ion electrode analysis of impinger catch	Method 5 aqueous impingers	30	75 to 130	80

REFERENCES

1. "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods," EPA SW-846, 3rd edition, November 1986.
2. 40 CFR, Part 261, Appendix II.
3. 40 CFR, Part 60, Appendix A.
4. 40 CFR, Part 61, Appendix B.
5. "Test Plan for an Incineration Treatability Study for Arsenic-Contaminated Soils from the Chemical Insecticide Corporation Superfund Site, Revision 2," prepared by Acurex Corporation under EPA Contract 68-C-9-0038, August, 1991.
6. "Quality Assurance Project Plan for an Incineration Treatability Study for Arsenic-Contaminated Soils from the Chemical Insecticide Corporation Superfund Site, Revision 1," prepared by Acurex Corporation under EPA Contract 68-C9-0038, July 1991.
7. "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-84-017, March 1984.

APPENDIX A

INCINERATOR OPERATING DATA

APPENDIX A-1
CONTROL ROOM DATA

8-6-91

(1)	MIN:	MAX:	AVG:
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
15	15	15	15
16	16	16	16
17	17	17	17
18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
24	24	24	24
25	25	25	25
26	26	26	26
27	27	27	27
28	28	28	28
29	29	29	29
30	30	30	30
31	31	31	31
32	32	32	32
33	33	33	33
34	34	34	34
35	35	35	35
36	36	36	36
37	37	37	37
38	38	38	38
39	39	39	39
40	40	40	40
41	41	41	41
42	42	42	42
43	43	43	43
44	44	44	44
45	45	45	45
46	46	46	46
47	47	47	47
48	48	48	48
49	49	49	49
50	50	50	50
51	51	51	51
52	52	52	52
53	53	53	53
54	54	54	54
55	55	55	55
56	56	56	56
57	57	57	57
58	58	58	58
59	59	59	59
60	60	60	60
61	61	61	61
62	62	62	62
63	63	63	63
64	64	64	64
65	65	65	65
66	66	66	66
67	67	67	67
68	68	68	68
69	69	69	69
70	70	70	70
71	71	71	71
72	72	72	72
73	73	73	73
74	74	74	74
75	75	75	75
76	76	76	76
77	77	77	77
78	78	78	78
79	79	79	79
80	80	80	80
81	81	81	81
82	82	82	82
83	83	83	83
84	84	84	84
85	85	85	85
86	86	86	86
87	87	87	87
88	88	88	88
89	89	89	89
90	90	90	90
91	91	91	91
92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

(1) During period of flue gas sampling

Control Room (Cont'd) 8-6-91
Flue gas sampling (0945 - 1257)

Time	AB Duct Exit Temp (°F)	Quench Exit Temp (°F)	Stack Temp (°F)	Quench Liq. Tank Temp (°F)	Quench Liquor pH	AB Gas Flow (scfh)	AB Air Flow (acfh)	AB Exit Temp (°F)	Kiln Gas Flow (scfh)	Kiln Air Flow (acfh)	Kiln Exit Temp. (°F)
900	2063	181	133	160	8.5	2390	9964	2184	1330	10724	1802
915	2086	182	134	164	8.2	2226	8311	2194	1248	7180	1803
930	2094	182	135	164	8.5	2344	8330	2202	1171	7192	1700
945	2095	183	137	164	8.5	2258	8332	2199	1261	7192	1780
1000	2096	182	137	164	8.5	2271	8342	2203	1262	7191	1792
1015	2092	183	138	164	8.5	2276	8351	2200	1259	7196	1787
1030	2096	182	138	164	8.5	2279	8349	2200	1256	7200	1789
1045	2095	182	138	170	8.1	2280	8361	2198	1253	7210	1746
1100	2096	182	138	170	8.5	2308	8368	2202	1253	7208	1792
1115	2091	183	138	170	8.6	2325	8378	2203	1249	7221	1773
1130	2093	183	138	170	8.6	2330	8362	2202	1247	7227	1798
1145	2095	183	138	170	8.6	2333	8368	2200	1244	7211	1785
1200	2096	182	138	170	8.6	2347	8366	2199	1241	7217	1779
1215	2091	182	138	170	8.6	2341	8368	2198	1240	7223	1762
1230	2093	182	138	170	8.6	2335	8357	2197	1238	7218	1769
1245	2092	182	139	170	8.6	2351	8376	2198	1236	7230	1775
1300	2094	183	139	170	8.6	2316	8369	2201	1236	7224	1786
1315	2112	182	139	170	8.5	2253	8372	2209	1257	7227	1855
1345	2100	182	139	170	8.6	2325	8372	2201	1281	7220	1796
(1) MIN:	2091	182	137	164	8.1	2258	8332	2197	1236	7191	1746
MAX:	2096	183	139	170	8.6	2351	8378	2203	1262	7230	1798
AVG:	2094	182	138	168	8.5	2310	8360	2200	1249	7211	1779

(1) During period of flue gas sampling

8-8-91

(1)

(1) During period of flue gas sampling

Control Room (Cont'd) 8-8-91
Flue gas sampling (1018 - 1247)

Time	AB Duct Exit Temp (°F)	Quench Exit Temp (°F)	Stack Temp (°F)	Quench Liq. Tank Temp (°F)	Quench Liquor pH	AB Gas Flow (scfh)	AB Air Flow (acfh)	AB Exit Temp (°F)	Kiln Gas Flow (scfh)	Kiln Air Flow (acfh)	Kiln Exit Temp. (°F)
935	2076	180	139	162	7.3	2489	10743	2168	1439	10367	1801
945	2096	181	140	162	7.3	2339	8197	2190	1499	70202	1803
1000	2092	182	140	162	7.3	2464	8195	2191	1366	6997	1784
1015	2094	182	141	165	7.2	2466	8205	2199	1365	7004	1768
1030	2098	182	141	165	7.2	2470	8208	2201	1365	7001	1756
1045	2102	182	142	165	7.1	2495	8220	2200	1365	7001	1752
1100	2097	182	141	165	7.1	2542	8224	2199	1364	7013	1801
1115	2096	181	140	165	7.1	2517	8218	2200	1363	7002	1768
1130	2098	182	141	165	7.0	2500	8223	2196	1362	7007	1798
1145	2099	181	142	168	6.9	2523	8235	2205	1362	7004	1812
1200	2099	181	142	168	6.8	2531	8237	2199	1360	7008	1806
1215	2097	181	142	168	6.7	2572	8237	2199	1360	7014	1782
1230	2099	182	142	168	6.5	2481	8230	2196	1357	7009	1812
1245	2103	182	142	168	6.3	2506	8233	2198	1356	7026	1809
1300	2101	182	143	168	6.5	2559	8245	2204	1357	7021	1813
1315	2100	182	143	168	8.6	2546	8242	2200	1355	7023	1831
1330	2098	181	143	168	7.6	2549	8261	2195	1354	7032	1799
1345	2099	182	143	168	7.6	2550	8266	2198	1354	7032	1816
1415	2096	181	141	168	7.8	2594	8259	2197	1381	7049	1808
(1) MIN:	2096	181	140	165	6.3	2470	8208	2196	1356	7001	1752
MAX:	2103	182	142	168	7.2	2572	8237	2205	1365	7026	1812
AVG:	2099	182	142	167	6.9	2514	8227	2199	1361	7009	1790

(1) During period of flue gas sampling

Control Room 8-13-91
Flue gas sampling (1040 - 1312)

Time	Soil (lbs)	Ash (lbs)	Quench Press. 1,2,3 (psi)	Quench Flow (gpm)	Quench Fresh Water (gpm)	Quench Blowdown Totalizer (gal)	Makeup Water Totalizer (gal)	Kiln Pressure (in w.c.)	AB Pressure (in w.c.)	E-duct Pressure (in w.c.)	Kiln Exit Temp (°F)	AB Exit Temp (°F)
900	532.0		47	37	0	7442	9145	0.02	>0.5	5.5	1801	2207
915	532.0		47	37	0	7480	9178	0.02	>0.5	4.5	1808	2209
930	532.5		47	37	0	7522	9206	0.02	>0.5	4.5	1809	2207
945	532.0		47	37	0	7560	9244	0.02	>0.5	4.5	1797	2199
1015	510.0		47	37	0	7569	9244	0.03	>0.5	4.5	1731	2207
1030	487.5		47	37	0	7569	9244	0.03	>0.5	4.5	1795	2207
1045	454.0		47	37	0	7569	9244	0.03	>0.5	4.5	1829	2213
1100	420.0		47	37	0	7576	9244	0.03	>0.5	4.5	1810	2206
1115	375.0		47	37	0	7605	9244	0.03	>0.5	4.5	1800	2210
1130	352.5		47	37	0	7643	9244	0.03	>0.5	4.5	1820	2206
1145	319.0		47	37	0	7681	9244	0.03	>0.5	4.5	1791	2203
1200	285.0		47	37	0	7736	9244	0.03	>0.5	4.5	1846	2207
1215	251.0		43	37	0	7736	9244	0.03	>0.5	5.0	1905	2206
1230	217.5		45	37	0	7736	9244	0.03	>0.5	5.0	1831	2209
1245	183.0		45	37	0	7736	9244	0.03	>0.5	5.0	1804	2209
1300	149.0		45	37	0	7736	9244	0.03	>0.5	4.8	1773	2210
1315	115.5		45	37	0	7736	9244	0.03	>0.5	4.5	1797	2205
1330	81.5		45	37	0	7767	9244	0.03	>0.5	4.5	1780	2203
1345	48.0		45	37	0	7823	9244	0.03	>0.5	4.5	1768	2204
1400	14.0		45	37	0	7855	9314	0.03	>0.5	4.5	1821	2206
1415	3.0		45	37	0	7855	9314	0.03	>0.5	4.5	1769	2206
1445	3.0		45	37	0	7872	9314	0.03	>0.5	4.5	1804	2207
1515	3.5		45	37	0	7900	9314	0.01	>0.5	4.5	1820	2202
(1) MIN:			43	37	0	7569	9244	0.03	>0.5	4.5	1773	2203
MAX:			47	37	0	7736	9244	0.03	>0.5	5.0	1905	2213
AVG:			46	37	0	7675	9244	0.03	>0.5	4.7	1821	2208

(1) During period of flue gas sampling

Gas Train (Cont'd) 8-13-91
Flue Gas Sampling (1040 - 1312)

Time	Afterburner					Afterburner Pilot				
	AB Air Flow (in w.c.)	AB Sec Air Flow (in w.c.)	Gas Press Static (psi)	Gas Press Dynamic (in w.c.)	AB Gas Temp (°F)	AB Pilot Air (in w.c.)	AB Atom Air (in w.c.)	Gas Press Static (in w.c.)	Gas Press Dynamic (in w.c.)	
900	2.6	0	3.0	1.05	78	0	4.5	8.5	0.30	
930	2.6	0	2.9	1.20	79	0	4.5	8.5	0.30	
1000	2.6	0	2.9	1.15	80	0	4.5	8.5	0.30	
1030	2.6	0	2.9	1.15	80	0	4.5	8.5	0.30	
1100	2.6	0	2.4	1.15	80	0	4.5	8.5	0.30	
1130	2.6	0	2.9	1.20	82	0	4.5	8.5	0.30	
1200	2.6	0	2.9	1.20	82	0	4.5	8.5	0.30	
1230	2.5	0	2.9	1.20	82	0	4.5	8.5	0.30	
1300	2.5	0	2.8	1.15	84	0	4.5	8.5	0.30	
1330	2.6	0	2.9	1.30	84	0	4.5	8.5	0.30	
1430	2.6	0	2.9	1.15	85	0	4.5	8.5	0.30	
(1) MIN:	2.5	0	2.4	1.15	80	0	4.5	8.5	0.30	
MAX:	2.6	0	2.9	1.20	84	0	4.5	8.5	0.30	
AVG:	2.6	0	2.8	1.18	82	0	4.5	8.5	0.30	

(1) During period of flue gas sampling

Control Room (Cont'd) 8-13-91
Flue gas sampling (1040 - 1312)

Time	AB Duct Exit Temp (°F)	Quench Exit Temp (°F)	Stack Temp (°F)	Quench Lq. Tank Temp (°F)	Quench Liquor pH	AB Gas Flow (scfh)	AB Air Flow (acfh)	AB Exit Temp (°F)	Klin Gas Flow (scfh)	Klin Air Flow (acfh)	Klin Exit Temp. (°F)
900	2075	179	126	156	9.3	2171	8250	2200	1510	11369	1806
915	2080	180	132	156	8.6	2225	8245	2201	1470	11365	1798
930	2093	181	134	158	8.0	2589	8261	2206	1495	11369	1800
945	2093	180	135	158	7.7	2179	8250	2194	1506	11379	1801
1015	2101	181	136	162	7.7	2432	8237	2199	1476	7390	1810
1030	2102	181	137	162	7.6	2423	8247	2199	1402	7404	1768
1045	2107	182	137	162	7.5	2409	8247	2202	1402	7391	1806
1100	2100	182	138	162	7.4	2430	8249	2195	1401	7399	1761
1115	2107	182	136	162	7.4	2511	8242	2209	1400	7399	1781
1130	2103	182	137	164	7.4	2436	8249	2197	1399	7400	
1145	2103	182	137	164	7.4	2440	8252	2202	1399	7414	1808
1200	2101	182	137	165	7.4	2429	8256	2197	1399	7412	1778
1215	2094	182	138	165	7.4	2442	8262	2199	1400	7426	1806
1230	2105	182	138	168	7.5	2451	8268	2201	1400	7435	1804
1245	2102	182	138	168	7.4	2470	8266	2200	1366	7429	1816
1300	2105	182	138	168	7.4	2472	8259	2201	1364	7431	1843
1315	2103	182	138	168	7.4	2487	8262	2200	1361	7428	1827
1330	2100	181	139	168	7.4	2478	8249	2199	1357	7414	1835
1345	2100	181	139	168	7.6	2496	8276	2197	1357	7426	1811
1400	2105	181	139	168	7.7	2463	8264	2200	1358	7435	1781
1415	2103	181	138	168	7.4	2514	8276	2201	1379	7424	1764
1445	2104	181	138	168	7.4	2489	8285	2202	1381	7431	1788
1515	2096	181	139	168	7.4	2553	8271	2202	1373	7438	1785
(1) MIN:	2094	182	136	162	7.4	2409	8242	2195	1364	7391	1761
MAX:	2107	182	138	168	7.5	2511	8268	2209	1402	7435	1843
AVG:	2103	182	137	165	7.4	2449	8255	2200	1393	7414	1800

(1) During period of flue gas sampling

Control Room 8-15-91
Flue gas sampling (1003 - 1245)

Time	Weigh Scale		Quench		Quench		Quench		Quench		Makeup		Kiln		AB		Kiln		AB		Kiln		AB	
	Soil	Ash	Press.	Flow	Water	Totalizer	Water	Pressure	AB	Pressure	Water	Pressure	Pressure	Pressure	Pressure	Pressure	Exit	Temp	Pressure	Pressure	Exit	Temp	Pressure	Pressure
	(lbs)	(lbs)	(psi)	(gpm)	(gpm)	(gal)	(gal)	(in w.c.)	(in w.c.)	(in w.c.)	(gal)	(in w.c.)	(in w.c.)	(in w.c.)	(in w.c.)	(in w.c.)	(°F)	(°F)	(in w.c.)	(in w.c.)	(°F)	(°F)	(in w.c.)	(in w.c.)
910	567.5		45	30	0	4542	3546	0.03	>0.5	0.03			6.0	1787	>0.5		2219							
930	556.0		45	30	0	4553	3579	0.03	>0.5	0.03			6.0	1764	>0.5		2212							
945	521.0		45	30	0	4553	3579	0.03	>0.5	0.03			6.0	1739	>0.5		2209							
1000	474.0		45	30	0	4553	3579	0.03	>0.5	0.03			6.0	1730	>0.5		2206							
1015	450.5		45	30	0	4572	3579	0.03	>0.5	0.03			6.0	1767	>0.5		2215							
1030	415.0	1.0	45	30	0	4611	3579	0.03	>0.5	0.03			6.0	1801	>0.5		2204							
1045	368.0	4.0	45	30	0	4646	3579	0.03	>0.5	0.03			6.0	1813	>0.5		2206							
1100	333.0	12.5	45	30	0	4646	3579	0.03	>0.5	0.03			6.0	1781	>0.5		2209							
1115	309.5	32.5	45	30	0	4646	3589	0.03	>0.5	0.03			6.0	1782	>0.5		2203							
1130	274.0	53.5	45	30	0	4646	3589	0.03	>0.5	0.03			6.0	1767	>0.5		2205							
1145	227.0	71.5	45	30	0	4646	3587	0.03	>0.5	0.03			6.0	1782	>0.5		2210							
1200	191.5	92.0	45	30	0	4686	3588	0.03	>0.5	0.03			6.0	1791	>0.5		2205							
1215	156.5	110.0	45	30	0	4692	3588	0.03	>0.5	0.03			6.0	1814	>0.5		2202							
1230	121.0	132.5	45	30	0	4692	3588	0.03	>0.5	0.03			6.0	1826	>0.5		2210							
1245	85.5	150.0	45	30	0	4692	3588	0.03	>0.5	0.03			6.0	1869	>0.5		2212							
1300	50.5	174.0	45	30	0	4714	3588	0.03	>0.5	0.03			6.0	1803	>0.5		2206							
1315	15.5	192.0	45	30	0	4749	3590	0.03	>0.5	0.03			6.0	1809	>0.5		2209							
1330	3.5	214.5	45	30	0	4751	3591	0.03	>0.5	0.03			6.0	1784	>0.5		2205							
1400	3.5	255.0	45	30	0	4751	3591	0.03	>0.5	0.03			6.0	1797	>0.5		2208							
(1) MIN:			45	30	0	4553	3579	0.03	>0.5	0.03			6.0	1730	>0.5		2202							
MAX:			45	30	0	4692	3589	0.03	>0.5	0.03			6.0	1869	>0.5		2215							
AVG:			45	30	0	4644	3584	0.03	>0.5	0.03			6.0	1794	>0.5		2207							

(1) During period of flue gas sampling

Control Room (Cont'd) 8-15-91
Flue gas sampling (1003 - 1245)

Time	AB Duct Exit Temp (°F)	Quench Exit Temp (°F)	Stack Temp (°F)	Quench Liq. Tank Temp (°F)	Quench Liquor pH	AB Gas Flow (scfh)	AB Air Flow (acfh)	AB Exit Temp (°F)	Kiln Gas Flow (scfh)	Kiln Air Flow (acfh)	Kiln Exit Temp. (°F)
910	2104	181	135	160	8.6	2307	8340	2204	1501	7184	1820
930	2104	181	134	160	8.0	2369	8534	2201	1368	7193	1749
945	2105	182	136	162	7.9	2398	8361	2201	1368	7198	1754
1000	2100	182	137	162	7.9	2337	8378	2199	1367	7219	1754
1015	2111	182	138	164	7.8	2301	8383	2203	1474	7228	1750
1030	2104	182	138	164	7.8	2301	8405	2202	1517	7224	1830
1045	2102	182	138	164	7.8	2300	8407	2201	1495	7235	1836
1100	2104	182	139	164	7.7	2338	8405	2200	1443	7240	1806
1115	2104	182	139	164	7.7	2312	8403	2198	1440	7233	1768
1130	2104	181	139	164	7.7	2335	8417	2199	1437	7227	1762
1145	2104	182	139	164	7.6	2322	8422	2200	1434	7241	1761
1200	2103	182	140	164	7.6	2376	8427	2200	1432	7245	1768
1215	2108	183	140	164	7.7	2466	8423	2196	1432	7239	1791
1230	2107	182	140	164	7.6	2440	8411	2199	1429	7250	1853
1245	2109	182	140	164	7.6	2462	8420	2201	1427	7256	1859
1300	2105	181	140	164	7.6	2479	8420	2200	1356	7254	1780
1315	2106	182	140	164	7.6	2491	8431	2201	1355	7254	1776
1330	2105	181	139	164	7.6	2446	8435	2202	1655	7261	1834
1400	2100	181	139	164	7.6	2439	8433	2200	1488	7257	1796
(1) MIN:	2100	181	137	162	7.6	2300	8378	2196	1367	7219	1750
MAX:	2111	183	140	164	7.9	2466	8427	2203	1517	7256	1859
AVG:	2105	182	139	164	7.7	2358	8408	2200	1444	7236	1795

(1) During period of flue gas sampling

APPENDIX A-2
GAS TRAIN DATA

Gas Train 8-6-91
Flue Gas Sampling (0945 - 1257)

Time	Blower				Kiln					Kiln Pilot				
	Air Plenum (in w.c.)	Blow Off Air (in w.c.)	Air Static (in w.c.)	Total Air Flow (in w.c.)	Air Temp (°F)	Kiln Air Flow (in w.c.)	Kiln Sec Air Flow (in w.c.)	Gas Pres Static (psi)	Gas Press Dynamic (in w.c.)	Kiln Gas Temp (°F)	Kiln Pilot Air (in w.c.)	Kiln Atom Air (in w.c.)	Gas Press Static (in w.c.)	Gas Press Dynamic (in w.c.)
900	42	0	40	0.6	110	3.2	0	2.5	0.60	84	0	5.0	0.5	0.05
930	42	0	39	0.6	111	2.2	0	2.5	0.50	85	0	5.0	0.5	0.05
1000	42	0	39	0.6	112	2.2	0	2.5	0.55	85	0	5.0	0.5	0.05
1030	42	0	39	0.6	114	2.2	0	2.5	0.55	86	0	5.0	0.5	0.05
1100	42	0	39	0.6	114	2.2	0	2.5	0.60	87	0	5.0	0.5	0.05
1130	42	0	39	0.6	116	2.2	0	2.5	0.60	88	0	5.0	0.5	0.05
1200	42	0	39	0.6	116	2.2	0	2.5	0.60	88	0	5.0	0.5	0.05
1230	42	0	39	0.6	118	2.2	0	2.5	0.60	92	0	5.0	0.5	0.05
1300	42	0	39	0.4	120	2.2	0	2.5	0.65	92	0	5.0	0.5	0.05
(1) MIN:	42	0	39	0.6	112	2.2	0	2.5	0.55	85	0	5.0	0.5	0.05
MAX:	42	0	39	0.6	118	2.2	0	2.5	0.60	92	0	5.0	0.5	0.05
AVG:	42	0	39	0.6	115	2.2	0	2.5	0.58	88	0	5.0	0.5	0.05

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Jark

Gas Train (Cont'd) 8-6-91

(1) MIN:
MAX:
AVG:

(1) During period of flue gas sampling

Gas Train 8-8-91
Flue Gas Sampling (1018 - 1247)

Time	Blower				Kiln				Kiln Pilot					
	Air Plenum (in w.c.)	Blow Off Air (in w.c.)	Air Static (in w.c.)	Total Air Flow (in w.c.)	Air Temp (°F)	Kiln Air Flow (in w.c.)	Kiln Sec Air Flow (in w.c.)	Gas Pres Static (psi)	Gas Press Dynamic (in w.c.)	Kiln Gas Temp (°F)	Kiln Pilot Air (in w.c.)	Kiln Atom Air (in w.c.)	Gas Press Static (in w.c.)	Gas Press Dynamic (in w.c.)
940	42	0	40	0.6	110	3.2	0	2.5	0.65	84	0	5.5	0.5	0.05
1000	42	0	39	0.4	112	2.2	0	2.5	0.65	84	0	5.5	0.5	0.05
1030	42	0	39	0.4	113	2.2	0	2.5	0.65	86	0	5.5	0.5	0.05
1100	42	0	39	0.4	114	2.2	0	2.5	0.65	88	0	5.5	0.5	0.05
1130	42	0	39	0.4	116	2.2	0	2.5	0.65	90	0	5.5	0.5	0.05
1200	42	0	39	0.4	117	2.2	0	2.5	0.65	91	0	5.5	0.5	0.05
1230	42	0	39	0.4	117	2.2	0	2.5	0.65	92	0	5.5	0.5	0.05
1300	42	0	38	0.4	117	2.2	0	2.5	0.65	92	0	5.5	0.5	0.65
1330	42	0	38	0.4	118	2.2	0	2.5	0.65	93	0	5.5	0.5	0.05
1400	42	0	38	0.4	120	2.2	0	2.5	0.65	94	0	5.5	0.5	0.05
(1) MIN:	42	0	39	0.4	113	2.2	0	2.5	0.65	86	0	5.5	0.5	0.05
MAX:	42	0	39	0.4	117	2.2	0	2.5	0.65	92	0	5.5	0.5	0.05
AVG:	42	0	39	0.4	115	2.2	0	2.5	0.65	89	0	5.5	0.5	0.05

(1) During period of flue gas sampling

Gas Train (Cont'd) 8-8-91
Flue Gas Sampling (1018 - 1247)

Time	Afterburner					Afterburner Pilot				
	AB Air Flow (in w.c.)	AB Sec Air Flow (in w.c.)	Gas Press Static (psi)	Gas Press Dynamic (in w.c.)	AB Gas Temp (°F)	AB Pilot Air (in w.c.)	AB Atom Air (in w.c.)	Gas Press Static (in w.c.)	Gas Press Dynamic (in w.c.)	
940	2.4	0	2.8	1.25	84	0	4.5	8.5	0.30	
1000	2.6	0	2.9	1.20	84	0	4.5	8.5	0.30	
1030	2.6	0	2.9	1.20	86	0	4.5	8.5	0.30	
1100	2.6	0	2.9	1.20	88	0	4.5	8.5	0.30	
1130	2.6	0	2.9	1.20	90	0	4.5	8.5	0.30	
1200	2.6	0	2.9	1.20	91	0	4.5	8.5	0.30	
1230	2.6	0	2.9	1.20	92	0	4.5	8.5	0.30	
1300	2.6	0	2.9	1.20	92	0	4.5	8.5	0.30	
1330	2.6	0	2.9	1.20	93	0	4.5	8.5	0.30	
1400	2.6	0	2.9	1.30	94	0	4.5	8.5	0.30	
(1) MIN:	2.6	0	2.9	1.20	86	0	4.5	8.5	0.30	
MAX:	2.6	0	2.9	1.20	92	0	4.5	8.5	0.30	
AVG:	2.6	0	2.9	1.20	89	0	4.5	8.5	0.30	

(1) During period of flue gas sampling

Gas Train 8-13-91
Flue Gas Sampling (1040 - 1312)

Time	Blower				Kiln					Kiln Pilot				
	Air Plenum (in w.c.)	Blow Off Air (in w.c.)	Air Static (in w.c.)	Total Air Flow (in w.c.)	Air Temp (°F)	Kiln Air Flow (in w.c.)	Kiln Sec Air Flow (in w.c.)	Gas Pres Static (psi)	Gas Press Dynamic (in w.c.)	Kiln Gas Temp (°F)	Kiln Pilot Air (in w.c.)	Kiln Atom Air (in w.c.)	Gas Press Static (in w.c.)	Gas Press Dynamic (in w.c.)
900	43	0	40	0.6	104	3.4	0	2.5	0.67	78	0	5.0	0.5	0.05
930	43	0	40	0.6	104	3.4	0	2.5	0.67	79	0	5.0	0.5	0.05
1000	43	0	40	0.6	104	3.4	0	2.5	0.67	80	0	5.0	0.5	0.05
1030	43	0	40	0.4	106	2.3	0	2.5	0.65	80	0	5.0	0.5	0.05
1100	42	0	40	0.4	106	2.3	0	2.5	0.65	80	0	5.0	0.5	0.05
1130	42	0	40	0.4	108	2.3	0	2.5	0.65	82	0	5.0	0.5	0.05
1200	42	0	40	0.4	108	2.3	0	2.5	0.65	82	0	5.0	0.5	0.05
1230	42	0	39	0.4	110	2.3	0	2.5	0.65	82	0	5.0	0.5	0.05
1300	42	0	40	0.4	110	2.4	0	2.5	0.65	84	0	5.0	0.5	0.05
1330	42	0	40	0.4	110	2.4	0	2.5	0.65	84	0	5.0	0.5	0.05
1430	42	0	40	0.4	111	2.4	0	2.5	0.67	85	0	5.0	0.5	0.05
(1) MIN:	42	0	39	0.4	106	2.3	0	2.5	0.65	80	0	5.0	0.5	0.05
MAX:	42	0	40	0.4	110	2.4	0	2.5	0.65	84	0	5.0	0.5	0.05
AVG:	42	0	40	0.4	108	2.3	0	2.5	0.65	82	0	5.0	0.5	0.05

(1) During period of flue gas sampling

Gas Train 8-15-91
Flue Gas Sampling (1003 - 1245)

Time	Blower				Kiln						Kiln Pilot			
	Air Plenum (in w.c.)	Blow Off Air (in w.c.)	Air Static (in w.c.)	Total Air Flow (in w.c.)	Air Temp (°F)	Kiln Air Flow (in w.c.)	Kiln Sec Air Flow (in w.c.)	Gas Pres Static (psi)	Gas Press Dynamic (in w.c.)	Kiln Gas Temp (°F)	Kiln Pilot Air (in w.c.)	Kiln Atom Air (in w.c.)	Gas Press Static (in w.c.)	Gas Press Dynamic (in w.c.)
915	43	0	40	0.4	103	2.2	0	2.5	0.65	76	0	5.0	0.5	0.05
930	42	0	40	0.4	104	2.2	0	2.5	0.60	76	0	5.0	0.5	0.05
1000	42	0	40	0.4	106	2.2	0	2.5	0.60	78	0	5.0	0.5	0.05
1030	42	0	40	0.4	108	2.2	0	2.5	0.70	80	0	5.0	0.5	0.05
1100	42	0	40	0.4	110	2.2	0	2.5	0.65	82	0	5.0	0.5	0.05
1130	42	0	40	0.4	110	2.2	0	2.5	0.65	84	0	5.0	0.5	0.05
1200	42	0	40	0.4	112	2.2	0	2.5	0.65	86	0	5.0	0.5	0.05
1230	42	0	40	0.4	113	2.2	0	2.5	0.65	86	0	5.0	0.5	0.05
1300	42	0	40	0.4	113	2.2	0	2.5	0.65	87	0	5.0	0.5	0.05
1330	42	0	40	0.4	114	2.2	0	2.5	0.65	88	0	5.0	0.5	0.05
1400	42	0	40	0.4	114	2.2	0	2.5	0.70	88	0	5.0	0.5	0.05
(1) MIN:	42	0	40	0.4	108	2.2	0	2.5	0.65	80	0	5.0	0.5	0.05
MAX:	42	0	40	0.4	113	2.2	0	2.5	0.70	86	0	5.0	0.5	0.05
AVG:	42	0	40	0.4	111	2.2	0	2.5	0.66	84	0	5.0	0.5	0.05

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(1) During period of flue gas sampling

Gas Train (Cont'd) 8-15-91
Flue Gas Sampling (1003 - 1245)

Time	Afterburner					Afterburner Pilot				
	AB Air Flow (in w.c.)	AB Sec Air Flow (in w.c.)	Gas Press Static (psi)	Gas Press Dynamic (in w.c.)	AB Gas Temp (°F)	AB Pilot Air (in w.c.)	AB Atom Air (in w.c.)	Gas Press Static (in w.c.)	Gas Press Dynamic (in w.c.)	
915	2.6	0	2.9	1.15	76	0	4.5	8.5	0.30	
930	2.6	0	2.9	1.15	76	0	4.5	8.5	0.30	
1000	2.6	0	2.9	1.15	78	0	4.5	8.5	0.30	
1030	2.6	0	2.9	1.10	80	0	4.5	8.5	0.30	
1100	2.6	0	2.9	1.10	82	0	4.5	8.5	0.30	
1130	2.6	0	2.9	1.10	84	0	4.5	8.5	0.30	
1200	2.6	0	2.9	1.10	86	0	4.5	8.5	0.30	
1230	2.6	0	2.9	1.15	86	0	4.5	8.5	0.30	
1300	2.6	0	2.9	1.20	87	0	4.5	8.5	0.30	
1330	2.6	0	2.9	1.20	88	0	4.5	8.5	0.30	
1400	2.6	0	2.9	1.15	88	0	4.5	8.5	0.30	
(1) MIN:	2.6	0	2.9	1.10	80	0	4.5	8.5	0.30	
MAX:	2.6	0	2.9	1.15	86	0	4.5	8.5	0.30	
AVG:	2.6	0	2.9	1.11	84	0	4.5	8.5	0.30	

(1) During period of flue gas sampling

APPENDIX A-3

**AIR POLLUTION CONTROL SYSTEM DATA
INCLUDING CALVERT SYSTEM OPERATING DATA**

Bay Area and Calvert Scrubber 8-6-91
Flue Gas Sampling (0945 - 1257)

Calvert Scrubber APCS														
Secondary APCS														
Time	2nd HEPA	Demister	Carbon Bed	1st HEPA	C/A Inlet	Collision Scrubber	Wet ESP	Fan	HX Into	HX From	HX Flowrate	C/A pH	Entrain. Separator	Pressure Drop
	dp (in w.c.)	dp (in w.c.)	Exit Press. (in w.c.)	dp (in w.c.)	(°F)	Inlet (°F)	Inlet (°F)	Exit (°F)	C/A (°F)	C/A (°F)	(gpm)		pH	
906	5.0	0.5	15.0	12.5	181	121	116	147	122	147	156	9.24	7.37	48
930	6.5	0.5	16.0	13.5	183	124	118	149	124	150	168	8.79	1.14	48
1000	8.0	0.5	16.0	13.5	183	125	119	150	125	152	158	8.37	7.47	48
1030	9.0	0.5	16.0	13.5	184	126	120	145	126	152	158	8.18	7.54	48
1100	9.0	0.5	16.0	13.5	184	126	121	143	126	152	158	7.59	7.41	48
1130	10.0	0.5	16.0	13.5	183	125	121	143	126	151	158	7.77	7.68	48
1200	10.0	0.5	16.0	13.5	184	125	120	143	125	141	160	7.65	7.72	48
1230	10.5	0.5	16.0	13.5	185	126	121	144	126	152	158	7.51	7.75	48
1300	10.0	0.5	16.0	13.0	185	126	121	152	126	152	160	7.44	7.76	48
(1) MIN:	8.0	0.5	16.0	13.5	183	125	119	143	125	141	158	7.51	7.41	48
MAX:	10.5	0.5	16.0	13.5	185	126	121	150	126	152	160	8.37	7.75	48
AVG:	9.4	0.5	16.0	13.5	184	126	120	145	126	150	158	7.85	7.60	48

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(1) During period of flue gas sampling

Bay Area and Calvert Scrubber 8-8-91
Flue Gas Sampling (1018 - 1247)

Secondary APCS										Calvert Scrubber APCS												
Time	2nd HEPA		Demister		Carbon Bed		1st HEPA		Collision		Wet ESP		Fan Exit		HX Into		HX From		C/A Flowrate		Entrain.	
	dp (in w.c.)	dp (in w.c.)	dp (in w.c.)	dp (in w.c.)	Exit Press. (in w.c.)	Bed (in w.c.)	dp (in w.c.)	dp (in w.c.)	C/A Inlet (°F)	Scrubber Inlet (°F)	Inlet (°F)	ESP Inlet (°F)	Exit (°F)	Exit (°F)	C/A (°F)	C/A (°F)	C/A (°F)	Flowrate (gpm)	pH	pH	Pressure Drop	
940	3.0		0.5		15.0		12.0		182	127	127	121	152	127	152	127	152	166	6.62	7.23	49	
1000	3.5		0.5		15.0		12.0		182	129	129	123	152	129	155	129	155	166	6.47	7.20	49	
1030	4.0		0.5		15.0		12.0		183	129	129	124	154	129	155	129	155	166	6.20	7.23	49	
1100	5.5		0.5		15.0		12.0		188	130	130	118	154	129	155	129	155	166	6.24	7.08	49	
1130	5.5		0.5		13.5		11.5		183	129	129	124	156	129	155	129	155	164	6.25	7.16	49	
1200	6.0		0.5		15.0		12.0		183	130	130	124	156	130	156	130	156	166	6.15	7.18	49	
1230	7.5		0.5		15.0		12.0		184	131	131	125	156	130	158	130	158	166	5.87	7.19	49	
1300	7.5		0.5		15.0		12.0		186	130	130	125	157	130	157	130	157	166	7.51	7.28	49	
1330	8.0		0.5		15.0		12.0		184	129	129	124	158	129	155	129	155	164	7.19	7.42	49	
1400	8.0		0.5		15.0		12.0		185	129	129	118	157	128	155	128	155	164	7.08	7.21	49	
(1) MIN:	4.0		0.5		13.5		11.5		183	129	129	118	154	129	155	129	155	164	5.87	7.08	49	
MAX:	7.5		0.5		15.0		12.0		188	131	131	125	156	130	158	130	158	166	6.25	7.23	49	
AVG:	5.7		0.5		14.7		11.9		184	130	130	123	155	129	156	129	156	166	6.14	7.17	49	

(1) During period of flue gas sampling

Bay Area and Calvert Scrubber 8-13-91
Flue Gas Sampling (1040 - 1312)

Secondary APCS										Calvert Scrubber APCS									
Time	2nd HEPHA		Demister		Carbon Bed		1st HEPHA		Collision Scrubber Inlet	Wet ESP Inlet	Fan Exit		HX C/A		HX Flowrate (gpm)	HX C/A	Entrain. Separator pH	Pressure Drop	
	dp (in w.c.)		dp (in w.c.)		Exit Press. (in w.c.)		dp (in w.c.)				C/A Inlet (°F)		(°F)						(°F)
900	1.0		0.5		15.5		12.5		180	121	116	149	121	147	166	7.27	7.77	50	
930	1.0		0.5		15.0		12.0		183	124	118	152	123	150	166	7.01	7.76	50	
1000	1.0		0.5		15.0		12.0		123	124	118	153	124	150	166	6.88	7.81	50	
1030	1.0		0.5		15.0		12.0		183	126	120	154	125	153	166	6.60	7.83	50	
1100	1.0		0.5		15.0		12.0		183	125	120	155	125	154	160	6.76	7.85	50	
1130	1.0		0.5		15.0		12.0		185	126	114	154	125	154	164	7.13	7.54	50	
1200	1.0		0.5		15.0		12.0		185	126	120	155	126	154	164	6.79	7.68	50	
1230	1.5		0.5		15.0		12.0		184	126	120	157	125	154	164	6.61	7.71	50	
1300	3.0		0.5		15.0		12.0		184	126	120	157	125	154	164	6.40	7.75	50	
1330	3.0		0.5		15.0		12.0		185	126	121	157	125	154	164	6.08	7.78	50	
1430	3.0		0.5		15.0		12.0		183	125	119	157	124	152	162	6.42	7.85	50	
(1) MIN:	1.0		0.5		15.0		12.0		183	125	114	154	125	154	160	6.40	7.54	50	
MAX:	3.0		0.5		15.0		12.0		185	126	120	157	126	154	164	7.13	7.85	50	
AVG:	1.5		0.5		15.0		12.0		184	126	119	156	125	154	163	6.74	7.71	50	

(1) During period of flue gas sampling

Bay Area and Calvert Scrubber 8-15-91
Flue Gas Sampling (1003 - 1245)

Secondary APCS										Calvert Scrubber APCS				
Time	2nd HEPA dp (in w.c.)	Demister dp (in w.c.)	Carbon Bed Exit Press. (in w.c.)	1st HEPA dp (in w.c.)	C/A Inlet (°F)	Collision Scrubber Inlet (°F)	Wet ESP Inlet (°F)	Fan Exit (°F)	HX Into C/A (°F)	HX From C/A (°F)	HX Flowrate (gpm)	C/A pH	Entrain. Separator pH	Pressure Drop
915	0.0	0.5	15.0	12.5	184	124	118	146	123	150	164	6.93	7.04	50
930	0.0	0.5	15.0	12.5	183	125	115	146	125	153	164	6.93	6.86	50
1000	0.0	0.5	15.0	12.5	182	126	119	149	126	154	164	6.68	7.04	50
1030	0.5	0.5	15.5	12.5	183	126	120	151	126	155	164	6.60	7.17	50
1100	1.0	0.5	15.5	12.5	183	126	121	152	126	154	166	6.30	7.28	50
1130	2.5	0.5	15.5	13.0	185	126	121	153	126	154	166	6.08	7.37	50
1200	2.5	0.5	15.5	12.5	186	127	121	154	126	154	166	6.04	7.43	50
1230	3.0	0.5	15.5	12.5	188	127	122	154	127	155	164	5.90	7.46	50
1300	4.0	0.5	15.5	12.5	187	126	121	155	125	153	164	5.83	7.53	50
1330	4.0	0.5	15.5	12.5	186	125	121	155	125	153	164	6.02	7.57	50
1400	4.5	0.5	15.5	12.5	186	125	120	155	125	153	164	6.08	7.65	50
(1) MIN:	0.5	0.5	15.5	12.5	183	126	120	151	126	154	164	5.90	7.17	50
MAX:	3.0	0.5	15.5	13.0	188	127	122	154	127	155	166	6.60	7.46	50
AVG:	1.9	0.5	15.5	12.6	185	126	121	153	126	154	165	6.18	7.34	50

(1) During period of flue gas sampling

APPENDIX A-4
CONTINUOUS EMISSION MONITOR DATA

CEM Data 8-6-91
Flue Gas Sampling (0945 - 1257)

Time	Kiln O ₂ (%)	AB O ₂ (%)	SE O ₂ (%)	SE CO (ppm)	SE CO ₂ (%)	SE TUHC (ppm)	SE NO _x (ppm)	Stack O ₂ (%)	Stack CO (ppm)	Stack CO ₂ (ppm)
905	14.3	7.6	15.6	-0.5	2.8	3.3	42.3	15.2	3.2	3.0
915	14.1	8.7	16.0	-2.5	2.7	3.7	40.0	15.4	3.2	2.8
930	13.2	7.4	15.3	0.0	3.2	3.9	42.8	14.8	3.3	3.3
945	12.5	7.1	15.3	0.5	3.2	3.2	40.8	14.7	3.8	3.4
1000	12.4	6.1	15.3	1.5	3.4	3.7	36.3	14.7	3.7	3.4
1015	12.9	6.4	15.2	0.5	3.4	3.7	27.0	14.7	3.8	3.3
1030	12.3	7.8	15.3	0.5	3.4	3.6	42.0	14.6	3.8	3.4
1045	12.3	7.6	15.2	1.0	3.3	3.6	40.8	14.7	4.1	3.4
1100	12.3	7.5	15.2	-1.0	3.3	3.4	39.5	14.7	3.8	3.3
1115	12.3	7.5	15.2	1.0	3.1	3.7	41.0	14.7	4.0	3.3
1130	12.6	7.3	15.2	0.0	3.3	3.7	40.0	14.7	3.9	3.3
1145	12.1	7.2	15.1	0.0	3.3	3.7	40.0	14.6	4.1	3.3
1200	11.5	6.7	15.1	0.0	3.6	3.6	29.0	14.5	3.9	3.6
1215	12.3	7.0	15.3	-1.0	3.2	3.6	39.5	14.6	4.2	3.3
1230	12.4	7.1	15.3	0.5	3.2	3.6	38.3	14.5	3.9	3.4
1245	12.4	6.7	15.1	1.0	3.5	3.9	34.5	14.6	4.3	3.4
1300	12.2	7.2	15.2	2.0	3.3	3.9	37.3	14.6	4.5	3.3
1315	9.9	7.5	15.1	1.0	3.2	3.6	41.3	14.3	4.2	3.4
1345	12.6	7.3	15.3	2.0	3.2	4.0	43.8	14.6	4.3	3.3
(1) MIN:	11.5	6.1	15.1	-1.0	3.1	3.2	27.0	14.5	3.7	3.3
MAX:	12.9	7.8	15.3	1.5	3.6	3.9	42.0	14.7	4.3	3.6
AVG:	12.3	7.1	15.2	0.3	3.3	3.6	37.6	14.6	3.9	3.4

CEM Data 8-8-91
Flue Gas Sampling (1018 - 1247)

Time	Kiln O ₂ (%)	AB O ₂ (%)	SE O ₂ (%)	SE CO (ppm)	SE CO ₂ (%)	SE TUHC (ppm)	SE NO _x (ppm)	Stack O ₂ (%)	Stack CO (ppm)	Stack CO ₂ (ppm)
939	13.5	8.4	15.0	-3.0	3.4	-2.4	40.0	16.5	3.5	3.4
945	12.4	7.6	14.9	-2.5	3.5	-2.0	36.5	16.2	3.9	3.6
1000	12.6	7.6	15.0	-2.5	3.4	-2.1	38.3	16.3	3.7	3.4
1015	13.0	7.6	14.9	-2.0	3.4	-2.0	40.5	16.1	3.7	3.5
1030	11.3	6.8	14.7	-3.0	3.7	-2.2	30.0	15.9	3.9	3.8
1045	11.9	7.3	14.8	-2.5	3.6	-2.1	34.3	15.9	3.8	3.6
1100	12.2	7.2	14.7	-1.5	3.8	-2.2	26.0	15.9	3.9	3.8
1115	11.9	7.3	14.6	-2.0	3.8	-2.0	12.5	15.9	3.9	3.8
1130	12.9	7.4	15.4	-3.0	3.0	-2.3	1.8	16.1	4.0	3.4
1145	12.5	7.7	14.7	-3.0	3.5	-2.1	40.0	16.0	4.1	3.6
1200	11.8	7.3	14.5	-2.0	3.7	-2.0	40.0	15.9	4.0	3.7
1215	12.8	7.9	15.0	-2.0	3.4	-2.3	40.0	16.1	4.0	3.5
1230	12.3	7.7	14.8	-3.0	3.4	-2.2	35.0	16.1	4.1	3.5
1245	12.4	7.7	14.8	-2.5	3.7	-2.2	35.0	16.1	4.2	3.6
1300	12.3	7.6	14.7	-2.5	3.4	-2.2	45.0	16.0	4.2	3.6
1315	12.0	6.6	14.5	-2.5	3.6	-2.1	40.0	15.8	4.2	3.8
1330	12.9	7.9	15.0	-2.5	3.4	-2.1	45.0	16.1	4.2	3.5
1345	13.0	8.1	14.9	-2.5	3.3	-2.3	40.0	16.1	3.9	3.5
1415	13.5	7.9	15.0	-2.0	3.3	-2.1	45.0	16.3	4.1	3.4
(1) MIN:	11.3	6.8	14.5	-3.0	3.0	-2.3	1.8	15.9	3.8	3.4
MAX:	12.9	7.9	15.4	-1.5	3.8	-2.0	40.0	16.1	4.2	3.8
AVG:	12.2	7.4	14.8	-2.5	3.6	-2.2	29.5	16.0	4.0	3.6

CEM Data 8-13-91
Flue Gas Sampling (1040 - 1312)

Time	Kiln O ₂ (%)	AB O ₂ (%)	SE O ₂ (%)	SE CO (ppm)	SE CO ₂ (%)	SE TUHC (ppm)	SE NO _x (ppm)	Stack O ₂ (%)	Stack CO (ppm)	Stack CO ₂ (ppm)
900	-5.6	13.2	14.0	-2.5	0.0	-2.4	0.5	0.3	2.9	0.0
915	19.6	20.7	21.1	-3.5	0.0	-2.2	0.0	21.9	3.2	0.0
930	7.9	6.9	14.9	-3.5	0.2	-2.5	0.5	12.5	2.7	2.7
945	-4.5	7.5	15.1	-4.5	3.3	-2.0	0.5	16.6	3.3	3.3
1015	11.3	7.9	15.2	-4.0	3.3	-2.0	0.5	16.5	3.1	3.3
1030	10.7	7.8	15.1	-3.0	3.3	-2.1	0.5	16.4	3.2	3.4
1045	10.7	7.6	14.9	-3.0	3.4	-1.9	0.0	16.3	3.0	3.5
1100	10.8	8.0	15.0	-4.0	3.4	0.0	40.0	16.3	3.3	3.4
1115	11.4	7.8	14.9	-3.0	3.4	0.0	35.0	16.3	3.3	3.5
1130	10.8	8.0	14.9	-3.0	3.4	0.0	35.0	16.3	3.3	3.4
1145	9.7	7.6	14.7	-3.0	3.7	0.0	40.0	15.8	3.5	3.8
1200	10.6	7.9	15.0	-3.0	3.4	0.0	40.0	16.2	3.4	3.5
1215	10.6	7.9	15.0	-4.5	3.3	0.0	40.0	16.3	3.4	3.4
1230	10.8	7.9	14.8	-3.0	3.4	0.0	40.0	16.1	3.8	3.5
1245	11.1	7.9	14.9	-3.0	3.5	0.0	40.0	16.3	3.6	3.4
1300	9.9	8.0	14.7	-4.0	3.5	0.0	40.0	16.1	3.7	3.5
1315	11.2	7.5	14.9	-3.5	3.6	0.0	40.0	16.1	3.6	3.4
1330	10.8	8.0	15.0	-4.5	3.4	0.0	45.0	16.2	3.6	3.5
1345	11.4	7.9	14.7	-3.0	3.7	0.0	40.0	16.1	3.7	3.7
1400	10.8	7.7	15.0	-3.5	3.7	0.0	40.0	16.2	3.7	3.4
1415	11.9	8.6	15.1	-4.0	3.3	0.0	40.0	16.3	3.5	3.4
1445	12.1	8.6	15.0	-3.0	3.3	0.0	50.0	16.3	3.4	3.3
1515								16.4	3.8	3.3

(1) MIN:
MAX:
AVG:

	9.7	7.6	14.7	-4.5	3.3	-1.9	0.0	15.8	3.0	3.4
	11.4	8.0	15.0	-3.0	3.7	0.0	40.0	16.3	3.8	3.8
	10.6	7.9	14.9	-3.4	3.4	-0.2	35.0	16.2	3.4	3.5

CEM Data 8-15-91
Flue Gas Sampling (1003 - 1245)

Time	Kiln O ₂ (%)	AB O ₂ (%)	SE O ₂ (%)	SE CO (ppm)	SE CO ₂ (%)	SE TUHC (ppm)	SE NO _x (ppm)	Stack O ₂ (%)	Stack CO (ppm)	Stack CO ₂ (ppm)
908	11.0	7.8	14.7	-1.0	3.5	0.0	45.0	16.0	3.1	3.5
930	12.3	7.5	14.7	-1.5	3.8	0.0	30.0	16.0	3.0	3.5
945	12.3	8.3	15.1	0.0	3.7	0.0	40.0	16.0	2.9	3.5
1000	12.0	8.3	15.1	-0.5	3.4	0.0	45.0	15.7	3.2	3.4
1015	11.2	8.1	14.9	0.5	3.4	0.0	45.0	15.9	3.0	3.6
1030	11.4	8.2	14.9	0.5	3.5	0.0	45.0	15.7	3.8	3.6
1045	11.4	8.3	14.8	-2.0	3.4	0.0	45.0	15.7	3.8	3.6
1100	12.6	8.3	15.0	-1.0	3.4	0.0	45.0	15.9	3.9	3.5
1115	11.9	8.3	14.9	0.0	3.4	0.0	45.0	15.9	3.7	3.5
1130	11.8	7.6	14.7	1.0	3.9	0.0	43.0	15.8	4.1	3.5
1145	12.5	8.4	14.9	-0.5	3.4	0.0	45.0	15.9	4.1	3.5
1200	13.3	8.5	14.9	0.5	3.4	0.0	50.0	15.9	4.3	3.5
1215	12.8	8.4	14.9	-1.0	3.5	0.0	45.0	15.9	4.3	3.5
1230	12.1	7.9	14.7	-0.5	3.6	0.0	45.0	15.7	4.3	3.6
1245	12.7	8.1	14.8	1.0	3.6	0.0	40.0	15.7	4.1	3.6
1300	12.1	7.9	14.5	0.5	3.5	0.0	40.0	15.7	4.3	3.7
1315	13.8	7.5	14.9	0.0	3.6	0.0	40.0	15.9	4.3	3.5
1330	14.3	8.3	14.9	-1.0	3.5	0.0	50.0	15.7	4.2	3.5
1400	15.7	8.7	15.0	-1.0	3.3	0.0	55.0	15.9	4.3	3.4
(1) MIN:	11.2	7.6	14.7	-2.0	3.4	0.0	40.0	15.7	3.0	3.5
MAX:	13.3	8.5	15.0	1.0	3.9	0.0	50.0	15.9	4.3	3.6
AVG:	12.2	8.2	14.9	-0.1	3.5	0.0	44.8	15.8	3.9	3.5

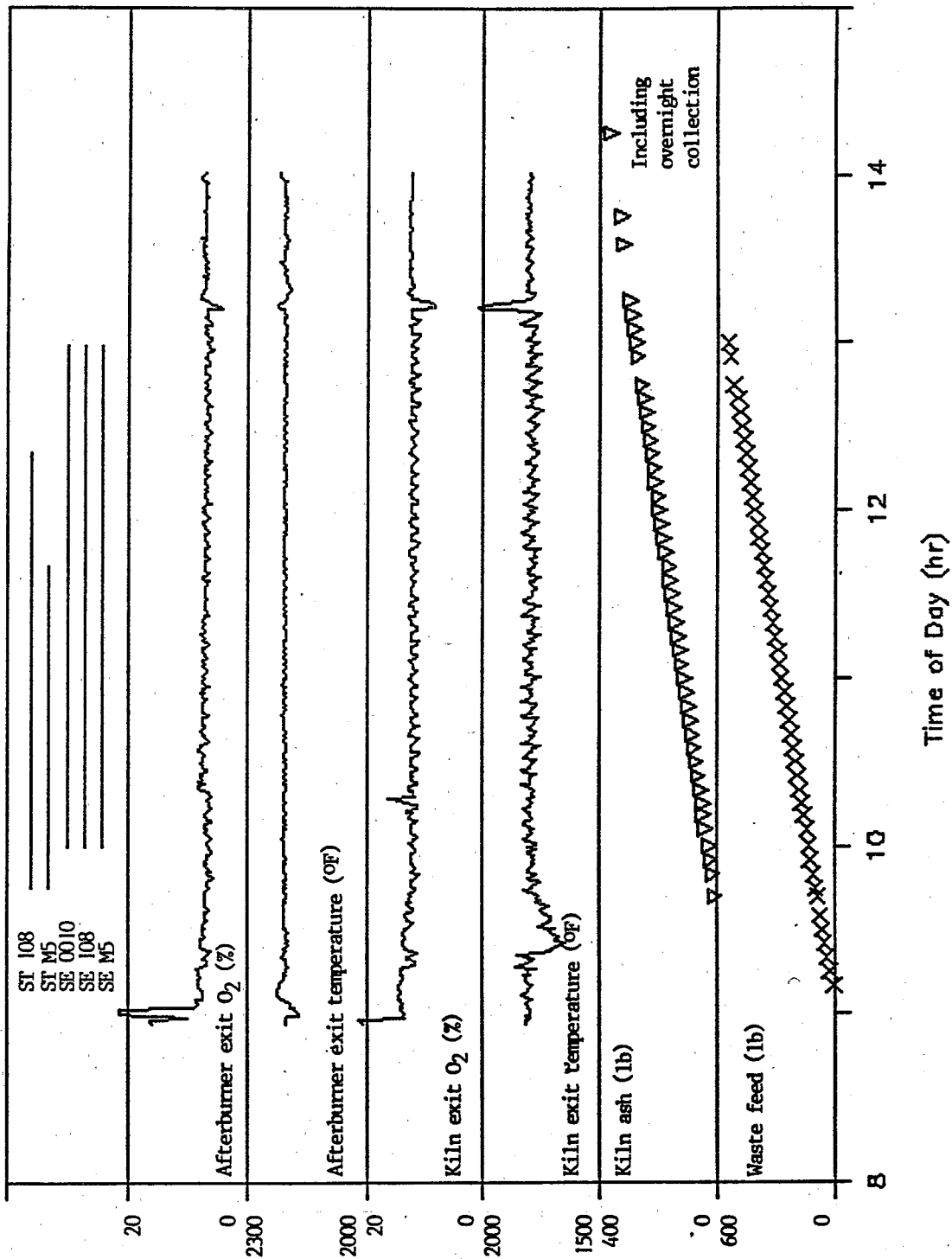
APPENDIX B
OPERATING DATA PLOTS

APPENDIX B-1

KILN AND AFTERBURNER OPERATION

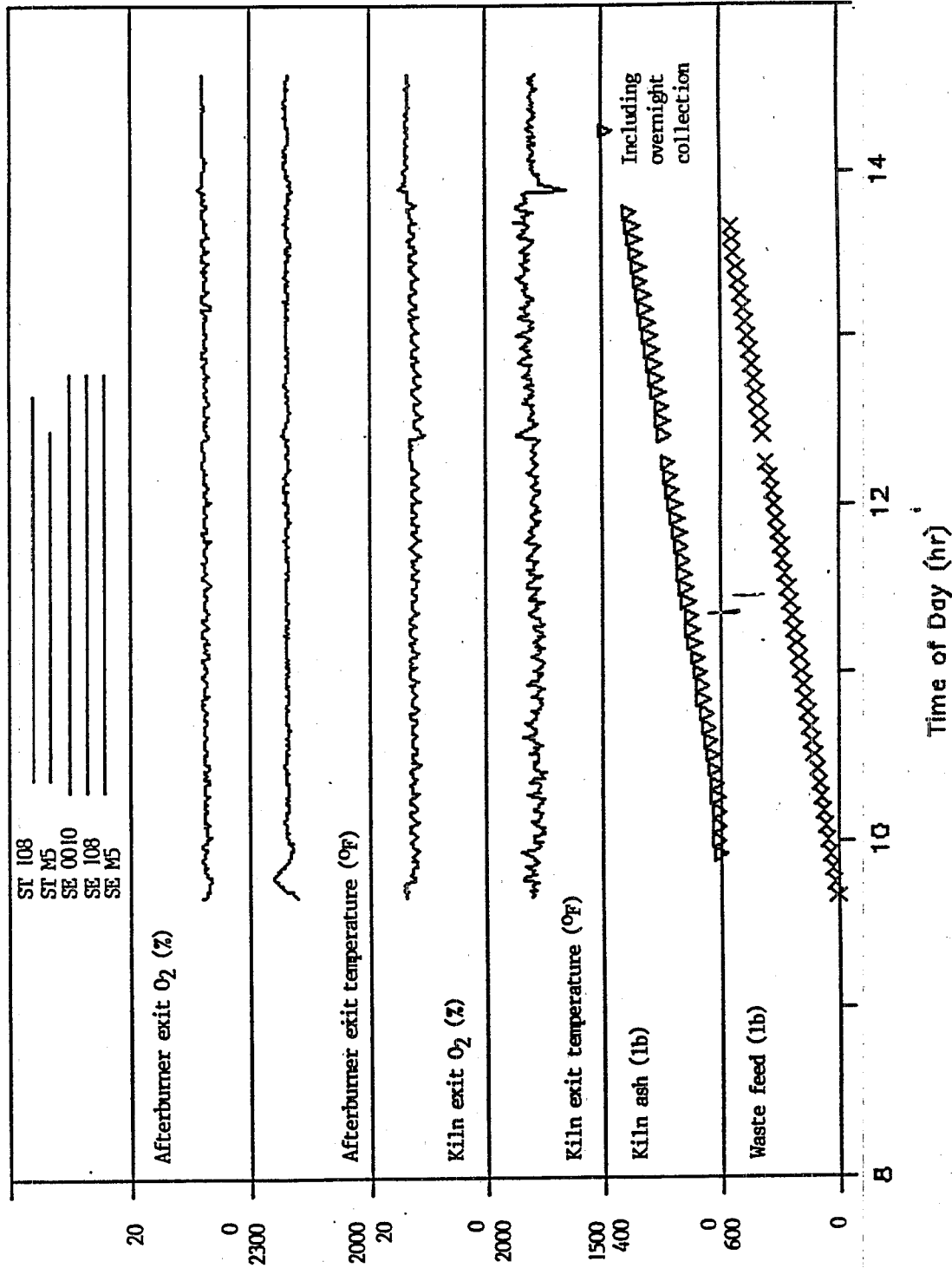
Test 1 (8/6/91)

Operation Data & Sampling Events



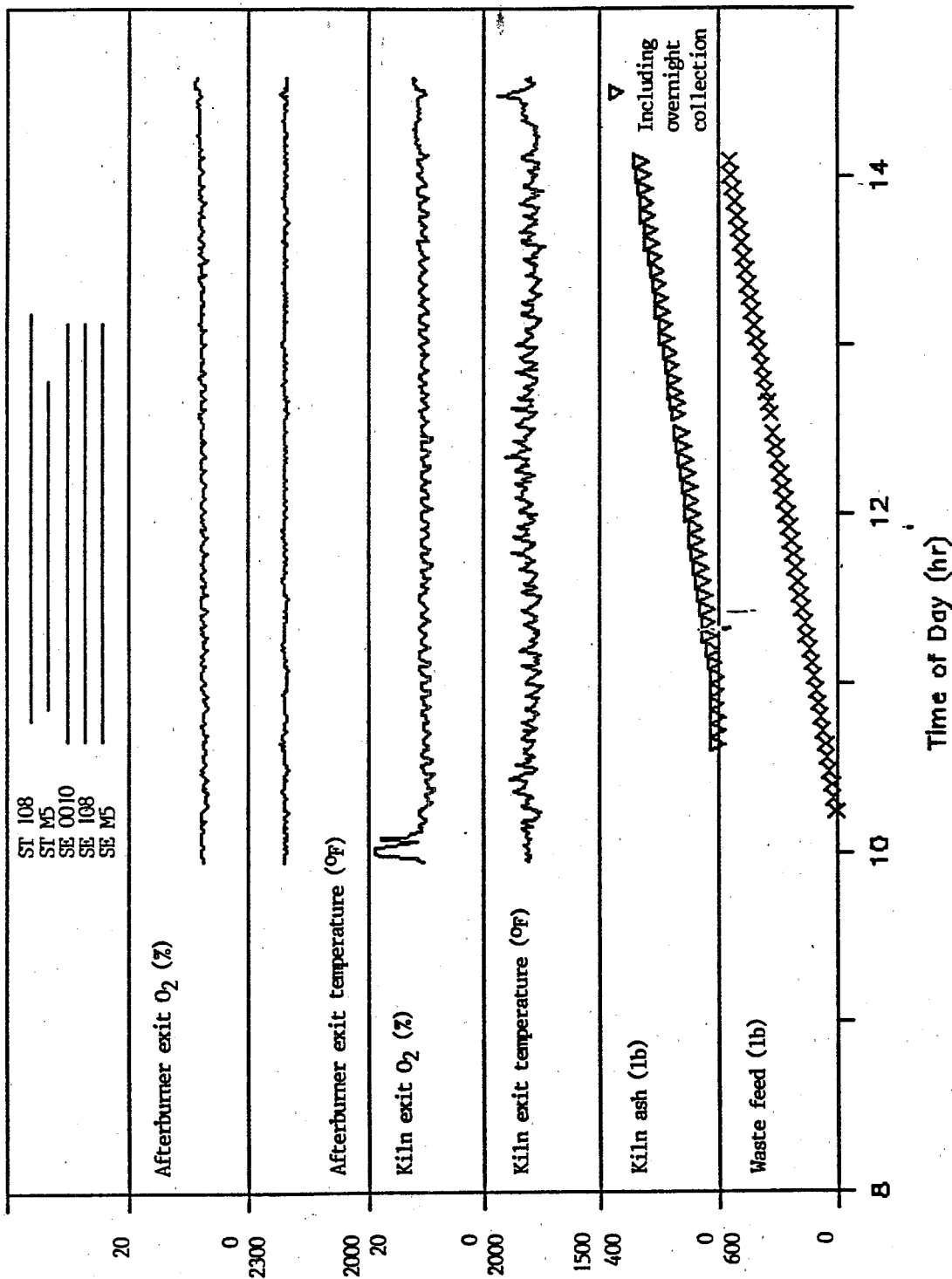
Test 2 (8/8/91)

Operation Data & Sampling Events



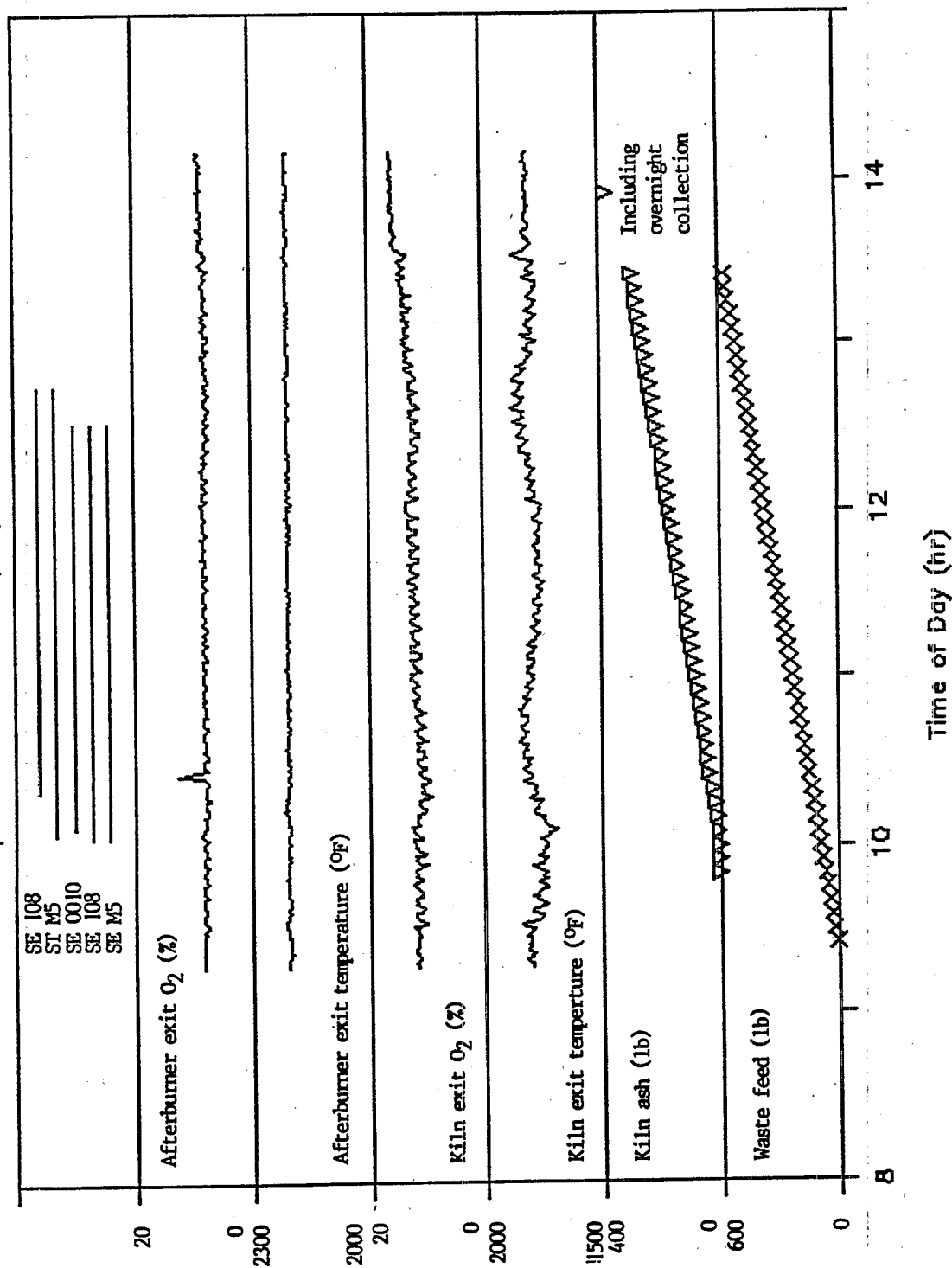
Test 3 (8/13/91)

Operation data & Sampling Events



Test 4 (8/15/91)

Operation Data & Sampling Events

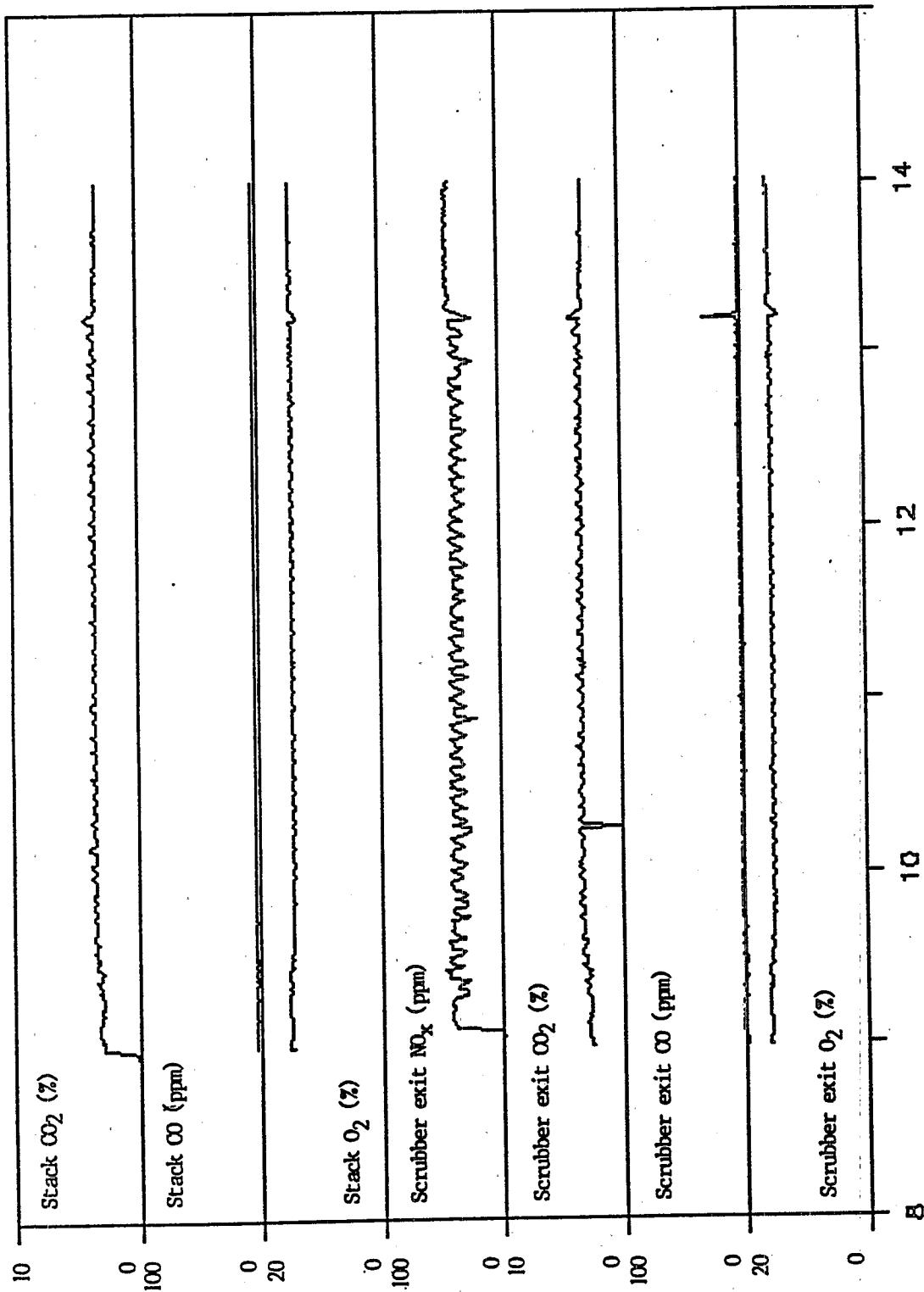


APPENDIX B-2

SCRUBBER EXIT AND STACK CONTINUOUS EMISSION MONITORS

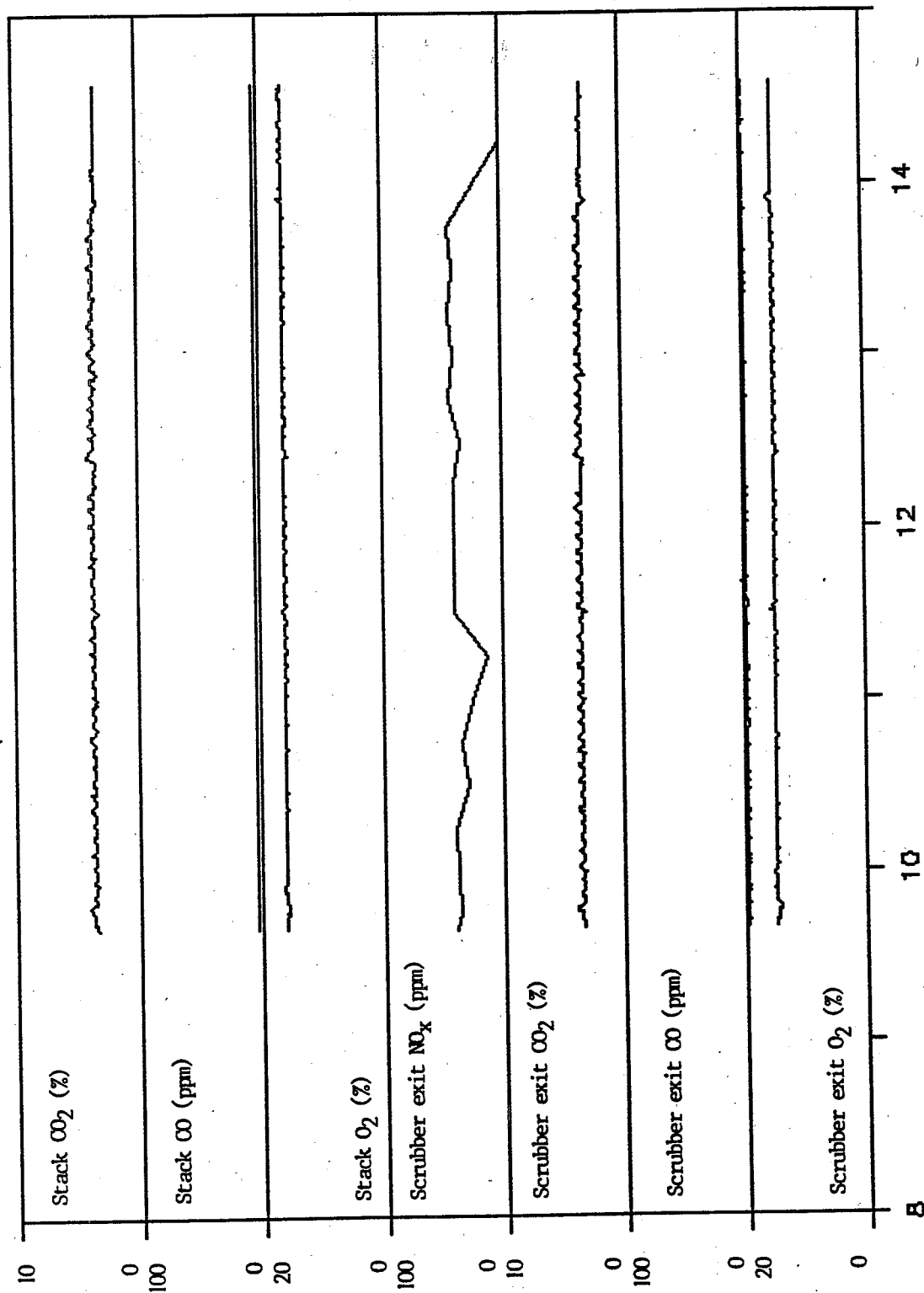
Test 1 (8/6/91)

Operation Data



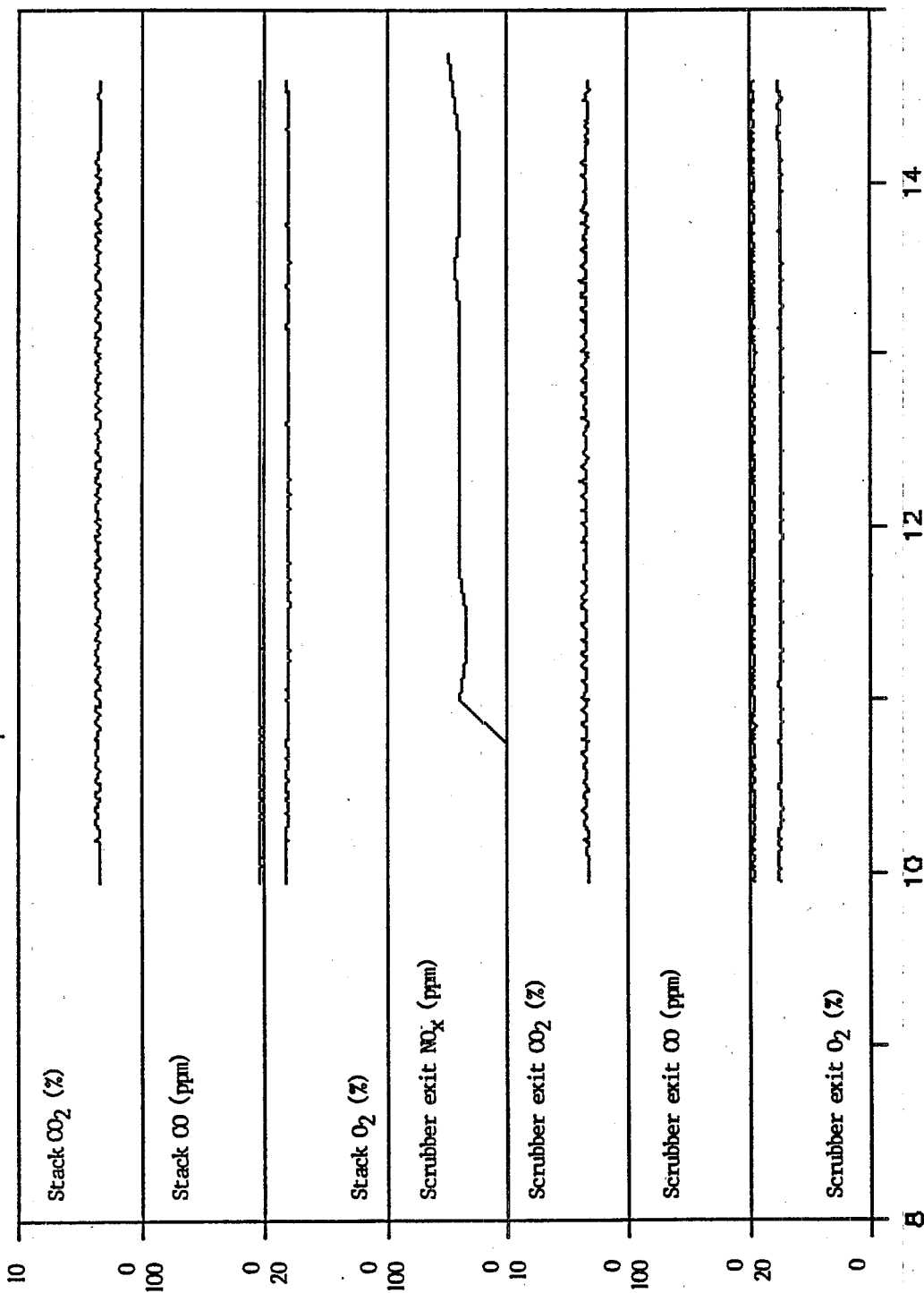
Test 2 (8/8/91)

Operation Data



Test 3 (8/13/91)

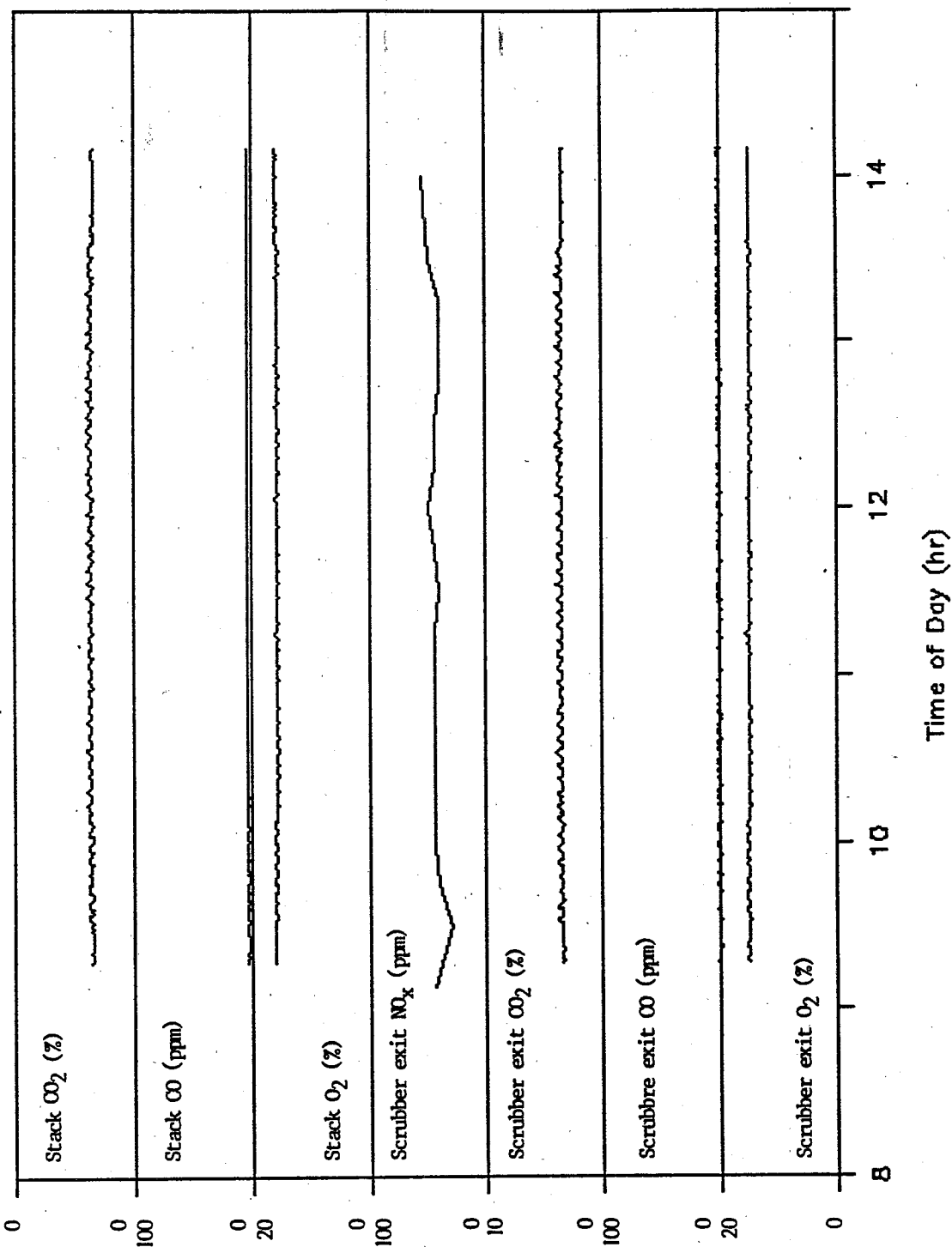
Operation Data



Time of Day (hr)

Test 4 (8/15/91)

Operation Data



APPENDIX C

LABORATORY ANALYSIS DATA

In the analytical reports that follow, test program samples are identified by a unique sample identifier. Table C-1 outlines the convention for assigning sample identifiers. Table C-2 lists the sample identifiers for the test program samples collected. Table C-3 lists the identifiers for the blank samples analyzed and Table C-4 lists the identifiers for the matrix spike samples prepared and analyzed.

TABLE C-1. IRF SAMPLE IDENTIFIER CONVENTION

Form of Sample Identifier

Y M D D H H M M 1 2 3 4 5

Original Generation Suffix

Original Generation

Y = Year, last digit: 1 = 91, 2 = 92, etc...

M = Month:

Jan - 1,

Feb - 2,

Mar - 3,

Apr - 4,

May - 5,

Jun - 6,

Jul - 7,

Aug - 8,

Sep - 9,

Oct - A,

Nov - B,

Dec - C

DD = Day, numeric

HH = Hour, numeric 24 hour convention

MM = Minute, numeric

Suffix

1 = Sample type:

A Afterburner exit flue gas

B Scrubber liquor

E Scrubber exit flue gas

F Feed

K Kiln exit flue gas

P Preburn feed

Q Prepared in laboratory

S Stack gas

T Ash

Z Other

2 = Sampling Procedure

0 Not Applicable

A Cascade impactor

C Composite

F Fluoride train (13B)

G Grab

H Mercury train (101A)

M Multiple metals train

P Method 5 (particulate/HCl)

R Arsenic train (108)

S Modified Method 5 (0010)

V VOST (0030)

Z Other

3 = Sample Fraction

0 Total sample

1 Individual impinger or impactor stage 1

2 Individual impinger or impactor stage 2

3 Individual impinger or impactor stage 3

4 Individual impinger or impactor stage 4

F Filter

I Combined impingers

M Probe wash + Impinger

P Probe wash + Filter

W Probe wash

X Sorbent resin (XAD-2)

Z Other

4 = Preparation Procedure

0 None

B Organic extract in Benzene

D Digestion or fusion digestate

E Aqueous leachate - EP toxicity

F Filtration Filtrate

G Organic extract in Hexane

H Organic extract in Hexane of TCLP leachate

M Organic extract in Methylene chloride

N Organic extract in Methylene chloride of TCLP leachate

S Filtration solids

T Aqueous leachate - TCLP

W Aqueous leachate - Water

Z Other

5 = QA Description

0 Not applicable

D Split sample duplicate

S Spiked sample

P Spiked sample duplicate

L Lab blank

M Method blank

F Field blank

T Trip blank

Z Other

TABLE C-2. TEST PROGRAM SAMPLES COLLECTED

Sample type	Test 1	Test 2	Test 3	Test 4
Soil feed				
Sample	18051245FCOOO	18051030FCOOO	18051445FCOOO	18141440FCOOO
Organic extract	18051245FCOGO	18051030FCOGO	18051445FCOGO	18141440FCOGO
TCLP leachate	18051245FCOTO	18051030FCOTO	18051445FCOTO	18141440FCOTO
TCLP leachate organic extract	18051245FCOHO	18051030FCOHO	18051445FCOHO	18141440FCOHO
Kiln ash				
Sample	18061310TG00O	18081345TG00O	18131405TG00O	18151325TG00O
Organic extract	18061310TGOGO	18081345TGOGO	18131405TGOGO	18151325TGOGO
TCLP leachate	18061310TGOTO	18081345TGOTO	18131405TGOTO	18151325TGOTO
Scrubber liquor				
Sample	18061616BG00O	18081656BG00O	18131656BG00O	18151652BG00O
Organic extract	18061616BGOGO	18081656BGOGO	18131656BGOGO	18151652BGOGO
Scrubber exit flue gas				
Method 0010 train organic extract	18061000ESOGO	18081018ESOGO	18131040ESOGO	18151003ESOGO
Flue gas Method 108 train				
Scrubber exit				
Filter	18061000ERFOO	18081018ERFOO	18131040ERFOO	18151003ERFOO
Probe wash	18061000ERWOO	18081018ERWOO	18131040ERWOO	18151003ERWOO
Impinger solution	18061000ERIOO	18081018ERIOO	18131040ERIOO	18151003ERIOO
Stack				
Filter	18060945SRFOO	18081022SRFOO	18131047SRFOO	18151020SRFOO
Probe wash	18060945SRWOO	18081022SRWOO	18131047SRWOO	18151020SRWOO
Impinger solution	18060945SRIOO	18081022SRIOO	18131047SRIOO	18151020SRIOO
Flue gas Method 5 train Impinger solutions				
Scrubber exit	180601000EPIOO	18081018EPIOO	18131040EPIOO	18151003EPIOO
Stack	180600945EPIOO	18081022SPIOO	18131051SPIOO	18151005SPIOO
Soil feed pretest characterization sample				
	Drum 1	Drum 2	Drum 3	Drum 4
	P02261500	P02261504	P02261509	P02261512

TABLE C-3. BLANK SAMPLES ANALYZED

	Organochlorine pesticides	Trace metals	Mercury	Arsenic	Chloride
Scrubber liquor	18130840BG00F	18130840BG00M	18130840BG00M		
Method 0010 train					
Solvent	18061452QOZZL				
Sorbent resin	18061452QOXGM				
Method 108 train					
Filter				18211000QRFOM	
Probe wash				18211000QRWOM	
Impinger solution				18211000QRIOM	
Method 5 train					18211000QPIOM
Impinger solution					
TCLP extraction fluid	18201500QOOHM	18271200QOUTM	18271200QOOTM		
Water blank	18281000QOOGL	19161100QGOOT	18211320QGOOT 19041430QGOOT	19131133QOOOT	

TABLE C-4. EXTERNAL MATRIX SPIKE SAMPLES ANALYZED

	Organochlorine pesticides	Trace metals	Mercury	Arsenic	Chloride
Spiking solution		19090857QGOOS 2109125QOOOS		19120853ZOFOS	
Soil feed					
MS	18051445FCOGS	18051445FCOOS	18051445FCOOS		
MSD	18051445FCOGP	18051445FCOOP	18051445FCOOP		
Kiln ash					
MS	18131405TGOGS	18131405TGOOS	18131405TGOOS		
MSD	18131405TGOGP	18131405TGOOP	18131405TGOOP		
Kiln ash TCLP leachate					
MS		18131405TGOTS	18131405TGOTS		
MSD		18131405TGOTP	18131405TGOTP		
Scrubber liquor					
MS	18151652BGOGS	18131656BGOOS	18131656BGOOS		
MSD	18151652BGOGP	18131656BCOOP	18131656BGOOP		
Method 0010 train sorbent resin					
MS	18131645QOXGS				
MSD	18131646QOXGP				
Method 108 train					
Filter, MS				18131010QRFOS	
Filter, MSD				181311112QRFOP	
Probe wash, MS				18131010QRWOS	
Probe wash, MSD				18131112QRWOP	
Impinger, MS				18131010QRIOS	
Impinger, MSD				18131112QRIOP	
Method 5 train impinger solution					
MS					18031040EPIOS
MSD					18031040EPIOP

APPENDIX C-1
PROXIMATE AND ULTIMATE ANALYSES

Ms. Joan Bass
Acurex Corporation
Highway 65N., NCTR Building 45
Jefferson, Arkansas 72079

September 16, 1991

Received: August 28th

Dear Ms. Bass:

Analysis of your compound gave the following results:

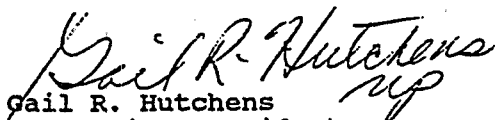
Your #,	Our #,	Analyses,	
1819010FC000*	S-6739	As Received,	
MI000958		% Moisture by Karl Fischer Water	16.34
		Dried and Ground Basis,	
		% Carbon	2.68
		% Hydrogen	<0.5
		% Nitrogen**	0.092
		% Chlorine	0.05
		% Sulfur	0.043
		% Ash	94.07
		BTU/pound	465

*We regret that we cannot determine Oxygen in dirt.

**The nitrogen results were determined by Leco Nitrogen analyzer.

We regret that we cannot determine Oxygen in the presence of high ash content.

Sincerely yours,


Gail R. Hutchens
Exec. Vice-President

GRH:dse

Project: Chemical Insecticide Corp.

Report Number: CIC-3

Revision: 0

U.S. E.P.A I.R.F Laboratory

Bulk Density (Specific Gravity) by Method D5057-90

Sample ID Number 18051030FC000 18051245FC000 18051445FC000 18141440FC000 18191010FC000

Collection Date 8/05/91 8/05/91 8/05/91 8/14/91 8/26/91

Analysis Date 9/11/91 9/11/91 9/11/91 9/11/91 9/11/91

Bulk Density (g/ml) 1.58 1.82 1.94 1.62 1.47

Sample ID Number 18061310TG000 18081345TG000 18131405TG000 18151325TG000

Collection Date 8/06/91 8/08/91 8/13/91 8/15/91

Analysis Date 9/11/91 9/11/91 9/11/91 9/11/91

Bulk Density (g/ml) 1.36 1.40 1.34 1.37

ANALYST Sharon Kings DATE 9/17/91

LAB SUPERVISOR Dennis B. Tabor DATE 9/17/91

Project: Chemical Insecticide Corp.
Report Number: CIC-1
Revision: 0

U.S. E.P.A I.R.F Laboratory
Scrubber Liquor pH Report

=====

Sample ID Number	18061616BG000	18081656BG000	18130840BG000
------------------	---------------	---------------	---------------

Collection Date	8/6/91	8/8/91	8/13/91
Analysis Date	8/20/91	8/20/91	8/20/91
pH value	9.22	10.54	7.3

=====

=====

Sample ID Number	18131656BG000	18151652BG000
------------------	---------------	---------------

Collection Date	8/13/91	8/15/91
Analysis Date	8/20/91	8/20/91
pH value	9.17	11.69

=====

ANALYST Joan E. Bass DATE 8-21-91

LAB SUPERVISOR Dennis J. Kaler DATE 8/21/91

APPENDIX C-2
TRACE METAL ANALYSES

DATE: June 20, 1991
TO: Howard Wall, RREL
FROM: Jim Voit, EMSL Analytical
Inorganic Group Leader
SUBJECT: Results of Metals Analyses

Attached, please find final results of the metals analyses for the samples submitted on April 25 from the Chemical Insecticides Project.

If you have any questions on these data, please contact me at extension 7152.

SUMMARY OF RESULTS FOR ANALYSIS OF METALS BY ICP

CONTRACTOR: TAI ANALYST: J. VOIT
DATE RECEIVED: 04/25/91 DATE REPORTED: 05/14/91
REQUESTOR: WALL MATRIX: SOIL
PAGES REPORTED: 1 METHOD: SW 846 - 6010,3050;7471
FILE NAME: WALL\$01 DISC: RCF/ICP 001
DATE OF ANALYSIS: 05/08/91
CHECKED BY:
RESULTS ARE EXPRESSED IN ppm (mg/kg)

TAI LAB	SAMPLE ID		As	Ag	Ba	Be	Cd	Cr	Pb
91-2270	P02261	500	1260	<0.33	63.3	0.343	2.25	16.5	54.6
91-2271	P02261	504	771	<0.35	52.1	0.246	1.47	17.0	79.6
91-2272	P02261	509	875	<0.34	59.1	0.350	2.11	17.5	104
91-2273	P02261	512	784	<0.49	59.9	0.346	1.86	17.5	103
LPC	IS050691.1		2.07	.194	2.09	.198	2.047	2.081	1.926
BLANK	0513918		<.070	<.010	<.006	<.001	.0007	<.002	<.035

TAI LAB	SAMPLE ID		Sb	Se	Ti	Hg
91-2270	P02261	500	11.8	<4.4	164	7.84
91-2271	P02261	504	9.50	<4.7	185	8.90
91-2272	P02261	509	24.3	<4.5	145	10.5
91-2273	P02261	512	33.2	<6.6	156	8.57
LPC	IS050691.1		2.09	2.15	2.10	.096
BLANK	0513918		<.052	<.080	<.005	<.002

SUMMARY OF MATRIX SPIKE RESULTS (% RECOVERY)

SPL	91- 2272	P02261509	As	Ag	Ba	Be	Cd	Cr	Pb
LEVEL OF SPIKE		ug/g	246	6.15	0	0	6.15	0	61
ORIG SPL CONC		MG/KG	875	<0.34	NS	NS	2.11	NS	104
MAT SPK CONC		MG/KG	943.9	5.45	NS	NS	7.66	NS	180
MAT SPK REC		% REC	28.0	88.6	NS	NS	90.3	NS	123

SPL	91- 2272	P02261509	Sb	Se	Ti	Hg
LEVEL OF SPIKE		ug/g	0	246	0	100
ORIG SPL CONC		MG/KG	NS	<4.5	NS	7.84
MAT SPK CONC		MG/KG	NS	276	NS	*
MAT SPK REC		% REC	NS	112	NS	*

SUMMARY OF LABORATORY DUPLICATE ANALYSIS

RESULTS ARE EXPRESSED IN ppm (mg/kg)

TAI LAB	SAMPLE ID	As	Ag	Ba	Be	Cd	Cr	Pb
91-2272	P02261509	875	<0.34	59.06	0.35	2.11	17.52	104
91-2272d	P02261509	827	<0.40	69.91	0.28	2.40	17.90	128
	REL % DIFF	5.7	NC	16.8	23.5	12.9	2.2	20.4

TAI LAB	SAMPLE ID	Sb	Se	Ti	Hg
91-2272	P02261509	24.32	4.49	145	7.84
91-2272d	P02261509	20.14	5.32	173	7.84
	REL % DIFF	18.8	16.9	17.8	0.0

NS=NOT SPIKED

NC=NO CALCULATION

* HG SPIKE LEVEL INAPPROPRIATE TO SAMPLE CONCENTRATION;
NO RECOVERY CALCULATED

NOTE: IEC CHECK FOR ~~AS~~, BE, PB OUTSIDE METHOD CRITERION OF 80 - 120%

summary of results for analysis of metals by ICAP

SUMMARY OF RESULTS FOR ANALYSIS OF METALS BY ICP

CONTRACTOR: TAI ANALYST: J. VOIT
 DATE RECEIVED: 04/25/91 DATE REPORTED: 05/23/91
 REQUESTOR: WALL MATRIX: LEACHATE
 PAGES REPORTED: 1 METHOD: SW 846 - 6010.3010;7471
 FILE NAME: WALL\$02 DISC: RCF/ICP 001
 DATE OF ANALYSIS: 05/23/91
 CHECKED BY:
 RESULTS ARE EXPRESSED IN ppm (mg/l)

TAI LAB	SAMPLE ID	As	Ag	Ba	Be	Cd
91-1932	P0226 1500TCLP	3.00	<.010	0.922	0.002	0.015
91-1933	P0226 1504TCLP	2.07	<.010	0.484	0.002	0.014
91-1934	P0226 1508TCLP	1.49	<.010	0.031	<.001	0.012
91-1935	P0226 1512TCLP	1.18	<.010	0.079	<.001	0.014
SPKBLK	IS052091.1	4.36	0.038	4.22	1.03	0.108
BLANK	052091	<.070	<.010	<.006	<.001	<.002

TAI LAB	SAMPLE ID	Cr	Pb	Sb	Se	Ti
91-1932	P0226 1500TCLP	0.051	0.062	0.175	<.080	0.016
91-1933	P0226 1504TCLP	0.076	0.052	0.058	<.080	0.018
91-1934	P0226 1508TCLP	0.072	0.051	0.077	<.080	0.026
91-1935	P0226 1512TCLP	0.216	0.051	0.113	<.080	0.029
SPKBLK	IS052091.1	0.654	1.06	3.06	4.64	NS
BLANK	052091	0.021	<.035	<.052	<.080	<.005

NS = NOT SPIKED

SUMMARY OF QUALITY CONTROL RESULTS

SUMMARY OF MATRIX SPIKE RESULTS (% RECOVERY)

SPL	91- 1932	P02261500	150	As	Ag	Ba	Be	Cd
LEVEL OF SPIKE		ug/ml		4.00	0.100	4.00	1.00	0.100
ORIG SPL CONC		ug/ml		3.00	<.010	0.922	0.002	0.015
MAT SPK CONC		ug/ml		7.18	0.106	4.98	0.984	0.114
MAT SPK REC		% REC		105	106	101	98.4	99.0

SPL	91- 1932	P02261500	Cr	Pb	Sb	Se	Ti
LEVEL OF SPIKE		ug/ml	0.600	1.00	2.00	4.00	0
ORIG SPL CONC		ug/ml	0.051	0.062	0.175	<.080	0.016
MAT SPK CONC		ug/ml	0.627	1.04	3.07	4.54	NS
MAT SPK REC		% REC	96.0	97.8	145	114	NS

Ms. Joan Bass
Acurex Corporation
Highway 65N., NCTR Building 45
Jefferson, Arkansas 72079

September 16, 1991

Received: Sept. 5th

Dear Ms. Bass:

Analysis of your compound gave the following results:

Your #,	Our #,	Mercury,	% Spike Recovery,
18051030FCOT0	S-7853	<0.002 mg/liter	
18051245FCOT0	S-7854	<0.002 mg/liter <0.002 mg/liter	
18051445FCOT0	S-7855	<0.002 mg/liter	
18141440FCOT0	S-7856	<0.002 mg/liter	
18061310TGOT0	S-7857	<0.002 mg/liter	
18081345TGOT0	S-7858	<0.002 mg/liter <0.002 mg/liter	
18131405TGOT0	S-7859	<0.002 mg/liter	63 74
18151325TGOT0	S-7860	<0.002 mg/liter	

Ms. Bass
Page 2
September 16, 1991

Your #,	Our #,	Mercury,	% Spike Recovery,
18271200Q00TM	S-7861	<0.002 mg/liter	
19041430QG00T	S-7862	<0.002 mg/liter	

Sincerely yours;


Gail R. Hutchens
Exec. Vice-President

GRH:dse

Mr. Dennis Tabor
Acurex Corporation
Highway 65 N. NCTR Building 45
Jefferson, Arkansas 72079

August 30, 1991

Received: August 22nd

Dear Mr. Tabor:

Analysis of your compounds gave the following results:

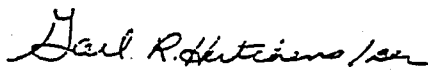
Your #,	Our #,	Mercury,	Spike Recovery,
18061616BG000-MI000868	S-5783	0.007 mg/liter	
18081656BG000-MI000869 18081656B600P	S-5784	<0.002 mg/liter <0.002 mg/liter	
18131656BG0000-MI000870	S-5785	<0.002 mg/liter	67.0 % B600S 71.6 % B600P
18130840BG00M-MI000875	S-5786	<0.002 mg/liter	
18151652BG000-MI000876	S-5787	<0.002 mg/liter	
18051030FC000-MI000877	S-5788	10.25 ppm	
18051245FC000-MI000878 18051245F600P	S-5789	5.78 ppm 8.47 ppm	
18051445FC000-MI000879	S-5790	5.39 ppm	112.7 % F600S 132.7 % F600P
18061310TG000-MI000881	S-5791	<1.0 ppm	
18081345TG000-MI000882 18081345T600P	S-5792	<1.0 ppm <1.0 ppm	
18131405TG000-MI000883	S-5793	<1.0 ppm	50.3 % T600S 65.4 % T600P

Mr. Tabor
Page 2
August 30, 1991

Your #,	Our #,	Mercury,	Spike Recovery,
18151325TG000-MI000884	S-5794	<1.0 ppm	
18211320QG00T-MI000885	S-5795	<0.002 mg/liter	
18141440FC000-MI000903	S-5796	6.17 ppm	

The spiked samples were spiked at two times the level found or 5 times the MDL and then digested.

Sincerely yours,



Gail R. Hutchens
Exec. Vice-President

GRH:dse



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
CINCINNATI, OHIO 45268

DATE: December 23, 1991
SUBJECT: Metals Analyses Data of CIC Samples
FROM: Nathan C. Malof, Project Officer *NCM*
EMSL Analytical
TO: Howard Wall
RREL

Attached are the metals results on 20 samples submitted September 19, 1991. The remainder of the data on the other 15 samples will be submitted to you the week of January 6, 1992.

If you have any questions, call me at 7286.

SUMMARY OF RESULTS FOR ANALYSIS OF METALS BY ICP AND FLAME AA SPECTROPHOTOMETRY

CONTRACTOR:	TAI	ANALYST:	J. Voit
DATE RECEIVED:	9/17/91	DATE REPORTED:	12/06/91
REQUESTOR:	H. WALL	MATRIX:	Liquid
PAGES REPORTED:	2	METHOD:	SW 846 - 6010, 3010
FILE NAME:	CIC01	DISC:	RCF/ICP02
DATE OF ANALYSIS:	10/24/91		
CHECKED BY:	JBV	APPROVED BY:	

RESULTS ARE EXPRESSED IN ppm (UG/ML)

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
91-05248	18061616BG000	093091-1	0.010	8.52	0.156	0.054	0.145	0.232	<0.130
91-05248	Spike	093091-1	0.052	10.3	2.00	0.238	1.03	1.14	1.92
91-05249	18081656BG000	093091-1	<.005	11.5	0.227	0.023	0.089	0.265	<0.130
91-05249	Duplicate	093091-1	<.005	11.4	0.227	0.024	0.096	0.285	0.183
91-05257	19090857QG00S	093091-1	0.041	0.678	0.043	0.110	0.361	1.15	0.436
91-05258	18130840BG00M	093091-1	<.005	<0.096	0.300	0.004	<0.029	0.118	<0.130
91-05259	18131656BG000	093091-1	<.005	10.2	0.207	0.017	0.064	0.289	0.139
91-05260	18151652BG000	093091-1	<.005	6.01	0.261	0.011	0.057	0.229	<0.130
91-05261	18131656BGZ0S	093091-1	0.025	26.2	0.262	0.117	0.430	1.27	0.477
91-05262	18131656BGZ0P	093091-1	0.032	22.1	0.257	0.113	0.439	1.27	0.467
blank	3010 93091-1	093091-1	<.005	<0.096	0.002	<0.002	<0.029	0.216	<0.130
spkblk	3010 93091-1	093091-1	0.028	1.99	1.95	0.204	0.939	1.02	1.89

Quality Control Results Summary: CIC01

Duplicates expressed as relative percent difference
Spikes expressed as percent recovery

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
91-05249	Duplicate	093091-1	N/C	0.79	0.00	4.26	7.57	7.27	N/C
91-05248	Spike	093091-1	10.5	89.5	92.2	92.0	88.5	90.8	96.0
spkblk	3010 93091-1	093091-1	6.90	100	97.6	102	93.9	102	94.3

N/C = Not Calculated

Analyte Spiking Levels (ug/ml):

Ag=0.4 As=2 Ba=2 Cd=.2 Cr=1 Pb=1 Se=2

SUMMARY OF RESULTS FOR ANALYSIS OF METALS BY ICP AND FLAME AA SPECTROPHOTOMETRY

CONTRACTOR: TAI ANALYST: W.H. RILEY
 DATE RECEIVED: 9/17/91 DATE REPORTED: 12/06/91
 REQUESTOR: H. Wall MATRIX: Solid
 PAGES REPORTED: 2 METHOD: SW 846 - 6010, 3010
 FILE NAME: C1C02 DISC: RCF/ICP02
 DATE OF ANALYSIS: 10/22-24/91
 CHECKED BY: JBV

APPROVED BY:

RESULTS ARE EXPRESSED IN ppm (UG/ML)

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
91- 05243	18051030FC000	101091-1	<0.438	1039	56.2	1.68	16.4	120	<11.4
91- 05243	Spike	101091-1	15.4	1108	138	9.66	55.3	155	85.8
91- 05244	18051245FC000	101091-1	<0.005	1040	65.6	1.10	19.0	118	<0.130
91- 05244	Duplicate	101091-1	0.093	808	54.9	0.96	18.1	94.7	<0.130
91- 05245	18051445FC000	101091-1	<0.434	794	48.1	0.859	16.7	104	<11.3
91- 05246	18061310TG000	101091-1	<0.473	653	59.9	0.501	9.72	73.5	<12.3
91- 05247	18081345TG000	101591-1	<0.449	619	59.6	0.422	11.3	57.8	16.4
91- 05247	Duplicate	101591-1	<0.460	608	56.8	0.672	11.8	53.5	<10.7
91- 05250	18141440FC000	101091-1	<0.476	803	43.1	0.971	13.1	85.8	14.9
91- 05251	18131405TG000	101091-1	<0.462	619	63.9	0.684	10.6	60.6	15.0
91- 05252	18151325TG000	101091-1	<0.436	1098	74.1	0.854	13.5	82.5	<11.3
91- 05253	18051445FCZ0S	101091-1	2.43	732	39.8	3.06	15.8	65.6	16.8
91- 05254	18051445FCZ0P	101591-1	2.37	849	42.6	3.38	17.5	72.8	25.7
91- 05255	18131405TGZ0S	101591-1	3.99	912	89.9	8.06	31.1	128	30.1
91- 05256	18131405TGZ0P	101591-1	3.62	909	98.6	7.74	33.9	135	32.4
blank	3005 101091-1	101091-1	0.018	<0.096	<0.001	<0.002	<0.029	<0.066	<0.130
spkblnk	3005 101091-1	101091-1	0.186	0.899	0.922	0.096	0.464	0.457	0.911
blank	3005 101591-1	101591-1	<0.005	<0.096	0.003	0.003	<0.029	<0.066	<0.143
spkblnk	3005 101591-1	101591-1	0.170	0.966	0.976	0.102	0.484	0.524	1.06

Quality Control Results Summary: CIC02

Duplicates expressed as relative percent difference
Spikes expressed as percent recovery

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
91-05243	Spike	101091-1	88	79	94	91	89	80	98
91-05244	Duplicate	101091-1	N/C	1.7	13.1	10.7	8.2	9.3	N/C
91-05247	Duplicate	101591-1	N/C	1.9	4.9	45.8	4.3	7.6	N/C
spkblk	3010 101091-1	101091-1	84	90	92	96	93	91	91
spkblk	3010 101591-1	101591-1	85	97	98	99	97	105	91

N/C = Not Calculated

Analyte Spiking Levels (ug/ml):

Ag=0.2 As=1 Ba=1 Cd=0.1 Cr=.5 Pb=.5 Se=1



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
CINCINNATI, OHIO 45268

DATE: January 10, 1992

SUBJECT: Metals Analyses Data for the Chemical Insecticide Project

FROM: Nathan C. Malof, Project Officer *NCM*
EMSL Analytical

TO: Howard Wall
RREL

Attached are the metals results for samples submitted September 17, 1991. The appended report CICO3 includes data for samples 91-05263 through 91-05270; report CICO4 includes results for samples 91-05271 through 91-05276.

If you have any questions, call me at 7286.

SUMMARY OF RESULTS FOR ANALYSIS OF METALS BY ICP AND FLAME AA SPECTROPHOTOMETRY

CONTRACTOR:	TAI	ANALYST:	J. Voit
DATE RECEIVED:	9/17/91	DATE REPORTED:	1/3/92
REQUESTOR:	H. WALL	MATRIX:	Liquid
PAGES REPORTED:	2	METHOD:	SW 846 - 6010, 3010
FILE NAME:	CIC03	DISC:	RCF/ICP02
DATE OF ANALYSIS:	12/31/91		
CHECKED BY:	JBV	APPROVED BY:	

RESULTS ARE EXPRESSED IN ppm (UG/ML)

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
91-05263	18051030FCOTO	100191-1	<.005	2.16	0.885	0.009	<.007	0.086	0.066
91-05263	Spike	100191-1	0.045	4.34	2.79	0.201	0.912	1.06	1.92
91-05263	Duplicate	100191-1	<.005	2.32	0.815	0.012	<.007	0.081	0.058
91-05264	18051245FCOTO	100191-1	<.005	2.20	0.573	0.012	<.007	0.079	0.057
91-05265	18051445FCOTO	100191-1	<.005	2.52	0.798	0.012	<.007	0.083	0.063
91-05266	18051445FCOTD	100191-1	<.005	2.13	0.670	0.009	<.007	0.070	0.059
91-05267	18141440FCOTO	100191-1	<.005	0.108	0.182	<.005	<.007	0.049	0.058
91-05268	18061310TGOTO	100191-1	<.005	5.83	0.762	0.005	<.007	0.281	0.059
91-05269	18081345TGOTO	100191-1	<.005	3.82	0.697	0.005	<.007	0.088	0.065
91-05270	18131405TGOTO	100191-1	<.005	4.13	0.779	0.005	<.007	0.095	0.062
blank	3010 100191-1	100191-1	<.005	<.026	0.002	<.005	<.007	0.051	0.053
spkblk	3010 100191-1	100191-1	0.032	1.93	1.95	0.198	0.971	1.05	1.90

Quality Control Results Summary: C1C03

Duplicates expressed as relative percent difference
Spikes expressed as percent recovery

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
91-05263	Duplicate	100191-1	N/C	7.5	8.3	29	N/C	6.0	13
91-05263	Spike	100191-1	11	109	95	96	91	97	96
spkblk	3010 100191-1	100191-1	8.0	96	98	99	97	105	95

N/C = Not Calculated

Analyte Spiking Levels (ug/ml):

Ag=0.4 As=2 Ba=2 Cd=.2 Cr=.1 Pb=.1 Se=2

SUMMARY OF RESULTS FOR ANALYSIS OF METALS BY ICP AND FLAME AA SPECTROPHOTOMETRY

CONTRACTOR:	TAI	ANALYST:	J. Voit
DATE RECEIVED:	9/17/91	DATE REPORTED:	1/3/92
REQUESTOR:	H. WALL	MATRIX:	Liquid
PAGES REPORTED:	2	METHOD:	SW 846 - 6010, 3010
FILE NAME:	CIC04	DISC:	RCF/ICP02
DATE OF ANALYSIS:	12/31/91		
CHECKED BY:	JBV	APPROVED BY:	

RESULTS ARE EXPRESSED IN ppm (UG/ML)

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
91-05271	18131405TGOTD	100291-1	<.005	4.58	0.807	<.005	<.007	0.091	0.068
91-05271	Spike	100291-1	0.055	6.37	2.63	0.187	0.890	1.03	1.88
91-05271	Duplicate	100291-1	<.005	4.57	0.800	<.005	<.007	0.124	0.071
91-05272	18151325TGOTO	100291-1	<.005	1.15	0.117	<.005	<.007	0.036	0.083
91-05273	18131405TGOTS	100291-1	0.049	14.8	2.06	0.042	0.391	0.285	0.193
91-05274	18131405TGOTP	100291-1	0.057	14.8	2.06	0.050	0.382	0.241	0.193
91-05275	18271200QQOTM	100291-1	0.006	<.027	0.028	<.005	<.007	0.041	0.051
91-05276	19161100QGOOT	100291-1	<.005	<.027	0.026	<.005	<.007	0.127	<.048
blank	3010 100291-1	100291-1	<.005	<.027	0.002	<.005	<.007	0.037	0.053
spbkik	3010 100291-1	100291-1	0.028	1.99	1.95	0.204	0.939	1.02	1.89

Quality Control Results Summary: C1C04

Duplicates expressed as relative percent difference

Spikes expressed as percent recovery

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
91-05271	Spike	100291-1	14	90	91	94	89	94	94
91-05271	Duplicate	100291-1	NC	0.2	0.9	NC	NC	31	4.3
spkblk	3010 100291-1	100291-1	6.9	100	98	102	94	99	94

N/C = Not Calculated

Analyte Spiking Levels (ug/ml):

Ag=0.4 As=2 Ba=2 Cd=.2 Cr=1 Pb=1 Se=2



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
CINCINNATI, OHIO 45268

DATE: February 7, 1992
SUBJECT: Revised Report - CIC/Wall As Analysis
FROM: Nate Malof, Project Officer *Nate*
EMSL - Analytical
Environmental Monitoring Systems
Laboratory - Cincinnati
TO: Howard Wall
Risk Reduction Engineering Laboratory

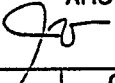
Report WallAs4A has been revised to include repeat duplicate analysis of samples 91-05183, 91-05184, and 91-05185 at the request of Accurex/IRF staff. In addition, the value reported for 91-05197 has been corrected and is included.

Also, in response to a previous query, the final volume of all filter sample digests is 50 ml.

If you have any questions, please call me at 684-7286.

Attachment

ARSENIC ANALYSIS BY GRAPHITE FURNACE AA.

CONTRACTOR: Technology Applications, Inc.
 DATE RECEIVED: 09/17/91
 REQUESTOR: Wall
 PAGES REPORTED: 2
 ANALYST: JCE
 DATES OF ANALYSIS: 10/18,21/91;01/09/92
 DISC: ARCTIC GFAA
 CHECKED BY: 

PROJECT: CIC
 DATE REPORTED: 10/31/91
 MATRIX: Aqueous
 METHODS: Federal Register;
 Pt. 61, App. B, Method 108;
 EMAP-NC; 200.9
 FILE NAME: WALLAS4A
 APPROVED BY:

LAB SAMPLE ID	CLIENT ID	DATE OF DIGESTION	DATE OF ANALYSIS	As (ug/L)	SPK/ STD %REC	DUP RPD
50 PPB CHK STD			10-18-91	45.9	91.8	
QC 19: 30 ppb			10-18-91	28.5	95.0	
DGSTN BLK		10-04-91	10-18-91	5.5		
SPK BLK		10-04-91	10-18-91	1920	96.0	
0.1 N NaOH		10-04-91	10-18-91	28.0		
91-05183	18081018ERIOO	10-04-91	10-18-91	<5		
91-05183	18081018ERIOO	10-04-91	01-09-92	<5		nc
91-05183 SPK	18081018ERIOO	10-04-91	01-09-92	2000	100	
91-05184 DUP	18081018ERWOO	10-04-91	10-18-91	32.4		
91-05184	18081018ERWOO	10-04-91	10-18-91	30.7		5.4
91-05184	18081018ERWOO	10-04-91	01-09-92	32.9		1.5
91-05185	18081018ERFOO	10-04-91	10-18-91	58.8		
91-05185	18081018ERFOO	10-04-91	01-09-92	71.6		
91-05187	18081022SRFOU	10-04-91	10-18-91	26.9		
91-05188	18081022SRIOO	10-04-91	10-18-91	<5		
91-05194	18131040ERIOO	10-04-91	10-18-91	<5		
50 PPB CHK STD			10-18-91	47.1	94.2	
91-05198	18131010QRIOO	10-04-91	10-18-91	107		
91-05186	18081022SRWOO	10-04-91	10-18-91	<5		
91-05208	18151003ERIOO	10-04-91	10-18-91	<5		
91-05217	18060945SRIOO	10-04-91	10-18-91	<5		
DGSTN BLK		10-08-91	10-18-91	<5		
0.1 N NaOH		10-08-91	10-18-91	<5		
91-05189	18131047SRWOO	10-08-91	10-18-91	<5		
91-05189 SPK	18131047SRWOO	10-08-91	10-18-91	2096	105	
91-05190	18131047SRFOO	10-08-91	10-18-91	42.2		
50 PPB CHK STD			10-18-91	44.0	88.0	
91-05191	18131047SRIOO	10-08-91	10-18-91	<5		
91-05191 DUP	18131047SRIOO	10-08-91	10-18-91	<5		nc
91-05192	18131040ERWOO	10-08-91	10-18-91	23.2		
91-05193	18131040ERFOO	10-08-91	10-18-91	39.8		
91-05207	18151003ERWOO	10-09-91	10-18-91	22.4		
91-05210	18151020SRIOO	10-08-91	10-18-91	<5		
91-05213	18211000QRFOM	10-09-91	10-18-91	21.7		
91-05214	18211000QRIOM	10-09-91	10-18-91	7.3		
91-05215	18211000QRWOM	10-09-91	10-18-91	<5		
91-05216	19131133QOOT	10-08-91	10-18-91	<5		
50 PPB CHK STD			10-18-91	45.0	90.0	

nc= no calculation

ARSENIC ANALYSIS BY GRAPHITE FURNACE AA.

CONTRACTOR: Technology Applications, Inc.
 DATE RECEIVED: 09/17/91
 REQUESTOR: Wall
 PAGES REPORTED: 2
 ANALYST: JCE
 DATES OF ANALYSIS: 10/18,21/91;01/09/92
 DISC: ARCTIC GFAA
 CHECKED BY:

PROJECT: CIC
 DATE REPORTED: 10/31/91
 MATRIX: Aqueous
 METHODS: Federal Register;
 Pt. 61, App. B, Method 108:
 EMAP-NC; 200.9
 FILE NAME: WALLAS4A
 APPROVED BY:

LAB SAMPLE ID	CLIENT ID	DATE OF DIGESTION	DATE OF ANALYSIS	As (ug/L)	SPK/ STD %REC	DUP RPD
50 PPB CHK STD			10-21-91	47.8	95.6	
QC 19: 30 ppb			10-21-91	28.2	94.0	
DGSTN BLK		10-09-91	10-21-91	<5		
0.1 N NaOH		10-09-91	10-21-91	<5		
91-05195	19120853ZOFOS	10-09-91	10-21-91	131		
91-05197	18131010QRWOS	10-09-91	10-21-91	85.6		
91-05199	18131112QRFOP	10-09-91	10-21-91	2952		
91-05200	18131112QRWOP	10-09-91	10-21-91	136		
91-05205	18060945SRWOO	10-09-91	10-21-91	<5		
91-05206	18060945SRFOO	10-09-91	10-21-91	42.1		
91-05209	18151003ERFOO	10-09-91	10-21-91	44.8		
91-05211	18151020SRFOO	10-09-91	10-21-91	37.1		
91-05212	18151020SRWOO	10-09-91	10-21-91	<5		
50 PPB CHK STD			10-21-91	54.6	109	
91-05202 UND	18061000ERIDO		10-21-91	7.1		
91-05203 UND	18061000ERFDO		10-21-91	1280		
91-05204 UND	18061000ERWDO		10-21-91	25.2		
SPK BLK		10-08-91	10-21-91	2136	107	
91-05196	18131010QRFOS	10-09-91	10-21-91	4136		
91-05201	18131112QRIOP	10-08-91	10-21-91	53.2		
50 PPB CHK STD			10-21-91	52.5	105	

UND- SAMPLE NOT DIGESTED



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
CINCINNATI, OHIO 45268 •

DATE: February 13, 1992

SUBJECT: Results of ICP Analysis

FROM: Nathan C. Malof, Project Officer
EMSL - Analytical
Environmental Monitoring Systems
Laboratory - Cincinnati

TO: Howard O. Wall
Risk Reduction Engineering Laboratory

Attached is a report containing the results of analysis on samples received January 10, 1992. If you have any questions concerning this report, please call me on x7286.

SUMMARY OF RESULTS FOR ANALYSIS OF METALS BY ICP AND FLAME AA SPECTROPHOTOMETRY

CONTRACTOR:	TAI	ANALYST:	J. Voit
DATE RECEIVED:	01/10/92	DATE REPORTED:	02/07/92
REQUESTOR:	H. WALL	MATRIX:	Liquid / Solid
PAGES REPORTED:	2	METHOD:	SW 846 - 6010, 3010, 3050
FILE NAME:	CIC05	DISC:	RCF/ICP02
DATE OF ANALYSIS:	02/06/92		
CHECKED BY:	JBV	APPROVED BY:	

RESULTS ARE EXPRESSED IN : 92-00762-00765 = mg/Kg
92-00766 = mg/L

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
92-00762	18131405TGOOS	13092-1	7.33	1339	172	13.9	55.0	230	26.2
92-00763	18131405TGOOP	13092-1	7.13	1232	179	14.5	55.0	220	25.0
92-00764	18051445FCOOS	13092-1	6.86	1953	143	11.7	51.3	229	31.9
92-00765	18051445FCOOP	13092-1	7.03	1844	143	14.1	72.1	249	28.1
92-00766	201091250QOOOS	13092-1	0.060	9.66	0.878	0.124	0.379	1.46	0.351
92-00766	Duplicate	13092-1	0.064	9.57	0.876	0.124	0.374	1.45	0.337
92-00766	Spike	13092-1	0.789	13.7	4.73	0.519	2.18	3.48	4.18
blank	3010 013092-1	13092-1	0.011	<.027	0.007	<.005	<.007	0.041	0.030
spkblk	3010 013092-1	13092-1	0.647	4.15	4.06	0.405	1.97	2.12	3.98

Quality Control Results Summary: C1C05

Duplicates expressed as relative percent difference
Spikes expressed as percent recovery

LAB ID	SAMPLE ID	QC SET	Ag	As	Ba	Cd	Cr	Pb	Se
92-00766	Spike	13092-1	91	103	96	99	90	102	96
92-00766	Duplicate	13092-1	7.4	0.9	0.2	0.0	1.2	0.8	4.0
spkblk	3010 013092-1	13092-1	81	104	101	101	99	104	100

Analyte Spiking Levels (ug/ml):

Ag=0.8 As=4 Ba=4 Cd=.4 Cr=2 Pb=2 Se=4

APPENDIX C-3

ORGANOCHLORINE PESTICIDE ANALYSES

EPA Method 8080 Analyses Data
By Hewlett Packard 5880A GC/ECD

Project: Chemical
Insecticide Corp
Report Number: CIC-3
Revision: 1

Sample ID Number	18051030FCOGO	18051245FCOGO	18051245FCOGD	Method POL
Master Index Number	866	826	827	
Sample Matrix/Type	Feed	Feed	Feed Dup	
Collection Date	8-05-91	8-05-91	8-05-91	
Extraction Date	8-20-91	8-13-91	8-13-91	
Analysis Date	9-03-91	9-04-91	9-04-91	
Analyte / Concentration	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Target Analytes				
Chlordane	17.2	14.2	15.8	10.0
alpha-BHC	< PQL	< PQL	< PQL	2.00
gamma-BHC	< PQL	< PQL	< PQL	2.00
p,p'-DDE	6.71	5.47	6.36	2.00
p,p'-DDD	7.33	7.27	9.89	2.00
p,p'-DDT	91.9	65.3	81.5	2.00
Surrogate Compound / Recovery (%)				
Dibutylchloredate	.	.	.	.

Sample ID Number	18051445FCOGO	18141440FCOGO	18051445FCOGS	18051445FCOGP
Master Index Number	887	906	888	889
Sample Matrix/Type	Feed	Feed	Feed Spike	Feed Spike Dup
Collection Date	8-05-91	8-14-91	8-05-91	8-05-91
Extraction Date	8-20-91	8-21-91	8-20-91	8-20-91
Analysis Date	9-03-91	9-04-91	9-03-91	9-03-91
Analyte / Concentration	(mg/kg)	(mg/kg)	(% REC)	(% REC)
Target Analytes				
Chlordane	< PQL	12.5	176	124
alpha-BHC	< PQL	< PQL	.	.
gamma-BHC	< PQL	< PQL	.	.
p,p'-DDE	3.37	4.83	187	104
p,p'-DDD	4.32	6.42	205	111
p,p'-DDT	41.4	45.6	107	119
Surrogate Compound / Recovery (%)				
Dibutylchloredate	.	.	.	.

* - Sample's dilution factor prohibits quantitation.
ND - Not Detected

Analyst Wes Vogel

Date 2/7/92

Lab Supervisor Dennis M. Taylor

Date 2/10/92

EPA Method 8080 Analyses Data
By Hewlett Packard 5880A GC/ECD

Project: Chemical
Insecticide Corp
Report Number: CIC-3
Revision: 1

Sample ID Number	18061616BGOGO	18081656BGOGO	18081656BGOGD	18131656BGOGO
Master Index Number	923	924	925	941
Sample Matrix/Type	Scrubber Liquor	Scrubber Liquor	Scrubber Liquor Dup	Scrubber Liquor
Collection Date	8-06-91	8-08-91	8-08-91	8-13-91
Extraction Date	8-22-91	8-22-91	8-22-91	8-23-91
Analysis Date	8-26-91	9-16-91	9-16-91	9-16-91
Analyte / Concentration	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/L}$)
Target Analytes				
Chlordane	ND	ND	ND	ND
alpha-BHC	ND	ND	ND	ND
gamma-BHC	ND	ND	ND	ND
p,p'-DDE	ND	ND	ND	ND
p,p'-DDD	ND	ND	ND	ND
p,p'-DDT	ND	ND	ND	ND
Surrogate Compound / Recovery (%)				
Dibutylchlorendate	74.6	26.0	33.9	13.9

Sample ID Number	18130840BGOGF	18151652BGOGO	Method PQL
Master Index Number	940	942	
Sample Matrix/Type	Scrubber Liquor Field Blank	Scrubber Liquor	
Collection Date	8-13-91	8-15-91	
Extraction Date	8-23-91	8-23-91	
Analysis Date	9-16-91	9-06-91	
Analyte / Concentration	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/L}$)
Target Analytes			
Chlordane	ND	ND	1.00
alpha-BHC	ND	ND	.200
gamma-BHC	ND	ND	.200
p,p'-DDE	ND	ND	.200
p,p'-DDD	ND	ND	.200
p,p'-DDT	ND	ND	.200
Surrogate Compound / Recovery (%)			
Dibutylchlorendate	< PQL	< PQL	13.3

* - Sample's dilution factor prohibits quantitation.
ND - Not Detected

Analyst Wes Vester Date 2/12/92
Lab Supervisor Dennis J. Tabor Date 2/12/92

EPA Method 8080 Analyses Data
By Hewlett Packard 5880A GC/ECD

Project: Chemical
Insecticide Corp
Report Number: CIC-3
Revision: 1

Sample ID Number	18151652BGOGS	18151652BGOGP
Master Index Number	933	944
Sample Matrix/Type	Liquor Spike	Liquor Spike Dup
Collection Date	8-15-91	8-15-91
Extraction Date	8-23-91	8-23-91
Analysis Date	9-06-91	9-06-91
Analyte / Concentration	(% Recovery)	(% Recovery)
Target Analytes		
Chlordane	117	95.0
alpha-BHC	60.7	45.0
gamma-BHC	65.1	49.9
p,p'-DDE	88.7	73.0
p,p'-DDD	97.3	79.5
p,p'-DDT	93.4	76.7

Surrogate Compound / Recovery (%)		
Dibutylchloroendate	< PQL	< PQL

* - Sample's dilution factor prohibits quantitation.

ND - Not Detected

Analyst Wes Veeh
Lab Supervisor Dennis J. Taylor

Date 2, 7, 92
Date 2, 10, 92

EPA Method 8080 Analyses Data
By Hewlett Packard 5880A GC/ECD

Project: Chemical
Insecticide Corp
Report Number: CIC-3
Revision: 1

Sample ID Number	18061310TGOGO	18081345TGOGO	18081345TGOGD	Method PQL
Master Index Number	802	801	800	
Sample Matrix/Type	Ash	Ash	Ash	
Collection Date	8-06-91	8-08-91	8-08-91	
Extraction Date	8-12-91	8-12-91	8-12-91	
Analysis Date	8-16-91	8-16-91	8-16-91	
Analyte / Concentration	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Target Analytes				
Chlordane	ND	ND	ND	0.100
alpha-BHC	ND	ND	ND	0.0200
gamma-BHC	ND	ND	ND	0.0200
p,p'-DDE	ND	ND	ND	0.0200
p,p'-DDD	ND	ND	ND	0.0200
p,p'-DDT	ND	ND	ND	0.0200

Surrogate Compound / Recovery (%)
Dibutylchloroendate

105 98.9 100 13.3

Sample ID Number	18131405TGOGO	18151325TGOGO	18131405TGOGS	18131405TGOGP
Master Index Number	894	905	907	908
Sample Matrix/Type	Ash	Ash	Ash Spike	Ash Spike Dup
Collection Date	8-13-91	8-15-91	8-13-91	8-13-91
Extraction Date	8-20-91	8-23-91	8-21-91	8-21-91
Analysis Date	9-06-91	9-06-91	9-06-91	9-06-91
Analyte / Concentration	(mg/kg)	(mg/kg)	(% Recovery)	(% Recovery)
Target Analytes				
Chlordane	ND	ND	106	108
alpha-BHC	ND	ND	115	121
gamma-BHC	ND	ND	115	125
p,p'-DDE	ND	ND	112	122
p,p'-DDD	ND	ND	138	144
p,p'-DDT	ND	ND	196	174

Surrogate Compound / Recovery (%)
Dibutylchloroendate

162 163 161 163

* - Sample's dilution factor prohibits quantitation.
ND - Not Detected

Analyst Wes Veech
Lab Supervisor Dennis M. Taylor

Date 2/7/92
Date 2/10/92

EPA Method 8080 Analyses Data
By Hewlett Packard 5880A GC/ECD

Project: Chemical
Insecticide Corp
Report Number: CIC-3
Revision: 1

Sample ID Number	18061000ESOGO	18081018ESOGO	18081018ESOGO	Method POL
Master Index Number	749	748	748	
Sample Matrix/Type	Flue Gas	Flue Gas	Flue Gas Dup Analysis	
Collection Date	8-06-91	8-08-91	8-08-91	
Extraction Date	8-06-91	8-08-91	8-08-91	
Analysis Date	8-15-91	8-16-91	8-16-91	
Analyte / Concentration	($\mu\text{g}/\text{train}$)	($\mu\text{g}/\text{train}$)	($\mu\text{g}/\text{train}$)	($\mu\text{g}/\text{train}$)
Target Analytes				
Chlordane	ND	ND	< POL	1.00
alpha-BHC	ND	ND	ND	.200
gamma-BHC	< POL	< POL	< POL	.200
p,p'-DDE	< POL	< POL	< POL	.200
p,p'-DDD	< POL	ND	< POL	.200
p,p'-DDT	.310	< POL	< POL	.200
Surrogate Compound / Recovery (%)				
Octafluorobiphenyl	110	114	77.9	
Dibutylchlorodane	112	177	46.8	

Sample ID Number	18131040ESOGO	18151003ESOGO	18131645QOXXGS	18131646QOXXGP
Master Index Number	810	838	892	891
Sample Matrix/Type	Flue Gas	Flue Gas	Resin Spike	Resin Spike Dup
Collection Date	8-13-91	8-15-91	8-13-91	8-13-91
Extraction Date	8-13-91	8-15-91	8-13-91	8-13-91
Analysis Date	8-26-91	9-13-91	8-15-91	8-16-91
Analyte / Concentration	($\mu\text{g}/\text{train}$)	($\mu\text{g}/\text{train}$)	(% Recovery)	(% Recovery)
Target Analytes				
Chlordane	ND	< POL	132	141
alpha-BHC	< POL	< POL	105	98.7
gamma-BHC	< POL	< POL	106	97.1
p,p'-DDE	< POL	< POL	102	101
p,p'-DDD	< POL	< POL	107	107
p,p'-DDT	< POL	0.247	127	125
Surrogate Compound / Recovery (%)				
Octafluorobiphenyl	66.0	49.1	N/A	N/A
Dibutylchlorodane	89.5	134	108	124

* - Sample's dilution factor prohibits quantitation.
ND - Not Detected

Analyst Wes Vestal
Lab Supervisor Dennis J. Tabor

Date 2/7/92
Date 2/10/92

EPA Method 8080 Analyses Data
By Hewlett Packard 5880A GC/ECD

Project: Chemical
Insecticide Corp
Report Number: CIC-3
Revision: 1

Sample ID Number	18061452QOXGM	18061453QOZZL
Master Index Number	855	854
Sample Matrix/Type	Resin Blank	Ext Solvent Blank
Collection Date	8-06-91	8-06-91
Extraction Date	8-06-91	8-06-91
Analysis Date	8-15-91	8-15-91
Analyte / Concentration	(μ g/train)	(μ g/train)
Target Analytes		
Chlordane	ND	ND
alpha-BHC	ND	ND
gamma-BHC	ND	ND
p,p'-DDE	ND	ND
p,p'-DDD	ND	ND
p,p'-DDT	ND	ND
Surrogate Compound / Recovery (%)		
Octafluorobiphenyl	110	N/A
Dibutylchlorodane	87.9	108

* - Sample's dilution factor prohibits quantitation.
ND - Not Detected

Analyst Wes Veld
Lab Supervisor Dennis H Tabor

Date 2,7,92
Date 2,10,92

EPA Method 8080 Analyses Data
By Hewlett Packard 5880A GC/ECD

Project: Chemical
Insecticide Corp
Report Number: CIC-3
Revision: 1

Sample ID Number	18051030FCOHO	18051245FCOHO	18051445FCOHO	Method POL
Master Index Number	967	969	970	
Sample Matrix/Type	Feed TCLP Leachate	Feed TCLP Leachate	Feed TCLP Leachate	
Collection Date	8-05-91	8-05-91	8-05-91	
Extraction Date	8-28-91	8-28-91	8-28-91	
Analysis Date	9-13-91	9-13-91	9-13-91	
Analyte / Concentration	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/L}$)
Target Analytes				
Chlordane	< PQL	< PQL	< PQL	1.00
alpha-BHC	8.32	4.44	3.58	.200
gamma-BHC	2.85	< PQL	< PQL	.200
p,p'-DDE	< PQL	< PQL	< PQL	.200
p,p'-DDD	< PQL	2.57	< PQL	.200
p,p'-DDT	< PQL	< PQL	< PQL	.200
Surrogate Compound / Recovery (%)				
Dibutylchlorendate	73.6	73.1	64.2	

Sample ID Number	18141440FCOHO	18281000QOQGL	18201500QOQHM
Master Index Number	968	972	971
Sample Matrix/Type	Feed TCLP Leachate	Water Blank	TCLP Blank
Collection Date	8-14-91	8-28-91	8-20-91
Extraction Date	8-28-91	8-28-91	8-28-91
Analysis Date	9-13-91	9-13-91	9-13-91
Analyte / Concentration	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/L}$)
Target Analytes			
Chlordane	< PQL	ND	ND
alpha-BHC	< PQL	ND	ND
gamma-BHC	< PQL	ND	ND
p,p'-DDE	< PQL	ND	ND
p,p'-DDD	< PQL	ND	ND
p,p'-DDT	< PQL	ND	ND
Surrogate Compound / Recovery (%)			
Dibutylchlorendate	60.5	67.7	67.4

* - Sample's dilution factor prohibits quantitation.
ND - Not Detected

Analyst Wes Veld Date 2/7/92
Lab Supervisor Dennis M. Tabor Date 2/10/92

CHEMICAL INSECTICIDE CORPORATION
METHOD 8080 GC/ECD ANALYSIS

ANALYTE	(ug/L) P02261500TCLP	(ug/L) P02261505TCLP	(ug/L) P02261509TCLP	(ug/L) P02261515TCLP	(ug/L) Q03191400TCLPBK	(ug/L) PQL
CHLORDANE	ND	ND	< PQL	ND	ND	10.0
p,p'-DDD	< PQL	< PQL	< PQL	< PQL	ND	1.00
p,p'-DDE	< PQL	< PQL	< PQL	< PQL	ND	1.00
p,p'-DDT	< PQL	< PQL	2.46	< PQL	ND	1.00
alpha-BHC	< PQL	< PQL	< PQL	< PQL	ND	1.00
gamma-BHC	< PQL	< PQL	< PQL	< PQL	ND	1.00

PQL - PRACTICAL QUANTITATION LIMIT

ND - NOT DETECTED

ANALYST

Was Vestal

DATE

May 23, 1991

DRAFT

ANALYTE	(ng/kg) P05290940E	(ng/kg) P05290950E	(ng/kg) P05291000E	(ng/kg) P05291010E	(ng/kg) PQL	207 TLP
alpha-BHC	<PQL	<PQL	<PQL	<PQL	0.824	
gamma-BHC	<PQL	<PQL	<PQL	<PQL	0.824	2
p,p'-DDE	4.33	2.78	2.27	3.07	0.824	
p,p'-DDD	3.00	1.93	1.47	1.80	0.824	
p,p'-DDT	32.7	32.3	21.0	18.9	0.824	
CHLORDANE	10.7	<PQL	<PQL	<PQL	8.24	0.6

PQL - PRACTICAL QUANTITATION LIMIT
ND - NOT DETECTED

ANALYST Was Verdel
DATE 6-3-91

Chemical Insecticide Corporation

Analyte	P0529-COMPOSITE	PQL (ug/kg)

* 2,4-D *	ND	* 4.17 *
* 2,4,5-T *	ND	* 4.17 *
* Silvex *	ND	* 4.17 *
* 2,3,7,8-TCDD *	ND	* 4.17 *

P0529-COMPOSITE = 1.0 mL from each of the four extracts were combined.

PQL = Practical Quantitation Limit.

ND = Not detected.

Chemist Wes Vozel Date 6-3-91

Laboratory Supervisor _____ Date _____

APPENDIX C-4
CHLORIDE ANALYSES

Particulate/HCl Train Chloride Report
By Ion-Selective Electrode

Project: Chemical
Insecticide Corp
Report Number: CIC-2
Revision: 1

Sample ID Number	18060945SPIOO	18061000EPIOO	18081022SPIOO	18081022SPIOO
Master Index Number	699	694	734	734
Collection Date	8-06-91	8-06-91	8-08-91	8-08-91
Analysis Date	8-30-91	8-30-91	9-03-91	9-03-91
Total Chloride (mg)	0.62	< 0.42	0.90	0.88

Sample ID Number	108081018EPIOO	18131051SPIOO	18131040EPIOO	18151005SPIOO
Master Index Number	736	793	791	812
Collection Date	8-08-91	8-13-91	8-13-91	8-15-91
Analysis Date	9-03-91	9-03-91	9-03-91	9-03-91
Total Chloride (mg)	0.62	0.61	0.56	0.56

Sample ID Number	18151003EPIOO	18211000QPIOM
Master Index Number	811	
Collection Date	8-15-91	8-21-91
Analysis Date	9-03-91	9-03-91
Total Chloride (mg)	< 0.42	0.11

Matrix Spikes

Sample ID Number	18131040EPIOS	18131040EPIOP
Master Index Number	791	791
Collection Date	8-13-91	8-13-91
Analysis Date	9-03-91	9-03-91
Spike Recovery (%)	113.4	112.9

Note: 18211000QPIOM Total Chloride was calculated using a 100 mL volume which is the volume used to initially fill the impingers.

Analyst Sharon King
Lab Supervisor Dennis J. Talar

Date 01/28/92
Date 1/28/92

APPENDIX D
SAMPLING TRAIN WORKSHEETS

APPENDIX D-1

METHOD 108 TRAIN WORKSHEETS

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill ^{ed}
 Date: 8-6-91 Printed 09/11/91 Test No./Type: 18061000ER
 Sample Location: Scrubber Exit Start/Stop Time: 1000-1259

PARAMETER	SYMBOL	VALUE
Nozzle Diameter, Actual (in)	N(d)	0.248
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	19
Total Sampling Time (min)	(theta) (173.00)	
Barometric Pressure (in Hg)	P(b)	30.16
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		598.431
Gas Meter Final Reading (cu ft)		712.771
Net Gas Sample Volume (cu ft)	V(m)	(114.34)
Vol of Liquid Collected (ml)	VL(c)	147.26
Vol of Liq @ Std. Conds. (scf)	V(w std) (6.932)	
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	15.22
CO2 Concentration (by CEM)	%	3.28
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.50)

CALCULATED RESULTS FOR SAMPLE # — 18061000ER

Isokineticity	% I	=	107.0
Metered Sample Gas Volume (scf)	V(m std)	=	105.71
	(scm)	V(m std)	= 2.994
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1759
std cond. (dscm/min)	Q(s)	=	49.8
actual (acfm)	Q(a)	=	2134
actual (acm/min)	Q(a)	=	60.4
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
(kg/hr)	E(p)	=	NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.062
Molecular Weight of Stack Gas, Dry	M(d)	=	29.13
Wet	M(s)	=	28.45
Stack Pressure, absolute (in Hg)	P(s)	=	29.87
Average Stack Velocity (ft/sec)	V(s avg)	=	34.4

I = 425

FIELD DATA AVERAGES FOR SAMPLE # — 18061000ER									
Sample Point	dClock Time (min)	Velocity (in H2O)	Drift (in H2O)	Stack Temp (degF)	Gas Meter in	Meter out	SQRT (dP)	Velocity Head (*wc)	dP (avg) = 0.326
1	9	0.34	1.3	140	96	89	0.5831	Orifice Meter Reading (*wc)	dH (avg) = 1.211
2	9	0.34	1.3	140	103	93	0.5831		
3	9	0.33	1.2	140	113	96	0.5745	Stack Temperature (deg F)	T(s avg) = 140.0
4	9	0.33	1.2	140	126	102	0.5745	(deg C)	T(s avg) = 60.0
5	9	0.34	1.3	140	127	103	0.5831		
6	9	0.33	1.2	140	127	105	0.5745	Meter Temperature (deg F)	T(m avg) = 117.1
7	9	0.32	1.2	140	128	108	0.5657	(deg C)	T(m avg) = 47.3
8	9	0.32	1.2	140	121	110	0.5657		
1	9	0.32	1.2	140	124	100	0.5657	Root-Mean-Square dP (*wc)	SQRT (dP) = 0.571
2	9	0.32	1.2	140	126	100	0.5657		
3	9	0.32	1.2	140	132	102	0.5657		
4	9	0.32	1.2	140	132	109	0.5657		
5	9	0.31	1.1	140	137	116	0.5568		
6	9	0.32	1.2	140	138	116	0.5657		
7	9	0.32	1.2	140	138	116	0.5657		
8	9	0.33	1.2	140	138	116	0.5745		
7	9	0.33	1.2	140	138	117	0.5745		
6	9	0.32	1.2	140	137	117	0.5657		
5	11	0.33	1.2	140	138	117	0.5745		
TOTALS	173	6.19	23.0000	2660.0	2419.0	2032.0	10.8440		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill *ed*
 Date: 8-8-91 Printed 09/11/91 Test No./Type: 1808101BER
 Sample Location: Scrubber Exit Start/Stop Time: 1018-1247

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.295
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	---
Width (if rectangular)	W	---
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(144.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		823.599
Gas Meter Final Reading (cu ft)		952.037
Net Gas Sample Volume (cu ft)	V(m)	(128.44)
Vol of Liquid Collected (ml)	VL(c)	287.88
Vol of Liq @ Std. Conds. (scf)	V(w std)	(13.551)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	14.89
CO2 Concentration (by CEM)	%	3.44
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.67)

CALCULATED RESULTS FOR SAMPLE # -- 1808101BER

Isokineticity	Z I	=	106.0
Metered Sample Gas Volume (scf)	V(m std)	=	117.87
	(scm)	V(m std)	= 3.338
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1681
std cond. (dscm/min)	Q(s)	=	47.6
actual (acfm)	Q(a)	=	2168
actual (acm/min)	Q(a)	=	61.4
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
	(kg/hr)	E(p)	= NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.103
Molecular Weight of Stack Gas, Dry	M(d)	=	29.15
	Wet	M(s)	= 28.00
Stack Pressure, absolute (in Hg)	P(s)	=	29.81
Average Stack Velocity (ft/sec)	V(s avg)	=	35.0

I = 550 mls.

Sample Point	clock Time (min)	Velocity (in H2O)	Orifice Head, dP (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	in	out	SORT (dP)	FIELD DATA AVERAGES FOR SAMPLE # -- 1808101BER
									Velocity Head (*wc) dP (avg) = 0.326
1	9	0.33	2.4	146	99	89	0.5745	Orifice Meter Reading (*wc)	dH (avg) = 2.356
2	9	0.33	2.4	146	107	98	0.5745		
3	9	0.32	2.3	146	119	105	0.5657	Stack Temperature (deg F)	T(s avg) = 148.3
4	9	0.32	2.3	146	125	107	0.5657	(deg C)	T(s avg) = 64.6
5	9	0.33	2.4	147	133	109	0.5745		
6	9	0.33	2.4	148	134	109	0.5745	Meter Temperature (deg F)	T(m avg) = 121.9
7	9	0.33	2.4	148	135	109	0.5745	(deg C)	T(m avg) = 49.9
8	9	0.32	2.3	148	136	109	0.5657		
1	9	0.32	2.3	149	136	109	0.5657	Root-Mean-Square dP (*wc)	SORT (dP) = 0.571
2	9	0.33	2.4	150	141	113	0.5745		
3	9	0.33	2.4	150	146	117	0.5745		
4	9	0.33	2.4	149	145	117	0.5745		
5	9	0.32	2.3	150	146	117	0.5657		
6	9	0.32	2.3	149	146	117	0.5657		
7	9	0.32	2.3	150	146	117	0.5657		
8	9	0.33	2.4	150	146	118	0.5745		
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TOTALS	144	5.21	37.7000	2372.0	2140.0	1760.0	9.1299		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill Ed
 Date: 8-13-91 Printed 09/11/91 Test No./Type: 18131040ER
 Sample Location: Scrubber Exit Start/Stop Time: 1040-1308

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.295
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(144.00)
Barometric Pressure (in Hg)	P(b)	30.11
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		994.437
Gas Meter Final Reading (cu ft)		1120.22
Net Gas Sample Volume (cu ft)	V(m)	(125.79)
Vol of Liquid Collected (ml)	Vl(c)	202.33
Vol of Liq @ Std. Conds. (scf)	V(w std)	(9.524)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	14.9
CO2 Concentration (by CEM)	%	3.47
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.63)

CALCULATED RESULTS FOR SAMPLE # — 18131040ER

Isokineticity	% I	=	101.8
Metered Sample Gas Volume (scf)	V(m std)	=	115.58
(scm)	V(m std)	=	3.273
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1716
std cond. (dscm/min)	Q(s)	=	48.6
actual (acfm)	Q(a)	=	2160
actual (acm/min)	Q(a)	=	61.2
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
(kg/hr)	E(p)	=	NA
Stack Gas Water Vapor Proportion	B(wc)	=	0.076
Molecular Weight of Stack Gas, Dry	M(d)	=	29.15
Wet	M(s)	=	28.30
Stack Pressure, absolute (in Hg)	P(s)	=	29.82
Average Stack Velocity (ft/sec)	V(s avg)	=	34.9

I = 480 m/s

FIELD DATA AVERAGES FOR SAMPLE # — 18131040ER									
Sample Point	dClock Time (min)	Velocity Head (in H2O)	Drift (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	in	out	Velocity Head	
1	9	0.33	2.4	151	97	88	0.5745	Orifice Meter Reading	(%wc) dP(avg) = 0.325
2	9	0.33	2.4	151	113	92	0.5745		
3	9	0.32	2.3	152	126	94	0.5657	Stack Temperature	(deg F) T(s avg) = 151.9
4	9	0.32	2.3	152	134	100	0.5657		(deg C) T(s avg) = 66.6
5	9	0.32	2.3	152	137	103	0.5657		
6	9	0.32	2.3	152	140	106	0.5657	Meter Temperature	(deg F) T(m avg) = 121.4
7	9	0.33	2.4	152	141	109	0.5745		(deg C) T(m avg) = 49.7
8	9	0.33	2.4	152	142	110	0.5745		
1	9	0.33	2.4	152	129	110	0.5745	Root-Mean-Square dP	(%wc) SQRT(dP) = 0.570
2	9	0.32	2.3	152	143	112	0.5657		
3	9	0.33	2.4	152	145	114	0.5745		
4	9	0.33	2.4	152	145	114	0.5745		
5	9	0.33	2.4	152	144	115	0.5745		
6	9	0.32	2.3	152	144	115	0.5657		
7	9	0.32	2.3	152	145	116	0.5657		
8	9	0.32	2.3	152	145	116	0.5657		
TOTALS	144	5.20	37.6000	2430.0	2170.0	1714.0	9.1211		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill Ed
 Date: 8-15-91 Printed 09/11/91 Test No./Type: 18151003ER
 Sample Location: Scrubber Exit Start/Stop Time: 1003-1232

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.295
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(144.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		123.043
Gas Meter Final Reading (cu ft)		244.673
Net Gas Sample Volume (cu ft)	V(m)	(121.63)
Vol of Liquid Collected (ml)	Vl(c)	175.38
Vol of Liq @ Std. Conds. (scf)	V(w std)	(8.255)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	14.85
CO2 Concentration (by CEM)	%	3.56
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.59)

CALCULATED RESULTS FOR SAMPLE # — 18151003ER

Isokineticity	% I	=	98.9
Metered Sample Gas Volume (scf)	V(m std)	=	111.66
	(scm)	V(m std)	= 3.162
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1708
std cond. (dscm/min)	Q(s)	=	48.4
actual (acfm)	Q(a)	=	2121
actual (acm/min)	Q(a)	=	60.1
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
(kg/hr)	E(p)	=	NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.069
Molecular Weight of Stack Gas, Dry	M(d)	=	29.16
Wet	M(s)	=	28.40
Stack Pressure, absolute (in Hg)	P(s)	=	29.81
Average Stack Velocity (ft/sec)	V(s avg)	=	34.2

I = 455 m/s.

Sample Point	dClock Time (min)	Velocity Head (in H2O)	Drift Meter, dH (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F) in	Gas Meter Temp (deg F) out	ISORT(dP)	FIELD DATA AVERAGES FOR SAMPLE # — 18151003ER
								Velocity Head ("wc) dP(avg) = 0.316
1	9	0.32	2.2	147	85	84	0.5657	Drift Meter Reading ("wc) dH(avg) = 2.200
2	9	0.31	2.2	147	114	87	0.5568	Stack Temperature (deg F) T(s avg) = 148.3
3	9	0.31	2.2	148	128	93	0.5568	(deg C) T(s avg) = 64.6
4	9	0.31	2.2	148	134	98	0.5568	Meter Temperature (deg F) T(m avg) = 121.5
5	9	0.32	2.2	148	138	103	0.5657	(deg C) T(m avg) = 49.7
6	9	0.31	2.2	148	141	107	0.5568	
7	9	0.32	2.2	148	141	109	0.5657	
8	9	0.32	2.2	148	144	112	0.5657	
1	9	0.32	2.2	148	132	112	0.5657	Root-Mean-Square dP ("wc) ISORT(dP) = 0.562
2	9	0.32	2.2	149	143	114	0.5657	
3	9	0.31	2.2	149	144	115	0.5568	
4	9	0.32	2.2	149	145	116	0.5657	
5	9	0.32	2.2	149	145	116	0.5657	
6	9	0.32	2.2	149	145	117	0.5657	
7	9	0.31	2.2	149	145	117	0.5568	
8	9	0.32	2.2	149	146	118	0.5657	
TOTALS	144	5.06	35.2000	2373.0	2170.0	1718.0	8.9975	

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: R JACKSON
 Date: 06-06-91 Printed 09/11/91 Test No./Type: 180609455R
 Sample Location: STACK Start/Stop Time: 0945-1220

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.244
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	0.99
Stack (Duct) Dimensions (in):		
Radius (if round)	R	7
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.06901)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(160.00)
Barometric Pressure (in Hg)	P(b)	30.16
Stack Pressure (in H2O)	P(stack)	0.4
Gas Meter Initial Reading (cu ft)		16.855
Gas Meter Final Reading (cu ft)		133.572
Net Gas Sample Volume (cu ft)	V(m)	(116.72)
Vol of Liquid Collected (ml)	Vl(c)	145.16
Vol of Liq @ Std. Conds. (scf)	V(w std)	(6.833)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	14.63
CO2 Concentration (by CEM)	%	3.36
CO Concentration (by CEM)	%	0
HC Concentration (by diff.)	%	(82.01)

CALCULATED RESULTS FOR SAMPLE # — 180609455R

Isokineticity	% I	=	91.6
Metered Sample Gas Volume (scf)	V(m std)	=	105.90
(scm)	V(m std)	=	2.999
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	2382
std cond. (dscm/min)	Q(s)	=	67.4
actual (acfm)	Q(a)	=	2855
actual (acm/min)	Q(a)	=	80.9
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
(kg/hr)	E(p)	=	NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.061
Molecular Weight of Stack Gas, Dry	M(d)	=	29.12
Met	M(s)	=	28.45
Stack Pressure, absolute (in Hg)	P(s)	=	30.19
Average Stack Velocity (ft/sec)	V(s avg)	=	44.5

Sample Point	dClock Time (min)	Velocity Head (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	in	out	ISQRT(dP)	FIELD DATA AVERAGES FOR SAMPLE # — 180609455R
									Velocity Head ("wc) dP(avg) = 0.550
1	10	0.55	1.98	139	98	95	0.7416	Orifice Meter Reading ("wc) dH(avg) = 1.980	
2	10	0.55	1.98	139	111	99	0.7416		
3	10	0.55	1.98	139	129	104	0.7416	Stack Temperature (deg F) T(s avg) = 140.0	
4	10	0.55	1.98	139	132	108	0.7416	(deg C) T(s avg) = 60.0	
5	10	0.55	1.98	140	135	111	0.7416		
6	10	0.55	1.98	140	139	116	0.7416	Meter Temperature (deg F) T(m avg) = 123.3	
1	10	0.55	1.98	140	132	115	0.7416	(deg C) T(m avg) = 50.7	
2	10	0.55	1.98	140	135	116	0.7416		
3	10	0.55	1.98	140	137	116	0.7416	Root-Mean-Square dP ("wc) ISQRT(dP) = 0.742	
4	10	0.55	1.98	140	139	118	0.7416		
5	10	0.55	1.98	140	139	119	0.7416		
6	10	0.55	1.98	140	140	121	0.7416		
5	10	0.55	1.98	141	141	121	0.7416		
4	10	0.55	1.98	141	141	121	0.7416		
3	10	0.55	1.98	141	140	120	0.7416		
2	10	0.55	1.98	141	138	119	0.7416		
—	—	—	0	—	—	—	—		
—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—		
TOTALS	160	8.80	31.6800	2240.0	2126.0	1819.0	11.8659		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: R JACKSON
 Date: 8-08-91 Printed 09/11/91 Test No./Type: 18081022SR
 Sample Location: STACK Start/Stop Time: 1022-1239

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.247
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	0.99
Stack (Duct) Dimensions (in):		
Radius (if round)	R	7
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.06901)
# of Sample Points	#	14
Total Sampling Time (min)	(theta)	(132.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	0.4
Gas Meter Initial Reading (cu ft)		136.745
Gas Meter Final Reading (cu ft)		248.185
Net Gas Sample Volume (cu ft)	V(m)	(111.44)
Vol of Liquid Collected (ml)	Vl(c)	169.82
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.993)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	16.3
CO2 Concentration (by CEM)	%	3.52
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(80.18)

CALCULATED RESULTS FOR SAMPLE # — 18081022SR

Isokineticity	% I	=	107.4
Metered Sample Gas Volume (scf)	V(m std)	=	101.46
(scm)	V(m std)	=	2.873
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	2301
std cond. (dscm/min)	Q(s)	=	65.2
actual (acfm)	Q(a)	=	2806
actual (acm/min)	Q(a)	=	79.5
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
(kg/hr)	E(p)	=	NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.073
Molecular Weight of Stack Gas, Dry	M(d)	=	29.22
Wet	M(s)	=	28.40
Stack Pressure, absolute (in Hg)	P(s)	=	30.13
Average Stack Velocity (ft/sec)	V(s avg)	=	43.7

I = 450 m/s.

FIELD DATA AVERAGES FOR SAMPLE # — 18081022SR									
Sample Point	dClock Time (min)	Velocity Head (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	Temp (deg F)	SQRT(dP)	Velocity Head ("wc)	dP(avg) = 0.529
1	10	0.55	2.2	140	99	96	0.7416	Orifice Meter Reading ("wc)	dH(avg) = 2.029
2	10	0.55	2.2	141	111	97	0.7416		
3	10	0.5	2	141	124	101	0.7071	Stack Temperature (deg F)	T(s avg) = 141.0
4	10	0.5	2	141	128	106	0.7071	(deg C)	T(s avg) = 60.6
5	10	0.55	2	141	132	111	0.7416		
6	10	0.55	2	141	134	113	0.7416	Meter Temperature (deg F)	T(m avg) = 120.2
1	10	0.55	2	141	128	114	0.7416	(deg C)	T(m avg) = 49.0
2	10	0.55	2	141	131	115	0.7416		
3	10	0.55	2	141	133	116	0.7416	Root-Mean-Square dP ("wc)	SQRT(dP) = 0.727
4	10	0.55	2	141	136	117	0.7416		
5	10	0.5	2	141	138	119	0.7071		
6	10	0.5	2	141	138	119	0.7071		
5	10	0.5	2	141	136	119	0.7071		
4	2	0.5	2	142	136	119	0.7071		
—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—		
TOTALS	132	7.40	28.4000	1774.0	1804.0	1562.0	10.1756		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: R JACKSON
 Date: 8-13-91 Printed 09/11/91 Test No./Type: 18131047SR
 Sample Location: STACK Start/Stop Time: 1047-1312

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.247
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	0.99
Stack (Duct) Dimensions (in):		
Radius (if round)	R	7
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.06901)
# of Sample Points	#	14
Total Sampling Time (min)	(theta)	(140.00)
Barometric Pressure (in Hg)	P(b)	30.11
Stack Pressure (in H2O)	P(stack)	0.4
Gas Meter Initial Reading (cu ft)		138.732
Gas Meter Final Reading (cu ft)		256.445
Net Gas Sample Volume (cu ft)	V(m)	(117.71)
Vol of Liquid Collected (ml)	Vl(c)	179.38
Vol of Liq @ Std. Conds. (scf)	V(w std)	(8.443)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	16.19
CO2 Concentration (by CEM)	%	3.51
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(80.30)

CALCULATED RESULTS FOR SAMPLE # — 18131047SR

Isokineticity	% I	= 108.4
Metered Sample Gas Volume (scf)	V(m std)	= 105.91
	(scm)	V(m std) = 2.999
Stack Gas Flow, std cond. (dscfa)	Q(s)	= 2244
std cond. (dscm/min)	Q(s)	= 63.6
actual (acfm)	Q(a)	= 2722
actual (acm/min)	Q(a)	= 77.1
Particulate Loading, dry (gr/dscf)	C(s std)	= NA
@ 7% O2 (gr/dscf)	C(s std)	= NA
@ 7% O2 (mg/dscm)	C(s std)	= NA
Particulate Emission Rate (lb/hr)	E(p)	= NA
(kg/hr)	E(p)	= NA
Stack Gas Water Vapor Proportion	B(wv)	= 0.074
Molecular Weight of Stack Gas, Dry	H(d)	= 29.21
Wet	H(s)	= 28.38
Stack Pressure, absolute (in Hg)	P(s)	= 30.14
Average Stack Velocity (ft/sec)	V(s avg)	= 42.4

$$I = 460 \text{ m/s.}$$

FIELD DATA AVERAGES FOR SAMPLE # — 18131047SR									
Sample Point	dClock Time (min)	Velocity (ft/min)	Drift (in H2O)	Stack Temp (degF)	Gas Temp (degF) in	Meter Temp (degF) out	SQRT(dP)	Velocity Head (*wc)	dP (avg) = 0.500
1	10	0.5	2	138	104	100	0.7071	Orifice Meter Reading (*wc)	dH (avg) = 2.000
2	10	0.5	2	138	123	102	0.7071		
3	10	0.5	2	137	132	106	0.7071	Stack Temperature (deg F)	T(s avg) = 137.4
4	10	0.5	2	137	136	111	0.7071	(deg C)	T(s avg) = 58.5
5	10	0.5	2	136	140	117	0.7071		
6	10	0.5	2	136	142	119	0.7071	Meter Temperature (deg F)	T(m avg) = 127.3
1	10	0.5	2	137	132	120	0.7071	(deg C)	T(m avg) = 52.9
2	10	0.5	2	137	142	122	0.7071		
3	10	0.5	2	137	142	123	0.7071	Root-Mean-Square dP (*wc)	SQRT(dP) = 0.707
4	10	0.5	2	138	143	123	0.7071		
5	10	0.5	2	138	145	124	0.7071		
6	10	0.5	2	138	146	125	0.7071		
5	10	0.5	2	138	146	126	0.7071		
4	10	0.5	2	138	147	126	0.7071		
TOTALS	140	7.00	28.0000	1923.0	1920.0	1644.0	9.8995		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: R JACKSON
 Date: 08-15-91 Printed 09/11/91 Test No./Type: 18151020SR
 Sample Location: STACK Start/Stop Time: 1020-1245

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.247
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	0.99
Stack (Duct) Dimensions (in):		
Radius (if round)	R	7
Length (if rectangular)	L	---
Width (if rectangular)	W	---
Area of Stack (sq ft)	A(s)	(1.06901)
# of Sample Points	#	14
Total Sampling Time (min)	(theta)	(140.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	0.4
Gas Meter Initial Reading (cu ft)		270.684
Gas Meter Final Reading (cu ft)		377.642
Net Gas Sample Volume (cu ft)	V(m)	(106.96)
Vol of Liquid Collected (ml)	Vl(c)	152.47
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.177)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	15.79
CO2 Concentration (by CEM)	%	3.59
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(80.62)

CALCULATED RESULTS FOR SAMPLE # — 18151020SR

Isokineticity	Z I	=	98.2
Metered Sample Gas Volume (scf)	V(m std)	=	95.36
	(scm)	V(m std)	= 2.700
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	2231
std cond. (dscm/min)	Q(s)	=	63.2
actual (acfm)	Q(a)	=	2698
actual (acm/min)	Q(a)	=	76.4
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
(kg/hr)	E(p)	=	NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.070
Molecular Weight of Stack Gas, Dry	M(d)	=	29.21
	Wet	M(s)	= 28.42
Stack Pressure, absolute (in Hg)	P(s)	=	30.13
Average Stack Velocity (ft/sec)	V(s avg)	=	42.1

I = 440 m/s

FIELD DATA AVERAGES FOR SAMPLE # — 18151020SR									
Sample Point	dClock Time (min)	Velocity (in H2O)	Orifice Head, dP (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	in	out	Velocity Head ("wc)	dP (avg) = 0.491
1	10	0.5	2	137	117	101	0.7071	Orifice Meter Reading ("wc)	dH (avg) = 1.957
2	10	0.5	2	137	135	105	0.7071		
3	10	0.5	2	137	141	111	0.7071	Stack Temperature (deg F)	T(s avg) = 138.1
4	10	0.5	2	137	143	114	0.7071	(deg C)	T(s avg) = 58.9
5	10	0.5	2	137	149	120	0.7071		
6	10	0.5	2	138	150	124	0.7071	Meter Temperature (deg F)	T(m avg) = 132.4
7	10	0.5	2	138	150	124	0.7071	(deg C)	T(m avg) = 55.8
1	10	0.5	2	138	141	126	0.7071		
2	10	0.48	1.9	138	141	127	0.6928	Root-Mean-Square dP ("wc)	SRRT(dP) = 0.701
3	10	0.48	1.9	138	144	127	0.6928		
4	10	0.48	1.9	138	150	128	0.6928		
5	10	0.48	1.9	140	151	129	0.6928		
6	10	0.48	1.9	140	151	128	0.6928		
7	10	0.48	1.9	140	151	128	0.6928		
0	0	0	0	0	0	0	0.0000		
0	0	0	0	0	0	0	0.0000		
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---	---	---	---	---	---	---	0.9		
TOTALS	140	6.88	27.4000	1933.0	2014.0	1692.9	9.8138		

APPENDIX D-2
METHOD 0010 TRAIN WORKSHEETS

ISO KINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill
 Date: 8-6-91 Printed 09/11/91 Test No./Type: 18061000ES
 Sample Location: Scrubber Exit Start/Stop Time: 1000-1259

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.263
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	19
Total Sampling Time (min)	(theta)	(173.00)
Barometric Pressure (in Hg)	P(b)	30.16
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		478.499
Gas Meter Final Reading (cu ft)		592.022
Net Gas Sample Volume (cu ft)	V(a)	(113.52)
Vol of Liquid Collected (ml)	VL(c)	166.12
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.819)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	15.22
CO2 Concentration (by CEM)	%	3.28
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.50)

CALCULATED RESULTS FOR SAMPLE # — 18061000ES

Isokineticity	Z I	=	96.5
Metered Sample Gas Volume (scf)	V(a std)	=	106.40
	(scm)	V(a std)	= 3.013
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1747
std cond. (dscm/min)	Q(s)	=	49.5
actual (acfm)	Q(a)	=	2153
actual (acm/min)	Q(a)	=	61.0
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
(kg/hr)	E(p)	=	NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.068
Molecular Weight of Stack Gas, Dry	M(d)	=	29.13
Wet	M(s)	=	28.37
Stack Pressure, absolute (in Hg)	P(s)	=	29.87
Average Stack Velocity (ft/sec)	V(s avg)	=	34.7

I = 151 m/s.

Sample Point	dClock Time (min)	Velocity (ft/min)	Drift (in H2O)	Stack Temp (degF)	Gas Meter Temp (degF)	in	out	ISQRT(dP)	FIELD DATA AVERAGES FOR SAMPLE # — 18061000ES
									Velocity Head ("wc) dP(avg) = 0.328
1	9	0.35	1.3	145	110	94	0.5916	Orifice Meter Reading ("wc)	dH(avg) = 1.211
2	9	0.35	1.3	145	114	95	0.5916		
3	9	0.34	1.3	145	115	97	0.5831	Stack Temperature (deg F)	T(s avg) = 145.0
4	9	0.33	1.2	145	116	98	0.5745	(deg C)	T(s avg) = 62.8
5	9	0.33	1.2	145	118	100	0.5745		
6	9	0.33	1.2	145	118	100	0.5745	Meter Temperature (deg F)	T(m avg) = 109.3
7	9	0.32	1.2	145	118	101	0.5657	(deg C)	T(m avg) = 42.9
8	9	0.32	1.2	145	118	101	0.5657		
1	9	0.33	1.2	145	116	99	0.5745	Root-Mean-Square dP ("wc)	ISQRT(dP) = 0.573
2	9	0.32	1.2	145	119	101	0.5657		
3	9	0.32	1.2	145	120	102	0.5657		
4	9	0.31	1.1	145	120	102	0.5568		
5	9	0.32	1.2	145	120	103	0.5657		
6	9	0.32	1.2	145	120	103	0.5657		
7	9	0.33	1.2	145	120	103	0.5745		
8	9	0.33	1.2	145	120	103	0.5745		
7	9	0.32	1.2	145	120	103	0.5657		
6	9	0.33	1.2	145	120	103	0.5745		
5	11	0.33	1.2	145	120	103	0.5745		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill *ed*
 Date: 8-8-91 Printed 09/11/91 Test No./Type: 18081018ES
 Sample Location: Scrubber Exit Start/Stop Time: 1018-1247

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.302
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	---
Width (if rectangular)	W	---
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta) (144.00)	
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		340.218
Gas Meter Final Reading (cu ft)		468.143
Net Gas Sample Volume (cu ft)	V(m)	(127.92)
Vol of Liquid Collected (ml)	Vl(c)	286.27
Vol of Liq @ Std. Conds. (scf)	V(w std)	(13.475)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	14.89
CO2 Concentration (by CEM)	%	3.44
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.67)

CALCULATED RESULTS FOR SAMPLE # --- 18081018ES

Isokineticity	% I	=	101.3
Metered Sample Gas Volume (scf)	V(m std)	=	117.75
	(scm)	V(m std)	= 3.334
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1677
std cond. (dscm/min)	Q(s)	=	47.5
actual (acfm)	Q(a)	=	2161
actual (acm/min)	Q(a)	=	61.2
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(d)	=	NA
	(kg/hr)	E(p)	= NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.103
Molecular Weight of Stack Gas, Dry	M(d)	=	29.15
Wet	M(s)	=	28.00
Stack Pressure, absolute (in Hg)	P(s)	=	29.81
Average Stack Velocity (ft/sec)	V(s avg)	=	34.9

I = 265 mls.

Sample Point								FIELD DATA AVERAGES FOR SAMPLE # --- 18081018ES		
Time	Head, dP	Orifice	Stack	Gas	Meter	SQRT(dP)				
(min)	(in H2O)	(in H2O)	(deg F)	in	out		Velocity Head	("wc)	dP (avg)	= 0.324
1	9	0.33	2.4	146	127	102	0.5745	Orifice Meter Reading	("wc)	dH (avg) = 2.338
2	9	0.32	2.3	146	131	102	0.5657			
3	9	0.33	2.4	146	132	104	0.5745	Stack Temperature	(deg F)	T(s avg) = 148.2
4	9	0.32	2.3	146	132	105	0.5657		(deg C)	T(s avg) = 64.5
5	9	0.32	2.3	147	133	105	0.5657			
6	9	0.32	2.3	148	133	106	0.5657	Meter Temperature	(deg F)	T(m avg) = 120.2
7	9	0.32	2.3	147	136	107	0.5657		(deg C)	T(m avg) = 49.0
8	9	0.32	2.3	148	134	107	0.5657			
1	9	0.33	2.4	149	128	107	0.5745	Root-Mean-Square dP	("wc)	SQRT(dP) = 0.569
2	9	0.32	2.3	150	134	107	0.5657			
3	9	0.32	2.3	150	135	108	0.5657			
4	9	0.33	2.4	149	134	108	0.5745			
5	9	0.33	2.4	150	136	110	0.5745			
6	9	0.33	2.4	149	137	110	0.5745			
7	9	0.32	2.3	150	137	110	0.5657			
8	9	0.32	2.3	150	137	111	0.5657			
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TOTALS	144	5.18	37.4000	2371.0	2136.0	1709.0	9.1036			

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill *el*
 Date: 8-13-91 Printed 09/11/91 Test No./Type: 18131040ES
 Sample Location: Scrubber Exit Start/Stop Time: 1040-1308

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.302
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(144.00)
Barometric Pressure (in Hg)	P(b)	30.11
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		530.511
Gas Meter Final Reading (cu ft)		655.996
Net Gas Sample Volume (cu ft)	V(m)	(125.49)
Vol of Liquid Collected (ml)	VL(c)	196.53
Vol of Liq @ Std. Conds. (scf)	V(w std)	(9.251)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	14.9
CO2 Concentration (by CEM)	%	3.47
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.63)

CALCULATED RESULTS FOR SAMPLE # — 18131040ES

Isokineticity	% I	=	97.1
Metered Sample Gas Volume (scf)	V(m std)	=	115.96
	(scm)	V(m std)	= 3.284
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1723
std cond. (dscm/min)	Q(s)	=	48.8
actual (acfm)	Q(a)	=	2163
actual (acm/min)	Q(a)	=	61.3
Particulate Loading, dry (gr/dscf)	C(s std)	=	NA
@ 7% O2 (gr/dscf)	C(s std)	=	NA
@ 7% O2 (mg/dscm)	C(s std)	=	NA
Particulate Emission Rate (lb/hr)	E(p)	=	NA
(kg/hr)	E(p)	=	NA
Stack Gas Water Vapor Proportion	B(wv)	=	0.074
Molecular Weight of Stack Gas, Dry	M(d)	=	29.15
Wet	M(s)	=	28.33
Stack Pressure, absolute (in Hg)	P(s)	=	29.82
Average Stack Velocity (ft/sec)	V(s avg)	=	34.9

I = 175 mls.

Sample Point	dClock Time (min)	Velocity Head (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	in	out	SQRT(dP)	FIELD DATA AVERAGES FOR SAMPLE # — 18131040ES
									Velocity Head (*wc) dP(avg) = 0.326
1	9	0.33	2.4	151	124	102	0.5745	Orifice Meter Reading (*wc) dH(avg) = 2.363	
2	9	0.32	2.3	151	126	103	0.5657		
3	9	0.32	2.3	152	130	103	0.5657	Stack Temperature (deg F) T(s avg) = 151.9	
4	9	0.33	2.4	152	130	104	0.5745	(deg C) T(s avg) = 66.6	
5	9	0.32	2.3	152	130	105	0.5657		
6	9	0.32	2.3	152	130	105	0.5657	Meter Temperature (deg F) T(m avg) = 118.1	
7	9	0.33	2.4	152	130	106	0.5745	(deg C) T(m avg) = 47.8	
8	9	0.33	2.4	152	131	106	0.5745		
1	9	0.33	2.4	152	119	105	0.5745	Root-Mean-Square dP (*wc) SQRT(dP) = 0.571	
2	9	0.32	2.3	152	132	106	0.5657		
3	9	0.33	2.4	152	134	107	0.5745		
4	9	0.33	2.4	152	134	107	0.5745		
5	9	0.32	2.3	152	134	108	0.5657		
6	9	0.33	2.4	152	134	109	0.5745		
7	9	0.33	2.4	152	133	109	0.5745		
8	9	0.33	2.4	152	133	109	0.5745		
—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—		
TOTALS	144	5.22	37.8000	2430.0	2084.0	1694.0	9.1387		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill Ed
 Date: 8-15-91 Printed 09/11/91 Test No./Type: 18151003ES
 Sample Location: Scrubber Exit Start/Stop Time: 1007-1232

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.302
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(144.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		658.73
Gas Meter Final Reading (cu ft)		780.54
Net Gas Sample Volume (cu ft)	V(m)	(121.81)
Vol of Liquid Collected (ml)	Vl(c)	206.92
Vol of Liq @ Std. Conds. (scf)	V(w std)	(9.740)
Wt. of Filter Particulate (gm)		N/A
Wt. of Probe Wash Particulate (gm)		N/A
Wt of Combined Particulate (gm)	M(p)	(ERR)
O2 Concentration (by CEM)	%	14.85
CO2 Concentration (by CEM)	%	3.56
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.59)

CALCULATED RESULTS FOR SAMPLE # — 18151003ES

Isokineticity	% I	= 98.3
Metered Sample Gas Volume (scf)	V(m std)	= 113.83
(scm)	V(m std)	= 3.223
Stack Gas Flow, std cond. (dscfm)	Q(s)	= 1671
std cond. (dscm/min)	Q(s)	= 47.3
actual (acfm)	Q(a)	= 2098
actual (acm/min)	Q(a)	= 59.4
Particulate Loading, dry (gr/dscf)	C(s std)	= NA
@ 7% O2 (gr/dscf)	C(s std)	= NA
@ 7% O2 (mg/dscm)	C(s std)	= NA
Particulate Emission Rate (lb/hr)	E(p)	= NA
(kg/hr)	E(p)	= NA
Stack Gas Water Vapor Proportion	B(wv)	= 0.079
Molecular Weight of Stack Gas, Dry	M(d)	= 29.16
Wet	M(s)	= 28.28
Stack Pressure, absolute (in Hg)	P(s)	= 29.81
Average Stack Velocity (ft/sec)	V(s avg)	= 33.9

I = 183 mls.

FIELD DATA AVERAGES FOR SAMPLE # — 18151003ES

Sample Point	Clock Time (min)	Velocity Head (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F) in	Gas Meter Temp (deg F) out	SQRT(dP)	FIELD DATA AVERAGES FOR SAMPLE # — 18151003ES
								Velocity Head ("wc) dP(avg) = 0.308
1	9	0.32	2.2	147	84	83	0.5657	Orifice Meter Reading ("wc) dH(avg) = 2.200
2	9	0.32	2.2	147	100	84	0.5657	
3	9	0.31	2.2	147	113	89	0.5568	Stack Temperature (deg F) T(s avg) = 148.3
4	9	0.3	2.2	148	120	93	0.5477	(deg C) T(s avg) = 64.6
5	9	0.31	2.2	148	125	97	0.5568	
6	9	0.3	2.2	148	127	100	0.5477	Meter Temperature (deg F) T(m avg) = 111.3
7	9	0.31	2.2	148	129	102	0.5568	(deg C) T(m avg) = 44.0
8	9	0.31	2.2	148	130	104	0.5568	
1	9	0.31	2.2	148	115	103	0.5568	Root-Mean-Square dP ("wc) SQRT(dP) = 0.555
2	9	0.31	2.2	149	130	105	0.5568	
3	9	0.3	2.2	149	130	105	0.5477	
4	9	0.3	2.2	149	131	106	0.5477	
5	9	0.31	2.2	149	131	107	0.5568	
6	9	0.3	2.2	149	131	107	0.5477	
7	9	0.31	2.2	149	131	108	0.5568	
8	9	0.31	2.2	149	132	108	0.5568	
TOTALS	144	4.93	35.2000	2372.0	1959.0	1601.0	8.8810	

APPENDIX D-3
METHOD 5 TRAIN WORKSHEETS

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill *Ed*
 Date: 8-6-91 Printed 09/11/91 Test No./Type: 18061000EP
 Sample Location: Scrubber Exit Start/Stop Time: 1000-1259

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.247
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	19
Total Sampling Time (min)	(theta)	(173.00)
Barometric Pressure (in Hg)	P(b)	30.16
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		198.16
Gas Meter Final Reading (cu ft)		308.564
Net Gas Sample Volume (cu ft)	V(a)	(110.40)
Vol of Liquid Collected (ml)	Vl(c)	148.03
Vol of Liq @ Std. Conds. (scf)	V(w std)	(6.968)
Wt. of Filter Particulate (gm)		0.0033
Wt. of Probe Wash Particulate (gm)		0.0109
Wt of Combined Particulate (gm)	M(p)	(0.0142)
O2 Concentration (by CEM)	%	15.22
CO2 Concentration (by CEM)	%	3.28
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.50)

CALCULATED RESULTS FOR SAMPLE # — 18061000EP

Isokineticity	% I	= 103.9
Metered Sample Gas Volume (scf)	V(m std)	= 102.07
	(scm)	V(m std) = 2.890
Stack Gas Flow, std cond. (dscfm)	Q(s)	= 1764
std cond. (dscm/min)	Q(s)	= 49.9
actual (acfm)	Q(a)	= 2163
actual (acm/min)	Q(a)	= 61.2
Particulate Loading, dry (gr/dscf)	C(s std)	= 0.0021
@ 7% O2 (gr/dscf)	C(s std)	= 0.0052
@ 7% O2 (mg/dscm)	C(s std)	= 12
Particulate Emission Rate (lb/hr)	E(p)	= 0.032
(kg/hr)	E(p)	= 0.015
Stack Gas Water Vapor Proportion	B(wv)	= 0.064
Molecular Weight of Stack Gas, Dry	M(d)	= 29.13
Wet	M(s)	= 28.42
Stack Pressure, absolute (in Hg)	P(s)	= 29.87
Average Stack Velocity (ft/sec)	V(s avg)	= 34.9

I = 420 mls.

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FIELD DATA AVERAGES FOR SAMPLE # — 18061000EP									
Sample Point	dClock Time (min)	Velocity (ft/min)	Drift (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	ISQRT(dP)	Velocity Head (*wc)	dP (avg)	
1	9	0.35	1.3	145	95	92	0.5916	Orifice Meter Reading (*wc)	dH (avg) = 1.226
2	9	0.35	1.3	145	117	97	0.5916		
3	9	0.34	1.3	145	122	100	0.5831	Stack Temperature (deg F)	T(s avg) = 145.0
4	9	0.34	1.3	145	126	104	0.5831	(deg C)	T(s avg) = 62.8
5	9	0.33	1.2	145	128	109	0.5745		
6	9	0.34	1.3	145	129	110	0.5831	Meter Temperature (deg F)	T(m avg) = 117.2
7	9	0.33	1.2	145	129	110	0.5745	(deg C)	T(m avg) = 47.3
8	9	0.32	1.2	145	129	111	0.5657		
1	9	0.33	1.2	145	126	102	0.5745	Root-Mean-Square dP (*wc)	ISQRT(dP) = 0.576
2	9	0.33	1.2	145	128	107	0.5745		
3	9	0.32	1.2	145	129	111	0.5657		
4	9	0.32	1.2	145	130	111	0.5657		
5	9	0.33	1.2	145	131	111	0.5745		
6	9	0.33	1.2	145	131	111	0.5745		
7	9	0.33	1.2	145	131	111	0.5745		
8	9	0.32	1.2	145	131	112	0.5657		
7	9	0.33	1.2	145	131	112	0.5745		
6	9	0.33	1.2	145	131	113	0.5745		
5	11	0.33	1.2	145	132	113	0.5745		
TOTALS	173	6.30	23.3000	2755.0	2406.0	2047.0	10.9398		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill
 Date: 8-8-91 Printed 09/11/91 Test No./Type: 18081018EP
 Sample Location: Scrubber Exit Start/Stop Time: 1018-1247

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.263
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	---
Width (if rectangular)	W	---
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(144.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		313.475
Gas Meter Final Reading (cu ft)		409.28
Net Gas Sample Volume (cu ft)	V(a)	(95.80)
Vol of Liquid Collected (ml)	Vl(c)	166.34
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.830)
Wt. of Filter Particulate (gm)		0.0045
Wt. of Probe Wash Particulate (gm)		0.0085
Wt of Combined Particulate (gm)	M(p)	(0.0130)
O2 Concentration (by CEM)	%	14.89
CO2 Concentration (by CEM)	%	3.44
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.67)

CALCULATED RESULTS FOR SAMPLE # -- 18081018EP

Isokineticity	Z I	= 98.5
Metered Sample Gas Volume (scf)	V(a std)	= 88.43
	(scm)	V(a std) = 2.504
Stack Gas Flow, std cond. (dscfm)	Q(s)	= 1708
std cond. (dscfm/min)	Q(s)	= 48.4
actual (acfm)	Q(a)	= 2150
actual (acfm/min)	Q(a)	= 60.9
Particulate Loading, dry (gr/dscf)	C(s std)	= 0.0023
@ 7% O2 (gr/dscf)	C(s std)	= 0.0052
@ 7% O2 (mg/dscm)	C(s std)	= 12
Particulate Emission Rate (lb/hr)	E(p)	= 0.033
(kg/hr)	E(p)	= 0.015
Stack Gas Water Vapor Proportion	B(wv)	= 0.081
Molecular Weight of Stack Gas, Dry	M(d)	= 29.15
Wet	M(s)	= 28.24
Stack Pressure, absolute (in Hg)	P(s)	= 29.81
Average Stack Velocity (ft/sec)	V(s avg)	= 34.7

I = 445 mls.

FIELD DATA AVERAGES FOR SAMPLE # -- 18081018EP									
Sample Point	dClock Time (min)	Velocity (in H2O)	Orifice (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	ISORT (dP)	Velocity Head ("wc)	dP (avg)	
1	9	0.32	1.2	146	90	87	0.5657	Orifice Meter Reading ("wc)	dH (avg) = 1.200
2	9	0.33	1.2	146	107	91	0.5745		
3	9	0.32	1.2	146	115	93	0.5657	Stack Temperature (deg F)	T(s avg) = 148.3
4	9	0.32	1.2	146	127	99	0.5657	(deg C)	T(s avg) = 64.6
5	9	0.33	1.2	147	132	103	0.5745		
6	9	0.32	1.2	148	135	105	0.5657	Meter Temperature (deg F)	T(a avg) = 116.9
7	9	0.32	1.2	148	135	105	0.5657	(deg C)	T(a avg) = 47.2
8	9	0.32	1.2	148	136	107	0.5657		
1	9	0.32	1.2	149	135	107	0.5657	Root-Mean-Square dP ("wc)	SQRT(dP) = 0.568
2	9	0.32	1.2	150	136	109	0.5657		
3	9	0.32	1.2	150	136	111	0.5657		
4	9	0.33	1.2	149	134	111	0.5745		
5	9	0.33	1.2	150	136	111	0.5745		
6	9	0.32	1.2	149	136	113	0.5657		
7	9	0.33	1.2	150	136	113	0.5745		
8	9	0.32	1.2	150	137	113	0.5657		
TOTALS	144	5.17	19.2000	2372.0	2063.0	1678.0	9.0948		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill Ed
 Date: 8-13-91 Printed 09/11/91 Test No./Type: 18131040EP
 Sample Location: Scrubber Exit Start/Stop Time: 1040-1308

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.263
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(144.00)
Barometric Pressure (in Hg)	P(b)	30.11
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		449.651
Gas Meter Final Reading (cu ft)		541.3
Net Gas Sample Volume (cu ft)	V(m)	(91.65)
Vol of Liquid Collected (ml)	Vl(c)	185.91
Vol of Liq @ Std. Conds. (scf)	V(w std)	(8.751)
Wt. of Filter Particulate (gm)		0.004
Wt. of Probe Wash Particulate (gm)		0.0161
Wt of Combined Particulate (gm)	M(p)	(0.0201)
O2 Concentration (by CEM)	%	14.9
CO2 Concentration (by CEM)	%	3.47
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.63)

CALCULATED RESULTS FOR SAMPLE # — 18131040EP

Isokineticity	% I	=	95.5
Metered Sample Gas Volume (scf)	V(m std)	=	84.90
	(scm)	V(m std)	= 2.404
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1691
std cond. (dscm/min)	Q(s)	=	47.9
actual (acfm)	Q(a)	=	2169
actual (acm/min)	Q(a)	=	61.4
Particulate Loading, dry (gr/dscf)	C(s std)	=	0.0037
@ 7% O2 (gr/dscf)	C(s std)	=	0.0084
@ 7% O2 (mg/dscm)	C(s std)	=	19
Particulate Emission Rate (lb/hr)	E(p)	=	0.053
(kg/hr)	E(p)	=	0.024
Stack Gas Water Vapor Proportion	B(wv)	=	0.093
Molecular Weight of Stack Gas, Dry	M(d)	=	29.15
Net	M(s)	=	28.11
Stack Pressure, absolute (in Hg)	P(s)	=	29.82
Average Stack Velocity (ft/sec)	V(s avg)	=	35.0

$I = 460 \text{ m/s.}$

Sample Point	dClock Time (min)	Velocity Head (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	in	out	SQRT(dP)	FIELD DATA AVERAGES FOR SAMPLE # — 18131040EP
									Velocity Head ("wc) dP(avg) = 0.326
1	9	0.33	1.2	151	122	100	0.5745	Orifice Meter Reading ("wc) dH(avg) = 1.200	
2	9	0.33	1.2	151	123	100	0.5745		
3	9	0.32	1.2	152	123	101	0.5657	Stack Temperature (deg F) T(s avg) = 151.9	
4	9	0.32	1.2	152	123	102	0.5657	(deg C) T(s avg) = 66.6	
5	9	0.32	1.2	152	123	102	0.5657		
6	9	0.33	1.2	152	124	103	0.5745	Meter Temperature (deg F) T(m avg) = 115.0	
7	9	0.33	1.2	152	125	104	0.5745	(deg C) T(m avg) = 46.1	
8	9	0.32	1.2	152	126	105	0.5657		
1	9	0.33	1.2	152	123	104	0.5745	Root-Mean-Square dP ("wc) SQRT(dP) = 0.571	
2	9	0.33	1.2	152	127	105	0.5745		
3	9	0.32	1.2	152	128	105	0.5657		
4	9	0.32	1.2	152	130	105	0.5657		
5	9	0.33	1.2	152	131	105	0.5745		
6	9	0.33	1.2	152	131	106	0.5745		
7	9	0.33	1.2	152	131	106	0.5745		
8	9	0.32	1.2	152	132	106	0.5657		
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—	—	—	—	—	—	—	—		
TOTALS	144	5.21	19.2000	2430.0	2022.0	1659.0	9.1299		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: E Hill ^{Ed}
 Date: 8-15-91 Printed 09/11/91 Test No./Type: 18151003EP
 Sample Location: Scrubber Exit Start/Stop Time: 1003-1232

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.263
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	1
Stack (Duct) Dimensions (in):		
Radius (if round)	R	6.88
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.03267)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(144.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	-4
Gas Meter Initial Reading (cu ft)		551.225
Gas Meter Final Reading (cu ft)		642.847
Net Gas Sample Volume (cu ft)	V(m)	(91.62)
Vol of Liquid Collected (ml)	VL(c)	139.53
Vol of Liq @ Std. Conds. (scf)	V(w std)	(6.568)
Wt. of Filter Particulate (gm)		0.0013
Wt. of Probe Wash Particulate (gm)		0.0085
Wt of Combined Particulate (gm)	M(p)	(0.0098)
O2 Concentration (by CEM)	%	14.85
CO2 Concentration (by CEM)	%	3.56
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(81.59)

CALCULATED RESULTS FOR SAMPLE # — 18151003EP

Isokineticity	% I	=	95.4
Metered Sample Gas Volume (scf)	V(m std)	=	85.05
	(scm)	V(m std)	= 2.408
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	1697
std cond. (dscm/min)	Q(s)	=	48.1
actual (acfm)	Q(a)	=	2114
actual (acm/min)	Q(a)	=	59.9
Particulate Loading, dry (gr/dscf)	C(s std)	=	0.0018
@ 7% O2 (gr/dscf)	C(s std)	=	0.0040
@ 7% O2 (mg/dscm)	C(s std)	=	9
Particulate Emission Rate (lb/hr)	E(p)	=	0.026
	(kg/hr)	E(p)	= 0.012
Stack Gas Water Vapor Proportion	B(wv)	=	0.072
Molecular Weight of Stack Gas, Dry	M(d)	=	29.16
Wet	M(s)	=	28.36
Stack Pressure, absolute (in Hg)	P(s)	=	29.81
Average Stack Velocity (ft/sec)	V(s avg)	=	34.1

I = 420 m/s.

FIELD DATA AVERAGES FOR SAMPLE # 18151003EP									
Sample Point	dClock Time (min)	Velocity Head (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (deg F)	Gas Temp in (deg F)	Meter Temp out (deg F)	SQRT(dP)	Velocity Head ("wc)	dP(avg) = 0.314
1	9	0.32	1.2	147	81	79	0.5657	Orifice Meter Reading ("wc)	dH(avg) = 1.138
2	9	0.31	1.1	147	100	83	0.5568		
3	9	0.31	1.1	148	106	89	0.5568	Stack Temperature (deg F)	T(s avg) = 148.4
4	9	0.31	1.1	148	131	95	0.5568	(deg C)	T(s avg) = 64.7
5	9	0.32	1.2	148	130	102	0.5657		
6	9	0.31	1.1	148	133	107	0.5568	Meter Temperature (deg F)	T(m avg) = 113.6
7	9	0.31	1.1	148	130	109	0.5568	(deg C)	T(m avg) = 45.3
8	9	0.32	1.2	148	131	109	0.5657		
1	9	0.31	1.1	149	109	108	0.5568	Root-Mean-Square dP ("wc)	SQRT(dP) = 0.560
2	9	0.32	1.2	149	130	109	0.5657		
3	9	0.31	1.1	149	131	109	0.5568		
4	9	0.31	1.1	149	133	109	0.5568		
5	9	0.32	1.2	149	134	110	0.5657		
6	9	0.32	1.2	149	134	111	0.5657		
7	9	0.31	1.1	149	135	111	0.5568		
8	9	0.31	1.1	149	135	111	0.5568		
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TOTALS	144	5.02	18.2000	2374.0	1983.0	1651.0	8.9619		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: R JACKSON
 Date: 08-06-91 Printed 09/11/91 Test No./Type: 18060945SP
 Sample Location: STACK Start/Stop Time: 0945-1140

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.231
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	0.99
Stack (Duct) Dimensions (in):		
Radius (if round)	R	7
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.06901)
# of Sample Points	#	12
Total Sampling Time (min)	(theta)	(120.00)
Barometric Pressure (in Hg)	P(b)	30.16
Stack Pressure (in H2O)	P(stack)	-0.3
Gas Meter Initial Reading (cu ft)		957.54
Gas Meter Final Reading (cu ft)		1044.55
Net Gas Sample Volume (cu ft)	V(m)	(87.01)
Vol of Liquid Collected (al)	VL(c)	103.55
Vol of Liq & Std. Conds. (scf)	V(w std)	(4.874)
Wt. of Filter Particulate (gm)		0.0008
Wt. of Probe Wash Particulate (gm)		0.0038
Wt. of Combined Particulate (gm)	M(p)	(0.0046)
O2 Concentration (by CEM)	%	14.63
CO2 Concentration (by CEM)	%	3.36
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(82.01)

CALCULATED RESULTS FOR SAMPLE # — 18060945SP

Isokineticity	% I	=	100.7
Metered Sample Gas Volume (scf)	V(m std)	=	78.36
	(scm)	V(m std)	= 2.219
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	2384
std cond. (dscm/min)	Q(s)	=	67.5
actual (acfm)	Q(a)	=	2856
actual (acm/min)	Q(a)	=	80.9
Particulate Loading, dry (gr/dscf)	C(s std)	=	0.0009
@ 7% O2 (gr/dscf)	C(s std)	=	0.0020
@ 7% O2 (mg/dscm)	C(s std)	=	5
Particulate Emission Rate (lb/hr)	E(p)	=	0.019
	(kg/hr)	E(p)	= 0.008
Stack Gas Water Vapor Proportion	B(wc)	=	0.059
Molecular Weight of Stack Gas, Dry	M(d)	=	29.12
	Wet	M(s)	= 28.47
Stack Pressure, absolute (in Hg)	P(s)	=	30.14
Average Stack Velocity (ft/sec)	V(s avg)	=	44.5

FIELD DATA AVERAGES FOR SAMPLE # — 18060945SP									
Sample Point	dClock Time (min)	Velocity (in H2O)	Orifice Head, dP (in H2O)	Stack Temp (degF)	Gas Meter Temp (degF)	SGRT (dP)	Velocity Head ("wc)	dP (avg)	
1	10	0.55	1.98	139	104	97	0.7416	Orifice Meter Reading ("wc)	dH (avg) = 1.980
2	10	0.55	1.98	139	120	102	0.7416	Stack Temperature (deg F)	T(s avg) = 139.7
3	10	0.55	1.98	139	138	107	0.7416	Stack Temperature (deg C)	T(s avg) = 59.8
4	10	0.55	1.98	139	141	111	0.7416	Meter Temperature (deg F)	T(m avg) = 127.7
5	10	0.55	1.98	140	144	116	0.7416	Meter Temperature (deg C)	T(m avg) = 53.1
6	10	0.55	1.98	140	146	118	0.7416	Root-Mean-Square dP ("wc)	SGRT (dP) = 0.742
1	10	0.55	1.98	140	139	119	0.7416		
2	10	0.55	1.98	140	145	121	0.7416		
3	10	0.55	1.98	140	148	124	0.7416		
4	10	0.55	1.98	140	149	125	0.7416		
5	10	0.55	1.98	140	149	125	0.7416		
6	10	0.55	1.98	140	150	126	0.7416		
TOTALS	120	6.60	23.7600	1676.0	1673.0	1391.0	8.8994		

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: R. JACKSON
 Date: 08-08-91 Printed 09/11/91 Test No./Type: 18081022SP
 Sample Location: STACK Start/Stop Time: 1022-1227

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.244
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	0.99
Stack (Duct) Dimensions (in):		
Radius (if round)	R	7
Length (if rectangular)	L	---
Width (if rectangular)	W	---
Area of Stack (sq ft)	A(s)	(1.06901)
# of Sample Points	#	12
Total Sampling Time (min)	(theta)	(120.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	0.4
Gas Meter Initial Reading (cu ft)		45.562
Gas Meter Final Reading (cu ft)		138.318
Net Gas Sample Volume (cu ft)	V(a)	(92.76)
Vol of Liquid Collected (ml)	VL(c)	168.23
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.919)
Wt. of Filter Particulate (gm)		0.0006
Wt. of Probe Wash Particulate (gm)		0.0024
Wt of Combined Particulate (gm)	M(p)	(0.0030)
O2 Concentration (by CEM)	%	16.13
CO2 Concentration (by CEM)	%	3.52
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(80.35)

CALCULATED RESULTS FOR SAMPLE # --- 18081022SP

Isokineticity	% I	=	100.6
Metered Sample Gas Volume (scf)	V(m std)	=	83.33
	(scm)	V(m std)	= 2.360
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	2275
std cond. (dscm/min)	Q(s)	=	64.4
actual (acfm)	Q(a)	=	2815
actual (acm/min)	Q(a)	=	79.7
Particulate Loading, dry (gr/dscf)	C(s std)	=	0.0006
@ 7% O2 (gr/dscf)	C(s std)	=	0.0016
@ 7% O2 (mg/dscm)	C(s std)	=	4
Particulate Emission Rate (lb/hr)	E(p)	=	0.011
(kg/hr)	E(p)	=	0.005
Stack Gas Water Vapor Proportion	B(wv)	=	0.087
Molecular Weight of Stack Gas, Dry	M(d)	=	29.21
Wet	M(s)	=	28.24
Stack Pressure, absolute (in Hg)	P(s)	=	30.13
Average Stack Velocity (ft/sec)	V(s avg)	=	43.9

I = 450 mls.

Sample Point	dClock Time (min)	Velocity Head (in H2O)	Drift Head (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F) in	Gas Meter Temp (deg F) out	SQRT(dP)	FIELD DATA AVERAGES FOR SAMPLE # --- 18081022SP	Velocity Head (*wc)	dP(avg)
1	10	0.55	1.98	140	108	99	0.7416	Orifice Meter Reading (*wc)	dH(avg)	1.830
2	10	0.55	1.98	141	126	101	0.7416	Stack Temperature (deg F)	T(s avg)	140.9
3	10	0.5	1.8	141	136	106	0.7071	Stack Temperature (deg C)	T(s avg)	60.5
4	10	0.5	1.8	141	139	111	0.7071	Meter Temperature (deg F)	T(m avg)	127.8
5	10	0.55	1.8	141	144	117	0.7416	Meter Temperature (deg C)	T(m avg)	53.2
6	10	0.55	1.8	141	146	119	0.7416	Root-Mean-Square dP (*wc)	SQRT(dP)	0.727
1	10	0.55	1.8	141	136	120	0.7416			
2	10	0.55	1.8	141	145	121	0.7416			
3	10	0.55	1.8	141	146	122	0.7416			
4	10	0.5	1.8	141	148	123	0.7071			
5	10	0.5	1.8	141	150	126	0.7071			
6	10	0.5	1.8	141	151	126	0.7071			
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TOTALS	120	6.35	21.9600	1691.0	1675.0	1391.0	8.7269			

ISOKINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: R JACKSON
 Date: 08-13-91 Printed 09/11/91 Test No./Type: 18131051SP
 Sample Location: STACK Start/Stop Time: 1051-1248

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.244
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	0.99
Stack (Duct) Dimensions (in):		
Radius (if round)	R	7
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.06901)
# of Sample Points	#	12
Total Sampling Time (min)	(theta)	(112.00)
Barometric Pressure (in Hg)	P(b)	30.11
Stack Pressure (in H2O)	P(stack)	0.4
Gas Meter Initial Reading (cu ft)		384.884
Gas Meter Final Reading (cu ft)		467.45
Net Gas Sample Volume (cu ft)	V(m)	(82.57)
Vol of Liquid Collected (ml)	VL(c)	162.57
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.652)
Wt. of Filter Particulate (gm)		0.0095
Wt. of Probe Wash Particulate (gm)		0.0118
Wt of Combined Particulate (gm)	M(p)	(0.0213)
O2 Concentration (by CEM)	%	16.19
CO2 Concentration (by CEM)	%	3.51
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(80.30)

CALCULATED RESULTS FOR SAMPLE # — 18131051SP

Isokineticity	% I	=	99.3
Metered Sample Gas Volume (scf)	V(m std)	=	74.48
(scm)	V(m std)	=	2.109
Stack Gas Flow, std cond. (dscfm)	Q(s)	=	2206
std cond. (dscm/min)	Q(s)	=	62.5
actual (acfm)	Q(a)	=	2732
actual (acm/min)	Q(a)	=	77.4
Particulate Loading, dry (gr/dscf)	C(s std)	=	0.0044
@ 7% O2 (gr/dscf)	C(s std)	=	0.0128
@ 7% O2 (mg/dscm)	C(s std)	=	29
Particulate Emission Rate (lb/hr)	E(p)	=	0.083
(kg/hr)	E(p)	=	0.038
Stack Gas Water Vapor Proportion	B(wv)	=	0.093
Molecular Weight of Stack Gas, Dry	M(d)	=	29.21
Wet	M(s)	=	28.16
Stack Pressure, absolute (in Hg)	P(s)	=	30.14
Average Stack Velocity (ft/sec)	V(s avg)	=	42.6

I = 440 m/s.

SAMPLE # — 18131051SP

Sample Point	dClock Time (min)	Velocity (in H2O)	Drift (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F)	Gas Meter In	Gas Meter Out	SQRT(dP)	FIELD DATA AVERAGES FOR SAMPLE # — 18131051SP
									Velocity Head ("wc) dP (avg) = 0.500
1	10	0.5	1.8	138	136	111	0.7071	Drift Meter Reading ("wc) dH (avg) = 1.800	
2	10	0.5	1.8	138	138	111	0.7071		
3	10	0.5	1.8	137	141	111	0.7071	Stack Temperature (deg F) T(s avg) = 137.3	
4	10	0.5	1.8	137	141	111	0.7071	(deg C) T(s avg) = 58.5	
5	10	0.5	1.8	136	141	111	0.7071		
6	10	0.5	1.8	136	141	111	0.7071	Meter Temperature (deg F) T(m avg) = 125.5	
1	10	0.5	1.8	137	128	108	0.7071	(deg C) T(m avg) = 51.9	
2	10	0.5	1.8	137	139	111	0.7071		
3	10	0.5	1.8	137	142	111	0.7071	Root-Mean-Square dP ("wc) SQRT(dP) = 0.707	
4	10	0.5	1.8	138	144	113	0.7071		
5	10	0.5	1.8	138	144	113	0.7071		
6	2	0.5	1.8	138	142	113	0.7071		
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TOTALS	112	6.00	21.6000	1647.0	1677.0	1335.0	8.4853		

ISO KINETIC RESULTS

Plant: IRF Updated 09-11-91 Performed by: R JACKSON
 Date: 08-15-91 Printed 09/11/91 Test No./Type: 18151005SP
 Sample Location: STACK Start/Stop Time: 1005-1245

PARAMETER	SYMBOL	VALUE
		(calc.)
Nozzle Diameter, Actual (in)	N(d)	0.244
Pitot Tube Correction Factor	C(p)	0.84
Gas Meter Correction Factor	(alpha)	0.99
Stack (Duct) Dimensions (in):		
Radius (if round)	R	7
Length (if rectangular)	L	—
Width (if rectangular)	W	—
Area of Stack (sq ft)	A(s)	(1.06901)
# of Sample Points	#	16
Total Sampling Time (min)	(theta)	(155.00)
Barometric Pressure (in Hg)	P(b)	30.1
Stack Pressure (in H2O)	P(stack)	0.4
Gas Meter Initial Reading (cu ft)		480.593
Gas Meter Final Reading (cu ft)		600.048
Net Gas Sample Volume (cu ft)	V(a)	(119.46)
Vol of Liquid Collected (ml)	VI(c)	159.66
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.515)
Wt. of Filter Particulate (gm)		0.0004
Wt. of Probe Wash Particulate (gm)		0.0017
Wt of Combined Particulate (gm)	M(p)	(0.0021)
O2 Concentration (by CEM)	%	15.79
CO2 Concentration (by CEM)	%	3.59
CO Concentration (by CEM)	%	0
N2 Concentration (by diff.)	%	(80.62)

CALCULATED RESULTS FOR SAMPLE # — 18151005SP

Isokineticity	% I	= 102.8
Metered Sample Gas Volume (scf)	V(m std)	= 108.30
	(scm)	V(m std) = 3.067
Stack Gas Flow, std cond. (dscfm)	Q(s)	= 2240
std cond. (dscm/min)	Q(s)	= 63.4
actual (acfm)	Q(a)	= 2695
actual (acm/min)	Q(a)	= 76.3
Particulate Loading, dry (gr/dscf)	C(s std)	= 0.0003
@ 7% O2 (gr/dscf)	C(s std)	= 0.0008
@ 7% O2 (mg/dscm)	C(s std)	= 2
Particulate Emission Rate (lb/hr)	E(p)	= 0.006
(kg/hr)	E(p)	= 0.003
Stack Gas Water Vapor Proportion	B(wv)	= 0.065
Molecular Weight of Stack Gas, Dry	M(d)	= 29.21
Wet	M(s)	= 28.48
Stack Pressure, absolute (in Hg)	P(s)	= 30.13
Average Stack Velocity (ft/sec)	V(s avg)	= 42.0

I = 440 mls

FIELD DATA AVERAGES FOR SAMPLE # — 18151005SP									
Sample Point	dClock Time (min)	Velocity Head (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (deg F)	Gas Meter Temp (deg F) in	Gas Meter Temp (deg F) out	SQRT(dP)	Velocity Head ("wc)	dP(avg) = 0.491
1	10	0.5	1.8	137	98	94	0.7071	Orifice Meter Reading ("wc)	dH(avg) = 1.756
2	10	0.5	1.8	137	116	95	0.7071	Stack Temperature (deg F)	T(s avg) = 138.1
3	10	0.5	1.8	137	124	98	0.7071	(deg C)	T(s avg) = 59.0
4	10	0.5	1.8	137	126	100	0.7071	Meter Temperature (deg F)	T(a avg) = 122.3
5	10	0.5	1.8	137	131	104	0.7071	(deg C)	T(a avg) = 50.2
6	10	0.5	1.8	137	139	108	0.7071	Root-Mean-Square dP ("wc)	SQRT(dP) = 0.701
7	10	0.5	1.8	137	141	110	0.7071		
1	10	0.5	1.8	138	126	110	0.7071		
2	10	0.5	1.8	138	142	111	0.7071		
3	10	0.48	1.7	138	142	113	0.6928		
4	10	0.48	1.7	138	143	114	0.6928		
5	10	0.48	1.7	139	144	115	0.6928		
6	10	0.48	1.7	140	144	115	0.6928		
7	10	0.48	1.7	140	144	115	0.6928		
6	10	0.48	1.7	140	142	115	0.6928		
5	5	0.48	1.7	140	142	114	0.6928		
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TOTALS	155	7.86	28.1000	2210.0	2144.0	1769.0	11.2137		

