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Project Summary

Hot Flue Gas Spiking and Recovery Study for Tetrachlorodibenzodioxins (TCDD) Using Modified Method 5 and SASS Sampling with a Simulated Incinerator

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This study was initiated to evaluate the sampling and analysis of ultratrace levels of dibenzodioxins using EPA's recommended source sampling procedures (Modified Method 5 (MM5) train and the Source Assessment Sampling System--SASS). A gas-fired combustion system was used to simulate incineration flue gas, and a precision liquid injection system was designed for the program. The precision liquid injector was used to administer dilute solutions of 1,2,3,4-tetrachlorodibenzo-p-dioxin (1,2,3,4-TCDD) directly into a hot--260°C (500°F)--flue gas stream. Injections occurred continuously during a sampling episode so that very low gas-phase concentrations of 1,2,3,4-TCDD were continuously mixed with flue gases.

Recoveries were measured for eight burn experiments. For all but one, the recoveries could be considered quantitative, demonstrating efficient collection by the EPA sampling systems. In one study, the components and connecting lines from a sampling device were analyzed separately to show where the 1,2,3,4- TCDD deposited in the train.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, 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

To test the collection efficiency of the recommended EPA sampling trains for TCDD isomers, a stack sampling program was carried out. A simulated incinerator flue gas was generated using a laboratory scale furnace. The flue gases from this furnace were spiked with a small quantity of 1,2,3,4-TCDD and then sampled to determine collection efficiency of the TCDD sampling system. Sampling rates and conditions were maintained at levels typical of those used with the Method 5 or SASS sampling devices.

Figure 1 shows the experimental setup: natural gas combustor outlet, hot gas spike injection, sampling train, charcoal safety filter, and gas moving system.

Combustion and Sampling Systems

In this study, two sampling systems (the Source Assessment Sampling System (SASS) and a modification of the Method 5 (MM5) sampling train) were used. In this program, the SASS equipment was operated in accordance with procedures outlined in the EPA Level 1 manual. Because a relatively clean fuel (natural gas) was used to produce the flue

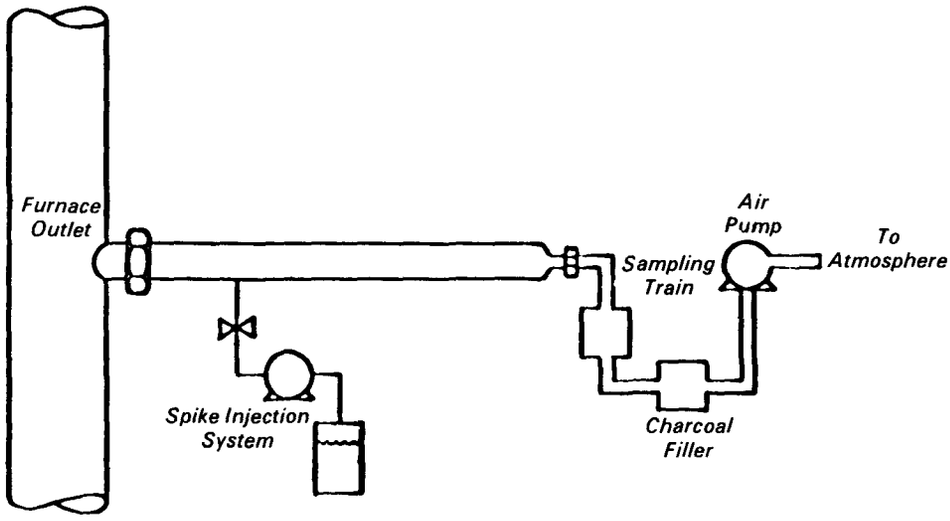

Figure 1. *TCDD injection and sampling apparatus.*

Table 1. *1,2,3,4-TCDD Recoveries from Tests 1-10*

Test Number	Sampling System	Liquid Spike Volume (ml)	1,2,3,4-TCDD Liquid Concentration (pg/ml)	Expected Concentration (ng)	Calculated Concentration (ng)	Percent Recovery
1 (Blank)	SASS	50	0	----	----	0
2 (Dry Air)	SASS	49	500	----	----	≃92
3	SASS	51	500	25	18	73
4	SASS	42	50	21	17	83
5	SASS	50	5	2.5	2.9	117
6	SASS	51	5	0.25	0.28	113
7	MM5	47	15	7.1	8.0	113
8	MM5	47	12	0.56	0.57	101
9	MM5	49	8	0.39	0.47	120
10	MM5	47	8	0.38	0.87	229

gas stream sampled,some modifications were made to the standard SASS apparatus. The normal stack sampling probe and cyclones were replaced with borosilicate glass connecting tubing. The stainless steel cyclones were removed to simplify equipment turnaround. The solutions that would normally be contained in impingers 1 and 2 were eliminated, although the impingers were left in the system as condensate traps.

A development of this study was a gas-phase spiking system that could inject liquid solutions of the test material into the hot flue gas stream. A fused silica capillary line was used to transfer the dioxin solution from a precision metering pump to the flue gas stream.

Results

A series of 10 experiments were performed. The first experiment (Test 1) was a system blank in which the SASS train and combustion system were operated normally using the solvent delivery system to generate a blank injection. No 1,2,3,4-TCDD was observed in the blank run. Test 2 was a heated air run in which the 1,2,3,4-TCDD spike was tested on heated room air.The air stream was dry, not containing the high moisture observed in many combustion gas streams. Tests 2-10 involved spiking the combustion flue gas with variable dioxin levels, using both SASS and MM5 trains for collection of gas-phase emissions.

Tests 3-10 were designed to challenge both the SASS and MM5 sampling systems at gas-phase concentrations that were expected to cover a range from high levels to the minimum levels detectable by available analytical methodology. Results of Tests 1-10 are given in Table 1. These data show good internal consistency and high recoveries for each experiment, except Test 10, where a 229% recovery was observed.

These experiments demonstrated the ability of two EPA source sampling trains to collect and stabilize TCDDs for subsequent analysis. The model compound used, 1,2,3,4-TCDD, is probably a good representative of all the tetrachlorinated dibenzo-p-dioxins, and the other isomeric members of this class of compounds can probably be analyzed by the techniques used in this study.

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The complete report, entitled "Hot Flue Gas Spiking and Recovery Study for Tetrachlorodibenzodioxins (TCDD) Using Modified Method 5 and SASS Sampling with a Simulated Incinerator," (Order No. PB 85-115 145; Cost: $8.50, subject to change) will be available only from:
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