



## Project Summary

# Controlled Air Incineration of Pentachlorophenol-Treated Wood

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**A research test program was conducted to investigate the destruction of pentachlorophenol-(PCP) treated wood in a controlled air incinerator. PCP-treated wood is frequently used in the manufacture of United States military ammunition boxes. The disposal of used boxes is a problem of considerable concern to the U.S. Department of Defense at military installations in the United States and, in particular, Korea. The results of test burns indicated that destruction efficiencies (DE) for PCP sampled in the hot zone transfer duct from the controlled air chamber leading to the high temperature afterburner were greater than U.S. Environmental Protection Agency stack emission standards in all tests. This research program was conducted in cooperation with and with partial funding from the U.S. Department of Defense, Defense Property Disposal Service, under Interagency Agreement AR-21-F-1-741-0.**

*This Project Summary was developed by EPA's Industrial Environmental 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

Incineration of pentachlorophenol-(PCP-) treated wood under inadequate combustion conditions or in open burning has shown to generate toxic products of incomplete combustion (PICs). Various chlorinated organic species can occur as combustion products from burning PCP-treated wood such as the chlorinated dibenzodioxins and the chlorinated dibenzofuran. The controlled air incinera-

tor (CAI) used in this study was capable of incinerating the PCP-treated wood effectively while avoiding production of PICs.

The disposal of wood treated with PCP has become a significant problem for the U.S. Department of Defense (DOD), particularly in the Republic of Korea (ROK). Wooden ammunition crates are treated with PCP to prevent decomposition of wood due to termite or other insect/ borer infestation during transportation and storage. Disposal of the empty crates by sale or burial is prohibited in Korea. The volume of wood is so large that shipment back to the United States is impractical. Incineration of the crates in the ROK is believed to be the most cost-effective option.

The ROK asked for evidence to support the case for incineration of these materials and to present data showing that incineration creates an additional problem. DOD, through the Defense Property Disposal Service (DPDS) partially supported an Interagency Agreement the EPA implemented with the Department of Energy (DOE) to conduct research using the CAI located at Los Alamos National Laboratory in Los Alamos, New Mexico. Thus, the EPA, DOD, and DOE all collaborated on this study for the safe incineration of PCP-treated wood.

### Process Description

The basis of the Los Alamos CAI is an Environmental Control Products (Charlotte, North Carolina) model 500-T incinerator.\* Many operational modifications were incorporated into the unit such as fully modulated burners, gravity ash removal, steam injection capability, and enhanced

\*Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

mixing of secondary air with primary chamber effluent. Many of these are not available as standard options on the basic unit; other modifications were made to fit the needs of DOE operations at Los Alamos. The basic incinerator and associated offgas cleaning equipment are schematically presented in Figures 1 and 2.

### Test Plan

The purpose of the research was to determine the destruction efficiency (DE) for PCP-treated wood as a feed component to the CAI while simulating conditions obtainable in a proposed disposal incinerator in the ROK. There was interest in studying the effects of feed rate, incinerator temperature, and excess air (and, indirectly, residence time) on the DE for PCP. Operating conditions included those that best simulated the proposed incinerator in the ROK. Special interest was also placed upon identifying conditions which avoided PIC formation.

PCP-treated wood for testing was actual ammunition crate wood supplied for the test runs by DPDS. The test plan was designed to provide combustion data over a range of conditions likely to be employed in a proposed incinerator for PCP-treated wood disposal. The CAI was operated at several conditions to provide parametric data and to model the proposed unit in the ROK. The research was conducted in two phases: Phase 1 with untreated wood and Phase 2 with actual ammunition boxes. The second phase consisted of four test periods at various operating conditions.

### Results

Results from analytical work on samples from the hot zone between the incinerator chambers and from the secondary chamber offgas are presented in Table 1. Variations in reported amounts of PCP in some samples is attributed to an analytical artifact with a similar retention time in the HPLC system. The HPLC work was done to provide preliminary data while problems with GC/ECD procedures were being resolved.

The DE for PCP in the primary chamber was greater than 99.99 percent in all cases, based on the GC/ECD analytical data. Results showed that PCP-treated wood can be incinerated at controlled conditions so as to achieve greater than 99.9 percent combustion efficiency (CE) without producing detectable levels of TCDD or TCDF at detection of limits of 1 ppb and 5 ppb, respectively.

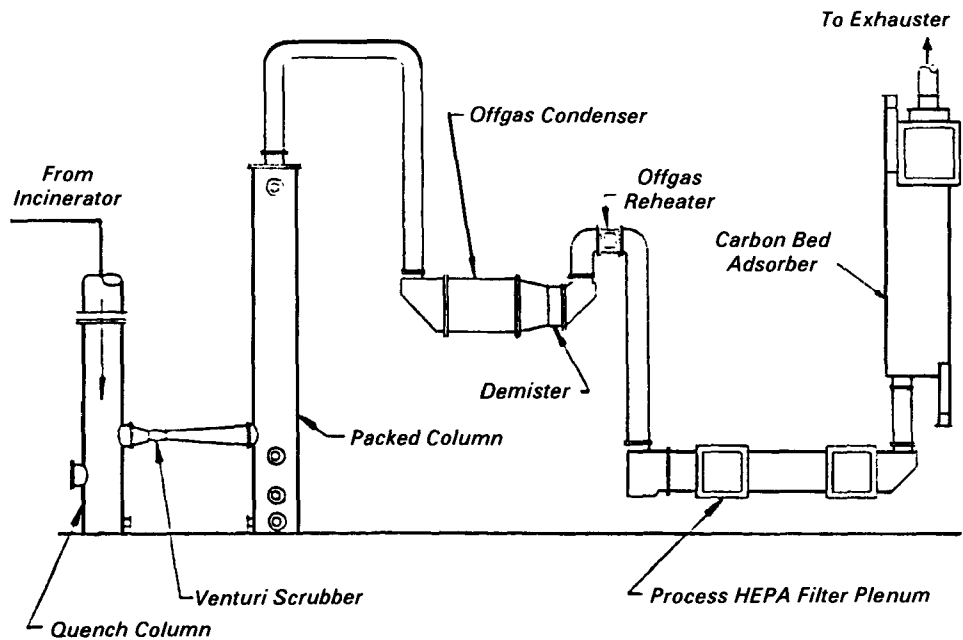


Figure 1. Offgas cleaning subsystem.

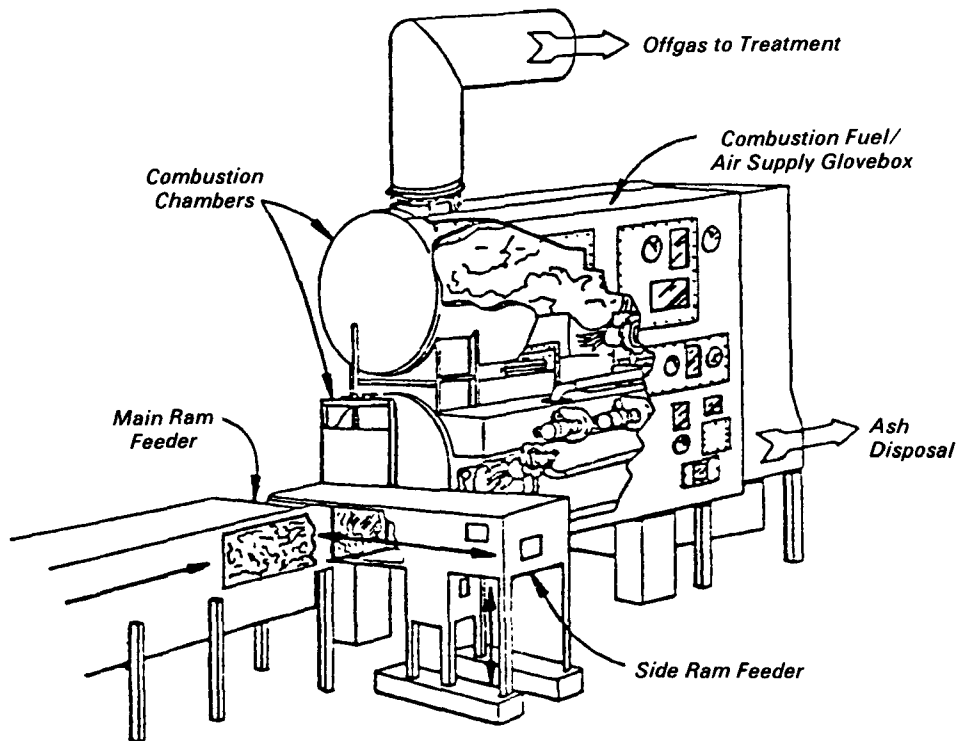


Figure 2. Basic controlled air incinerator.

## Experimental

### Test Phase 1, Period 1

● Untreated wood, establish operating baseline

● Conditions	Sample 1	Sample 2
Feed Rate	60 lb/h	60 lb/h
Lower Chamber Temperature	916°C Avg.	927°C Avg.
Afterburner Temperature	1010°C Avg.	1010°C Avg.
Lower Chamber O <sub>2</sub>	6% Avg.	6% Avg.
Afterburner O <sub>2</sub>	11% Avg.	11% Avg.
Testing Period	4 hours	4 hours

### Test Phase 1, Period 2

● Untreated Wood

● Conditions	Sample 1	Sample 2
Feed Rate	100 lb/h	85 lb/h
Lower Chamber Temperature	1004°C Avg.	1000°C Avg.
Afterburner Temperature	1093°C Avg.	1093°C Avg.
Lower Chamber O <sub>2</sub>	6% Avg.	6% Avg.
Afterburner O <sub>2</sub>	8% Avg.	8% Avg.
Testing Period	4 hours	4 hours

### Test Phase 2, Period 1

● PCP treated ammo boxes

● Conditions	Sample 1	Sample 2
Feed Rate	80 lb/h	90 lb/h
Lower Chamber Temperature	918°C Avg.	1002°C Avg.
Afterburner Temperature	1099°C Avg.	1104°C Avg.
Lower Chamber O <sub>2</sub>	4% Avg.	4% Avg.
Afterburner O <sub>2</sub>	8% Avg.	7.8% Avg.
Testing Period	4 hours	4 hours

### Test Phase 2, Period 2

● PCP treated ammo boxes

● Conditions	Sample 1	Sample 2
Feed Rate	65 lb/h	70 lb/h
Lower Chamber Temperature	927°C Avg.	938°C Avg.
Afterburner Temperature	1202°C Avg.	1210°C Avg.
Lower Chamber O <sub>2</sub>	5% Avg.	6% Avg.
Afterburner O <sub>2</sub>	7.5% Avg.	7% Avg.
Testing Period	4 hours	4 hours

### Test Phase 2, Period 3

● PCP treated ammo boxes

● Conditions	Sample 1	Sample 2
Feed Rate	90 lb/h	85 lb/h
Lower Chamber Temperature	1027°C Avg.	1032°C Avg.
Afterburner Temperature	1203°C Avg.	1204°C Avg.
Lower Chamber O <sub>2</sub>	5% Avg.	5% Avg.
Afterburner O <sub>2</sub>	6.5% Avg.	6% Avg.
Testing Period	4 hours	4 hours

### Test Phase 2, Period 4

● PCP treated ammo boxes

● Conditions	Sample 1	Sample 2
Feed Rate	65 lb/h	60 lb/h
Lower Chamber Temperature	954°C Avg.	916°C Avg.
Afterburner Temperature	1210°C Avg.	1174°C Avg.
Lower Chamber O <sub>2</sub>	1% Avg.	0.5% Avg.
Afterburner O <sub>2</sub>	7.5% Avg.	8% Avg.
Testing Period	4 hours	4 hours

## Conclusions

PCP-treated wood was incinerated in the CAI at Los Alamos under a variety of test conditions and a DE of >99.99 percent was observed. Analytical results from several sources showed no evidence of TCDD at a detection limit of 1 ppb or TCDF at a detection limit of 5 ppb. The DE is greater than 99.99 percent for the primary chamber alone, indicating that such a DE can routinely be accomplished in a single chamber unit if proper conditions are maintained.

**Table 1. Analysis of PCP Test Samples**

Sample**	Sample from			Results* (in sample)						
				by GC/ECD			by HPLC	by GC/MS		
	Phase	Period	Interval	PCP	TCDD	TCDF	PCP	PCP	TCDD	TCDF
HZ	1	1	1	ND†	ND	ND	ND	ND	ND	ND
HZ	1	1	2	ND	ND	ND	ND	ND	ND	ND
HZ	1	2	1	ND	ND	ND	ND	ND	ND	ND
HZ	1	2	2	ND	ND	ND	ND	ND	ND	ND
HZ	2	1	1	ND	ND	ND	1.64 ppm	ND	ND	ND
HZ	2	1	2	ND	ND	ND	ND	ND	ND	ND
HZ	2	2	1	ND	ND	ND	ND	ND	ND	ND
HZ	2	2	2	ND	ND	ND	ND	ND	ND	ND
HZ	2	3	1	ND	ND	ND	ND	ND	ND	ND
HZ	2	3	2	ND	ND	ND	ND	ND	ND	ND
HZ	2	4	1	ND	ND	ND	0.41 ppm	ND	ND	ND
HZ	2	4	2	ND	ND	ND	5.09 ppm	ND	ND	ND
HZ	individual samples from all test intervals			ND	ND	ND	ND	ND	ND	ND
Ash	individual samples from phase 1 and each phase 2 period			ND	ND	ND	ND	ND	ND	ND
Scrub liquids	composite of all phase 2 periods			ND	ND	ND	ND	—††	—	—
HZ XAD-2	2	2	1	ND	ND	ND	ND	—	—	—
OG XAD-2	2	2	1	ND	ND	ND	ND	—	—	—
HZ XAD-2	2	4	1	ND	ND	ND	ND	—	—	—
OG XAD-2	2	4	1	ND	ND	ND	ND	—	—	—
HG XAD-2	2	4	2	ND	ND	ND	ND	—	—	—
OG XAD-2	2	4	2	ND	ND	ND	ND	—	—	—
HZ XAD-2	composite of other phase 2			ND	ND	ND	ND	—	—	—
OG XAD-2	composite of other phase 2			ND	ND	ND	ND	—	—	—

\*GC/ECD and HPLC by Los Alamos.

GC/MS by Southwest Research Institute.

\*\*Sample HZ = Hot zone between primary and secondary chambers;

OG = Offgas (secondary chamber effluent);

XAD-2 = Sorbent polymer extracts.

†ND = Below detection limits which are:

15 ppb for PCP by GC/ECD (Los Alamos),

1 ppb for TCDD by GC/ECD (Los Alamos),

5 ppb TCDF by GC/ECD (Los Alamos),

10 ppb for PCP by HPLC (Los Alamos),

170 ppb for PCP by GC/MS (Southwest Research Institute),

17 ppb for TCDD and TCDF by GC/MS (Southwest Research Institute).

††— indicates not analyzed.

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Richard A. Carnes is the EPA Project Officer (see below).

The complete report, entitled "Controlled Air Incineration of Pentachlorophenol-Treated Wood," (Order No. PB 84-189 851; Cost: \$13.00, subject to change) will be available only from:

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