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Project Summary

Pilot-Scale Incineration Testing of Fluff and Soil from the M.W. Manufacturing Superfund Site

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At the request of U.S. Environmental Protection Agency (U.S. EPA) Region III and U.S. Army Corps of Engineers, a series of six tests was conducted at the U.S. EPA Incineration Research Facility (IRF) to evaluate the incinerability of the fluff waste and contaminated soil from the M. W. Manufacturing Corporation Superfund site in Danville, PA. Both materials are contaminated with volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), chlorinated dioxins and furans, and several trace metals, including antimony, arsenic, barium, cadmium, chromium, copper, lead, nickel, silver, and zinc. Copper and lead, in particular, are at very high concentrations in both the fluff waste and contaminated soil. The fluff was incinerated at two kiln exit gas temperatures: nominally 871° and 760°C (1,600° and 1,400°F). The soil was incinerated only at the higher kiln exit gas temperature of 871°C (1,600°F). Each test was run in duplicate. The afterburner exit gas temperature for all tests was nominally at 1,090°C (2,000°F). The primary air pollution control system consisted of a venturi/packed column scrubber system followed by a flue gas reheater and baghouse.

Test results showed that greater than 99.99% Destruction and Removal Efficiency (DRE) of the VOC and SVOC contaminants was uniformly achieved. HCl emissions were well below 1.8 kg/hr and system HCl control efficiencies well above 99%. Particulate emissions at the baghouse exit were well below 34 mg/dscm (0.015 gr/dscf) corrected to 7% O_2, a guideline level announced in the draft waste combustion strategy in May 1993. Baghouse exit flue gas total chlorinated dioxin/furan levels were well below 30 ng/dscm corrected to 7% O_2, another draft combustion strategy guideline. Incineration effectively decontaminated both the fluff waste and soil of their VOC and SVOC contaminants. However, the kiln ash discharge from the incineration of contaminated site soil at a kiln gas temperature of 871°C (1,600°F) contained total chlorinated dioxin/furan concentrations of 2.4 to 3.6 μg/kg. Levels in the kiln ash from fluff incineration at the same temperature were 65 to 89 μg/kg, and significantly increased, at 830 to 2,700 μg/kg, for incineration at a kiln gas temperature of 760°C (1,400°F). In addition, the flue gas particulate collected as baghouse ash for all tests was a cadmium- and lead-contaminated toxicity characteristic (TC) hazardous waste.

This Project Summary was developed by EPA's National Risk Management Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

One of the primary missions of EPA's Incineration Research Facility (IRF) is to support Regional Offices in evaluations of the potential of incineration as a treatment

option for wastes and other contaminated materials at Superfund sites. One priority site is the M. W. Manufacturing site in Danville, PA. EPA Region III and the U.S. Army Corps of Engineers (USACE) requested that a pilot-scale test program be conducted at the IRF to support evaluations of the suitability of incineration as a treatment technology for wastes and contaminated soil at the site.

The M. W. Manufacturing site began operation in 1966. M. W. Manufacturing Corporation reclaimed copper from scrap wire using both mechanical and chemical processes. Reclamation activities began in 1969 and continued until 1972 when M. W. Manufacturing filed for bankruptcy. The chemical recovery processes used by M. W. Manufacturing led to site contamination with volatile organic solvents. Warehouse 81, Inc., acquired the site in 1976 and began mechanical recovery operations from the existing waste piles onsite. The mechanical recovery operations generated large volumes of waste material, termed fluff.

The fluff waste produced by the mechanical stripping process consists of fibrous insulation material mixed with plastic. Phthalate esters, copper, and lead are the major contaminants in this material. The chemical recovery process used by M. W. Manufacturing was a two-step process. The first step involved the use of a hot oil bath to melt the plastic insulation away from the metal in the scrap wire. Residual oils were removed from the separated copper in the second step through the use of chlorinated solvents, including trichloroethene and tetrachloroethene. Thus, these solvents are waste and soil contaminants at the site.

The June 1990 record of decision (ROD) document for the site identified onsite incineration as the selected treatment for two site-contaminated materials, fluff waste and organic- and trace-metal-contaminated soil. The specific objectives of the IRF test program were defined as follows:

- Verify that the fluff waste and the contaminated soil at the site can be incinerated in compliance with the hazardous waste incinerator performance standards and permit requirements.
- Measure the effectiveness of incineration treatment in decontaminating fluff and soil of their organic contaminants and evaluate whether incineration temperature affects the effectiveness of fluff decontamination.
- Measure the distribution of the contaminant metals in the fluff and the contaminated soil among the incineration system discharge streams.
- Determine whether the bottom ash residue and the Air Pollution Control System (APCS) discharges from the incineration of fluff and contaminated soil will be toxicity characteristic (TC) hazardous wastes.
- Determine whether the bottom ash residue from the incineration of contaminated soil meets the cleanup levels for soil given in the ROD.

To address these objectives, a series of seven tests was performed in the rotary kiln incineration system (RKS) at the IRF.

Test Program

A process schematic of the RKS is shown in Figure 1.

Waste Description

The major organic contaminants in site wastes are the two phthalate esters, bis (2-ethylhexyl) phthalate (BEHP) and di-n-octyl phthalate (DNOP). Thus, these compounds would be considered the Principal Organic Hazardous Constituents (POHCs) in the site wastes. However, because both BEHP and DNOP are compounds ranked relatively easy to thermally destroy, according to the thermal stability based incinerability ranking, the test waste materials were spiked with naphthalene, a compound ranked quite difficult to destroy, at 2% by weight. In addition, Region III was interested in establishing that tetrachloroethene, one of two volatile organic compounds (VOCs) found in site wastes, is effectively destroyed by incineration, so tetrachloroethene was also defined to be a POHC. As a result, tetrachloroethene was also spiked into test materials, at a level of 3,100 mg/kg by weight, because site material concentrations of the compound were too low to allow establishing a 99.99% DRE at achievable flue gas concentration quantitation limits. Site wastes are also highly contaminated with copper and lead, and with lesser, though still significant, amounts of antimony, barium, chromium, nickel, and zinc.

Test Conditions

In the test program, two sets of duplicate tests feeding fluff waste alone and one set of duplicate tests feeding contaminated soil alone were performed. The two sets of fluff feed tests were conducted at different kiln exit gas temperatures. The target test operating conditions were as given in Table 1. A seventh test, denoted Test 0 in Table 1, was performed as a blank burn. Only feed packaging materials, the cardboard box, Polyethylene bag liner, high density polyethylene spike bottles (no POHC spike), and box closure items (plastic tie and paper tape) were fed to the RKS for the blank burn. The target test material feedrate was 54.5 kg/hr (120 lb/hr) for all tests except the blank burn. For all tests, the afterburner exit gas temperature was 1,090°C (2,000°F), and the kiln rotation rate was set to give a 30-min kiln solids residence time.

Sampling and Analysis Procedures

For all tests, the sampling matrix entailed obtaining composite samples of the test feed material, the kiln ash discharge, the pre-test and post-test scrubber system liquor, and the baghouse ash; and sampling flue gas at the baghouse exit for trace metals, semivolatile organic compounds (SVOCs), VOCs, polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofurans (PCDDs/PCDFs), and particulate and HCl. Test program samples were analyzed for matrix-specific combinations of SVOCs, VOCs, PCDDs/PCDFs, contaminant trace metals, and chloride.

Test Results

SVOC Results

Table 2 summarizes the measured concentrations of the SVOC POHCs in test program samples collected. The data in the table show that the native and spiked SVOC contaminants were essentially completely removed from the fluff waste by incineration at both kiln temperatures tested, as evidenced by their absence in the kiln ash discharge for all fluff waste tests at method detection limits (MDLs) of 0.3 to 1.3 mg/kg. Similarly, these contaminants were removed from the contaminated soil for both soil tests at the single kiln temperature tested for this matrix. No kiln ash concentration data are given for the blank burn test, Test 0, in Table 2 because no kiln ash was discharged for this test. None of the three SVOC contaminants was found in the post-test scrubber liquor for any test at the MDLs noted in the table. Naphthalene was absent from the baghouse ash for all tests. However, low levels of both BEHP and DNOP were found in the baghouse ash for all tests, including the blank burn. No explanation as to why these site contaminants are found at these levels in the baghouse ash is offered, other than the fact that phthalates are commonly encountered laboratory contaminants. Neither naphthalene nor DNOP was present in the baghouse exit

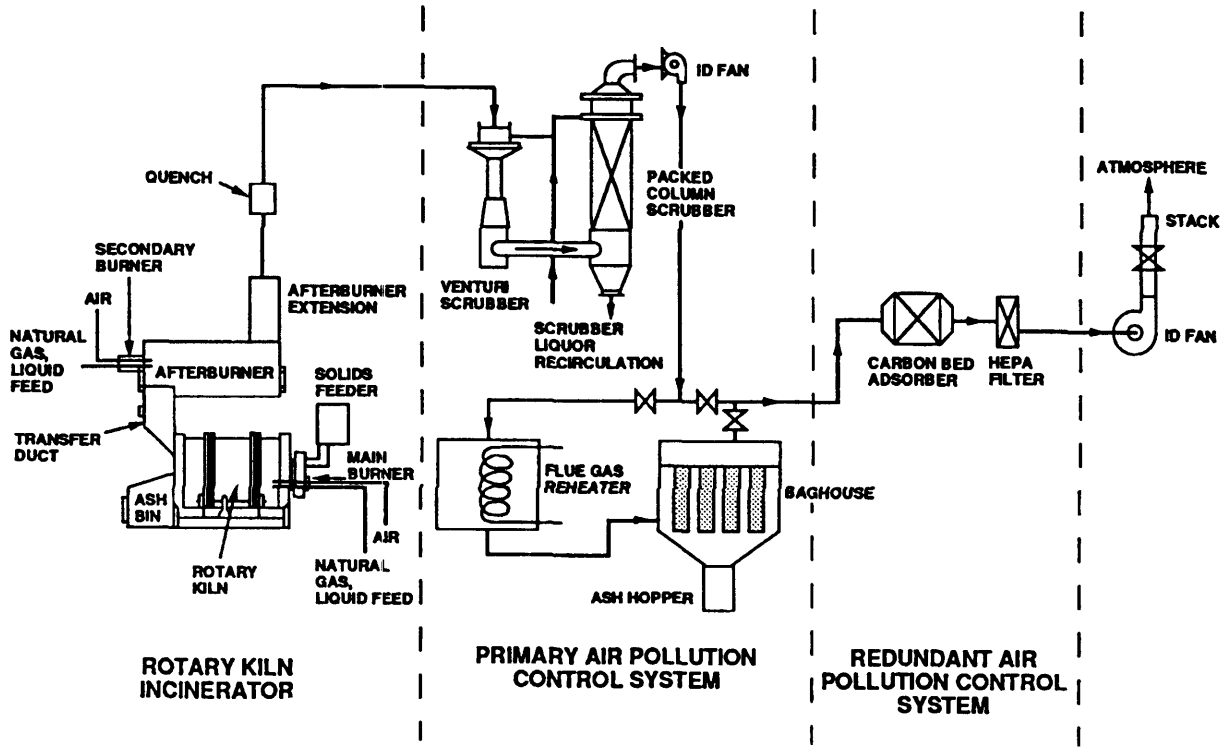

Figure 1. *Schematic of the IRF rotary kiln incineration system.*

Table 1. *Test Matrix*

Test	*Feed*	*Target kiln exit gas temperature, °C (°F)*
0	*Packaging container material*	*870 (1,600)*
1	*Fluff*	*870 (1,600)*
2	*Duplicate of Test 1*	
3	*Soil*	*870 (1,600)*
4	*Duplicate of Test 3*	
5	*Fluff*	*760 (1,400)*
6	*Duplicate of Test 5*	

flue gas for any test. BEHP was found in the baghouse exit flue gas for all tests, including the blank burn, at the levels noted.

VOC Results

Table 3 summarizes the measured concentrations of the target VOC analytes in test program samples collected. As was the case for the SVOC contaminants, incineration treatment of the fluff waste at both temperatures tested, and of the contaminated soil at the one temperature tested, was essentially completely effective in decontaminating the feed materials of their native and spiked VOC contaminants. The kiln ash discharge for all tests contained no detectable VOC contaminants, with one exception at a concentration just above the MDL. In addition, neither the scrubber liquor nor the baghouse ash from any test contained detectable VOC contaminants.

The baghouse exit flue gas for all tests, including the blank burn test, contained low levels of both trichloroethene and tetrachloroethene. No 1,1,2-trichloroethane was found in the baghouse exit flue gas for the blank burn test, either fluff test at the higher incinerator temperature, one of the two fluff tests at the lower incineration temperature, and one of the two soil feed tests.

POHC DREs

Feed contaminant concentration, feedrate, baghouse exit flue gas contaminant concentration, and flue gas flowrate data can be combined to calculate contaminant DREs for each of the tests. Calculated DREs are summarized in Table 4. All DREs demonstrated were greater than the 99.99% level required by the current hazardous waste incinerator performance standard.

Dioxin and Furan Results

A summary of the PCDD/PCDF data obtained in this test program is given in Table 5, in terms of the two summary concentration values typically reported, the total PCDD/PCDF and the 2,3,7,8-TCDD toxicity equivalents (TEQs). In many cases, concentrations in Table 5 are reported as ranges. This arises out of the fact that analyzed concentrations for both homologue group totals and specific congeners are often reported as being less than an MDL. Thus, in cases where a concentration is listed as a range in Table 5, the maximum value in the range corresponds to the assumption that constituents not detected were present at the MDL, and the minimum value in the range corre-

Table 2. Semivolatile Organic Contaminant Analysis Results

Sample	Concentration		
	BEHP	DNOP	Naphthalene
Test 0 (10/27/93), kiln temperature: 871°C (1,599°F)			
Packaging container material, mg/kg	<1.3	<0.4	<0.3
Scrubber liquor, mg/L	<0.013	<0.004	<0.003
Baghouse ash, mg/kg	6.6	4.1	<0.3
Baghouse exit flue gas, µg/dscm	8.4	<0.9	<0.8
Fluff Waste Tests			
Test 1 (11/9/93), kiln temperature: 883°C (1,622°F)			
Fluff feed, mg/kg	48,800	1,850	20,200[a]
Kiln ash, mg/kg	<1.3	<0.4	<0.3
Scrubber liquor, mg/L	<0.013	<0.004	<0.003
Baghouse ash, mg/kg	14.3	9.9	<0.3
Baghouse exit flue gas, µg/dscm	7.0	<1.2	<0.9
Test 2 (11/16/93), kiln temperature: 876°C (1,608°F)			
Fluff feed, mg/kg	53,300	2,610	20,200[a]
Kiln ash, mg/kg	<1.3	<0.4	<0.3
Scrubber liquor, mg/L	<0.013	<0.004	<0.003
Baghouse ash, mg/kg	4.5	2.2	<0.3
Baghouse exit flue gas, µg/dscm	9.9	<1.3	<1.1
Test 5 (11/18/93), kiln temperature: 762°C (1,403°F)			
Fluff feed, mg/kg	48,300	2,870	20,200[a]
Kiln ash, mg/kg	<1.3	<0.4	<0.2
Scrubber liquor, mg/L	<0.013	<0.004	<0.003
Baghouse ash, mg/kg	21.1	13.4	<0.3
Baghouse exit flue gas, µg/dscm	9.8	<1.1	<0.9
Test 6 (11/23/93), kiln temperature: 767°C (1,412°F)			
Fluff feed, mg/kg	49,000	2,810	20,200[a]
Kiln ash, mg/kg	<1.3	<0.4	<0.3
Scrubber liquor, mg/L	<0.013	<0.004	<0.003
Baghouse ash, mg/kg	18.7	12.1	<0.3
Baghouse exit flue gas, µg/dscm	6.2	<1.2	<1.0
Soil Feed Tests			
Test 3 (12/1/93), kiln temperature: 876°C (1,609°F)			
Soil feed, mg/kg	9,810	580	20,200[a]
Kiln ash, mg/kg	<1.3	<0.4	<0.3
Scrubber liquor, mg/L	<0.013	<0.004	<0.003
Baghouse ash, mg/kg	23.5	17.0	<0.3
Baghouse exit flue gas, µg/dscm	7.8	<1.2	<1.0
Test 4 (12/2/93), kiln temperature: 874°C (1,606°F)			
Soil feed, mg/kg	9,440	550	20,200[a]
Kiln ash, mg/kg	<1.3	<0.4	<0.3
Scrubber liquor, mg/L	<0.013	<0.004	<0.003
Baghouse ash, mg/kg	14.2	9.7	<0.3
Baghouse exit flue gas, µg/dscm	7.0	<1.2	<1.0

[a]Spiked concentration.

Table 3. Volatile Organic Contaminant Analysis Results

Sample	Concentration		
	Tetrachloroethene	1,1,2-Trichloroethane	Trichloroethene
Test 0 (10/27/93), kiln temperature: 870°C (1,599°F)			
Packaging container material, mg/kg	<4	<1	<1
Scrubber liquor, mg/L	<0.015	<0.004	<0.004
Baghouse ash, mg/kg	<4	<1	<1
Baghouse exit flue gas, µg/dscm	0.66	<0.09	0.15
Fluff Waste Tests			
Test 1 (11/9/94), kiln temperature: 883°C (1,622°F)			
Fluff feed, mg/kg, native	4.9	<1	2.4
Fluff feed, mg/kg, spiked	3,100		
Kiln ash, mg/kg	<4	<1	<1
Scrubber liquor, mg/L	<0.015	<0.004	<0.004
Baghouse ash, mg/kg	<4	<1	<1
Baghouse exit flue gas, µg/dscm	0.27	<0.14	0.16
Test 2 (11/16/93), kiln temperature: 876°C (1,608°F)			
Fluff feed, mg/kg, native	<4	<1	<1
Fluff feed, mg/kg, spiked	3,100		
Kiln ash, mg/kg	<4	<1	<1
Scrubber liquor, mg/L	<0.015	<0.004	<0.004
Baghouse ash, mg/kg	<4	<1	<1
Baghouse exit flue gas, µg/dscm	0.71	<0.09	0.14

(continued)

Table 3. Continued

Sample	Concentration		
	Tetrachloroethene	1,1,2-Trichloroethane	Trichloroethene
Test 5 (11/18/93), kiln temperature: 762°C (1,403°F)			
Fluff feed, mg/kg, native	<4	<1	<1
Fluff feed, mg/kg, spiked	3,100		
Kiln ash, mg/kg	<4	<1	<1
Scrubber liquor, mg/L	<0.015	<0.004	<0.004
Baghouse ash, mg/kg	<4	<1	<1
Baghouse exit flue gas, µg/dscm	0.68	<0.09	0.23
Test 6 (11/23/93), kiln temperature: 767°C (1,412°F)			
Fluff feed, mg/kg, native	17	<1	<1
Fluff feed, mg/kg, spiked	3,100		
Kiln ash, mg/kg	5.6	<1	<1
Scrubber liquor, mg/L	<0.015	<0.004	<0.004
Baghouse ash, mg/kg	<4	<1	<1
Baghouse exit flue gas, µg/dscm	0.61	0.23	0.09
Soil Feed Tests			
Test 3 (12/1/93), kiln temperature: 876°C (1,609°F)			
Soil feed, mg/kg, native	50	<1	<1
Soil feed, ng/kg, spiked	3,200		
Kiln ash, mg/kg	<4	<1	<1
Scrubber liquor, mg/L	<0.015	<0.004	<0.004
Baghouse ash, mg/kg	<4	<1	<1
Baghouse exit flue gas, µg/dscm	1.57	1.27	0.73
Test 4 (12/2/93), kiln temperature: 874°C (1,606°F)			
Soil feed, mg/kg, native	93	2.8	3.9
Soil feed, mg/kg, spiked	3,300		
Kiln ash, mg/kg	<4	<1	<1
Scrubber liquor, mg/L	<0.015	<0.004	<0.004
Baghouse ash, mg/kg	<4	<1	<1
Baghouse exit flue gas, µg/dscm	0.14	<0.05	0.17

Table 4. POHC DREs

Parameter	BEHP	DNOP	Naphthalene	Tetrachloroethene
Fluff Waste Tests				
Test 1 (11/9/93), kiln temperature: 883°C (1,622°F)				
Feed concentration, mg/kg	48,800	1850	20,200	3,100
Feedrate, kg/hr	2.93	0.11	1.21	0.19
Baghouse exit flue gas:				
Concentration, µg/dscm	7.0	<1.2	<0.9	0.27
Emission rate, mg/hr	11.9	<2.0	<1.5	0.46
DRE, %	99.99959	>99.9982	>99.99987	99.99975
Test 2 (11/16/93), kiln temperature: 876°C (1,608°F)				
Feed concentration, mg/kg	53,300	2,610	20,200	3,100
Feedrate, kg/hr	3.15	0.15	1.19	0.18
Baghouse exit flue gas:				
Concentration, µg/dscm	9.9	<1.3	<1.1	0.71
Emission rate, mg/hr	19.4	<2.5	<2.2	1.4
DRE, %	99.99939	>99.9984	>99.99982	99.99924
Test 5 (11/18/93), kiln temperature: 762°C (1,403°F)				
Feed concentration, mg/kg	48,300	2,870	20,200	3,100
Feedrate, kg/hr	2.94	0.18	1.23	0.19
Baghouse exit flue gas:				
Concentration, µg/dscm	9.8	<1.1	<0.9	0.68
Emission rate, mg/hr	20.1	<2.3	<1.8	1.4
DRE, %	99.99932	>99.9987	>99.99985	99.99926
Test 6 (11/23/93), kiln temperature: 767°C (1,412°F)				
Feed concentration, mg/kg	49,000	2,810	20,200	3,100
Feedrate, kg/hr	2.98	0.17	1.23	0.19
Baghouse exit flue gas				
Concentration, µg/dscm	6.2	<1.2	<1.0	0.61
Emission rate, mg/hr	11.3	<2.2	<1.8	1.1
DRE, %	99.99962	>99.9987	>99.99985	99.99941
Soil Feed Tests				
Test 3 (12/1/93), kiln temperature: 876°C (1,609°F)				
Feed concentration, mg/kg	9,810	580	20,200	3,200
Feedrate, kg/hr	0.58	0.034	1.19	0.19
Baghouse exit flue gas:				
Concentration, µg/dscm	7.8	<1.2	<1.0	1.57
Emission rate, mg/hr	15.0	<2.3	<1.0	3.0
DRE, %	99.9974	>99.9933	>99.99984	99.9984

(continued)

Table 4. *Continued*

Parameter	BEHP	DNOP	Naphthalene	Tetrachloroethene
Test 4 (12/2/93), kiln temperature: 874°C (1,606°F)				
Feed concentration, mg/kg	9,440	547	20,200	3,300
Feedrate, kg/hr	0.56	0.034	1.19	0.19
Baghouse exit flue gas:				
Concentration, µg/dscm	7.0	<1.2	<1.0	0.14
Emission rate, mg/hr	11.3	<1.9	<1.6	0.23
DRE, %	99.9980	>99.9940	>99.99986	99.99988

Table 5. *Dioxin and Furan Analysis Results*

Sample	Total PCDD/PCDF	TEQ
Test 0 (10/27/93), kiln temperature: 870°C (1,599°F)		
Packaging container material, ng/kg	180	1.2-1.3
Scrubber liquor, pg/L	68-170	9.7-25
Baghouse ash, ng/kg	64	0.94-1.0
Baghouse exit flue gas ng/dscm at 7% O_2	0.21	0.005-0.017
Fluff Waste Tests		
Fluff feed, ng/kg	56,000	730
Test 1 (11/9/93), kiln temperature: 883°C (1,622°F)		
Kiln ash, ng/kg	65,000	1,200
Scrubber liquor, pg/L	370-380	4.6-12
Baghouse ash, ng/kg	520	6.8-7.0
Baghouse exit flue gas, ng/dscm at 7% O_2	1.3	0.048-0.052
Test 2 (11/16/93), kiln temperature: 876°C (1,608°F)		
Kiln ash, ng/kg	89,000	2,000
Scrubber liquor, pg/L	730-750	7.0-23
Baghouse ash, ng/kg	740	8.9-9.2
Baghouse exit flue gas, ng/dscm at 7% O_2	1.3	0.044-0.049
Test 5 (11/18/93), kiln temperature: 762°C (1,403°F)		
Kiln ash, ng/kg	830,000	29,000
Scrubber liquor, pg/L	290	17-18
Baghouse ash, ng/kg	340	81
Baghouse exit flue gas, ng/dscm at 7% O_2	0.44	0.016-0.027
Test 6 (11/23/93), kiln temperature: 767°C (1,412°F)		
Kiln ash, ng/kg	2,700,000	110,000
Scrubber liquor, pg/L	520-540	6.7-23
Baghouse ash, ng/kg	1,000	22-23
Baghouse exit flue gas, ng/dscm at 7% O_2	0.96	0.038-0.049
Soil Feed Tests		
Soil feed, ng/kg	10,000	210
Test 3 (12/1/93), kiln temperature: 876°C (1,609°F)		
Kiln ash, ng/kg	2,400	55
Scrubber liquor, pg/L	2,300-2,400	46-54
Baghouse ash, ng/kg	2,600	39
Baghouse exit flue gas, ng/dscm at 7% O_2	0.68	0.025-0.032
Test 4 (12/2/93), kiln temperature: 874°C (1,606°F)		
Kiln ash, ng/kg	3,600	98
Scrubber liquor, pg/L	260-280	1.3-15
Baghouse ash, ng/kg	390	8.2-8.4
Baghouse exit flue gas, ng/dscm at 7% O_2	0.48	0.018-0.020

sponds to the assumption that they were not present, i.e., at zero concentration.

The data in Table 5 show that, not only was incineration treatment ineffective in destroying contaminant dioxins and furans in the fluff waste, but that, in fact, conditions experienced by the noncombustible fraction of the fluff waste during incineration likely led to PCDD/PCDF formation at the lower temperature. Further discussion in the report supports this supposition.

The data in Table 5 show that the scrubber liquor for the fluff waste tests contained total PCDD/PCDF concentrations in the 290 to 750 pg/L range, or 4.6 to 23 pg/L on a TEQ basis. No apparent difference in the scrubber liquor concentrations with incineration temperature was seen. Scrubber liquor PCDD/PCDF concentrations for one of the two soil feed tests were also comparable to those measured for the fluff waste tests, although levels measured for the other soil feed test were substantially higher.

Baghouse ash total PCDD/PCDF concentrations ranged from 340 to 1,000 ng/kg for the fluff waste tests, with no apparent change associated with changing incineration temperature. On a TEQ basis, the measured range was 6.8 to 23 ng/kg. As for the scrubber liquor, baghouse ash dioxin levels for one of the two soil feed tests were comparable to those measured for the fluff waste tests; they were higher for the other soil feed test.

Baghouse exit flue gas total PCDD/PCDF levels were 1.3 ng/dscm at 7% O_2 for the high kiln temperature fluff waste tests. Levels for the low kiln temperature fluff waste tests, at 0.44 to 0.96 ng/dscm at 7% O_2, were slightly lower. Levels for

the soil feed tests were comparable, at 0.48 to 0.68 ng/dscm. All measured levels were significantly lower than the EPA guidance announced in 1993 of 30 ng/dscm at 7% O_2.

On a TEQ basis, baghouse exit flue gas dioxin/furan levels were 0.044 to 0.052 ng/dscm at 7% O_2 for the high kiln temperature fluff waste tests. Comparable to slightly decreased emissions, at 0.016 to 0.049 ng/dscm at 7% O_2, were measured for the low kiln temperature fluff waste tests, and for the soil feed tests at 0.018 to 0.032 ng/dscm at 7% O_2. The European-suggested dioxin emission limit for waste incinerators is 0.1 ng/Nm^3 TEQ corrected to 11% O_2. Thus, while the temperature correction for scm is slightly different than for Nm^3, and the O_2 correction for the European standard, at 11% O_2, differs from the 7% O_2 used in the Table 5 data, all emission levels reported in Table 5 will be lower than the suggested European standard.

Trace Metal and TCLP Results

Trace metal concentrations were measured in test program samples and are summarized in the report. Fluff and soil feed, kiln ash, scrubber liquor, and baghouse ash samples from the test program were also subjected to the toxicity characteristic leaching procedure (TCLP), and resulting TCLP leachates were analyzed for the contaminant trace metals. Leachate analysis data for the six site contaminant trace metals having TC regulatory levels defined are summarized in the report. The data show that no resulting kiln ash discharge from the incineration of fluff waste or contaminated soil would be a TC hazardous waste due to its leachable concentrations. Similarly, the scrubber liquor from all tests was not TC hazardous. However, the baghouse ash for all tests would be a lead-contaminated TC hazardous waste and, for all but one fluff test, a cadmium-contaminated TC hazardous waste.

Particulate and HCl Emissions

The baghouse exit flue gas particulate and HCl emission data developed in the test program are summarized in Table 6. The data show that baghouse exit particulate concentrations were less than 10 mg/dscm corrected to 7% O_2 for all but one test for which they were 14 mg/dscm at 7% O_2. All measured levels were well below the current hazardous waste incinerator performance standard of 180 mg/dscm at 7% O_2, and even substantially below the EPA's announced 1993 guidance of 34 mg/dscm at 7% O_2.

Baghouse exit flue gas HCl emission rates were at most 2.6 g/hr. Apparent system collection HCl efficiencies were greater than 99.9% for all except one soil feed test for which the apparent system HCl collection efficiency was 99.76%.

Conclusions

Results of the test program conducted to evaluate the incineration treatment of fluff waste and contaminated soil from the M. W. Manufacturing Superfund site confirm that incineration represents an effective treatment option, with cautions regarding its use. Indeed, incineration of the fluff waste offers several benefits including substantial waste volume reduction, and effective, near complete, decontamination and destruction of both the VOC and SVOC contaminants in the waste. While the volume reduction benefit is less significant in the incineration treatment of the contaminated soil, the benefit of effective and near complete decontamination and destruction of organic contaminants remains.

Both site materials can be incinerated in compliance with the current hazardous waste incinerator performance standards in a rotary kiln incineration system of the type in place at the IRF. Specifically, POHC DREs greater than 99.99% were uniformly measured, and HCl emissions were well below 1.8 kg/hr and system HCl control efficiencies well above 99%. In addition, compliance with the more stringent incinerator emissions guidance announced in 1993 was demonstrated. Specifically, particulate emissions measured were well below 34 mg/dscm, and total PCDD/PCDF emissions measured were well below 30 ng/dscm, both corrected to 7% O_2. In fact, measured dioxin/furan emissions on a TEQ basis were well below the suggested European emission limit of 0.1 ng/Nm^3 dry at 11% O_2.

However, the kiln ash discharge from the incineration of both site materials remains dioxin-contaminated. The kiln ash discharge from the incineration of contaminated site soil at a kiln temperature of nominally 870°C (1,600°F) contained total PCDD/PCDF concentrations of 2.4 to 3.6 µg/kg. Levels in the kiln ash discharge from the incineration of fluff waste at this same temperature were higher, at 65 to 89 µg/kg. Levels in the kiln ash discharge from the incineration of fluff waste at a nominal kiln temperature of 760°C (1,400°F) were substantially higher, at 830 to 2,700 µg/kg.

Thus, with respect to fluff waste, incineration offers substantial volume reduction, however the resulting treated waste discharge (kiln ash) may still need to be managed as a dioxin-contaminated material. Dioxin contamination levels were decreased at higher incineration temperatures, but they remained significant nonetheless. In addition, the flue gas particulate collected as baghouse ash in essentially all tests was a cadmium- and lead-contaminated TC hazardous waste. So this discharge would need to be appropriately managed as a hazardous waste.

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Table 6. *Particulate and HCl Emissions*

		Baghouse exit		
Test	*Cl feedrate, kg/hr*	*Particulate concentration, mg/dscm at 7% O_2*	*HCl emission rate, g/hr*	*Apparent system HCl collection efficiency, %*
Test 0 (10/27/93)	*0.28*	*7*	*<0.2*	*>99.93*
Fluff Waste Tests				
Test 1 (11/9/93)	*9.48*	*7*	*1.7*	*99.98*
Test 2 (11/16/93)	*9.48*	*4*	*2.0*	*99.98*
Test 5 (11/18/93)	*9.48*	*6*	*2.0*	*99.98*
Test 6 (11/23/93)	*9.48*	*14*	*2.3*	*99.98*
Soil Feed Tests				
Test 3 (12/1/93)	*1.1*	*5*	*2.6*	*99.76*
Test 4 (12/2/93)	*1.1*	*9*	*0.7*	*99.94*

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The complete report, entitled "Pilot-Scale Incineration Testing of Fluff and Soil from the M.W. Manufacturing Superfund Site," (Order No. PB95-255725; Cost: $27.00, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
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