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TITLE: CHARACTERIZATION OF EXPLOSIVES PROCESSING WASTE DECOMPOSITION DUE TO COMPOSTING

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Characterization of Explosives Processing Waste Decomposition Due to Composting

FINAL, PHASE I REPORT

January 1990

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C.-h. Ho, and E. Tan

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Explosives-contaminated (primarily TNT, RDX, and HMX) sediments composted under mesophilic and thermophilic conditions at the Louisiana Army Ammunition Plant were subjected to regulatory leaching (Toxicity Characteristic Leaching Procedure and Synthetic Precipitation Leach Test) and organic solvent extraction followed by chemical characterization and toxicity tests. Chemical characterization included EPA Contract Laboratory Program Target compound list volatile and semivolatile organics, PCBs, pesticides, metals, and also explosive compounds and TNT metabolites. The toxicity testing utilized Ceriodaphnia dubia, fathead minnow larvae, and the Ames test. Regulatory compounds were not detected at significant concentrations in the leachates or extracts and the main constituents found were TNT, HMX, RDX, and two monoamino dinitrotoluenes at low to sub-ppm levels. Low toxicity was detected in the aqueous leachates, with the leachate from the mesophilic compost being more toxic. Particles recovered from the leachates had only low extractable toxicity. Considerably higher toxicity was found in the organic solvent extracts, because of lesser dilution than the regulatory leachates. Comparison of toxicity calculated per g of compost extracted or leached did not reveal any substantial toxicity in the compost which was not liberated by the regulatory leaching procedure, but the high dilutions (100g compost per 2L of leachate) considerably reduced the sensitivity of the Ames test unless the leachates were concentrated 100-fold. Considering the lack of a composted blank devoid of explosives (not included in the original compost engineering study design) and the age of the compost samples (ca. 10 months) before characterization these results must be considered as preliminary. The application of Phase I methods and experiences to Phase II studies of fresh samples including proper blanks and controls will provide a more conclusive test of explosives process waste detoxification by composting.

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W. H. Durst 6/5/90
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EXECUTIVE SUMMARY

Laboratory, pilot scale, and field demonstration studies show that composting can reduce the concentrations of explosives in contaminated soils and sediments, and they suggest that composting has the potential to be a viable option to incineration. However, the final forms of the transformed explosives compounds and the toxicity of the compost product have not been established. Such information is needed to determine if composting can decontaminate explosives-contaminated soils to products which can be safely disposed by surface application or burial. This project addresses these questions. The purpose of Phase 1, reported in this document, was to investigate the chemical and toxicological characteristics of the mesophilic and thermophilic composts produced from explosives-contaminated lagoon sediments at the Louisiana Army Ammunition Plant by Roy F. Weston, Inc. in the spring and summer of 1988.

Samples of the mesophilic and thermophilic composts were subjected to the U. S. Environmental Protection Agency (EPA) Synthetic Precipitation Leach Test (CCLT for "Clean Closure Leach Test") and the Toxicity Characteristic Leaching Procedure (TCLP). The leachates were analyzed for EPA Contract Laboratory Program volatile and semivolatile organics, PCBs and pesticides; several metals on the Target Compound List; and explosive compounds and 2,4,6-trinitrotoluene (TNT) metabolites. The aquatic toxicity and bacterial mutagenicity of the CCLT leachates were determined using <u>Ceriodaphnia</u> <u>dubia</u> and fathead minnow larvae, and the Ames test (respectively). Very little of importance was detected in the chemical characterization of the leachates except for low μg/mL concentrations of TNT, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), and two monoaminodinitrotoluenes. Low toxicity was detected in the CCLT leachates, and mutagenicity was difficult to measure except when the leachate was concentrated 100-fold. The mesophilic compost leachate was slightly more toxic than that of the thermophilic compost. This is consistent with the greater biotransformation of the explosives in the thermophilic compost and the lower concentrations of such compounds found in the leachate, but the lack of a compost blank prevents assigning the cause(s) of the toxicity to explosives. Only minor levels of mutagenic activity were found to be associated with suspended particles which pass through the pressure filter in the EPA leaching protocols. Compost heterogeneity considerably complicated chemical analysis and toxicity testing, and it requires that relatively large masses of sample or large numbers of samples be tested.

Organic solvent extracts were considerably more toxic than the aqueous leachates on the basis of toxicity per mg of extractable matter or per mL of extract, but not on the basis of toxicity per g of compost leached or extracted. The CCLT does not appear to miss large reservoirs of aquatic organism toxicity or bacterial mutagenicity which are available to organic solvent extraction, but the high dilution of the leached material in the CCLT protocol makes determination of mutagenic activity difficult without preconcentration of the CCLT. Although a substantial portion of the bacterial mutagenic activity apparently could be accounted for by the TNT content of the extract, the lack of a blank compost prevents assignment of such activity to explosives compounds or their biotransformation products. Indeed, the relative mutagenic responses with two bacterial strains were different from those of TNT and most of its available metabolites. This observation suggests that compounds other than those identified contribute or affect the extractable mutagenicity. Hydrolysis of the organic solvent-extracted composts to release a labile bound fraction of transformed explosive compound products did not produce detectable toxicity, but the survivability of mutagens to the hydrolysis conditions remains a question.

Although the Phase 1 results showed low toxicity of the aqueous leachates of the composts, the age of these compost samples (ca. 10 months after composting was completed) and the lack of proper controls (such as the original sediment used for composting and a blank compost from uncontaminated sediment) for a toxicity investigation prevent definitive conclusions from being made regarding the detoxification of explosives-contaminated soils. The techniques developed and lessons learned from the Phase 1 studies will allow a more conclusive assessment to be made in Phase 2 with compost samples to be produced in a second field composting experiment scheduled for the spring of 1990.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

Table

LIST OF TABLES - (Cont'd)

LIST OF FIGURES

Figure

CHAPTER 1. INTRODUCTION

The environmental restoration of explosive compound-contaminated soils and sediments at U. S. Army installations will be a very expensive and time-consuming process (1). Decontamination of approximately 28 installations will require the treatment of at least 1,000,000 cubic yards of contaminated soil (total). Incineration is the only decontamination technology available at the present, but at a cost of $200 to $300 per ton, tens of millions of dollars will be required per site. Two existing incinerators each can treat less than one ton of soil per hour. Alternative technologies are clearly needed to reduce costs and time.

Composting is an attractive alternate to incineration, and laboratory (2), pilot scale (3), and field scale studies (4) have demonstrated that the concentrations of explosives in soil or sediment can be effectively reduced by biotransformation. The field composting experiment conducted at the Louisiana Army Ammunition Plant (LAAP) by Roy F. Weston, Inc. (4) reduced the concentrations of TNT, RDX, and HMX (see Appendix A-1 for list of abbreviations) in lagoon sediments by 99.9, 99.1, and 96.5% (respectively) in 153 days of composting under thermophilic conditions. Under mesophilic composting conditions, the percentage reductions were slightly lower (99.6, 94.8, and 86.9%, respectively).

Major questions to be answered include the ultimate fate of the biotransformed explosives and the toxicity of the compost product. This project has two objective, which address these questions. The first objective is to determine the chemical and toxicological characteristics of the two composts produced in the Roy F. Weston, Inc. ("Weston") experiments at the LAAP (4). This characterization is the subject of this Phase 1 report. The second objective, to be addressed in Phase 2 of this project, focuses on more fundamental issues associated with composting munitions wastes. These issues include identifying and determining toxic major biotransformation products of the explosives compounds, and determining the potential for long-term releases of organically-bound explosive compound products formed during composting. Phase 2 also provides for the chemical and toxicological characterization of materials from a second, more extensive field demonstration experiment planned for the spring of 1990 by Weston. This experiment includes the proper controls and samples for a more conclusive toxicity determination.

It must be strongly emphasized that the results presented in this report must be considered only as preliminary, and more of a methods development effort. This is because the Weston experiment was designed only from engineering considerations, and this Phase 1 chemical characterization and toxicity study was conducted afterward. Proper controls and blanks for toxicity investigations, such as the lagoon sediment used in composting and a control compost with uncontaminated sediment, were not a part of the engineering study. In addition, the samples characterized in Phase 1 had been stored ca. 10 months, and the effects of such storage are unknown. These considerations in no way detract from the engineering study, but they do limit the conclusions which can be drawn from this work. A conclusive characterization of toxicity associated with the composting option will not available until the second field composting experiment and the Phase 2 studies are complete.

CHAPTER 2. COMPOST SAMPLE PREPARATION AND CHEMICAL CHARACTERIZATION

2.1. Compost Acquisition and Sampling

One 55 gallon drum each of the mesophilic (pile no. 3) and the thermophilic (pile no. 4) composts from the LAAP field composting experiment (4) were received from Weston on April 17, 1989. The contents of the drums were first sampled for the laboratory studies on April 20, 1989. The drums were rotated at ca. 12 rpm for 5 min by rolling back and forth along a sloped concrete walkway. The drums were found to be ca. 7/8 full upon opening. The interior surfaces of each carbon-steel drum had rusted, but the structural integrity of the drums was not breached. The composts probably have been contaminated with a small amount of the rust. Six 1 L widemouth bottles were filled with compost taken from the upper portion of each drum. The drums were then archived in a monitored cold-storage (4°C) unit on April 24, 1989.

The second sampling of the drums was conducted on June 30, 1989, to obtain more compost for the organic solvent extraction experiments (sections 2.3.1 and 2.3.2). The drums were opened inside the cold storage facility, and a light mould growth was noted on the surface of the compost. The top layer was scraped aside and six 1 L samples were taken from underlying compost.

The third and final sampling was carried out on August 10, 1989, to provide sufficient compost for the preparation of the organic solvent extracts. Before this sampling, the composts were mixed in the drums by rotating them about their horizontal axis for 2 hrs. at 20 rpm. Three L volumes of compost were collected from each drum. Two L were used for the organic solvent extracts and 1 L was archived at -20°C. The drums were returned to 4°C storage.

2.2. Preparation and Chemical Characterization of Regulatory Leachates

2.2.1. Preliminary Trial of EPA Synthetic Precipitation Leach Test

A preliminary leaching was conducted on samples of the two composts using the EPA Synthetic Precipitation Leach Test ("Clean Closure Leach Test" or CCLT, SW-846 method 1312, reference 5). This preliminary run was performed to determine the behavior of the composts in leaching, and to generate leachate samples for range-finding in the toxicity tests. The latter was necessary to estimate the volumes of leachate which would be required for the toxicology battery. The leachates also were analyzed for explosive compounds and TNT metabolites.

As per the EPA protocol, the samples were leached with the "western" synthetic precipitation fluid (ASTM Type II water adjusted to pH 5.0 with a mixture of sulfuric and nitric acids) because the composts were generated at a site west of the Mississippi. Two L of CCLT leachate were generated from 100 g of each compost. It was observed that the required 10 mm screening of the composts removed mainly wood chips from the samples. These chips were analyzed later for explosive compound contamination (see section 2.6.). The main problem encountered in the CCLT preparation was that the filtration step was quite difficult and time-consuming. The EPA protocol pressure filter plugged rapidly from the fine clay particles present in the composted soil, and only ca. 250 mL could be filtered before plugging. A preliminary treatment of the crude leachate was needed to prevent this. Several pretreatments of the leachate were investigated in working with this leaching test and with the EPA Toxicity Characteristic Leaching Procedure (see below). The best pretreatment method appears to be a centrifugation of the crude leachate at 350 XG for 10 min. followed by prefiltration through a 1-to 3-um porosity, binderless glass fiber (Nucleopore type P100) filter before the pressure filtration step. Ca. 1 L of crude leachate were filtered through the prefilter and the EPA protocol pressure filter step before the filters required replacement.

These preliminary leachates were analyzed for explosive compounds and TNT metabolites by HPLC (method described in Appendix A-2, compound abbreviations are listed in Appendix A-1). The compounds identified and concentrations determined in the leachates from the mesophilic and thermophilic composts were TNT (0.2 and <0.05 μg/mL for the mesophilic and thermophilic leachates, respectively), 2-A-4,6-DNT (0.1 and 0.01 μg/mL), 4-A-2,6-DNT (0.13 and 0.07 μg/mL), HMX (0.98 and 0.27 μg/mL), and RDX (9.2 and 3.3 μg/mL). None of the diaminomononitrotoluenes were identified although there were very small peaks at retention times which were very close to those of the standard compounds. Trinitrobenzyl alcohol, tetryl, and the hydroxyaminodinitrotoluene were not detected (< ca. 0.05 μg/mL). A peak close to that of the azoxydimer also was observed.

2.2.2. Final Trial of EPA Synthetic Precipitation Leach Test

The CCLT was conducted upon the mesophilic and thermophilic composts as per the EPA protocol (5) to produce the large volume of leachates necessary to conduct the chemical and toxicity testing battery. Our toxicity testing of the preliminary CCLT run (see following chapters) indicated that 28 L of each leachate would be needed for the chemical analyses and toxicity tests. Of this, 26 L were required for the toxicity tests, most of which was for the fathead minnow larvae test. The CCLT leachates were generated over a period of ca. two weeks, and required 15 two-L tumbler bottle loads. The Extraction Fluid No. 2 (ASTM Type II water adjusted to pH 5.0 with a 60/40 wt.% mixture of sulfuric/nitric acids) was used because the composts were generated from a site west of the Mississippi (LAAP) and presumably would be surface-applied at or near that site. The EPA protocol was followed, with the addition of centrifugation (350 to 1,100 XG for 30 min.) and prefiltration immediately before the pressure filtration step to prevent plugging of the EPA protocol pressure filter. Experiments (see section 2.2.3.) with the EPA Toxicity Characteristic Leaching Procedure leachates indicated no significant effects upon leached explosives and TNT metabolites from this preliminary centrifugation and filtration.

The CCLT leachates were collected in 4 L jugs after preparation, and were composited after all of the necessary leachate had been generated. Two composited aliquots were prepared. Aliquot no. 1 (designated "CCLT-1" in Table 2-2) was composited from the first 14 L, and aliquots were withdrawn for chemical characterization only. The compositing was continued, and the second aliquot was composed of all 28 L (identified as "CCLT-2" in Table 2-2). One-half of the second aliquot was composed of the first; thus the two aliquots were not true duplicates. The second aliquot was subjected to both chemical analyses and toxicity characterization. Chemical analysis included semivolatile organic compounds, PCBs, pesticides, and metals (inductively coupled plasma emission spectroscopy screen [ICP] only) by EPA SW-846 (6) and Contract Laboratory Program (CLP) (7) procedures. Explosive compounds and TNT metabolites were determined using high performance liquid chromatography (HPLC) (see Appendix A-2) after U. S. Army Cold Regions Research and Engineering Laboratory methods (8,9). Toxicity characterization consisted of fathead minnow and Ceriodaphnia dubia aquatic toxicity tests and the Ames bacterial mutagenicity test.

2.2.3. EPA Toxicity Characteristic Leaching Procedure

Samples of both composts were subjected to the Toxicity Characteristic Leaching Procedure (TCLP) per the EPA protocol (10). A total of 2 L of leachate were generated from 100 g of the thermophilic compost, and 4 L were generated from 200 g of the mesophilic compost. The leaching medium, TCLP extraction fluid no. 1 (pH 4.93 acetate buffer), was used because the pH in the preliminary test was < 5.0. The pH of the solution prepared from 96.5 mL of ASTM Type II water and 5.0 g of compost stirred for 5 min. was 9.1 for the mesophilic compost and 8.7 for the thermophilic compost. Per the TCLP protocol, 3.5 mL of 1 N hydrochloric acid were added and stirred at 50° C for 10 min., and the pH was redetermined For the mesophilic compost, the resulting pH was 2.3, and for the thermophilic compost, the pH was 2.2. Because this was < 5.0, extraction fluid no. 1 was required. The only deviation from the EPA protocol was the centrifuging and prefiltering conducted before the EPA protocol pressure filtration. This pretreatment was similar to that used for the CCLT leachates.

Samples of the TCLP leachate were analyzed by EPA SW-846 (6) and CLP (7) procedures for semivolatile organic compounds, pesticides, PCBs, and metals (ICP screen only). Explosive compounds and TNT metabolites also were determined by HPLC (Appendix A-2). No toxicity tests were conducted on these leachates because of interferences by the acetate buffer.

To investigate the possible consequences of the prefiltration, samples of the final leachates of both composts were spiked with known concentrations of explosive compounds and TNT metabolites. A 55 mL volume of each leachate was spiked with 1.0 mL of a 1 μg/mL (each compound) standard of explosives and metabolites in acetonitrile. The spiked solutions were filtered through a 57 mm diameter filter of the same type as used for the prefiltration to preserve the same leachate volume/filter diameter ratio. The spiked leachates were sampled before and after prefiltration. The leaching medium also was sampled before and after prefiltration to determine if the prefilter contaminated the leachates. The samples were analyzed by HPLC. As shown in Table 2-1, no significant changes in concentration were found for TNT, HMX, RDX, two diaminomononitrotoluenes, two monoaminodinitrotoluenes, and trinitrobenzyl alcohol, but a 15-20% decrease was observed for 4-hydroxyamino-2,6-dinitrotoluene, and the azoxydimer. The latter two compounds are more hydrophobic than the other species and may have sorbed on fine particles which were subsequently filtered out. No contamination by the filter was detected.

TABLE 2-1. RECOVERY OF EXPLOSIVE COMPOUNDS AND TNT METABOLITES FROM PREFILTRATION OF TCLP LEACHATES FROM COMPOSTS

	Recovery[a], %	
Compound	Mesophilic	Thermophilic
2,6-DA-4-NT	99	95
2,4-DA-6-NT	100	99
2,4,6-TNBAlc	102	97
RDX	99	100
HMX	97	93
2-A-4,6-DNT	98	99
4-A-2,6-DNT	98	99
TNT	98	100
4-OHA-2,6-DNT	84	83
Azoxydimer	83	80

[a] 0.9 μg/mL spike added to leachates. Recovery is calculated by
(100%) x (peak area after filtration)/(peak area before filtration).
N=1

2.2.4. Chemical Characterization of Regulatory Leachates

The analyses consisted of gross leachate characteristics, explosives compounds and TNT metabolites by HPLC, semivolatile organic compounds (the "SVOA") and PCBs/pesticides by the EPA CLP and SW-846 methods 3550 and 8270 for SVOA and 8080 for PCBs/pesticides, and a metals screen by ICP.

Gross Chemical Characteristics of Leachates:

Two types of gross measurements were conducted upon the leachates immediately after their generation. Leachate pH was measured using a glass combination electrode, and the extractable matter was estimated by evaporating and reweighing 10 mL of leachate in a tared aluminum pan. As shown in Table 2-2, the pH of the TCLP extracts increased slightly during the extraction, while the blank remained at 4.9. A greater pH increase was observed for the CCLT leachates, consistent with the much lesser buffering capacity of the CCLT extractant (a very dilute combination of nitric and sulfuric acids) versus that of the TCLP (sodium acetate/acetic acid buffer). Most of the extractable mass from the TCLP was contributed by the sodium acetate/acetic acid buffer. It appears that a greater mass was extracted from the thermophilic compost than from the mesophilic compost. This also was observed with the CCLT leachates. In fact, the masses extracted by the CCLT leaching are close to those for the TCLP if the blank is subtracted from the TCLP. Additional characterization of the CCLT leachates, conducted as a part of the toxicity testing protocol, is reported in Table 3-3 of the following chapter.

TABLE 2-2. COMPARISON OF GROSS CHARACTERISTICS OF CCLT AND TCLP LEACHATES OF COMPOSTS

			Extractable Matter	
Leaching Method	Compost	pH	mg/mL[a]	mg/g[b]
CCLT-Prelim.	Meso.	8.4	0.51	10
	Thermo.	8.4	0.95	19
CCLT-Final	Meso.	7.8	0.92	18
	Thermo.	7.8	1.19	24
	Blank	6.1	0.025	0.5
TCLP	Meso.	5.05	6.85	137
	Thermo.	5.05	7.04	141
	Blank	4.9	5.53	111

[a] mg of matter per mL of leachate
[b] mg of matter per g of compost

Explosive Compounds and TNT Metabolites

Of the organic chemical analyses, only the HPLC analyses (method described in Appendix A-2) revealed the presence of appreciable organic compounds. The data shown in Table 2-3 (abbreviations are listed in Appendix A-1) indicate that low μg/mL concentrations of RDX and HMX are leached by both the TCLP and CCLT. It is not clear why the TCLP was a more aggressive extractant than the CCLT for the mesophilic compost. We suspect that it may be due to inhomogeneity in the compost (see below), and that the 200 g of mesophilic compost taken for the TCLP contained a "rich" deposit of the explosives, while the much greater mass of compost (1400 g) taken for the CCLT averaged out such inhomogeneities. The thermophilic compost leachates contained lower concentrations of explosives in both the TCLP and CCLT leaching than did the mesophilic compost leachates. This is consistent with the lower concentrations of these compounds in the composts, as determined by Weston (4) and our own analysis (see below). Approximately 40 - 100% of the available explosives and metabolites were leached from the compost. For the CCLT, the percentages leached, as averages of the data for the mesophilic and thermophilic compost leachates, were HMX (100%), RDX (57%), TNT (72%), 2-A-4,6-DNT (43%), and 4-A-2,6-DNT (46%).

TABLE 2-3. RESULTS OF EXPLOSIVES COMPOUNDS AND TNT METABOLITES ANALYSIS OF COMPOST LEACHATES

	Concentration in Leachate[a], μg/mL					
	Mesophilic			Thermophilic		
Compound	TCLP[b]	CCLT-1[b]	CCLT-2[c]	TCLP[b]	CCLT-1[c]	CCLT-2[c]
2,6-DA-4-NT	-	-	-	-	-	-
2,4-DA-6-NT	-	-	-	-	-	-
2,4,6-TNBAlc	-	-	-	-	-	-
RDX	16.6	6.1	6.2	0.5	2.0	1.2
HMX	1.5	0.8	0.8	-	0.6	0.2
TNB+DNB	-	-	-	-	-	-
2-A-4,6-DNT	0.13	0.08	0.08	-	0.11	-
4-A-2,6-DNT	0.11	0.18	0.17	-	0.40	0.09
2,6-DNT	-	-	-	-	-	-
2,4-DNT	-	-	-	-	-	-
TNT	5.3	3.0	3.7	0.1	0.90	1.0
Tetryl	-	-	-	-	-	-
4-OHA-2,6-DNT	-	-	-	-	-	-
Azoxydimer	-	-	-	-	-	-
Total ID	23.6	10.2	11.0	0.6	4.0	2.5

[a]- =[a]- = not detected (ca. 0.01-0.05 μg/mL). Concentrations < 0.1 μg/mL are estimates.
[b]n = 1
[c]n = 2

Regulatory Organic Compounds

Appendix A-3 contains the reporting forms for the characterization of the TCLP leachates and Appendix A-4 contains those for the CCLT leachates. Briefly, the SVOA did not detect any of the 65 EPA Target Compound List (TCL) semivolatile organic constituents in the TCLP or CCLT leachates of either compost, with reporting limits of 11-65 μg/L (depending upon the exact constituent). The SVOA Tentatively Identified Compounds ("TICs") included TNT and 2-5 compounds which were not identified by the NBS mass spectral library machine search. Comparison of their mass spectra with those of authentic standards identified two of these compounds as the monoaminodinitrotoluenes.

None of the 20 TCL pesticides were found in the TCLP leachates with reporting limits of 0.5 - 5 μg/L, and none of the 7 TCL PCBs were found at reporting limits of 5-10 μg/L (Appendix A-3). In contrast, the analysis of the CCLT leachates (Appendix A-4) did reveal the presence of low concentrations of several pesticides, probably because a larger volume of leachate was analyzed, and the sensitivity was better. Three pesticides were determined at the same concentrations in both the mesophilic and thermophilic CCLT leachates: beta-BHC at 0.3 μg/L, gamma-BHC at 0.2 μg/L, and dieldrin at 0.01 μg/L. Gamma-chlordane was estimated at 0.12 μg/L in the mesophilic leachate and at 0.04 μg/L in the thermophilic leachate, which suggests that the composting may have reduced its concentration. In addition, a trace (0.02 μg/L) of heptachlor was estimated in one of the aliquots of the mesophilic leachate. These concentrations are too low to be significant, and the compounds most likely were not contributed by the explosives-contaminated sediment, but rather from the amendments used in composting. They would be highly site- and amendment-specific.

Volatile organic compounds also were determined in CCLT leachates prepared separately from the others. The zero headspace extractor was not used because it is difficult to operate and the history of the compost samples suggests that the effort required to use the zero headspace extractor would not be justified. The composts had been aerated (4) during composting and then they were stored in a partially filled drum for nearly one year before analysis. Most volatile organic compounds would be lost. Therefore, 2 g samples of the composts were shaken for 18 hrs with 42 mL of the CCLT extraction fluid in a 40 mL VOA vial. The CLP VOA surrogate standards were added to the vials before shaking. The analysis by the CLP purge and trap GC-MS method (similar to SW-846 method 8240) did not reveal any VOA different from the blank with reporting limits of 5-10 μg/L (Appendix A-4). Although the surrogate standard recoveries were low for toluene and bromofluorobenzene, any volatiles present would have been detected.

Metals Screen by ICP

The results for the determination by ICP of 29 elements in the TCLP and CCLT leachates of the two composts and leaching blanks are listed in Appendix A-3 and A-4. The metals compositions of the mesophilic and thermophilic leachates were almost identical because they are contributed by the soil, and not the munitions, and are not bacterially degraded. They would be highly site-specific.

2.2.5. Leachate and Compost Homogeneity

The final report by Weston (4) shows that the composts are inhomogeneous with respect to explosives concentrations. Obtaining representative samples for study is important. This concern was addressed in the mixing of the contents of the drums before sampling. In the generation of the CCLT leachates for toxicity testing and chemical analysis, the relatively large masses of compost (1400 g) required to generate the 28 L of leachate allowed a considerable "averaging" of local inhomogeneities in the composts. This was demonstrated by HPLC analysis of individual 4 L aliquots which were composited to prepare the CCLT leachate of the thermophilic compost. Table 2-4 shows the variability in the results for RDX and TNT. The concentrations for each ranged from "not detected" (ca. 0.05 μg/mL) to nearly 2 μg/mL, and the relative standard deviations were 60% for RDX and 122% for TNT. Thus, the final composited leachate "averaged" a wide variation in compost explosives concentrations.

TABLE 2-4. VARIATION IN RDX AND TNT CONCENTRATIONS IN INDIVIDUAL 4L PORTIONS OF THERMOPHILIC COMPOST CCLT LEACHATES

	Concentration,[a] μg/mL	
Aliquot	RDX	TNT
1	1.3	1.0
2	1.8	1.8
3	ND	0.2
4	0.8	1.1
5	0.9	0.6
6	0.7	ND
7	0.8	ND
---	---	---
Avg.	0.91	1.39
SD	0.54	1.67
RSD	60%	122%

[a] ND = not detected (use 0.05 μg/mL for calculations).

Our previous experiences in preparing the TCLP and CCLT leachates, as well as Weston's analytical data on the compost piles, indicate that a lack of homogeneity in the composts must be considered in the design of experiments. Preliminary to the comparison of organic solvents for compost extraction, samples of the composts were mixed carefully and analyzed to establish their homogeneity as a baseline before the extractions were carried out. Ca. 1.5 kg of each compost were sieved to ≤ 10 mm per the TCLP and CCLT protocol, and then were sieved again to ≤ 3.35 mm. The sieved material was then tumbled for ca. 1 hr in the TCLP apparatus (without solvent), spread in a glass tray, and mixed again with a spatula. Attempts to homogenize the composts with a food homogenizer or with a grinder failed because the composts caked and plugged the equipment. The composts were not dried because of concerns that explosives metabolites could be oxidized.

Duplicate 5 g aliquots were taken from five points in the glass tray, and these were extracted with 20 mL of acetonitrile for 18 hrs in an ultrasonic bath, and were analyzed using HPLC. The data are included in Table 2-5. The relative standard deviations (RSD) ranged from 5 to 26% for all compounds (except for TNT) for the mesophilic compost, and from 8.5 to 53% for the thermophilic compost. The somewhat better homogeneity for the mesophilic compost may be due to its lesser

TABLE 2-5. EXAMINATION OF HOMOGENEITY OF COMPOST SAMPLES USED FOR SOLVENT COMPARISON STUDY

	Concentration in Compost[a], μg/g			
	Mesophilic		Thermophilic	
Compound	Range	Avg ± SD (RSD)	Range	Avg ± SD (% RSD)
RDX	77-196	129 ± 33.7 (26%)	12-36	23 ± 8.4 (37%)
HMX	29-44	35 ± 5.3 (15%)	3-14	6.0 ± 3.2 (53%)
2-A-4,6-DNT	3.3-4.4	3.7 ± 0.37 (10%)	1-2	1.87 ± 0.42 (23%)
4-A-2,6-DNT	7.4-8.6	8.0 ± 0.44 (5.5%)	3.2-4.2	3.6 ± 0.31 (8.5%)
TNT	30-3530	487 ± 1084 (223%)	8-1400	179 ± 430 (240%)
(TNT)[b]	30-213	89 ± 68 (77%)	8-76	34 ± 24 (72%)

[a] n = 10

[b] Two highest results deleted

moisture content, and the greater ease in mixing a less sticky compost. The RSDs for TNT in both composts were ca. 240% for all 10 data points, and dropped to ca. 75% when the two highest data points (for n=8) were deleted. The lesser precision for TNT suggests either considerable inhomogeneities in the distribution of the TNT in the composts or an analytical interference that itself is not constant. These RSDs are similar to those observed by Weston (4) over one year ago at the end of the field experiment at the LAAP. The concentration data, with the exception of TNT, are also similar to the Weston data. The TNT was higher in our measurements, again suggesting that the TNT peak is subject to an analytical interference, or that the CRREL extraction procedure was unable to recover all the TNT.

2.3. Preparation and Characterization of Organic Solvent Extracts

Organic solvent extracts were prepared from the two composts to provide material enriched in potentially toxic compounds for chemical analysis and toxicological testing. The aqueous leaching would not be expected to mobilize toxic organic compounds as readily as organic solvent extraction, and thus toxicity in the composts could be missed by the latter. The solvents to be used and the extraction method were first determined before preparing extracts for characterization.

2.3.1. Comparison of Organic Solvents for Compost Extraction

Seven solvents were compared for their ability to extract explosives and metabolites from the composts. For this purpose, the homogenized composts samples described immediately above were used. Triplicate 5 g aliquots of the mesophilic compost were extracted for 18 hrs in an ultrasonic bath using 20 mL of each solvent. The solvents were chosen because of their proven efficiency for explosives (i.e., acetonitrile), their extensive use in bioanalytical (i.e., ethyl acetate) or environmental (i.e, methanol, methylene chloride) analysis, or their good solubility characteristics (i.e., tetrahydrofuran, diethyl ether, and dimethyl sulfoxide [DMSO]). Explosives and metabolites analyses were performed by HPLC, and the total extractable matter was estimated by weighing the residue from evaporating 10 mL of the extract. The results are listed in Table 2-6. DMSO was not evaporated because of its relatively poor volatility. Of the seven solvents, acetonitrile and ethyl acetate appeared to offer the best recoveries, and were selected for preparing the extracts for chemical and toxicological characterization. It is not clear why TNT and one of the metabolites were not detected in the DMSO extraction.

2.3.2. Comparison of Organic Solvent Extraction Procedures

Several different extraction procedures have been used in these studies. These include the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) method (8), the U. S. EPA SW-846 method 3550 (6), and ORNL variations of both methods. Results of the applications of these methods to the composts are shown in Table 2-7. Basically, the ultrasonic extractions performed using a probe appear to be more efficient than those done with a bath, although compost inhomogeniety complicates comparison of the results. However, the data do indicate that the procedure (90 g of compost extracted three times with 300 mL of solvent [each time] using a probe-type sonicator) chosen for preparing the extracts for toxicological testing was at least as effective as the CRREL analytical method while providing nearly two orders of magnitude scaleup. Analysis of the extracts from each of the three extraction steps showed that 80% of the extracted explosives and metabolites were recovered on the first extraction, 16% on the second, and 4% in the third extraction. These results also suggest the completeness of the extraction.

TABLE 2-6. COMPARISON OF ORGANIC SOLVENTS FOR MESOPHILIC COMPOST EXTRACTION[a]

		Avg ± Std. Dev. (n = 3 unless otherwise noted)				
		Explosives and Metabolites, µg/g				
Solvent	Total Extractable Matter, mg/g	RDX	HMX	2-A-4, 6-DNT	4-A-2, 6-DNT	TNT
Acetonitrile[b]	3.5[c]	129 ± 34	35 ± 5	3.7 ± 0.4	8.0 ± 0.4	487 ± 1100 89 ± 68[d]
Methanol	5.1 ± 0.4	63 ± 37	10 ± 1.5	2.7 ± 0.6	6.0 ± 1	1540 ± 2570 55[e]
Diethyl Ether	2.1 ± 0.6	165 ± 41	8 ± 1	4.0 ± 0	8.7 ± 1.2	580 ± 880 76[e]
Methylene Chloride	2.0 ± 0.3	200 ± 97	13 ± 1.7	3.6 ± 0.6	8.7 ± 0.6	53 ± 29
Tetrahydrofuran	5.5 ± 0.4	124 ± 25	29 ± 3.6	3.3 ± 1.2	5.6 ± 4.9	193 ± 146
Ethyl Acetate	3.8 ± 0.4	186 ± 90	25 ± 23	5.7 ± 1.2	10 ± 4.4	544 ± 744 116[e]
Dimethyl Sulfoxide	-[f]	132 ± 22	31 ± 11	ND[g]	8.0 ± 1.7	ND[g]

[a] 5g compost extracted overnight with 20 mL solvent.
[b] n = 10 for explosives.
[c] Total extractable matter is weighed residue from composite of 10 replicates.
[d] n = 8 with 2 highest data points deleted.
[e] n = 2 with highest data point deleted.
[f] Solvent not evaporated.
[g] ND = not detected

TABLE 2-7. COMPARISON OF SOLVENT EXTRACTION METHODS FOR COMPOSTS

		Avg ± STD, μg/g (n = 3 unless otherwise indicated)				
Compost	Extraction Method	RDX	HMX	2-A-46 DNT	4-A-26 DNT	TNT
Mesophilic	CRREL, lg/25ml, Bath	157 ± 74	27 ± 8.7	ND	6 ± 1	13 ± 14
	ORNL, 5g/30ml, Bath	141 ± 32	35 ± 9.0	3.6 ± 0	10 ± 0	318 ± 470 47[a]
	ORNL, 5g/20ml, Bath[b]	129 ± 34	35 ± 5.3	3.7 ± 0.4	8. ± 0.4	487 ± 1080 89 ± 68[c]
	ORNL, 30g/100ml Probe[a]	170	37	3.5	8.2	473
	SW-846, 30g/100mlx3, Probe	273 ± 68	52 ± 9.5	5.1 ± 0.2	12.7 ± 1.5	557 ± 95
	ORNL, 90g/300mlx3, Probe[d]	226 ± 34	51 ± 3.9	6.0 ± 0.4	16 ± 0.5	628 ± 96
Thermophilic						
	ORNL, 5g/20 mL, Bath[b]	23 ± 8.4	6.0 ± 3.2	1.8 ± 0.4	3.6 ± 0.3	179 ± 430 34 ± 24[c]
	ORNL, 30g/100mL Probe[a]	23	5.3	1.3	3.7	483
	SW-846, 30g/100mLx3, Probe	13 ± 13	ND	ND	3.5 ± 0.7	28 ± 27
	ORNL, 90g/300mLx3, Probe[d]	80 ± 81 40 ± 17[e]	9.3 ± 9.2	2 ± 0	6.8 ± 0.8	158 ± 158

[a] n = 2

[b] n = 10

[c] n = 8, 2 highest data points deleted

[d] Batch 2 of compost, n = 4

[e] n = 3, highest data point deleted

2.3.3. Preparation of Organic Solvent Extracts

A preliminary small-scale extract was prepared from both composts to provide material for range-finding in the toxicological assays, and to estimate the mass of extractable matter needed for the full toxicological tests. Ca. 30 g of each compost were extracted with 100 mL of acetonitrile using a probe-type ultrasonicator. Three batches of each compost were extracted (total of 90 g). The solvent was removed using rotary evaporation, and the residues were resuspended in DMSO for toxicity testing.

On the basis of the preliminary toxicity tests, it was estimated that ca. 2 g of extractable matter were needed for the full battery of toxicity tests and chemical characterization. The 55 gallon drums of compost were resampled to provide enough compost for the extractions. The drums were rotated for several hours and the upper portion was mixed with a shovel before sampling. Ca. 1 kg aliquots were sieved through 10 mm and 3.35 mm screens and were mixed further by tumbling and stirring to promote homogeneity. Subaliquots of 450 g of the mesophilic compost and 900 g of the thermophilic compost were extracted 90 g per batch, using three 300 mL volumes of acetonitrile and ultrasonic extraction with a probe-type sonicator, after EPA SW-846 method 3550. This solvent was removed by rotary evaporation. For the ethyl acetate, a total of 180 and 360 g of compost (respectively) were used, and the same extraction protocol was followed. The residues from both sets of extractions were redissolved in DMSO. Table 2-8 summarizes the preparation parameters. Chemical characterization of the DMSO-reconstituted extracts included semivolatile organic compounds, PCBs/pesticides, and explosive compounds and TNT metabolites. Toxicity tests consisted of fathead minnow larvae (acetonitrile extract only) and *Ceriodaphnia dubia* freshwater toxicity and the Ames microbial mutagenicity test.

2.3.4. Chemical Characterization of Organic Solvent Extracts

The acetonitrile and ethyl acetate extracts generated from the mesophilic and thermophilic composts were analyzed for EPA semivolatile organic and PCB/pesticide Target Compound List species. For this characterization, aliquots of the extracts were solvent exchanged from DMSO into methylene chloride (semivolatile organics) or hexane (PCBs/pesticides) at a concentration of ca. 4 mg of extractable residue/mL by azeotropic distillation and redissolution. The analyses were performed by EPA Contract Laboratory Program GC-MS (semivolatile organics) and GC with electron capture detection (PCBs/pesticides) procedures. None of the TCL semivolatile organics were detected with a reporting limit of 10 to 50 mg/L, none of the pesticides with a reporting limit of 200 μg/L, and none of the PCBs with a reporting limit of 20 mg/L. As expected, TNT was detected as a TIC in the semivolatile organics analysis. Explosives and TNT metabolites analyses performed on the DMSO solutions by HPLC are included in Table 2-9. The explosives and metabolites concentrations were much higher than those in the aqueous leachates. There may have been an interference in the HPLC peak for HMX (note that the apparent HMX concentration extracted by ethyl acetate from the thermophilic compost was higher than that from the mesophilic compost) but the spectra did not disprove the apparent identification.

Qualitative gas chromatographic scans were made of the solvent extracts to supplement the GC-MS analyses. Ten mL aliquots of the preliminary acetonitrile extracts of the mesophilic and thermophilic composts were taken to dryness under a gentle stream of nitrogen, and were extracted with 1 mL of acetonitrile. Not all of the residue redissolved, even after warming the flask, suggesting the presence of inorganic or high molecular weight matter. Two μL injections were made by the solvent flush technique into a capillary column gas chromatograph equipped with a splitless injection port, a fused silica capillary column (30 m x 0.25 mm ID x 0.25 μm film) with DB-5 bonded phase, and a flame ionization detector. The column temperature program was 100°C (5 min. isothermal hold) to 300°C at 8°C/min with a 30 min. hold at 300°C, the injector and detectors were

TABLE 2-8. PARAMETERS OF ORGANIC SOLVENT EXTRACTS FOR CHEMICAL AND TOXICITY TESTING.

	Acetonitrile Extract		Ethyl Acetate Extract	
Parameter	Mesophilic	Thermophilic	Mesophilic	Thermophilic
Mass of Compost Extracted, g	450	900	180	360
Extractable Matter, g	1.33	2.03	0.85	0.92
Volume of DMSO for Reconstitution, mL	135	270	54	108
Concentration in DMSO				
mg Residue/mL	9.9	7.5	15.7	8.5
g Compost/mL	3.3	3.3	3.3	3.3

TABLE 2-9. EXPLOSIVE COMPOUND AND TNT METABOLITE ANALYSIS OF ORGANIC SOLVENT EXTRACTS AND HYDROLYZED BOUND FRACTION

Solvent Extract/Compost or Hydrolyzed Bound Fraction/ Compost	Concentration[a], µg/mL				
	RDX	HMX	TNT	4-A-2, 6-DNT	2-A-4, 6-DNT
Ethyl Acetate/Mesophilic	1900	26	515	14	13
Ethyl Acetate/Thermophilic	750	125	50	6	4
Acetonitrile/Mesophilic	1550	210	550	13	12
Acetonitrile/Thermophilic	710	119	20	3	-
Hydrolyzed Mesophilic	3	-	-	101[b]	-
Hydrolyzed Thermophilic	4	-	-	120[b]	-
Hydrolysis Blank	-	-	-	-	-

[a] "_"= not detected (ca. 0.3 µg/mL)

[b] HPLC peak observed at correct retention time window and spectra did not allow elimination.

maintained at 270°C and 300°C (respectively), and the helium carrier gas flow rate was 1 mL/min. The extracts were then derivatized by adding 1 mL of N-methyl-N-trimethylsilyltrifluoroacetamide and letting the vial set at room temperature overnight. A 3 μL aliquot was analyzed similarly. The chromatograms are shown in Figure 2-1. Very little gas chromatographable matter is visualized by the direct analysis of the solvent extracts (Figure 2-1 A and B). The mesophilic compost extract exhibits ca. 3-fold more peak area per mg of extractable matter than does the thermophilic compost extract. The main peaks are TNT and the monoaminodinitrotoluenes and some higher molecular weight material toward the end of the chromatogram. This confirms the small number of compounds detected by the GC-MS. In contrast, the derivatized extracts (Figure 2-1 C and D) show 4 to 5 times more detectable matter, indicating that the bulk of the organic matter is polar in nature. This suggests that the technique of derivatization followed by gas or supercritical fluid chromatography would be a powerful analytical technique to analyzing compost extracts and leachates.

2.4. Preparation and Chemical Characterization of Hydrolyzed Bound Fraction

Aliquots of the ethyl acetate-extracted composts were hydrolyzed to prepare samples for tests of toxicity associated with a bound, but chemically labile form of explosives transformation product. For example, transformation products bound through hydrolyzable amide bonds would be hydrolysed back to the original amines while products bound through nonhydrolyzable ether or heterocyclic linkages would not be liberated. The solvent-extracted composts remaining from the studies described in section 2.3. were hydrolyzed because all the unbound explosives compounds and their metabolites had been removed, and explosives-related compounds (if any) could be attributed to their bound forms.

Fifty g of the ethyl acetate-extracted mesophilic and thermophilic composts were refluxed for 6 hrs with 250 mL of 6 N hydrochloric acid following earlier work (11) showing the release of organic compounds from humic acids by boiling acid. The hydrolyzate was filtered off and extracted three times with 250 mL of methylene chloride, made alkaline (pH 11) with 50% sodium hydroxide solution, and re-extracted with methylene chloride. The methylene chloride extracts were combined and taken to dryness, and the residue was weighed and redissolved in dimethylsulfoxide (DMSO). A blank (no compost) and a positive control (50 g of ethyl acetate-extracted thermophilic compost spiked with 50 mg each of 4-amino-2,6-dinitrotoluene and 2,4-diamino-6-nitrotoluene) also were treated similarly. The only noteworthy observation from the preparation was that a precipitate formed upon addition of the sodium hydroxide to the hydrolyzate. The precipitate probably was composed of humic acids. It was filtered out and rinsed with methylene chloride to recover any products. Table 2-10 lists the preparation parameters for the experiment. The DMSO-reconstituted residues were subjected to the Ceriodaphnia dubia toxicity test and the Ames bacterial mutagenicity test.

Characterization was limited to HPLC analysis of explosives and TNT metabolites. The results are included in Table 2-9. HPLC peaks corresponding to a trace of RDX and 4-A-2,6-DNT were observed in the final extracts. The spectra of the peak for the latter would not allow conclusive confirmation or elimination of the peak identity, so the identification must be considered as tentative at the present. The spikes were not recovered in the spiked positive control sample. It was found in a subsequent experiment that the acidic refluxing of the spikes in the presence of the compost caused them to decompose. Future work must include more gentle hydrolysis conditions.

FIGURE 2-1. CAPILLARY COLUMN GC OF CRUDE AND DERIVATIZED COMPOST EXTRACTS. ELUTION OF TNT IS LABELED. BRACKETS SHOW ELUTION RANGE OF METABOLITES (CRUDE) AND TNT PLUS METABOLITES (TMS-DERIVATIZED).

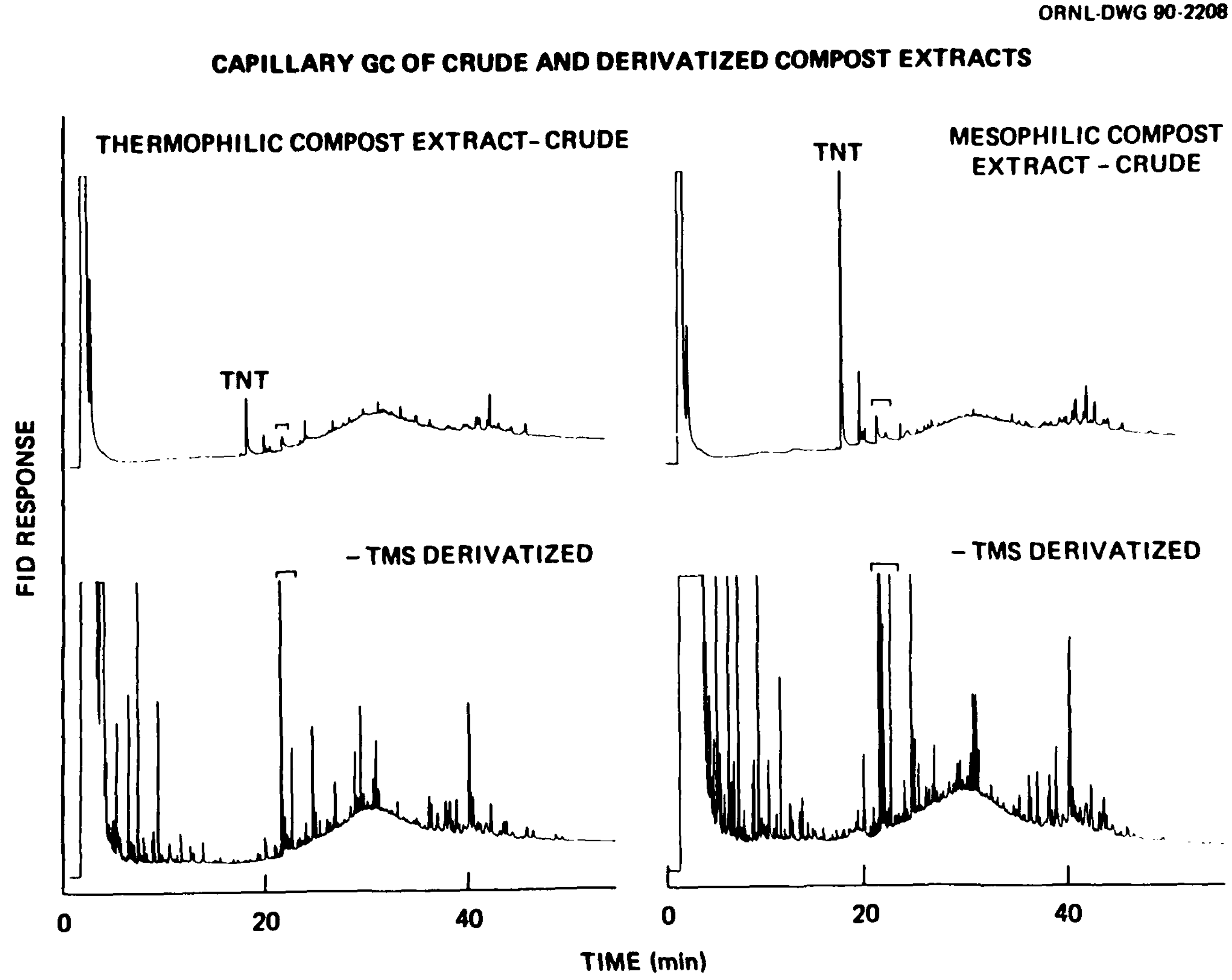

TABLE 2-10. PARAMETERS FOR PREPARATION OF HYDROLYZED BOUND FRACTIONS FOR CHEMICAL AND TOXICITY TESTING

	Results for Sample		
Parameter	Mesophilic Compost	Thermophilic Compost	Blank
Mass of Compost, g	50	50	-
Mass of Bound Fraction Residue, mg	270	219	1.5
Volume of DMSO for Bound Fraction, mL	15	15	1.5
Concentrations in DMSO:			
mg Bound Fxn/mL DMSO	18.0	14.6	0.1
g of Compost/mL DMSO	3.3	3.3	-

2.5. Preparation of Particle-bound Organics Extract from CCLT Leachate

Our previous work suggested that organic compounds leached from the composts by the aqueous leaching tests could be adsorbed on particles. Organic compounds on particles would not be available for mutagenicity testing when the leachate is sterilized by filtration before application to the agar plate. Similarly, submicron-sized particles would not be ingested by the freshwater organisms unless they were attached to food particles. To investigate this, samples were prepared to test for particle bound mutagenicity. Four L of CCLT leachate were generated from 200 g of the mesophilic compost using the procedure we described in section 2.2.2. The CCLT leachate (3.9 L) was centrifuged for 30 min at 2900 rpm (rotor radius of 19 cm) to isolate 701 mg of particles. The particles were extracted with DMSO and were subjected to Ames mutagenicity testing. HPLC analysis of the particle extract revealed RDX (70 μg/g of particles), 2-A-4,6-DNT (120 μg/g), and 4-A-2,6-DNT (40 μg/g). It is not clear why TNT and HMX (which were present in the leachate) were not detected.

2.6. Analysis of Mesophilic Compost Wood Chips for Explosive Compounds and TNT Metabolites

Wood chips were screened out of the composts during the preparation for regulatory leaching or organic solvent extraction, and it is possible that they could have absorbed explosive compounds and biotransformation products. This could occur while the chips were insulating the piles or (more an HPLC analysis of the wood chips screened out of the mesophilic compost. The results listed in Table 2-11 show definite sorption of explosive compounds and metabolites by the wood chips. The observation that the concentration ratios of the compounds in the wood chips to those in the compost are reasonably consistent for the compounds (except for TNT) suggests that the sorption occurred post-composting (i.e., while stored in the drum) and not during the composting. The latter could create an additional waste problem at the composting field site.

TABLE 2-11. CHARACTERIZATION OF MESOPHILIC COMPOST WOOD CHIPS FOR EXPLOSIVES AND BIOTRANSFORMATION PRODUCTS

Compound	Concentration, $\mu g/g$	Ratio, chips/compost
RDX	68 ± 11	0.29
HMX	20 ± 1.5	0.39
2-A-4,6-DNT	2.7 ± 0.6	0.45
4-A-2,6-DNT	9.0 ± 1.0	0.56
TNT	25 ± 8.7	0.04

2.7. Conclusions

The chemical analyses demonstrate that the greater biotransformation of explosives achieved with the thermophilic composting condition versus the mesophilic composting condition results in lower concentrations of explosives and metabolites in the aqueous leachates and organic solvent extracts of the composts. The main compounds determined in the leachates and extracts were RDX, HMX, TNT, 2-A-4,6-DNT, and 4-A-2,6-DNT. Substantial percentages of these compounds in the composts can be leached by the CCLT or TCLP. GC-MS, GC-ECD, and ICP analyses of leachates and extracts do not reveal any EPA TCL constituents at significant concentrations, but the presence of these compounds would be site-specific and not necessarily associated with the explosives wastes which were composted. Additional polar organic compounds in the extracts can be visualized by the technique of chemical derivatization and GC, but at the present they cannot be assigned to explosives compounds or their transformation products because of the lack of a compost blank.

CHAPTER 3. AQUATIC TOXICITY TESTS

3.1. Introduction

The U.S. Environmental Protection Agency (EPA) and regulatory agencies in many states are requiring, with increasing frequency, the use of bioassays to (a) determine whether or not treated and nontreated wastewaters are suitable for release to the environment, (b) document water quality in streams that receive runoff or point-source discharges of treated or nontreated wastes, and (c) identify the toxic constituent(s) that reduce the biological quality of problematic wastewaters. Although many types of toxicity tests can provide meaningful information, "mini-chronic" 7-d static-renewal tests that use the survival and growth of fathead minnow larvae (Pimephales promelas) and the survival and fecundity of Ceriodaphnia dubia to quantify toxicity have become widely accepted and are now the preferred systems for assessing the biological quality of effluents and freshwater ambient receiving systems by many states. Recent studies show how tests with these two species can be applied to (a) toxicity assessments for effluents and ambient waters (cf. references 12-14) and (b) wastewater treatment process optimization efforts (15,16).

3.2. Methods

The present study was designed to provide information about (a) the chemical constituents present in composted high explosives, and (b) the toxicity and potential mutagenicity of materials extracted from the compost. Both aqueous and organic-solvent extracts of the compost were tested for toxicity and mutagenicity. The toxicity evaluations, which are discussed in this section, were made using fathead minnow larvae and Ceriodaphnia; the procedures used for these two tests closely followed EPA method 1000.0 (for the fathead minnow larvae survival and growth test) and EPA method 1002.0 (for the Ceriodaphnia dubia survival and reproduction test); EPA methods 1000.0 and 1002.0 are described by Horning and Weber (17). Some latitude is permitted in the use of these two test procedures. The type of dilution water, for example, can be varied according to the objectives of the study (reference 17, p. 17). In tests reported here, controls and test solutions were prepared using mineral water (Perrier^R) diluted to 10% of full-strength with deionized distilled water. Batches of water prepared for the tests were degassed by gentle aeration for 24 h at room temperature before use. Our experience has shown that diluted mineral water (DMW) prepared in this manner is satisfactory for both Ceriodaphnia and fathead minnow larvae. In the case of the Ceriodaphnia test, EPA method 1002.0 recommends the use of a mixture of fermented trout chow, cerophyll, and yeast (TCY). However, various studies, including many conducted in our laboratory, have shown that additions of algae (e.g., Ankistrodesmus falcatus) to TCY can increase Ceriodaphnia fecundity and decrease variability of fecundity among replicates. The net effect of such food amendments is more statistical power and a greater ability to quantify toxicity. Thus, the Ceriodaphnia used in all tests reported here were fed with Ankistrodesmus-augmented TCY. Standard operating procedures detailing the method for preparing algal-amended TCY, and all other procedures of the tests with both species, are available upon request (18). Ceriodaphnia are much more sensitive than fathead minnow larvae to a wide variety of effluents (cf. references 14 and 19). Additionally, Ceriodaphnia tests can be conducted using less than 20% of the amount of test solution that is needed for the fathead minnow test, and have been shown to be more cost-effective than the minnow test (20). For these reasons, we used the Ceriodaphnia test rather than the minnow test for many of the assessments reported here.

In some instances, the amount of material available for testing was small. Some of the organic-solvent extracts of the compost, for example, when brought to dryness, contained a few hundred milligrams of residue. These residue samples were analyzed both chemically and biologically (i.e., for toxicity and mutagenicity). When such small quantities of residue were available, it was sometimes necessary to scale down even the Ceriodaphnia test system. Normally, the Ceriodaphnia test is conducted by exposing single neonates to 17 mL volumes of test solution. Pre-rinsed 20 mL polystyrene microbeakers are used in this situation; 10 replicates are typically used to provide the necessary statistical power for accurate toxicity estimates. We used side-by-side comparisons of two test procedures (single Ceriodaphnia in 2.5 mL volumes of test solution in borosilicate glass test tubes, versus single Ceriodaphnia in 17 mL volumes of test solution in polystyrene microbeakers) to verify that a scaled down daphnid test system could be used to provide accurate estimates of toxicity.

Quality assurance/quality control (QA/QC) is an important aspect of toxicity testing if the results of the tests are to be used for regulatory purposes. Reports in Appendix A-5 show the kinds of QA/QC information available for each of the toxicity tests reported here; more complete information regarding the QA/QC for any of the tests described in the following sections is available upon request.

3.3. Observations

The toxicity tests included preliminary and final assessments of CCLT leachates of mesophilic and thermophilic composts (Tables 3-1 through 3-3), preliminary tests with acetonitrile extracts of mesophilic and thermophilic composts (Table 3-4), final tests of acetonitrile and ethyl acetate extracts of mesophilic and thermophilic composts (Tables 3-5 and 3-6), and a test of an acid-hydrolyzed extract of the bound fractions from mesophilic and thermophilic composts (Table 3-7). The use of controls and blanks among the various experiments differed according to objectives specific to the different tests, and thus are described, when appropriate, in the context of the individual tests below.

3.3.1. Tests of Preliminary CCLT Leachates

Toxicity of the CCLT leachates from both compost types was evaluated using Ceriodaphnia. Four concentrations (30%, 20%, 10%, and 5% of full-strength) of each leachate were tested to estimate toxicity. This test was conducted in 2.5-mL test chambers; two concentrations (20% and 5%) of each leachate type were also tested using 17-mL test chambers. The data for these tests are shown in Table 3-1.

Survival and reproduction of Ceriodaphnia was high both in the controls and in all tested concentrations of the CCLT leachates, and there was no difference in survival or reproduction attributable to the type of test system (i.e., 2.5-mL vs. 17-mL). Thus, the tests did not detect acute or chronic toxicity in either leachate up to highest concentration tested (30% of full-strength).

3.3.2. Tests of Final CCLT Leachates

Toxicity of the CCLT leachates prepared from the mesophilic and thermophilic composts was evaluated using both Ceriodaphnia and fathead minnow larvae. Each leachate was tested at four concentrations (40%, 60%, 80%, and 100% of full-strength) with each species. The synthetic acid rainwater (CCLT blank) used to prepare the leachates was also tested (at 40% and 60% of full-strength) to ensure that leachate toxicity, if detectable, could be attributed to materials originating from the compost rather than from the water used to prepare the leachates. The results of the tests are summarized in Table 3-2.

TABLE 3-1. RESULTS OF CERIODAPHNIA TOXICITY TESTS OF PRELIMINARY CCLT LEACHATES IN 2.5 ML (UPPER) AND 17-ML (LOWER) TEST CHAMBERS

Sample	Concentration (%)	Survival[a] (%)	Fecundity[b] (offspring per female)
Control[c]	100	90	18.7 ± 1.3
Thermophilic	5	100	22.2 ± 1.8
Thermophilic	10	100	21.4 ± 2.0
Thermophilic	20	100	22.0 ± 2.1
Thermophilic	30	90	23.0 ± 2.5
Mesophilic	5	90	22.1 ± 3.1
Mesophilic	10	100	22.2 ± 1.6
Mesophilic	20	90	20.6 ± 1.4
Mesophilic	30	90	20.2 ± 1.6

17-ML TEST CHAMBERS

Sample	Concentration (%)	Survival[a] (%)	Fecundity[b] (offspring per female)
Control[c]	100	100	21.2 ± 1.6
Thermophilic	5	100	19.7 ± 2.2
Thermophilic	20	100	20.2 ± 3.1
Mesophilic	5	100	19.9 ± 2.6
Mesophilic	20	90	17.8 ± 3.4

[a] Ten replicates were used for each treatment. Thus, 90% survival (e.g., for the control) means that nine of ten animals survived all 7 d.

[b] Mean ± 1 SD, calculated using only females that survived the full 7-d test period, and their offspring. n=10.

[c] Diluted mineral water.

TABLE 3-2. RESULTS OF CERIODAPHNIA AND FATHEAD MINNOW LARVAE TOXICITY TESTS OF CCLT LEACHATES PREPARED FROM THERMOPHILIC AND MESOPHILIC COMPOSTS

	Fathead minnow larvae		Ceriodaphnia	
Sample Type and Concentration	Survival[a] (%)	Growth[b] (mg/fish ± 1 SD)	Survival[c] (%)	Fecundity[d] (offspring per female ± 1 SD)
Control[e]	97.5	0.36 ± 0.02	91.6	20.6 ± 4.3
Thermophilic				
40%	100.0	0.47 ± 0.03	91.6	26.3 ± 8.0
60%	93.0	0.41 ± 0.04	100.0	21.3 ± 7.4
80%	90.0	0.41 ± 0.05	66.7	10.3 ± 4.4
100%	66.7	0.52 ± 0.05	91.6	6.4 ± 3.9
Mesophilic				
40%	73.3	0.40 ± 0.04	83.3	12.6 ± 6.2
60%	26.7	0.30 ± 0.08	58.3	1.9 ± 2.7
80%	0.0	---	91.6	1.3 ± 4.2
100%	0.0	---	0.0	---
Artificial Rain				
40%	93.3	0.41 ± 0.08	91.6	19.7 ± 5.4
60%	96.7	0.45 ± 0.04	91.6	17.4 ± 3.0

[a] Based on 3 replicates (10 fish per replicate).

[b] Mean mg/fish, based on 3 replicates (10 fish per replicate). Growth is calculated as change in dry weight over the 7-d test period.

[c] Twelve replicates (1 neonate per replicate) were used.

[d] Fecundity (mean ± 1 SD) is calculated using only females that survived all 7 d of the test, and their offspring.

[e] Control was diluted mineral water.

TABLE 3-3. SUMMARY OF RESULTS FOR CHEMICAL ANALYSES[a] OF CONTROL WATER, SYNTHETIC RAINWATER, AND MESOPHILIC AND THERMOPHILIC LEACHATES PERFORMED IN CONJUNCTION WITH TOXICITY TESTS

Sample	pH	Cond. (μS/cm)	Alkalinity (mg/L)	Hardness (mg/L)	Nitrate (mg N/L)	Phosphate (mg P/L)
Control[b]	7.7	86	30.1	41.1	0.505	0.009
Art. Rain.	5.8	4	1.5	< 2.0	0.026	0.012
Meso. Leach.	7.8	329	78.0	40.0	2.620	7.650
Therm. Leach.	7.9	310	78.0	40.0	0.726	6.025

[a] Data for pH and conductivity are means for 7 daily measurements; data for alkalinity, hardness, nitrate and phosphate are for single measurements made on the first day of the toxicity tests.

[b] Diluted mineral water (1:9, v:v, Perrier and deionized distilled water).

TABLE 3-4. <u>CERIODAPHNIA</u> SURVIVAL AND FECUNDITY IN VARIOUS CONCENTRATIONS OF ACETONITRILE EXTRACTS OF THERMOPHILIC (T) OR MESOPHILIC (M) COMPOSTS CONTAMINATED WITH EXPLOSIVES

Compost type	Final concentration[a] (mg of dried residue per L)	Survival (%)	Fecundity[b] (mean ± SD)
Control	----	90	20.1 ± 2.5
M	12	80	0
M	24	0	---
M	36	0	---
M	48	0	---
M	72	0	---
T	12	90	16.8 ± 2.0
T	24	40	0
T	36	10	0
T	48	0	---
T	72	0	---

[a] Dried residues of each extract were reconstituted in dimethyl sulfoxide (DMSO) before being tested.

[b] Calculated using only females that survived all 7 d, and their offspring.

TABLE 3-5. RESULTS OF CERIODAPHNIA TOXICITY TESTS OF PURE DIMETHYLSULFOXIDE (DMSO), ACETONITRILE EXTRACTS[a] OF THERMOPHILIC (T-A) AND MESOPHILIC COMPOST, AND ETHYL ACETATE EXTRACTS OF THERMOPHILIC(T-E) AND MESOPHILIC (M-E) COMPOST.

Sample	Conc.[b] (mg/L)	No. of reps.	No. of animals surviving for 7 d	Mean no. of offspring per female (± S)
Control		10	10	21.5 ± 2.4
DMSO	2 mL/L	10	9	21.7 ± 4.6
DMSO	5.5 mL/L	10	9	9.6 ± 3.5
T-A	7.6	10	8	4.3 ± 2.4
T-A	15.2	10	0	--- ± ---
T-A	27.8	10	0	--- ± ---
T-A	50.6	10	0	--- ± ---
T-A	76.0	10	0	--- ± ---
M-A	6.0	10	0	--- ± ---
M-A	12.0	10	0	--- ± ---
M-A	22.0	10	0	--- ± ---
M-A	39.9	10	0	--- ± ---
M-A	60.0	10	0	--- ± ---
T-E	6.0	10	10	18.7 ± 2.3
T-E	11.9	10	9	10.1 ± 3.7
T-E	22.1	10	8	1.8 ± 1.3
T-E	40.0	10	0	--- ± ---
T-E	59.9	10	0	--- ± ---
M-E	6.0	10	10	13.7 ± 2.7
M-E	11.9	10	4	8.3 ± 2.1
M-E	22.0	10	0	--- ± ---
M-E	40.0	10	0	--- ± ---
M-E	59.9	10	0	--- ± ---

[a] The dried residues of all solvent extracts were reconstituted into pure DMSO before being tested.
[b] Concentration of total extractables.

TABLE 3-6. RESULTS OF FATHEAD MINNOW TOXICITY TESTS OF ACETONITRILE EXTRACTS[a] OF MESOPHILIC (M-A) AND THERMOPHILIC (T-A) COMPOSTS

Sample	Conc.[b] (mg/L)	No. of reps.	Mean survival (percent)	Mean growth (mg/fish ± SD)
Control		3	100.0	0.33 ± 0.05
T-A	7.6	3	86.7	0.29 ± 0.03
T-A	15.2	3	76.7	0.24 ± 0.01
T-A	27.8	3	30.0	0.18 ± 0.04
T-A	50.6	3	0	--- ± ---
T-A	76.0	3	0	--- ± ---
M-A	6.0	3	70.0	0.30 ± 0.08
M-A	12.0	3	0	--- ± ---
M-A	22.0	3	0	--- ± ---
M-A	39.9	3	0	--- ± ---
M-A	60.0	3	0	--- ± ---

[a] The dried residues of the solvent extracts were reconstituted into pure DMSO before being tested.
[b] Concentration of total extractables.

Data in Table 3-2 showed that the mesophilic leachate was about twice as toxic as the leachate prepared from the thermophilic compost: fecundity of Ceriodaphnia in the 80% concentration of the thermophilic leachate, for example, was similar to fecundity of Ceriodaphnia in the 40% concentration of the mesophilic leachate. The two species used in the toxicity assessments appeared to be about equally sensitive to mesophilic leachate: in each case, this leachate's no-observed-effect concentration was about 40% of full-strength. The synthetic rainwater was not toxic to either species at the highest tested concentration. The full Toxicity Test Reports are included in Appendix A-5.

In conjunction with the toxicity assessments, samples of the CCLT leachates, the synthetic rainwater, and control water were analyzed for alkalinity, hardness, nitrate nitrogen, and total soluble phosphorus using EPA methods. The results of these analyses, plus those for pH and conductivity, are given in Table 3-3.

The greater nitrate content of the mesophilic leachate appears to correlate with its greater explosives content (see Table 2-3).

3.3.3. Tests of Preliminary Acetonitrile Extracts

Acetonitrile extracts of the thermophilic and mesophilic composts were tested for toxicity to Ceriodaphnia only. The dried residues of the two extracts were reconstituted in dimethyl sulfoxide (DMSO) before being tested. Each DMSO preparation contained about 15 mg of dried residue per

TABLE 3-7. SURVIVAL AND FECUNDITY OF CERIODAPHNIA TESTED WITH THE ACID-HYDROLYZED EXTRACTS[a] OF THERMOPHILIC (T) AND MESOPHILIC (M) COMPOST

Sample	DMSO extract[b] (uL/200 mL)	Residue tested (mg/L)	No. of reps.	No. of animals surviving for 7 d	Mean no. of offspring per female (SD)[c]
Neg. control	----	0.00	10	10	19.8 3.8
T	23.5	1.72	10	10	23.0 2.8
T	47.0	3.43	10	10	24.6 3.9
T	94.0	6.86	10	10	23.3 3.1
T	176.0	12.85	10	10	25.5 2.2
T	353.0	25.77	10	10	17.6 3.2 *
M	23.5	2.12	10	9	24.7 1.5
M	47.0	4.24	10	9	24.6 2.2
M	94.0	8.46	10	10	25.1 2.0
M	176.0	15.84	10	10	23.7 3.2
M	353.0	31.77	10	10	17.1 3.8 *
Blank	23.5	0.01	10	10	22.1 1.8
Blank	47.0	0.02	10	10	19.9 2.1 *
Blank	94.0	0.05	10	10	23.2 3.9
Blank	176.0	0.09	10	10	22.0 2.5
Blank	353.0	0.18	10	10	24.2 3.2

[a] The residues of the extracts were reconstituted into DMSO before being tested.

[b] Concentrations of dried residue (in mg/mL of DMSO) for the thermophilic and mesophilic samples were 14.6 and 18.0, respectively; the concentration of dried residue in the positive control was 0.1 mg/mL of DMSO.

[c] In each residue test, asterisks show concentrations in which fecundity values were significantly ($p < 0.01$) lower than other concentrations.

mL. Five concentrations of each DMSO solution were tested. These tests included a negative control (i.e., diluted mineral water). The pure DMSO was also tested for toxicity to fathead minnow larvae. Only two concentrations (2.0 and 4.0 ppm DMSO by volume) and a control (no DMSO) were used in this test; the higher concentration was selected because it was equal to the highest concentration of DMSO to which *Ceriodaphnia* were exposed in the test described above. Survival of the fish in the controls and in the two test solutions >96% in each case. One-way analysis of variance did not reveal significant differences in growth of the fish among the three treatments ($p = 0.64$; $F = 0.47$, d.f. 2,6). The test results that are summarized in Table 3-4 showed that the acetonitrile-soluble residue extracted from the mesophilic compost was about twice as toxic (on a per-unit mass basis) as the residue extracted from the thermophilic compost. These findings were in good general agreement with the relative toxicities for the two CCLT leachates. Additionally, the toxicity of pure DMSO was moderately low for both *Ceriodaphnia* and the fathead minnows, which justifies its use as a carrier solvent for explosives residues in future tests.

3.3.4. Tests of Final Organic Solvent Extracts

Ceriodaphnia and fathead minnow larvae were both used to quantify the toxicity of the DMSO-reconstituted solutions of acetonitrile and ethyl acetate extracts of both coextractant types with both types of compost. Only fathead minnow larvae were used to test for toxicity of the acetonitrile extracts of the thermophilic and mesophilic composts. The results of the tests with these two species are summarized in Tables 3-5 and 3-6.

For both compost types, the residues from the acetonitrile extracts proved to be considerably more toxic than residues from the corresponding ethyl acetate extracts, based on the results of the *Ceriodaphnia* tests (Table 3-5). Additionally, for a given type of extractant, residues of the mesophilic compost were more toxic than those of the thermophilic compost (Table 3-5). Finally, a comparison of the results from Tables 3-5 and 3-6 suggested that the *Ceriodaphnia* were about two to three times more sensitive than the fathead minnows to the acetonitrile-extracted residues of each compost type. The definitive tests of the acetonitrile extracts (Table 3-5) showed that these residues were considerably more toxic than those evaluated in the preliminary tests (Table 3-4). This suggests that an additional toxic species may have been extracted from the compost. The extraction used to produce residues for the definitive tests was performed upon a separate sampling of the composts from the drums. Thus, it is also possible that inhomogeneities in the compost, or changes in the composts themselves, may have contributed to the observed differences.

3.3.5. Tests of The Hydrolyzed Bound Fraction from Composts

In these tests, three samples were evaluated for acute and chronic toxicity to *Ceriodaphnia*. One was an acid-hydrolyzed extract of the bound fraction from thermophilic compost, one was an acid-hydrolyzed extract of the bound fraction from mesophilic compost, and the third was a blank (i.e., a neutralized sample of the same acidic solution that was used to hydrolyze the residues of the two types of compost). A negative control (i.e., diluted mineral water) was also included with the test. The results of these tests are summarized in Table 3-7.

Survival of *Ceriodaphnia* in each case was high ($\geq$ 90%). The highest tested concentration of hydrolyzed residue from each compost type slightly depressed *Ceriodaphnia* reproduction. This reduction was evident based on within-residue statistical analysis (SAS General Linear Models Procedure, followed by a Least Significant Difference test; $p < 0.001$ for both cases, with $F_{4,45} = 9.97$ for the thermophilic material and $F_{4,45} = 13.05$ for the mesophilic material). The overall amount of variance explained by concentration in these analyses, however, was low in both cases (47.0% and 53.7%, respectively, for acid-hydrolyzed residues of the thermophilic and mesophilic composts). Using the same type of analysis, one concentration of positive control residue also reduced reproduction significantly (p = 0.006). However, in this instance the overall percentage of variance explained by concentration was quite small (27.0%).

For interpretative purposes, it is useful to point out that EPA guidelines indicate that a test in which fecundity of the control equals or exceeds 15 offspring per female can be judged to be acceptable. The average fecundity of Ceriodaphnia exceeded 15 even in the highest tested concentration of hydrolyzed residue from each compost type (Table 3-7). Thus, the evidence for toxicity was largely statistical.

In the tests described above, little reduction in fecundity was noted even at concentrations as high as 20-25 mg/L for either hydrolyzed residue. In contrast, acetonitrile extracts of the two compost types tested earlier proved to be strongly toxic at 20-25 mg/L (Tables 3-4, 3-5 and 3-6). Thus, acid hydrolysis did not appear to release toxic amounts of substances that were bound to compost particles. Either the hydrolysis conditions were not strong enough to promote the release of such materials, or the concentration of bound toxic materials available to be released by acidic conditions was very low.

3.4. Conclusions

The overall conclusions to be drawn from the results of the toxicity tests described above are as follows: First, the CCLT leachates of the thermophilic compost show very little evidence for acute or chronic toxicity to either Ceriodaphnia or fathead minnows, but CCLT leachates of mesophilic compost were moderately toxic (Tables 3-1, 3-2). There was also not much evidence for toxicity associated with bound constituents for either compost type (cf. Table 3-7). Strong organic solvent (i.e., acetonitrile, ethyl acetate) extracts of both compost types were quite toxic, but those from the thermophilic compost were less toxic than those from the mesophilic compost. The toxicity of acetonitrile extracts were also greater than those of ethyl acetate: This pattern was concordant with the notion that most of the toxicity in the reconstituted residues of the solvent extracts could be accounted for by explosives and/or their degradation products. Thus, the EPA-approved toxicity tests conducted with Ceriodaphnia and fathead minnow larvae suggest that composting could be an effective means to lower toxicity, as well as the concentration, of high explosives such as TNT, RDX, and HMX.

The approximate toxic threshold for each type of leachate for both compost types was estimated from their capacity to reduce fecundity of Ceriodaphnia. These values, expressed as the concentration of residue (in mg/L) needed to show evidence of toxicity, could be determined only as 'less than' the lowest tested concentration (e.g., in the case of acetonitrile extracts of both compost types; Table 3-4). The toxicity threshold concentrations were then converted to toxic units (TUs; the reciprocal of the threshold toxicity concentration, expressed as g/L). The TUs, in turn, were used to estimate the intrinsic toxicity of each compost sample by correcting for (a) the amount of solvent (CCLT solution, acetonitrile, or ethyl acetate) used to prepare the extract, and (b) the mass of compost extracted. The results of these calculations are shown in Table 3-8.

The information shown in Table 3-4 shows that the mesophilic compost was 2 to 3 times more toxic than the thermophilic compost. However, within a particular type of compost, there appeared to be little difference in toxicity that could be attributed to the pe of solvent. Thus, the CCLT procedure for estimating compost toxicity seems to provide toxicity estimates as good as those obtained using stronger solvents, and thus there does not appear to be any toxicity that the CCLT leaching procedure misses.

TABLE 3-8. ESTIMATED TOXICITY (TOXIC UNITS/GRAM) OF THERMOPHILIC AND MESOPHILIC COMPOST BASED ON RESULTS OF CERIODAPHNIA TESTS OF EXTRACTED MATERIAL OBTAINED USING AQUEOUS (CCLT) AND ORGANIC-SOLVENT (ACETONITRILE AND ETHYL ACETATE) EXTRACTANTS

Compost type	Solvent type	Toxic units/gram
Thermophilic	CCLT (aqueous)	0.03
Mesophilic	CCLT (aqueous)	0.11
Thermophilic	ethyl acetate	0.05
Mesophilic	ethyl acetate	0.10
Thermophilic	acetonitrile	> 0.04
Mesophilic	acetonitrile	> 0.05

CHAPTER 4. AMES TESTS

4.1. Introduction

In 1975 Bruce Ames described a technique (21) utilizing bacteria as a screening device for chemical mutagens. Test data on more than 5000 chemicals have been described since the original publication, establishing the Ames test as a major assay in detection of mutagenicity. The test measures back-mutation to histidine independence of mutant strains in the *his* operon of *Salmonella typhimurium* that can be reverted by base-pair substitutions (TA-100) or frameshift mutations (TA-98). These are the two most widely-used tester strains for mutagenicity assay. By inoculating a histidine deficient medium with the tester strains and various concentrations of the test material, revertant (mutated) colonies can be counted and the mutagenicity of the test material quantitated. Considering the universal acceptance of the Ames test and the need to test the toxicological characteristics of products resulting from composting of explosives wastes we undertook extensive Ames testing of the aqueous leachaies and organic solvent extracts of the mesophilic and thermophilic composts.

4.2. Materials and Methods

The Ames assay is performed by mixing the following components in a sterile test tube placed in a 43°C heating block.

(a) 2.0 mL of 0.6% agar containing 0.6% NaCl,, 0.05 mM biotin, and 0.05 mM histidine,

(b) 0.1 mL of freshly grown indicator organisms (10^9 organisms/mL) TA-98 or TA-100, and (if metabolic activation is used) 0.5 mL of S-9 solution,

(c) appropriate amount of test material.

The contents of the tube are gently vortexed and poured and evenly distributed over the entire surface of a minimal glucose agar plate. Duplicate plates are run for each dilution of test substance. The top agar is allowed to solidify and then is incubated for 48 hours at 37°C. The number of *his*$^+$-revertant colonies can then be counted. Spontaneous, negative (solvent), and positive controls (sodium azide and nitrofluorene) are run concurrently with each experiment.

The top agar is made by adding 6 g of Difco-Bacto agar and 5 g NaCl to 1 liter of distilled water, which is autoclaved and stored in 100-mL bottles at room temperature. Before use, the agar is melted (in an autoclave or microwave) and 10 mL of a sterile solution of 0.5 mM L-histidine-HCl, 0.5 mM biotin is added to the 100 mL of molten agar and mixed thoroughly.

Vogel-Bonner medium E with 2 percent glucose and 1.5 percent Bacto-Difco agar is used as the minimal medium and is prepared as follows:

Vogel-Bonner Salts (50X)	
Warm Distilled Water	670 mL
Magnesium Sulfate ($MgSO_4{\cdot}7H_2O$)	10 g
Citric Acid Monohydrate	100 g
Potassium Hydrogen Phosphate (K_2HPO_4)	500 g
Sodium Ammonium Hydrogen Phosphate ($NaHNH_4PO_4{\cdot}4H_2O$)	175 g

The above salts are added to the warm water (45°C) in the specified order. Each salt is completely dissolved before the next is added. When the salts are all dissolved, the solution is cooled to room temperature. About 5 mL of chloroform is added to the solution and stored in a capped bottle at room temperature.

Dissolve 15 g of Difco-Bacto agar in 1 liter of water by autoclaving. Cool to about 60 to 70°C and add 20 mL of 50X V-B salt solution and 50 mL of sterile 40 percent glucose solution. Mix thoroughly and dispense into 100 x 15 mm plastic petri dishes (25 mL per plate).

The indicator *Salmonella* strains are kept frozen in nutrient broth supplemented with 10% sterile glycerol at -80°C in 1 mL aliquots, each of which contains about 10^9 cells. For each experiment, the 1 mL frozen aliquots are allowed to thaw at room temperature and inoculated into 30 ml of nutrient broth. The cultures are grown at 37°C, unshaken for 4 hours, then gently shaken (100 rpm) for 11 to 14 hours. Histidine dependency is checked for each strain whenever experiments are performed.

The S-9 preparation was a rat liver S-9 with Aroclor activation, obtained from Litton Bionetics (Oklahoma City, OK). It was diluted 0.04 ml to 0.5 mL with salt solution before addition with the tester strains.

4.3. Observations

Preparatory to testing of compost extracts for mutagenic activity, the genotypes of the *Salmonella* tester strains were confirmed as was their response to known mutagens, known explosives, and some explosive derivatives.

4.3.1. Confirmation of Strains

The Bacterial tester strains TA-98 and TA-100 used in the test procedure have mutations in the rfa and uvrB genes. They also contain the R-factor plasmid pKM101. The genotypes of the tester strains were confirmed by evaluating their sensitivity to crystal violet and to UV light and to resistance to ampicillin. Both strains were killed by exposure to crystal violet and UV irradiation but were unharmed by ampicillin, thus confirming their genotype.

The known mutagens, nitrofluorene, acetylaminofluorene, and sodium azide, were then tested for their mutagenic effects on the tester strains with and without metabolic activation (rat liver microsomal fraction S-9). The effects of the known mutagens are shown in Table 4-1. As with the crystal violet, UV light and ampicillin, the tester strains showed good response to the known mutagens. Having verified the genomic integrity and the expected reversion in response to known mutagens, tests of known explosives and their derivatives were undertaken and compared with extracts of the composted explosives.

4.3.2. Tests of Explosive Compounds and TNT Metabolites

We initially tested four of the explosives known or suspected to be present in the compost piles, i.e., TNT, tetryl, RDX, and HMX. Only TNT and tetryl were found to be mutagenic, with the latter more mutagenic and toxic than the former (Appendix Table 6A-1). The addition of a rat liver metabolic activation system had no effect on the mutagenicity of the two compounds. Based on the slope of the plot of the number of revertants induced versus mg of test compound, it is estimated that for TA-98, tetryl induced 8,200 revertants per mg (rev/mg) and for TA-100 the value is 23,000 rev/mg. The corresponding values for TNT are 5,400 and 6,600 rev/mg, respectively.

TABLE 4-1. RESULTS FROM AMES TESTING OF KNOWN MUTAGENS

Sample	TA98[c] revertants/plate -S9	TA98[c] revertants/plate +S9	TA100[c] revertants/plate -S9	TA100[c] revertants/plate +S9
1. Control	24	28	117	111
2. Nitrofluorene[a]	874	NT	NT	NT
3. Acetylaminofluorene[a]	NT	533	NT	227
4. Sodium Azide[a]	NT[b]	NT	586	NT

[a] Positive controls. Nitrofluorene (10 μg/plate). Acetylaminofluorene (10 μg/plate). Sodium azide (2 μg/plate).

[b] NT - not tested

[c] Salmonella overnight culture ~ 2 x 10^9 cells/ml. Ampicillin resistant, UV sensitive, crystal violet sensitive.

In addition to TNT and tetryl, we also tested biotransformation products of TNT. The results are summarized in Table 4-2 and are detailed in Appendix Table 6A-2. On a weight basis, TNT was more mutagenic than the two monoamino metabolites for both strains of bacteria. The relative sensitivity of the TA-98 strain to TNT and its metabolites was TNT > 4-A-2,6-DNT > 2-A-4,6-DNT, while for TA-100 the relative sensitivity was TNT > 2-A-4,6-DNT > 4-A-2,6-DNT. HMX and RDX do not show detectable mutagenicity, but tetryl was the most mutagenic of the explosives and metabolites tested.

Finally, two other diaminonitrotoluenes were tested to complete our investigation into the potential changes in toxicity associated with biotransformation of TNT. The specific mutagenic activities for 2,4-DA-6-NT and 2,6-DA-4-NT) are included in Table 4-2, and the data are listed in Table 6A-3. It is apparent that the mutagenicity was diminished as nitro groups were reduced to amino groups, and the activity is highly isomer-specific. The 2,4-DA-6-NT does not exhibit detectable mutagenicity, while 2,6-DA-4-NT is approximately one-tenth as mutagenic as TNT.

4.3.3. Tests of CCLT Leachates and Suspended Particles

Having confirmed the genome and mutagenic reactivity of the *Salmonella* tester strains and their reaction to explosives and their biotransformation products known or suspected to be in the test compost, we began analysis of the leachates. Testing of the preliminary CCLT leachates of the mesophilic and thermophilic composts showed little mutagenic activity (Appendix Table 6A-4). Subsequently, we retested larger volumes of fresh CCLT leachates from the final leaching of the mesophilic and thermophilic composts and found similar results. Only the mesophilic compost leachate tested in bacterial strain TA-98 showed a positive, albeit slight mutagenic response up to the maximum allowable dose in the test protocol (see Table 6A-5). The test was performed without the addition of a rat liver metabolic activation system (S-9). The response for the mesophilic

TABLE 4-2. SUMMARY OF AMES MUTAGENICITY TESTS FOR EXPLOSIVES AND METABOLITES

Compound	Specific Activity[a], rev/mg TA-98	 TA-100
HMX	ND	ND
RDX	ND	ND
Tetryl	8,200	23,000
TNT	5,400	6,600
4-A-2,6-DNT	1,000	500
2-A-4,6-DNT	500	2,300
2,4-DA-6-NT	ND	ND
2,6-DA-4,NT	325	750

[a]Without S-9 metabolic activation

leachate, ca. 59 rev/mL with the TA-98 strain, was only slightly above background. This corresponds to ca. 60 rev/mg of extractable matter and 1,200 rev/g of leached compost.

The mutagenicity calculated for the CCLT leachate from the concentrations of the explosive compounds and TNT metabolites and their specific mutagenicities mathematically accounts for 37% of the observed mutagenicity (TA-98 strain), with TNT constituting 36% of the activity. The observed TNT metabolites accounted for ca. 1%. Although this suggests that removal of TNT would effectively detoxify the compost and leachates, 37% of the observed activity cannot be attributed to TNT and its metabolites because there was no blank compost without explosives. In addition, this mathematical exercise does not take into account potential synergistic and antagonistic interactions among and with the explosives compounds and their metabolites. The presence of other mutagens in the CCLT leachate is suggested by its greater response with the TA-98 strain while the pure explosives and TNT metabolites generally caused a greater response with the TA-100 strain (Table 4-2).

Because the CCLT leachates did not elicit a clear mutagenic response even when tested at the maximum dose levels tolerated by the assay system, we concentrated the CCLT leachates 100-fold by flash evaporating 100 mL to dryness and then extracting the residue with 1 mL of DMSO. The results for these mutagenicity tests are summarized in Table 4-3, and the full data set is included in Table 6A-6. The specific activity in revertants per mL, calculated per mL of original CCLT leachate (i.e., corrected for the concentration factor) was approximately 700 and 150 for the mesophilic leachate in the TA-98 and TA-100 strains (respectively), and 170 and 40 (respectively) for the thermophilic leachate. Corresponding calculations for revertants per mg of extracted matter and revertants per g of leached compost also are shown in Table 4-3. In all cases, the TA-98 strain was more sensitive than TA-100 to the mutagens in the extracts. The mesophilic leachate is 2 to 4-fold more mutagenic than the thermophilic leachate, which was in agreement with the Ceriodaphnia and fathead minnow larvae tests. Also, the specific activities were ca. 10-fold higher than those measured on the original leachates. Two explanations are possible. Because the leachate was concentrated 100-fold for these tests, much greater doses were applied to the plates and it is possible that different regions in the dose-response curve are being compared. In general, the overall mutagenicity of a complex mixture (such as compost leachates) depends upon the different mutagens present in the mixture. Because the mutagenic response of each individual mutagen is different at different dose ranges, the comparison of the overall mutagenicity data of complex mixtures at various dose ranges is easily misleading.

TABLE 4-3. SUMMARY OF RESULTS FOR AMES MUTAGENICITY TEST OF THE DMSO CONCENTRATE OF THE MESOPHILIC AND THERMOPHILIC COMPOST CCLT LEACHATES

Sample	Specific Activity[a], rev.			
	TA-98		TA-100	
DMSO Concentrates of Dried CCLT Leachates:	Per mg of Extractables	Per g of Compost	Per mg of Extractables	Per g of Compost
Mesophilic Compost	760	14,000	160	3,000
Thermophilic Compost	150	3,400	34	800

[a]Without S-9 metabolic activation

It also is possible that these higher activities were contributed by particle-associated mutagens which the DMSO extracted from the dried residue. Particles were filtered out of the CCLT leachates before the direct Ames testing, because of the need to remove interfering bacteria. Subsequently another CCLT leachate of mesophilic compost was prepared and tested before and after centrifuging to remove the particles (section 2.5). The particles resulting from centrifugation were extracted with DMSO and the DMSO extract also was tested. The results of these tests are shown in Table 4-4 (full data set in Table 6A-7). Although the experiment confirms the association of mutagenicity with the particulate fraction, the total leachate activity is ca. 10-fold greater than that of the particles alone. This experiment suggests that the particles do not harbor large amounts of toxicity unavailable to the toxicity tests. Because the mutagenicity of the leachate is very low and slightly above background, we do not feel that the apparent differences between the uncentrifuged and centrifuged leachate samples are significant. The differences between the absolute activities determined for this small-volume leachate (4 L of leachate from 200 g of compost) and the larger generation of leachate (28 L generated from 1400 g of compost) discussed above are attributed to compost inhomogeniety (see section 2.2.5.).

TABLE 4-4. AMES TEST OF MESOPHILIC CCLT LEACHATES[a], BEFORE AND AFTER CENTRIFUGATION, AND LEACHATE SOLIDS EXTRACTED WITH DMSO

Sample	Specific Activity[a], rev.			
	TA-98		TA-100	
Mesophilic CCLT Leachates:	Per mL of Compost Leachate[c]	Per g of Compost[d]	Per mL of Compost Leachate	Per g of Compost[d]
Before Centrifugation	400	8,000	300	6,000
After Centrifugation	200	4,000	100	2,000
Leachate Solids	35	700	15	300
Mesophilic CCLT[e]	59	1,200	ND	ND

[a] 4 L of Mesophilic CCLT Leachate prepared from 200 g of compost

[b] Without S-9 metabolic activation

[c] Activity was calculated based on 1 mL of compost leachate

[d] Activity was calculated based on 1 g of compost

[e] Test of final CCLT leachate (pg. 42 for comparison)

4.3.4. Tests of Organic Solvent Extracts

Preliminary acetonitrile extracts of the composts were tested for rangefinding purposes. The acetonitrile extracts were dried and reconstituted with DMSO. The results of Ames testing are summarized in Table 4-5 and are fully listed in Table 6A-8. On the basis of revertants per mg of extractable matter or per g of compost extracted, the specific activities are greater than those measured directly upon the CCLT leachates, but are comparable with those measured upon the concentrated CCLT leachate residues. This undoubtedly is due partly to the better solubilities of mutagens in acetonitrile versus the acidified water in the CCLT and the great dilution of mutagens in the CCLT. It is also possible that the different sample vehicles (DMSO versus acidified water) applied to the plates contributed to the differences in observed mutagenic activity, or that inhibitors present in the aqueous leachates were not extracted with the organic solvents.

In this experiment, unlike the CCLT leachates, the mesophilic compost extract was only slightly more mutagenic than was the thermophilic compost extract. As with the CCLT leachates, however, the TA-98 strain was more sensitive than TA-100. Only the mesophilic compost extract was tested with the S-9 rat liver metabolic activation system, and no increase in activity was observed (data not shown). Comparison of the actual mutagenicity with that predicted from the concentrations and specific mutagenicities of TNT and its metabolites mathematically accounted for 73% of the actual activity found with the TA-100 strain for the extract of the mesophilic compost and only 19% for the thermophilic compost. The mathematical accounting for the activity found using the TA-100 strain was about two-thirds less. Again, this activity cannot be confidently assigned to TNT and its metabolites.

TABLE 4-5. AMES TEST OF PRELIMINARY ACETONITRILE EXTRACTS OF COMPOST

Compost	Specific Activity[a], rev.			
	TA-98		TA-100	
	Per mg of Extractables	Per g of Compost	Per mg of Extractables	Per g of Compost
Mesophilic	3,400	11,200	1,300	4,300
Thermophilic	2,500	4,500	1,000	1,800

[a]Without S-9 Activation

In two subsequent experiments both acetonitrile and ethyl acetate were tested for their ability to extract mutagens from mesophilic and thermophilic composts. The acetonitrile and ethyl acetate extracts of the composts were tested for bacterial mutagenicity with strains TA-98 and TA-100. Activation with rat liver S-9 was not included because our previous experience with both aqueous leachates and with the preliminary acetonitrile extracts showed no enhancement of mutagenicity, indicating the presence of direct-acting mutagens. The data for the extracts are summarized in Table 4-6, and the full data sets are listed in Appendix Tables 6A-9 - 6A-11. As before, the organic solvent extracts exhibited considerable mutagenicity. It is interesting to note that the mutagenic activities found in the acetonitrile and ethyl acetate extracts were comparable with each other and also there was no significant difference between the extracts from the mesophilic and thermophilic composts. The former observation suggests that all available mutagenicity has been extracted. The reason for the latter is not clear, but may be related to compost inhomogeneity.

4.3.5. Tests of Hydrolyzed Bound Fraction

The hydrolyzed bound fraction sample (see section 2.4) was tested to determine if the hydrolysis conditions liberated mutagenic compounds. The data listed in Appendix Table 6A-12 show that no mutagenicity was detected in the acid-hydrolyzed bound fraction of either compost. At this stage it cannot be concluded that hydrolyzable mutagens are absent because the hydrolysis conditions were subsequently found (see section 2.4) to be too severe for the survival of mutagenic 4-A-2,6-DNT and 2,4-DA-6-NT. The latter are potential hydrolysis products of a bound fraction with acid-labile bonds. More gentle hydrolysis conditions are needed.

4.4 Discussion and Conclusions

Not surprisingly, tetryl, TNT and some known TNT derivatives shown or thought to be present in the compost were found to be mutagenic. It is important to note that the mutagenicity of TNT is diminished as nitro groups are reduced to amino groups, and that the activity is highly isomer-specific. In general, greater biotransformation results in lesser mutagenicity. The CCLT leachates

TABLE 4-6. AMES TEST RESULT SUMMARY FOR FINAL ORGANIC SOLVENT EXTRACTS OF COMPOSTS

Compost/solvent[a]	Specific Activity[a], rev.			
	TA-98		TA-100	
	Per mg of Extractables	Per g of Compost	Per mg of Extractables	Per g of Compost
Mesophilic/MeCN	6,400	19,000	3,600	10,600
Mesophilic/EtoAc	4,300	20,000	2,200	7,400
Thermophilic/MeCN	10,000	22,400	2,600	5,900
Thermophilic/EtoAc	6,600[c]	16,800[c]	5,100	13,000

[a] MeCN = Actonitrile, EtoAc = EthylAcetate
[b] Average value based on duplicate data
[c] Single value

of mesophilic but not thermophilic compost showed mutagenic activity some of which could be attributed to TNT. Comparing the predicted activities of the extracts or leachates of the composts (calculated from the concentrations of the explosives or metabolites and their specific mutagenicities) with the actual activities would suggest that TNT contributes substantially to their activities. For example, ca. 37% of the mutagenicity of the mesophilic compost CCLT leachate is mathematically accounted by TNT alone. However, it is premature to attribute 37% of the activity to TNT because of potential synergistic or antagonistic effects, and the possible presence of other mutagens which have not been identified. While CCLT extraction originally indicated mutagenic activity was found only in the mesophilic compost, the extractions with organic solvents indicated mutagenic activity remaining in both mesophilic and thermophilic composts. The mutagenic activity determined in the 100-fold concentrated CCLT residue also showed that the high dilution of the CCLT makes detection of mutagenicity difficult. In the absence of the starting material (i.e., contaminated sediment) for comparison, the degree to which composting reduced the mutagenic activity of the starting material could not be ascertained. The lack of a compost blank (from sediment without explosives) prevents assigning any of the observed activity to explosives or their biotransformation products.

To place these findings in perspective, Table 4-7 compares the mutagenicities of the mesophilic compost extracts and leachates with those of a coal combustion stack ash extract, a petroleum crude oil, crude shale oil, a coal-derived fuel oil blend, and pure TNT. The compost is more mutagenic than the stack ash, comparable to the petroleum crude oil, and much less active than the shale oil and coal-derived fuel oil blend and pure TNT. Although the oils and fuels required S-9 metabolic activation for the mutagenicity test (and therefore represent predominantly direct-acting mutagens) and the data for the compost leachates or extracts were obtained without metabolic activation, the incorporation of S-9 into the test for the compost did not increase the activity.

TABLE 4-7. COMPARISON OF MUTAGENIC ACTIVITIES

Material	Mutagenic Activity with Strain TA-98, rev/g[a]
CCLT Leachate of Mesophilic Compost	1,200
100-Fold DMSO Condentrate of CCLT Leachate of Mesophilic Compost	14,000
Acetonitrile Extract of Mesophilic Compost	19,000
Methylene Chloride Extract of Coal Combustion Stack Ash[b]	61
Wilmington Crude Oil[c]	5,000[d]
Paraho-SOHIO Crude Shale Oil[c]	390,000[d]
SRC-II coal-Derived Fuel Oil Blend[c]	1,100,000[d]
TNT	5,400,000

[a] Data are for TA-98 without S-9 metabolic activation unless otherwise indicated.
[b] Reference 22. [c] Reference 23. [d] S-9 metabolic activation used.

CHAPTER 5.0 CONCLUSIONS

The major conclusions from this characterization of the mesophilic and thermophilic composts from the LAAP field composting experiment are as follows:

(a) The major explosives-related compounds determined in the leachates and organic solvent extracts of the composts were HMX, RDX, TNT, and two TNT biotransformation products, 2-A-4,6-DNT, and 4-A-2,6-DNT.

(b) Compost heterogeneity considerably complicates chemical analysis and toxicity testing, and requires that relatively large masses of sample or large numbers of samples be tested.

(c) The composted product of explosives processing wastes contains low levels of leachable toxic compounds. The leachates from the mesophilic compost were slightly more toxic than those from the thermophilic compost. The toxicity cannot be attributed to explosives or their biotransformation products without tests of a suitable blank compost. Reduction in toxicity of explosives processing wastes by composting cannot be proved without tests of the starting material. The effects of the 10 month interval between composting and characterization are unknown.

(d) The CCLT does not appear to miss large reservoirs of aquatic organism toxicity or bacterial mutagenicity which are available to organic solvent extraction, but the high dilution of the leached material in the CCLT protocol makes determination of mutagenic activity difficult without preconcentration of the CCLT leachate.

(e) Particles which pass with the CCLT leachate through the EPA pressure filtering protocol do not appear to harbor significant amounts of organic solvent extractable mutagenicity.

(f) Liberation of a bound fraction of explosives transformation products will require a gentler hydrolysis than refluxing 6N hydrochloric acid to allow potential mutagens to survive.

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APPENDIX A-1

LIST OF ABBREVIATIONS

List of Abbreviations

Abbreviation	Full Name
Explosive Compounds and TNT Metabolites:	
2,6-DA-4-DT	2,6-Diamino-4-nitrotoluene
2,4-DA-6-DT	2,4-Diamino-6-nitrotoluene
2,4,6-TNBAlc	2,4,6-Trinitrobenzylalcohol
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
1,3,5-TNB	1,3,5-Trinitrobenzene
TNB	1,3,5-Trinitrobenzene
1,3-DNB	1,3-Dinitrobenzene
2-A-4,6-DNT	2-Amino-4,6-dinitrotoluene
4-A-2,6-DNT	4-Amino-2,6-dinitrotoluene
2,6-DNT	2,6-Dinitrotoluene
2,4-DNT	2,4-Dinitrotoluene
TNT	1,3,5-Trinitrotoluene
Tetryl	N-methyl-N,2,4,6-Tetranitroaniline
4-OHA-2,6-DNT	4-Hydroxyamino-2,6-dintitrotoluene
Azoxydimer	2,2',6,6'-tetranitro-4,4'-azoxytoluene
Others:	
CCLT	Clean Closure Leach Test
CLP	EPA Contract Laboratory Program
EPA	U.S. Environmental Protection Agency
GC-MS	Gas chromatography-mass spectrometry
ICP	Inductively coupled plasma emission spectroscopy
L	Liter
m	Milli-
SVOA	Semivolatile organic compound analysis
TCLP	Toxicity characteristic leaching procedure
VOA	Volatile organic compound analysis
μ	Micro-

APPENDIX A-2

HPLC METHOD FOR EXPLOSIVES AND TNT METABOLITES

HPLC Analysis of Explosive Compounds and TNT Metabolites

Reverse Phase Separation on Octadecylsilane Column

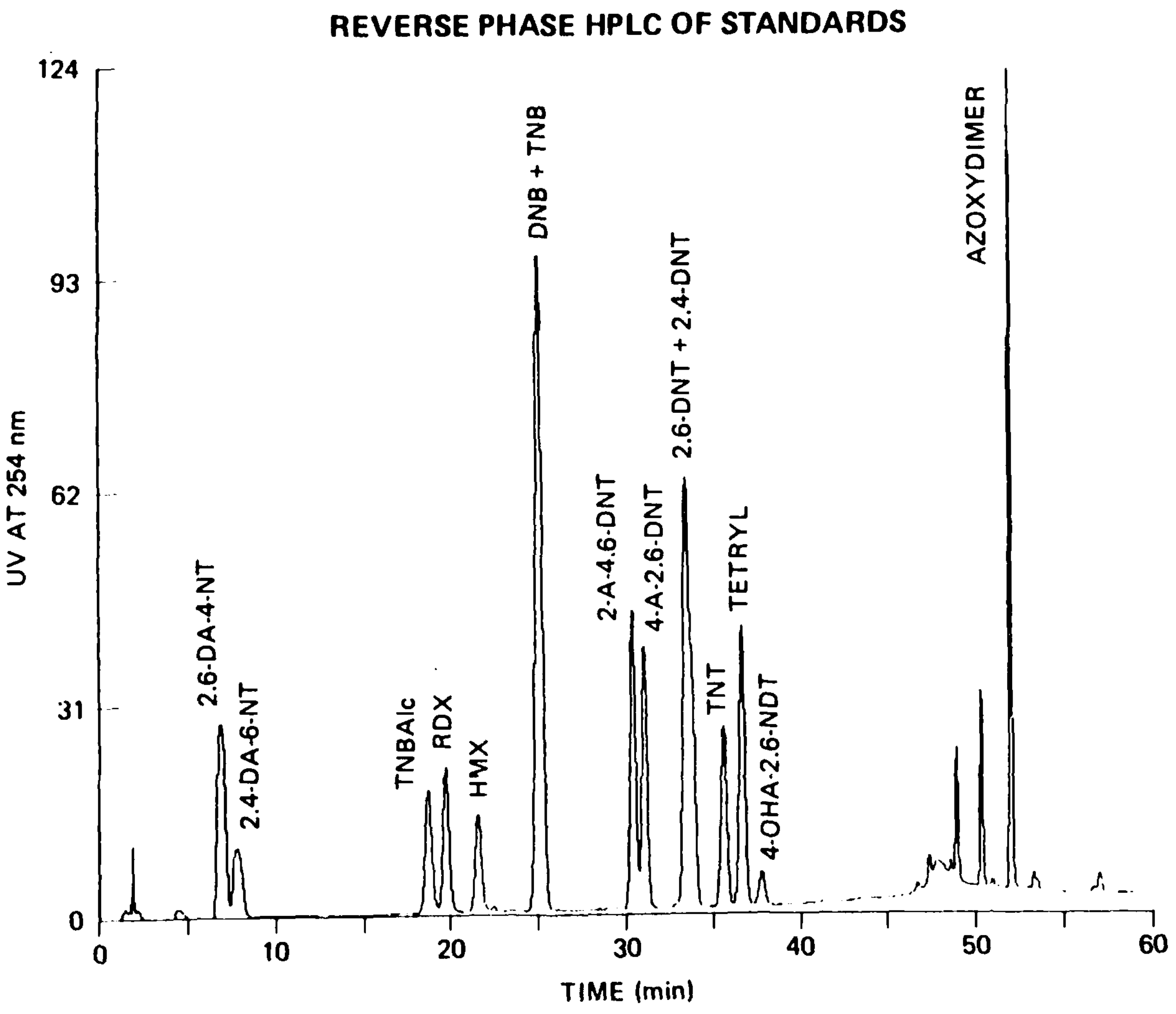
The aqueous leachates were analyzed using a reverse phase separation on an octyldecylsilane (ODS) phase. This procedure is capable of resolving TNT, tetryl, HMX, RDX, monoaminodinitrotoluenes, diaminonitrotoluenes, trinitrobenzyl alcohol, and the azoxzydimer. However, the dinitrotoluenes are resolved with difficulty, mono and dinitrobenzene are not separated, and the trinitrobenzoic acid elutes very early and is difficult to separate from the solvent peak.

A 250 μL sample of aqueous leachate or standard is injected onto a 150 X 4.6 mm Zorbax ODS column and then eluted at a flow rate of 1 mL/min. with the following solvent program: 0 to 8 min., 20% aqueous acetonitrile; 8 to 18 min., an aqueous acetonitrile gradient increasing in acetonitrile concentration from 20% to 30%; 18 to 38 min., an aqueous acetonitrile gradient from 30% acetonitrile to 45% acetonitrile; 38 to 50 min., an aqueous acetonitrile gradient from 45% acetonitrile to 75% acetonitrile; 50 to 60 min., 75% aqueous acetonitrile; 60 to 70 min., a reverse acetonitrile gradient going from 75% acetonitrile to 20% acetonitrile; and 70 to 80 min., equilibration of the column with 20% acetonitrile in preparation for the next injection. This method yields the chromatogram shown in Fig. A2-1. Several chromatographic parameters are summarized in Table A2-1. Abbreviations used in the figure are listed in Appendix A-1. Although the total run time is 80 min., the k-values listed in Table A2-1 indicate good separations and the peak shape is quite good as indicated by the peak asymmetry. Further examination of this data does indicates that 1,3-dinitrobenzene and 1,3,5-trinitrobenzene are not separated adequately for individual quantitation. In addition 2,4-dinitrotoluene and 2,6-dinitrotoluene are not adequately separated in Figure 2A-1; however, as indicated by the k-values in Table 2A-1, the dinitrotoluenes can be separately quantitated under more ideal conditions, (new column). The one pontential metabolite that can not be determined with this procedure is trinitrobenzoic acid which is essentially not retained by the column, (k=0.23). Even a much weaker eluent, (10% or less acetonitrile) will not cause trinitrobenzoic to be significantly retained.

The method described above yields very good results for most metabolites even though a sample that is 10 to 100 times the ideal sample volume is injected. Sensitivities for clean standards range from approximately 0.042 ppm in the injected solution (coresponding to 11 ng injected) for 2-amino-4,6-dinitrotoluene to 0.53 ppm (133 ng) for 4-hydroxyamino-2,6-dinitrotoluene using a 250 μL injection volume and a diode array detector and a wavelength of 254 nm for quantitation. The typical sensitivity is represented by the 0.064 ppm (16 ng) for TNT. Quantitation is achieved by external standardization with 9 concentrations of authentic standards ranging from 0.1 to 4 μg/mL. Peak areas are used for calculations and the spectra of the peaks are examined to confirm identifications.

FIGURE 2-A1. SEPARATION OF EXPLOSIVE COMPOUNDS AND TNT METABOLITES ON OCTADECYLSILANE REVERSE PHASE COLUMN. SAMPLE WAS 250 μL OF A 1 PPM STANDARD MIXTURE.

ORNL-DWG 90-2207



REVERSE PHASE HPLC OF STANDARDS

Table 2A-1. Chromatographic Parameters for Explosives and TNT Metabolites on Zorbax Column with Acetonitrile Gradient

COMPOUND	RET. TIME, MIN	k[1]	WIDTH[2]
1,3,5-TNBA	1.61	0.23	0.19
2,4-DA-6-NT	6.93	4.28	0.28
2,6-DA-4NT	7.87	4.99	0.30
TNBAlc	18.57	13.1	0.36
RDX	19.59	13.9	0.33
HMX	21.34	15.2	0.35
1,3-DNB	24.82	17.90	0.35
1,3,5-TNB	24.94	17.99	0.35
2-A-4,6-DNT	30.11	21.9	0.32
4-A-2,6-NT	30.76	22.4	0.32
2,6-DNT	33.18	24.2	0.35
2,4-DNT	33.45	24.5	0.30
2,4,6-TNT	35.28	25.9	0.35
TETRYL	36.29	26.6	0.34
4-OHA-2,6-DNT	37.43	27.5	0.37
Azoxydimer	51.92	38.54	0.23

---

[1] The k-value is the corrected retention time divided by the time required for an unretained compound to travel through the system.

[2] Width is the peak width at the inflection points expressed in minutes.

Anion Exchange/Reverse Phase Separation on Mixed Mode Column

This procedure improved upon the separation of explosives and metabolites, particularly to allow the trinitrobenzoic acid to be determined. It was used beginning with the organic solvent extracts of the composts. The separation procedure has been developed using a mixed-mode HPLC column in which the phase bonded to the silica surface contains both an octyldecylsilane (reversed-phase function) and a secondary amine (anion exchange function) incorporated into a single ligand in a 1:1 ratio. The separation that can be achieved on this 150 mm X 4.6 mm i.d. column is illustrated in Figure 2A-2. Because of the dual nature of this separating media a mixture of compounds with a wide range of polarities such as those anticipated for TNT and its metabolites can be fractionated in a reasonable run time. The method developed for this separation utilizes a gradient built from three different eluting solvents: A. an aqueous solution containing phosphate that has been adjusted to pH 5.1 with the final concentration of phosphate being 0.015 M in a 10:90 water:methanol solvent, (the sources of phosphate are potassium dihydrogen phosphate and dipotassium hydrogen phosphate in the appropriate amounts to achieve the desired pH and concentration); B. methanol; and C. acetonitrile. The gradient program for this separation starts with equilibration at 72% Solvent A and 28% acetonitrile and elution with this mixture for 1 min after sample injection. From 1 to 5 min a linear gradient reduces solvent A from 72 to 68% and increases acetonitrile from 28 to 32%. Isocratic elution conditions are then maintained for the time interval from 5 to 14 minutes. Between 14 and 20 min a linear gradient reduces solvent A by 4% per minute and and increases both methanol and acetonitrile by 2% per minute so that at 20 min the eluting solution is 44% solvent A, 12% methanol and 44% acetonitrile. From 20 to 26 min a linear gradient reduces solvent A from 44 to 2% and increases methanol from 12 to 54% while maintaining the acetonitrile at 44%. Isocratic conditions are then maintained from 26 to 33 min. Then between 33 and 38 min a very steep gradient restores the eluting solution to its starting conditions after which the column is reequilibrated for 7 min. This solvent program is summarized in Table 2A-2. The incorporation of both acetonitrile and methanol in building the gradient appear to be necessary. Peak shape in the early portion of the chromatogram is much better when acetonitrile is the major portion of the organic portion of the eluting solution. However, if acetonitrile is used exclusively in the more rapidly changing portions of the gradient, (after 14 min), large momentary pressure fluctuations are observed. Some of these fluctuations are sufficient to terminate the operation of the more sensitive HPLC instrumentation systems. It is believed that these pressure fluctuations may result from a momentary precipitation of phosphate in a capilliary or near a frit. At any rate the substitution of methanol resolves this problem. However, for many HPLC systems where transfer lines are 0.25 mm or greater and frits porosity is 5 microns, it is quite probable that the gradient profile could utilize acetonitrile instead of methanol.

The separation on the mixed-mode column allows trinitrobenzoic acid to be determined along with the other anticipated metabolites. The various chromatographic parameters are listed in Table 2A-3, using the above solvent program, a 50 μL injection volume, and a wavelength of 254 nm for qunatitation. Quantitation is achieved as described above for the reverse phase separation. The detection limits have been determined according to the procedure discussed by Hubaux and Vos, [Anal. Chem. 42, 849 (1970)]. Limits are presented for two different confidence levels. The results listed in Table 2A-2 and the chromatogram shown in Figure 2A-2 were generated from sample injection volumes of 50 μL; and thus they represent a realistic expectation for this method. More ideal results have been generated by injecting standards in volumes of 10 μL or less. In summary, the method described above yields very good results for most metabolites even though a sample that is 5 or more times the ideal sample volume is injected.

Table 2A-2. Gradient Program for HPLC Method on Anion/C18 Column

Solvent A: 0.015 M Potassium Phosphate at pH 5.1 in 10:90 methanol:water.

Solvent B: Methanol

Solvent C: Acetonitrile

Time	% A	% B	% C
1	72	0	28
5	68	0	32
14	68	0	32
20	44	12	44
26	2	54	44
33	2	54	44
38	72	0	28
45	72	0	28

FIGURE 2A-2. CHROMATOGRAM SHOWING SEPARATION OF EXPLOSIVES AND TNT METABOLITES ON ANION/C18 MIXED-MODE COLUMN. SAMPLE WAS 50 μL OF A 1 PPM STANDARD MIXTURE.

ORNL-DWG 90-6906

MIXED MODE HPLC OF STANDARDS

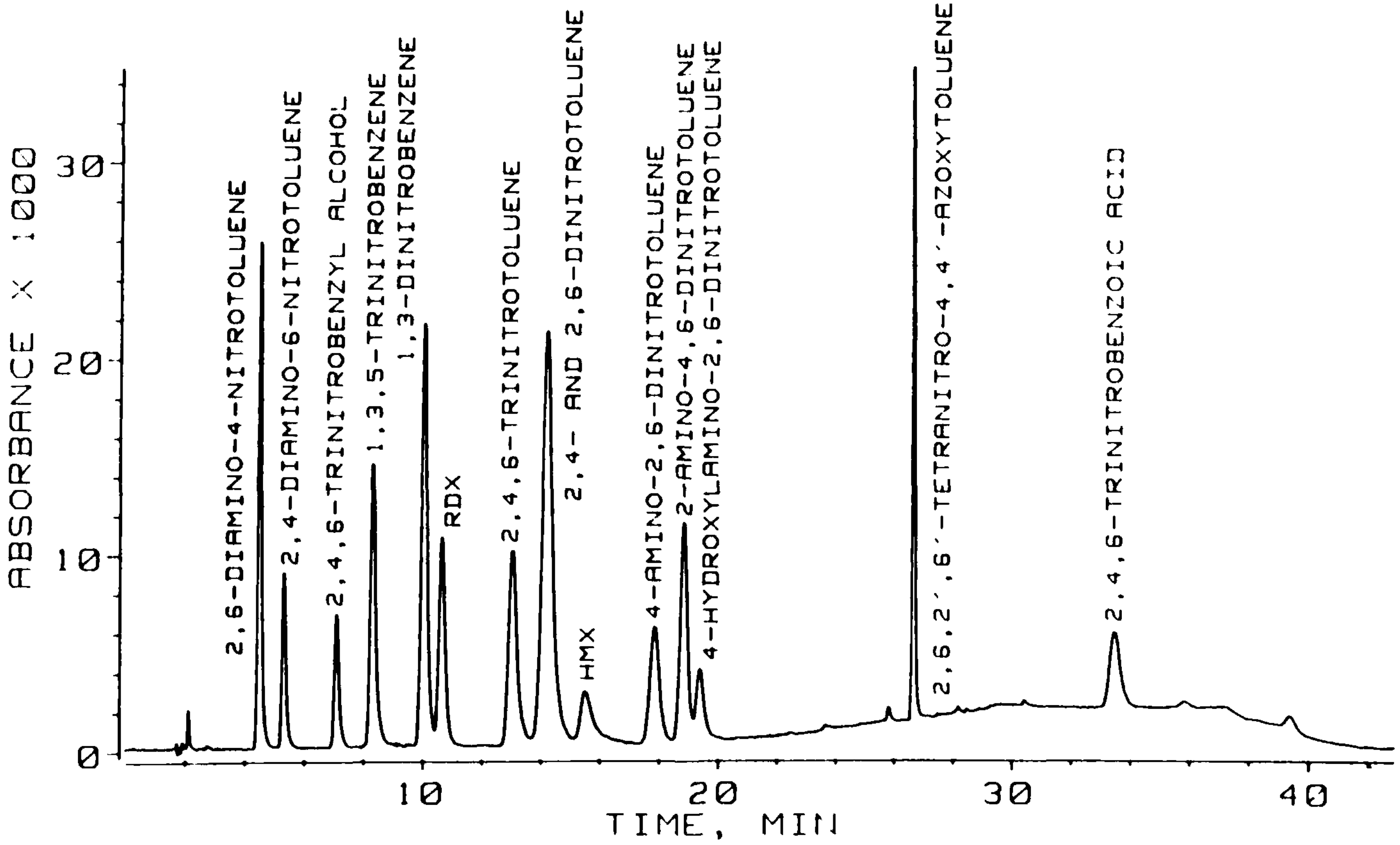


Table 2A-3. Chromatographic Parameters for Explosives and TNT Metabolites on Mixed Mode Anion/C18 column

COMPOUND	RET. TIME, MIN.	K[1]	SYM[2] MIN.	DET. 95, PPM	LIMIT[3] 99, PPM
1,3,5-TNBA	34.0	17.3	1.3	0.28	0.40
2,4-DA-6-NT	5.7	2.1	1.1	0.36	0.48
2,6-DA-4-NT	4.8	1.6	1.3	0.12	0.16
2,4,6-TNBAlc	7.2	13.3	0.84	0.52	0.72
RDX	11.0	4.9	0.72	0.41	0.56
HMX	14.8	7.0	1.2	0.36	0.54
1,3-DNB	10.1	4.5	1.2	0.20	0.28
1,3,5-TNB	8.3	3.5	1.2	0.20	0.28
2-A-4,6-DNT	19.1	9.3	1.1	0.60	0.88
4-A-2,6-DNT	18.2	8.8	0.93	0.24	0.36
2,6-DNT	14.4	6.8	1.1	0.60	0.80
2,4-DNT	14.5	6.8	1.1	0.48	0.64
2,4,6-TNT	12.8	5.9	1.1	0.20	0.40
4-OHA-2,6-DNT	20.2	9.9	1.2	0.8	1.2[4]
Azoxydimer	26.6	13.3	1.3	4.00	2.8

---

[1] The K-value, (capacity ratio), is the corrected retention time divided by the time required for an unretained compound to travel through the system.

[2] SYM is the total peak area after the apex divided by the total peak area before the apex.

[3] DET. LIMIT is the detection limit in PPM calculated for the 95 % and 99 % confidence levels according the methods suggested by Hubaux and Vos, [Anal. Chem. 42, 849 (1970)].

[4] The detection limits listed for 4-hydroxy-2,6-dinitrotoluene must be considered approximations because this compound has limited stability under the chromatographic conditions employed.

APPENDIX A-3

DATA REPORTS FOR ORGANICS AND METALS ANALYSES OF TCLP LEACHATES

>>> REQUEST FOR ANALYTICAL SERVICES <<<

ACD Request No
OAL 92741

[6]Deadline(11)

*[1]Chain of Custody(1): Yes (N)

[5]Sample Matrix(16): TCLP EXTRACT

[9]Customer Name(20): WH GRIEST

BLDG W/S

[7]Project No(5):

[8]Section(10):

[10]Charge No(8): 33900213

[12]Cust Dept No(6):

[13]Sampled From(14):

[18]Frequency(12):

[19]Material Description(32): HE COMPOST

NOTE: Customers should pick up samples within 10 days of reporting results.
Additional charges may result if Analytical is required to dispose of samples.

Compliance Sample? RCRA ( ) NPDES ( ) OTHER ( )

If other, please specify in comments

Comments

TCLP extracts (1L each) of high explosive soil compost.
2BBL353 + 2BBL354 are for spiking w/ matrix spikes. 2BBL352 is for unspiked sample.
MS/MSD + surrogates have not been added.

ACD Number	[11]Cust Sample ID(15)	~~[17]~~Sample Date mm dd yy time	[23]Analysis(30)	Method ID(14)	Detection Limits
890524-~~072~~	1BBL351	190589	Semivolatiles		
890524-073	2BBL352		+ PCB/Pesticides		
890524-074	2BBL353 for MS				
890524-~~075~~	2BBL354 for MSD		delete -072, -075, -077,		
890524-076	1BBL451		-078 LJW 6/14/89		
890524-~~077~~	1BBL452		(samples were not split		
890524-~~078~~	BLK		from PCB anal. in prep.)		

*[Field No]Field Name(No Chars)

To arrange E-trans of data send E-mail to [illegible] or TEASLEYHATR on OA VAX

REV 5/88

Rec'd by: LJW

Submitted by / Phone: W.N [illegible] 4-1264

2C

WATER SEMIVOLATILE SURROGATE RECOVERY

Name: OAK RIDGE NATIONAL LAB   Contract: NR

Code: OR   Case No.: [illegible]   SAS No.: 92741   SDG No.: C705

	EPA SAMPLE NO.	S1 (NBZ)#	S2 (FBP)#	S3 (TPH)#	S4 (PHL)#	S5 (2FP)#	S6 (TBP)#	OTHER	TOT OUT
01	890605-119	44	[illegible]	89	25	35	49		0
02	890602-166	[illegible]	[illegible]	93	27	37	56		0
03	890602-168	47	[illegible]	92	23	27	24		0
04	890602-170	[illegible]	[illegible]	87	21	25	40		0
05	890605-120	59	[illegible]	67	26	32	52		0
06	890605-121	[illegible]	[illegible]	82	21	28	55		0
07	890622-041	[illegible]	[illegible]	91	28	37	53		0
08	890524-072	[illegible]	[illegible]	79	28	38	57		0
09	890524-073	[illegible]	[illegible]	63	32	45	61		0
10	[illegible]	[illegible]	[illegible]	[illegible]	32	41	[illegible]		0
11	[illegible]	[illegible]	[illegible]	[illegible]	36	46	61		1
12	[illegible]	[illegible]	[illegible]	[illegible]	42	55	54		0
13	[illegible]	[illegible]	46	[illegible]	41	47	[illegible]		0
14	[illegible]	[illegible]	[illegible]	[illegible]	31	31*	[illegible]		1
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

GSF 2/15/90

		QC LIMITS
S1 (NBZ)	= Nitrobenzene-d5	(35-114)
S2 (FBP)	= 2-Fluorobiphenyl	(43-116)
S3 (TPH)	= Terphenyl-d14	(33-141)
S4 (PHL)	= Phenol-d5	(10-94)
S5 (2FP)	= 2-Fluorophenol	(21-100)
S6 (TBP)	= 2,4,6-Tribromophenol	(10-123)

\# Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogates diluted out

1 of 1

FORM II SV-1   1/87 Rev.

Best Available Copy

GSF
7/1/89

3C
WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: [illegible] Contract: [illegible]

Lab Code: [illegible] Case No.: [illegible] SAS No.: [illegible] SDG No.: [illegible]

Matrix Spike - EPA Sample No.: [illegible]

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC LIMITS REC.
Phenol	[illegible]	0.0	[illegible]	[illegible]	12- 89
2-Chlorophenol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1,4-Dichlorobenzene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N-Nitroso-di-n-prop.(1)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1,2,4-Trichlorobenzene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4-Chloro-3-methylphenol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Acenaphthene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4-Nitrophenol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2,4-Dinitrotoluene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pentachlorophenol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pyrene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2-Chlorophenol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1,4-Dichlorobenzene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N-Nitroso-di-n-prop.(1)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1,2,4-Trichlorobenzene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4-Chloro-3-methylphenol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Acenaphthene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4-Nitrophenol	[illegible]	0.0	0 *	[illegible]	[illegible]	[illegible]
2,4-Dinitrotoluene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pentachlorophenol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pyrene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(1) [illegible]

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: [illegible]

COMMENTS: ______________________________________

FORM III [illegible]

Best Available Copy

EPA SAMPLE NO.

TCLP Leachate
1BBL3S1 of
Mesophilic Compost
(Aliquot 1)

WRC
1-18-90

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-072

Sample wt/vol: 900 ML Lab File ID: >C1476

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 5-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	56.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	56.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	56.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

By

Date 8/8/89

EPA SAMPLE NO.

1BBL3S1

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-072

Sample wt/vol: 900 ML Lab File ID: >C1476

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 5-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	56.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	56.00	U
100-02-7	4-nitrophenol	56.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	56.00	U
534-52-1	4,6-dinitro-2-methylphenol	56.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	56.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	22.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

By LJ Wachter

Date 8/8/89

EPA SAMPLE NO.

1BBL3S1

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-072

Sample wt/vol: 900 ML Lab File ID: >C1476

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 5-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

Number TICs found: 5 CONCENTRATION UNITS:
(UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	TRINITROTOLUENE	24.27	850	J
2.	UNKNOWN	26.46	13	J
3.	UNKNOWN	28.21	24	J
4.	UNKNOWN	28.46	10	J
5.	UNKNOWN	43.82	10	J

REVIEWED

Wachter
8/8/89

EPA SAMPLE NO.

TCLP Leachate
2BBL3S2 of
Mesophilic Compost
(Aliquot 2)

WHG
1-30-90

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-073

Sample wt/vol: 900 ML Lab File ID: >C1477

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 5-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	56.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	56.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	56.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

By Wachter

Date 8/8/89

EPA SAMPLE NO.

2BBL3S2

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-073

Sample wt/vol: 900 ML Lab File ID: >C1477

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 5-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	56.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	56.00	U
100-02-7	4-nitrophenol	56.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	56.00	U
534-52-1	4,6-dinitro-2-methylphenol	56.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	56.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	22.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

LJ Wachter
8/8/89

EPA SAMPLE NO.

2BBL3S2

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270   Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89   Lab Sample ID: 890524-073

Sample wt/vol: 900 ML   Lab File ID: >C1477

Date Sampled: 19-May-1989   Date Received 24-May-1989 09:10

% Moisture: not dec.   dec: Date Analyzed: 5-Jul-1989

Material Description HE COMPOST   Date of Report: 14-JUL-89

Number TICs found: 4   CONCENTRATION UNITS: (UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	TRINITROTOLUENE	24.31	1200	J
2.	UNKNOWN	28.20	22	J
3.	UNKNOWN	28.46	11	J
4.	UNKNOWN	43.83	14	J

REVIEWED

Wachter

Date 8/8/89

EPA SAMPLE NO.

TCLP Leachate
2BBL3S2 of
Mesophilic Composit
(Aliquot 2)

WMG
1-28-90

Pesticide Organics Analysis Data Sheet

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-073

Sample wt/vol: 100 ML Lab File ID: NR

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 16-Jun-1989

Material Description NE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	ALPHA-BHC	0.50	U
319-85-7	BETA-BHC	0.50	U
319-86-8	DELTA-BHC	0.50	U
58-89-9	GAMMA-BHC (LINDANE)	0.50	U
76-44-8	HEPTACHLOR	0.50	U
309-00-2	ALDRIN	0.50	U
1024-57-3	HEPTACHLOR EPOXIDE	0.50	U
959-98-8	ENDOSULFAN I	0.50	U
60-57-1	DIELDRIN	1.00	U
72-55-9	4,4'-DDE	1.00	U
72-20-8	ENDRIN	1.00	U
33213-65-9	ENDOSULFAN II	1.00	U
72-54-8	4,4'-DDD	1.00	U
1031-07-8	ENDOSULFAN SULFATE	1.00	U
50-29-3	4,4'-DDT	1.00	U
72-43-5	METHOXYCHLOR	5.00	U
53494-70-5	ENDRIN KETONE	1.00	U
5103-71-9	ALPHA CHLORDANE	5.00	U
5103-74-2	GAMMA CHLORDANE	5.00	U
8001-35-2	TOXAPHENE	10.00	U
12674-11-2	AROCLOR-1016	5.00	U
11104-28-2	AROCLOR-1221	5.00	U
11141-16-5	AROCLOR-1232	5.00	U
53469-21-9	AROCLOR-1242	5.00	U
12672-29-6	AROCLOR-1248	5.00	U
11097-69-1	AROCLOR-1254	10.00	U
11096-82-5	AROCLOR-1260	10.00	U

EVIEWED

Wachter
8/8/89

EPA SAMPLE NO.

TCLP Leachate
2BBL3S3 of
Mesophilic Compost
(Matrix Spike)

WHG
1-30-90

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-074

Sample wt/vol: 900 ML Lab File ID: >C1478

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	72.00	MS
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	87.00	MS
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	48.00	MS
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	38.00	MS
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	7.00	J
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	56.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	53.00	MS
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	60.00	MS
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	56.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	56.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

B: Wachter

8/8/89

EPA SAMPLE NO.

2BBL3S3

Semivolatile Organic Analysis Data

Request Number: OAL92741		
Procedure Number: 8270	Matrix: TCLP EXTRACT	
Series:	Frequency:	Charge Number: 33900213
Customer Name: GRIEST/7/24/89		Lab Sample ID: 890524-074
Sample wt/vol: 900 ML		Lab File ID: >C1478
Date Sampled: 19-May-1989		Date Received 24-May-1989 09:10
% Moisture: not dec.	dec:	Date Analyzed: 6-Jul-1989
Material Description HE COMPOST		Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	56.00	U
83-32-9	acenaphthene	57.00	MS
51-28-5	2,4-dinitrophenol	56.00	U
100-02-7	4-nitrophenol	58.00	MS
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	44.00	MS
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	56.00	U
534-52-1	4,6-dinitro-2-methylphenol	56.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	91.00	MS
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	55.00	MS
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	22.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

By Wachter

Date 8/8/89

EPA SAMPLE NO.

Mesophilic Compost
2BBL3S3
TCLP Leachate
(Matrix Spike)

WMG
1-28-90

Pesticide Organics Analysis Data Sheet

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-074

Sample wt/vol: 100 ML Lab File ID: NR

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 16-Jun-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	ALPHA-BHC	0.50	U
319-85-7	BETA-BHC	0.50	U
319-86-8	DELTA-BHC	0.50	U
58-89-9	GAMMA-BHC (LINDANE)	3.55	
76-44-8	HEPTACHLOR	1.84	
309-00-2	ALDRIN	1.96	
1024-57-3	HEPTACHLOR EPOXIDE	0.50	U
959-98-8	ENDOSULFAN I	0.50	U
60-57-1	DIELDRIN	6.35	
72-55-9	4,4'-DDE	1.00	U
72-20-8	ENDRIN	6.23	
33213-65-9	ENDOSULFAN II	1.00	U
72-54-8	4,4'-DDD	1.00	U
1031-07-8	ENDOSULFAN SULFATE	1.00	U
50-29-3	4,4'-DDT	10.02	
72-43-5	METHOXYCHLOR	5.00	U
53494-70-5	ENDRIN KETONE	1.00	U
5103-71-9	ALPHA CHLORDANE	5.00	U
5103-74-2	GAMMA CHLORDANE	5.00	U
8001-35-2	TOXAPHENE	10.00	U
12674-11-2	AROCLOR-1016	5.00	U
11104-28-2	AROCLOR-1221	5.00	U
11141-16-5	AROCLOR-1232	5.00	U
53469-21-9	AROCLOR-1242	5.00	U
12672-29-6	AROCLOR-1248	5.00	U
11097-69-1	AROCLOR-1254	10.00	U
11096-82-5	AROCLOR-1260	10.00	U

REVIEWED

J J Wachter

Date 8/8/89

EPA SAMPLE NO.

TCLP Leachate
2BBL3S4 of
Mesophilic Compost
(matrix Spike Duplicate)

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-075

Sample wt/vol: 900 ML Lab File ID: >C1479

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	87.00	MS
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	86.00	MS
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	42.00	MS
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	48.00	MS
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	56.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	47.00	MS
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	71.00	MS
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	56.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	56.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

JJ Wachter

Date 8/8/89

EPA SAMPLE NO.

Semivolatile Organic Analysis Data

2BBL3S4

Request Number: 0AL92741		
Procedure Number: 8270	Matrix: TCLP EXTRACT	
Series:	Frequency:	Charge Number: 33900213
Customer Name: GRIEST/7/24/89		Lab Sample ID: 890524-075
Sample wt/vol: 900 ML		Lab File ID: >C1479
Date Sampled: 19-May-1989		Date Received 24-May-1989 09:10
% Moisture: not dec.	dec:	Date Analyzed: 6-Jul-1989
Material Description HE COMPOST		Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	56.00	U
83-32-9	acenaphthene	79.00	MS
51-28-5	2,4-dinitrophenol	56.00	U
100-02-7	4-nitrophenol	56.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	53.00	MS
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	56.00	U
534-52-1	4,6-dinitro-2-methylphenol	56.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	82.00	MS
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	60.00	MS
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	22.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

By

Date 8/8/89

EPA SAMPLE NO.

TCLP Leachate
1BBL4S1 of
Thermophilic Compost
(Aliquot 1)

WNG
1-28-90

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-076

Sample wt/vol: 900 ML Lab File ID: >C1480

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	56.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	56.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	56.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED
By Jf Waechter
Date 8/8/89

EPA SAMPLE NO.

Semivolatile Organic Analysis Data

1BBL4S1

Request Number: 0AL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-076

Sample wt/vol: 900 ML Lab File ID: >C1480

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% M ure: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	---------3-nitroaniline	56.00	U
83-32-9	---------acenaphthene	11.00	U
51-28-5	---------2,4-dinitrophenol	56.00	U
100-02-7	--------4-nitrophenol	56.00	U
132-64-9	--------dibenzofuran	11.00	U
121-14-2	--------2,4-dinitrotoluene	11.00	U
84-66-2	---------diethylphthalate	11.00	U
7005-72-3	-------4-chlorophenyl-phenylether	11.00	U
86-73-7	---------fluorene	11.00	U
100-01-6	--------4-nitroaniline	56.00	U
534-52-1	--------4,6-dinitro-2-methylphenol	56.00	U
86-30-6	---------n-nitrosodiphenylamine (1)	11.00	U
101-55-3	--------4-bromophenyl-phenylether	11.00	U
118-74-1	--------hexachlorobenzene	11.00	U
87-86-5	---------pentachlorophenol	56.00	U
85-01-8	---------phenanthiene	11.00	U
120-12-7	--------anthracene	11.00	U
84-74-2	---------di-n-butylphthalate	4.00	J
206-44-0	--------fluoranthene	11.00	U
129-00-0	--------pyrene	11.00	U
85-68-7	---------butylbenzylphthalate	11.00	U
91-94-1	---------3,3'-dichlorobenzidine	22.00	U
56-55-3	---------benzo(a)anthracene	11.00	U
218-01-9	--------chrysene	11.00	U
117-81-7	--------bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	--------di-n-octylphthalate	11.00	U
205-99-2	--------benzo(b)fluoranthene	11.00	U
207-08-9	--------benzo(k)fluoranthene	11.00	U
50-32-8	---------benzo(a)pyrene	11.00	U
193-39-5	--------indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	---------dibenz(a,h)anthracene	11.00	U
191-24-2	--------benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

REVIEWED

B. SJ Wachter

Date 8/8/89

EPA SAMPLE NO.

1BBL4S1

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-076

Sample wt/vol: 900 ML Lab File ID: >C1480

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

Number TICs found: 5 CONCENTRATION UNITS: (UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	UNKNOWN	7.36	14	J
2.	TRINITROTOLUENE	24.26	260	J
3.	UNKNOWN	28.46	16	J
4.	UNKNOWN HYDROCARBON	40.67	28	J
5.	UNKNOWN	43.84	51	J

REVIEWED

Wachter
8/8/89

EPA SAMPLE NO.

TCLP Leachate
1BBL4S1 of
Thermophilic Compost
(Aliquot 2)

WMG
1-23-90

Pesticide Organics Analysis Data Sheet

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-076

Sample wt/vol: 100 ML Lab File ID: NR

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 16-Jun-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	--------ALPHA-BHC	0.50	U
319-85-7	--------BETA-BHC	0.50	U
319-86-8	--------DELTA-BHC	0.50	U
58-89-9	---------GAMMA-BHC (LINDANE)	0.50	U
76-44-8	---------HEPTACHLOR	0.50	U
309-00-2	--------ALDRIN	0.50	U
1024-57-3	-------HEPTACHLOR EPOXIDE	0.50	U
959-98-8	--------ENDOSULFAN I	0.50	U
60-57-1	---------DIELDRIN	1.00	U
72-55-9	---------4,4'-DDE	1.00	U
72-20-8	---------ENDRIN	1.00	U
33213-65-9	------ENDOSULFAN II	1.00	U
72-54-8	---------4,4'-DDD	1.00	U
1031-07-8	-------ENDOSULFAN SULFATE	1.00	U
50-29-3	---------4,4'-DDT	1.00	U
72-43-5	---------METHOXYCHLOR	5.00	U
53494-70-5	------ENDRIN KETONE	1.00	U
5103-71-9	-------ALPHA CHLORDANE	5.00	U
5103-74-2	-------GAMMA CHLORDANE	5.00	U
8001-35-2	-------TOXAPHENE	10.00	U
12674-11-2	------AROCLOR-1016	5.00	U
11104-28-2	------AROCLOR-1221	5.00	U
11141-16-5	------AROCLOR-1232	5.00	U
53469-21-9	------AROCLOR-1242	5.00	U
12672-29-6	------AROCLOR-1248	5.00	U
11097-69-1	------AROCLOR-1254	10.00	U
11096-82-5	------AROCLOR-1260	10.00	U

REVIEWED

8/8/89

EPA SAMPLE NO

TCLP Leachate
BBL4S2 of
Thermophilic Compost
(Aliquot 2)

WMG
1-28-90

Semivolatile Organic Analysis Data

Request Number: OAL92741
Procedure Number: 8270 Matrix: TCLP EXTRACT
Series: Frequency: Charge Number: 33900213
Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-077
Sample wt/vol: 900 ML Lab File ID: >C1481
Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10
% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989
Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	56.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	56.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	56.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

LJWachter
Date 8/8/89

EPA SAMPLE NO.

1BBL4S2

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-077

Sample wt/vol: 900 ML Lab File ID: >C1481

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	56.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	56.00	U
100-02-7	4-nitrophenol	56.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	56.00	U
534-52-1	4,6-dinitro-2-methylphenol	56.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	56.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	8.00	J
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	22.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

AJ Wachter
8/8/89

EPA SAMPLE NO.

1BBL4S2

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-077

Sample wt/vol: 900 ML Lab File ID: >C1481

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

Number TICs found: 2 CONCENTRATION UNITS:
(UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	UNKNOWN	7.37	14	J
2.	TRINITROTOLUENE	24.26	240	J

REVIEWED
JJ Wachter
8/8/89

EPA SAMPLE NO.

| TCLP Blank |
| BLK wmG 1-28-90 |

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID 890524-078

Sample wt/vol: 900 ML Lab File ID: >C1482

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	56.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	56.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	56.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

[illegible]

SJ Wachter

Date 8/08/89

EPA SAMPLE NO.

BLK

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-078

Sample wt/vol: 900 ML Lab File ID: >C1482

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	56.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	56.00	U
100-02-7	4-nitrophenol	56.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	56.00	U
534-52-1	4,6-dinitro-2-methylphenol	56.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	56.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	22.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

REVIEWED

Wachter

Date 8/08/89

EPA SAMPLE NO.

BLK

Semivolatile Organic Analysis Data

Request Number: OAL92741

Procedure Number: 8270 Matrix: TCLP EXTRACT

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/7/24/89 Lab Sample ID: 890524-078

Sample wt/vol: 900 ML Lab File ID: >C1482

Date Sampled: 19-May-1989 Date Received 24-May-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 6-Jul-1989

Material Description HE COMPOST Date of Report: 14-JUL-89

Number TICs found: 4

CONCENTRATION UNITS:
(UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	UNKNOWN	7.40	24	J
2.	UNKNOWN	28.46	29	J
3.	UNKNOWN HYDROCARBON	40.68	70	J
4.	UNKNOWN	43.84	140	J

REVIEWED
B. Wachter
Date 8/8/89

1D

PESTICIDE ORGANICS ANALYSIS DATA SHEET

LAB NAME: OAK RIDGE NATIONAL LAB	EPA SAMPLE NO.: 2BBL3S2
LAB CODE: ORNL CASE NO: NA	SAS NO: NA SDG NO: 2741R
MATRIX: WATER	LAB SAMPLE ID: 890524-073
SAMPLE WT/VOL: 100 ML	LAB FILE ID:
LEVEL: LOW	DATE RECEIVED: 05/24/89
% MOISTURE:	DATE EXTRACTED: 06/06/89
EXTRACTION METHOD: SEPF	DATE ANALYZED: 06/16/89
GPC CLEANUP: N pH: 5.3	DILUTION FACTOR: 1

CAS NO	COMPOUND	CONCENTRATION UNITS (UG/L)	Q
319-84-6	ALPHA-BHC	0.50	U
319-85-7	BETA-BHC	0.50	U
319-86-8	DELTA-BHC	0.50	U
58-89-9	GAMMA-BHC (LINDANE)	0.50	U
76-44-8	HEPTACHLOR	0.50	U
309-86-8	ALDRIN	0.50	U
1024-57-3	HEPTACHLOR EPOXIDE	0.50	U
959-98-8	ENDOSULFAN I	0.50	U
60-57-1	DIELDRIN	1.00	U
72-55-9	4,4'-DDE	1.00	U
77-20-8	ENDRIN	1.00	U
33213-65-9	ENDOSULFAN II	1.00	U
72-54-8	4,4'-DDD	1.00	U
1031-07-8	ENDOSULFAN SULFATE	1.00	U
50-29-3	4,4'-DDT	1.00	U
72-43-5	METHOXYCHLOR	5.0	U
53494-70-5	ENDRIN KETONE	1.00	U
5103-71-9	ALPHA-CHLORDANE	5.0	U
5103-74-2	GAMMA-CHLORDANE	5.0	U
8001-35-2	TOXAPHENE	10.0	U
1267-11-2	AROCLOR-1016	5.0	U
11104-28-2	AROCLOR-1221	5.0	U
11141-16-5	AROCLOR-1232	5.0	U
53469-21-9	AROCLOR-1242	5.0	U
12672-29-6	AROCLOR 1248	5.0	U
11097-69-1	AROCLOR-1254	10.0	U
11096-82-5	AROCLOR-1260	10.0	U

FORM I PEST

1D

PESTICIDE ORGANICS ANALYSIS DATA SHEET

LAB NAME: OAK RIDGE NATIONAL LAB
EPA SAMPLE NO.: 1BBL4S1
LAB CODE: ORNL CASE NO: NA
SAS NO: NA SDG NO: 2741F
MATRIX: WATER
LAB SAMPLE ID: 890524-074
SAMPLE WT/VOL: 100 ML
LAB FILE ID:
LEVEL: LOW
DATE RECEIVED: 05/24/89
% MOISTURE:
DATE EXTRACTED: 06/06/89
EXTRACTION METHOD: SEPF
DATE ANALYZED: 06/16/89
GPC CLEANUP: N pH: 5.4
DILUTION FACTOR: 1

CAS NO	COMPOUND	CONCENTRATION UNITS (UG/L)	Q
319-84-6	ALPHA-BHC	0.50	U
319-85-7	BETA-BHC	0.50	U
319-86-8	DELTA-BHC	0.50	U
58-89-9	GAMMA-BHC (LINDANE)	0.50	U
76-44-8	HEPTACHLOR	0.50	U
309-86-8	ALDRIN	0.50	U
1024-57-3	HEPTACHLOR EPOXIDE	0.50	U
959-98-8	ENDOSULFAN I	0.50	U
60-57-1	DIELDRIN	1.00	U
72-55-9	4,4'-DDE	1.00	U
77-20-8	ENDRIN	1.00	U
33213-65-9	ENDOSULFAN II	1.00	U
72-54-8	4,4'-DDD	1.00	U
1031-07-8	ENDOSULFAN SULFATE	1.00	U
50-29-3	4,4'-DDT	1.00	U
72-43-5	METHOXYCHLOR	5.0	U
53494-70-5	ENDRIN KETONE	1.00	U
5103-71-9	ALPHA-CHLORDANE	5.0	U
5103-74-2	GAMMA-CHLORDANE	5.0	U
8001-35-2	TOXAPHENE	10.0	U
1267-11-2	AROCLOR-1016	5.0	U
11104-28-2	AROCLOR-1221	5.0	U
11141-16-5	AROCLOR-1232	5.0	U
53469-21-9	AROCLOR-1242	5.0	U
12672-29-6	AROCLOR 1248	5.0	U
11097-69-1	AROCLOR-1254	10.0	U
11096-82-5	AROCLOR-1260	10.0	U

FORM I PEST

2E

WATER PESTICIDE SURROGATE RECOVERY

LAB NAME: OAK RIDGE NATIONAL LABORATORY CONTRACT: NA

LAB CODE: ORNL CASE NO.: NA SAS NO.:NA SDG NO.: 2741R

	EPA SAMPLE NO.	S1 (DCBP) #	OTHER #
1	BLANK	94	
2	2BBL3S2	95	
3	2BBL3S3MS	79	
4	1BBL4S1	85	
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
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16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

ADVISORY QC LIMITS (20-150)

S1 (DBC)=Dibutylchlorendate
Column used to flag recovery values
* Value outside QC limits
+ No surrogate detected in sample
D Surrogates diluted out

* Value outside QC limits
+ No surrogate detected in sample

1D

PESTICIDE ORGANICS ANALYSIS DATA SHEET

LAB NAME: OAK RIDGE NATIONAL LAB		EPA SAMPLE NO.: 2BPL3S3MS	
LAB CODE: ORNL	CASE NO: NA	SAS NO: NA	SDG NO: 2741R
MATRIX: WATER		LAB SAMPLE ID: 890524-074	
SAMPLE WT/VOL: 100 ML		LAB FILE ID:	
LEVEL: LOW		DATE RECEIVED: 05/24/89	
% MOISTURE:		DATE EXTRACTED: 06/06/89	
EXTRACTION METHOD: SEPF		DATE ANALYZED: 06/16/89	
GPC CLEANUP: N	pH: 5.5	DILUTION FACTOR: 1	

CAS NO	COMPOUND	CONCENTRATION UNITS (UG/L)	Q
319-84-6	ALPHA-BHC	0.50	U
319-85-7	BETA-BHC	0.50	U
319-86-8	DELTA-BHC	0.50	U
58-89-9	GAMMA-BHC (LINDANE)	3.55	
76-44-8	HEPTACHLOR	1.84	
309-86-8	ALDRIN	1.96	
1024-57-3	HEPTACHLOR EPOXIDE	0.50	U
959-98-8	ENDOSULFAN I	0.50	U
60-57-1	DIELDRIN	6.35	
72-55-9	4,4'-DDE	1.00	U
77-20-8	ENDRIN	6.23	
33213-65-9	ENDOSULFAN II	1.00	U
72-54-8	4,4'-DDD	1.00	U
1031-07-8	ENDOSULFAN SULFATE	1.00	U
50-29-3	4,4'-DDT	10.02	
72-43-5	METHOXYCHLOR	5.0	U
53494-70-5	ENDRIN KETONE	1.00	U
5103-71-9	ALPHA-CHLORDANE	5.0	U
5103-74-2	GAMMA-CHLORDANE	5.0	U
8001-35-2	TOXAPHENE	10.0	U
1267-11-2	AROCLOR-1016	5.0	U
11104-28-2	AROCLOR-1221	5.0	U
11141-16-5	AROCLOR-1232	5.0	U
53469-21-9	AROCLOR-1242	5.0	U
12672-29-6	AROCLOR 1248	5.0	U
11097-69-1	AROCLOR-1254	10.0	U
11096-82-5	AROCLOR-1260	10.0	U

FORM I PEST

Oak Ridge National Laboratory
Analytical Chemistry Division
Results of Analyses
Chemical and Physical Analysis

CPA9565 Page 1

Customer Name	W.H. GRIEST	Date Received	24-May-1989 09:53
Request Number	CPA9565	Charge Number	33900213
Project Number		Dept Number	3390
Series		Date of Report	7-JUN-89

Approved By

Date 6-1-89.

Analy No. Customers Id Date/Time Sampled Matrix Material Desc. Frequency	Analysis	Result	Units	Procedure No	Completed
890524-036 1BBL351 TCLP EXTRACT ME COMPOST Mesophilic (No. 1 Aliquot) Compost WHG 1-28-90	AG	1.2E-02	MG/L	EPA 200.7	6-Jun-1989
	AL	2.8E+00	MG/L	EPA 200.7	6-Jun-1989
	AS	< 1.0E-01	MG/L	EPA 200.7	6-Jun-1989
	B	5.8E-01	MG/L	EPA 200.7	6-Jun-1989
	BA	7.5E-01	MG/L	EPA 200.7	6-Jun-1989
	BE	< 8.0E-04	MG/L	EPA 200.7	6-Jun-1989
	CA	1.2E+02	MG/L	EPA 200.7	6-Jun-1989
	CD	< 4.0E-03	MG/L	EPA 200.7	6-Jun-1989
	CO	1.1E-02	MG/L	EPA 200.7	6-Jun-1989
	CR	2.7E-02	MG/L	EPA 200.7	6-Jun-1989
	CU	< 2.0E-02	MG/L	EPA 200.7	6-Jun-1989
	FE	9.9E-01	MG/L	EPA 200.7	6-Jun-1989
	GA	< 6.0E-01	MG/L	EPA 200.7	6-Jun-1989
	MG	2.4E+01	MG/L	EPA 200.7	6-Jun-1989
	MN	1.7E+00	MG/L	EPA 200.7	6-Jun-1989
	MO	< 8.0E-02	MG/L	EPA 200.7	6-Jun-1989
	NA	1.6E+03	MG/L	EPA 200.7	6-Jun-1989
	NI	< 1.2E-02	MG/L	EPA 200.7	6-Jun-1989
	P	2.3E+01	MG/L	EPA 200.7	6-Jun-1989
	PB	< 6.0E-02	MG/L	EPA 200.7	6-Jun-1989
	SB	< 8.0E-02	MG/L	EPA 200.7	6-Jun-1989
	SE	< 1.6E-01	MG/L	EPA 200.7	6-Jun-1989
	SI	5.9E+00	MG/L	EPA 200.7	6-Jun-1989
	SN	< 1.0E-01	MG/L	EPA 200.7	6-Jun-1989
	SR	6.7E-01	MG/L	EPA 200.7	6-Jun-1989
	TI	< 4.0E-02	MG/L	EPA 200.7	6-Jun-1989
	V	< 8.0E-03	MG/L	EPA 200.7	6-Jun-1989
	ZN	8.2E-01	MG/L	EPA 200.7	6-Jun-1989
	ZR	< 4.0E-02	MG/L	EPA 200.7	6-Jun-1989

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|Analy No. Customers Id   Date/Time Sampled  |
|Matrix       Material Desc.                 |
|Frequency                                   | Analysis                    Result    Units      Procedure No    Completed
--------------------------------------------------------------------------------------------------------------------------
|890524-037 2BBL352                          |
|TCLP EXTRACT HE COMPOST                     |
|                                            |
                                              AG                        < 1.0E-02  MG/L       EPA 200.7       6-Jun-1989
                                              AL                          4.2E+00  MG/L       EPA 200.7       6-Jun-1989
                                              AS                        < 1.0E-01  MG/L       EPA 200.7       6-Jun-1989
                                              B                           9.4E-01  MG/L       EPA 200.7       6-Jun-1989
                                              BA                          7.5E-01  MG/L       EPA 200.7       6-Jun-1989
                                              BE                        < 8.0E-04  MG/L       EPA 200.7       6-Jun-1989
                                              CA                          1.1E+02  MG/L       EPA 200.7       6-Jun-1989
                                              CD                        < 4.0E-03  MG/L       EPA 200.7       6-Jun-1989
                                              CO                          8.9E-03  MG/L       EPA 200.7       6-Jun-1989
                                              CR                          2.3E-02  MG/L       EPA 200.7       6-Jun-1989
                                              CU                        < 2.0E-02  MG/L       EPA 200.7       6-Jun-1989
                                              FE                          1.6E+00  MG/L       EPA 200.7       6-Jun-1989
                                              GA                        < 6.0E-01  MG/L       EPA 200.7       6-Jun-1989
                                              MG                          2.2E+01  MG/L       EPA 200.7       6-Jun-1989
                                              MN                          1.6E+00  MG/L       EPA 200.7       6-Jun-1989
                                              MO                        < 8.0E-02  MG/L       EPA 200.7       6-Jun-1989
                                              NA                          1.5E+03  MG/L       EPA 200.7       6-Jun-1989
                                              NI                        < 1.2E-02  MG/L       EPA 200.7       6-Jun-1989
                                              P                           2.2E+01  MG/L       EPA 200.7       6-Jun-1989
                                              PB                        < 6.0E-02  MG/L       EPA 200.7       6-Jun-1989
                                              SB                        < 8.0E-02  MG/L       EPA 200.7       6-Jun-1989
                                              SE                        < 1.6E-01  MG/L       EPA 200.7       6-Jun-1989
                                              SI                          8.3E+00  MG/L       EPA 200.7       6-Jun-1989
                                              SN                        < 1.0E-01  MG/L       EPA 200.7       6-Jun-1989
                                              SR                          6.2E-01  MG/L       EPA 200.7       6-Jun-1989
                                              TI                        < 4.0E-02  MG/L       EPA 200.7       6-Jun-1989
                                              V                         < 8.0E-03  MG/L       EPA 200.7       6-Jun-1989
                                              ZN                          6.5E-01  MG/L       EPA 200.7       6-Jun-1989
                                              ZR                        < 4.0E-02  MG/L       EPA 200.7       6-Jun-1989
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Mesophilic (No 2 Aliquot)
Compost

WHG
1-28-90

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|Analy No. Customers Id   Date/Time Sampled  |
|Matrix        Material Desc.                |
|Frequency                                   | Analysis                          Result     Units      Procedure No   Completed
--------------------------------------------------------------------------------------------------------------------------------
|890524-038 1BBL451                          |
|TCLP EXTRACT HE COMPOST                     |
|     Thermophilic (No 1  Aliquot)           |
       Compost                                 AG                             < 1.0E-02   MG/L       EPA 200.7      6-Jun-1989
                     WMG                       AL                               2.2E+00   MG/L       EPA 200.7      6-Jun-1989
                     1-28-90                   AS                             < 1.0E-01   MG/L       EPA 200.7      6-Jun-1989
                                               B                                5.9E-01   MG/L       EPA 200.7      6-Jun-1989
                                               BA                               8.0E-01   MG/L       EPA 200.7      6-Jun-1989
                                               BE                             < 8.0E-04   MG/L       EPA 200.7      6-Jun-1989
                                               CA                               1.5E+02   MG/L       EPA 200.7      6-Jun-1989
                                               CD                             < 4.0E-03   MG/L       EPA 200.7      6-Jun-1989
                                               CO                               6.6E-03   MG/L       EPA 200.7      6-Jun-1989
                                               CR                               2.0E-02   MG/L       EPA 200.7      6-Jun-1989
                                               CU                             < 2.0E-02   MG/L       EPA 200.7      6-Jun-1989
                                               FE                               8.5E-01   MG/L       EPA 200.7      6-Jun-1989
                                               GA                             < 6.0E-01   MG/L       EPA 200.7      6-Jun-1989
                                               MG                               2.4E+01   MG/L       EPA 200.7      6-Jun-1989
                                               MN                               1.6E+00   MG/L       EPA 200.7      6-Jun-1989
                                               MO                             < 8.0E-02   MG/L       EPA 200.7      6-Jun-1989
                                               NA                               1.5E+03   MG/L       EPA 200.7      6-Jun-1989
                                               NI                             < 1.2E-02   MG/L       EPA 200.7      6-Jun-1989
                                               P                                1.9E+01   MG/L       EPA 200.7      6-Jun-1989
                                               PB                             < 6.0E-02   MG/L       EPA 200.7      6-Jun-1989
                                               SB                             < 8.0E-02   MG/L       EPA 200.7      6-Jun-1989
                                               SE                             < 1.6E-01   MG/L       EPA 200.7      6-Jun-1989
                                               SI                               4.9E+00   MG/L       EPA 200.7      6-Jun-1989
                                               SN                             < 1.0E-01   MG/L       EPA 200.7      6-Jun-1989
                                               SR                               6.7E-01   MG/L       EPA 200.7      6-Jun-1989
                                               TI                             < 4.0E-02   MG/L       EPA 200.7      6-Jun-1989
                                               V                              < 8.0E-03   MG/L       EPA 200.7      6-Jun-1989
                                               ZN                               5.9E-01   MG/L       EPA 200.7      6-Jun-1989
                                               ZR                             < 4.0E-02   MG/L       EPA 200.7      6-Jun-1989
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                                                                                      CPA9565       Page    4

|Analy No. Customers Id   Date/Time Sampled  |
|Matrix       Material Desc.                 |
|Frequency                                   | Analysis                      Result    Units       Procedure No     Completed
--------------------------------------------------------------------------------------------------------------------------------
|890524-039 2BBL452                          |
|TCLP EXTRACT HE COMPOST                     |
|                                            |
                                               AG                          < 1.0E-02  MG/L        EPA 200.7        6-Jun-1989
                                               AL                            8.6E+00  MG/L        EPA 200.7        6-Jun-1989
                                               AS                          < 1.0E-01  MG/L        EPA 200.7        6-Jun-1989
                                               B                             6.3E-01  MG/L        EPA 200.7        6-Jun-1989
                                               BA                            9.4E-01  MG/L        EPA 200.7        6-Jun-1989
                                               BE                          < 8.0E-04  MG/L        EPA 200.7        6-Jun-1989
                                               CA                            1.3E+02  MG/L        EPA 200.7        6-Jun-1989
                                               CD                            4.5E-03  MG/L        EPA 200.7        6-Jun-1989
                                               CO                            9.7E-03  MG/L        EPA 200.7        6-Jun-1989
                                               CR                            2.9E-02  MG/L        EPA 200.7        6-Jun-1989
                                               CU                          < 2.0E-02  MG/L        EPA 200.7        6-Jun-1989
                                               FE                            3.6E+00  MG/L        EPA 200.7        6-Jun-1989
                                               GA                          < 6.0E-01  MG/L        EPA 200.7        6-Jun-1989
                                               MG                            2.2E+01  MG/L        EPA 200.7        6-Jun-1989
                                               MN                            1.6E+00  MG/L        EPA 200.7        6-Jun-1989
                                               MO                          < 8.0E-02  MG/L        EPA 200.7        6-Jun-1989
                                               NA                            1.5E+03  MG/L        EPA 200.7        6-Jun-1989
                                               NI                            2.9E-02  MG/L        EPA 200.7        6-Jun-1989
                                               P                             2.0E+01  MG/L        EPA 200.7        6-Jun-1989
                                               PB                          < 6.0E-02  MG/L        EPA 200.7        6-Jun-1989
                                               SB                            1.6E-01  MG/L        EPA 200.7        6-Jun-1989
                                               SE                          < 1.6E-01  MG/L        EPA 200.7        6-Jun-1989
                                               SI                            1.4E+01  MG/L        EPA 200.7        6-Jun-1989
                                               SN                          < 1.0E-01  MG/L        EPA 200.7        6-Jun-1989
                                               SR                            7.0E-01  MG/L        EPA 200.7        6-Jun-1989
                                               TI                            1.5E-01  MG/L        EPA 200.7        6-Jun-1989
                                               V                           < 8.0E-03  MG/L        EPA 200.7        6-Jun-1989
                                               ZN                            6.5E-01  MG/L        EPA 200.7        6-Jun-1989
                                               ZR                          < 4.0E-02  MG/L        EPA 200.7        6-Jun-1989
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Thermophilic (NaZ Algiers)
Compost
w.hc.
1-28-90

Analy No. Customers Id Date/Time Sampled Matrix Material Desc. Frequency	Analysis	Result	Units	Procedure No	Completed
890524-040 BLK TCLP EXTRACT HE COMPOST Blank					
wmc 1-28-90	AG	< 1.0E-02	MG/L	EPA 200.7	6-Jun-1989
	AL	< 1.0E-01	MG/L	EPA 200.7	6-Jun-1989
	AS	< 1.0E-01	MG/L	EPA 200.7	6-Jun-1989
	B	3.7E-01	MG/L	EPA 200.7	6-Jun-1989
	BA	1.5E-01	MG/L	EPA 200.7	6-Jun-1989
	BE	< 8.0E-04	MG/L	EPA 200.7	6-Jun-1989
	CA	< 1.2E-01	MG/L	EPA 200.7	6-Jun-1989
	CD	< 4.0E-03	MG/L	EPA 200.7	6-Jun-1989
	CO	7.9E-03	MG/L	EPA 200.7	6-Jun-1989
	CR	< 6.0E-03	MG/L	EPA 200.7	6-Jun-1989
	CU	< 2.0E-02	MG/L	EPA 200.7	6-Jun-1989
	FE	3.3E-02	MG/L	EPA 200.7	6-Jun-1989
	GA	< 6.0E-01	MG/L	EPA 200.7	6-Jun-1989
	MG	< 2.0E-02	MG/L	EPA 200.7	6-Jun-1989
	MN	6.7E-02	MG/L	EPA 200.7	6-Jun-1989
	MO	< 8.0E-02	MG/L	EPA 200.7	6-Jun-1989
	NA	1.6E+03	MG/L	EPA 200.7	6-Jun-1989
	NI	1.5E-02	MG/L	EPA 200.7	6-Jun-1989
	P	< 6.0E-01	MG/L	EPA 200.7	6-Jun-1989
	PB	< 6.0E-02	MG/L	EPA 200.7	6-Jun-1989
	SB	< 8.0E-02	MG/L	EPA 200.7	6-Jun-1989
	SE	< 1.6E-01	MG/L	EPA 200.7	6-Jun-1989
	SI	< 4.0E-01	MG/L	EPA 200.7	6-Jun-1989
	SN	< 1.0E-01	MG/L	EPA 200.7	6-Jun-1989
	SR	1.2E-02	MG/L	EPA 200.7	6-Jun-1989
	TI	< 4.0E-02	MG/L	EPA 200.7	6-Jun-1989
	V	< 8.0E-03	MG/L	EPA 200.7	6-Jun-1989
	ZN	2.4E-01	MG/L	EPA 200.7	6-Jun-1989
	ZR	< 4.0E-02	MG/L	EPA 200.7	6-Jun-1989

End of data for Request Number CPA9565 Total pages = 5 Cust. Copy ____ File Copy ____

APPENDIX A-4

DATA REPORTS FOR ORGANICS AND METALS ANALYSES OF CCLT LEACHATES

>>> REQUEST FOR ANALYTICAL SERVICES <<<

ACD Request No
OAL 92805

[1]Chain of Custody(1): Yes M
[5]Sample Matrix(15): WATER
[6]Deadline(11):
[7]Project No(4):
[8]Section(10):
[9]Customer Name(20): W. H. GRIEST
MIDC M/S
[10]Charge No(8): 33900213
[12]Cust Dept No(4):
[13]Sampled From(16):
[14]Frequency(12):
[19]Material Description(32):

Comments
Matrix is pH 5.0 water (acidified w/ H_2SO_4/HNO_3); leachates of compost.
Samples are in refrigerator #7, shelf #1 left side (our archival samples are on the rt side!) F-155

NOTE: Customers should pick up samples within 10 days of reporting results. Additional charges may result if Analytical is required to dispose of samples

Compliance Sample? RCRA ( ) NPDES ( ) OTHER ( )
If other, please specify in comments.

ACD Number	[11]Cust Sample ID(15)	[17]Sample Date mm dd yy time	[23]Analysis(30)	Method ID(14)	Detection Limits
890622-027	MESP CC4T 1		SVOA + PCB/Pesticides (no herbicides)		
890622 028	MESP CCLT 2				
890622 ~~030~~ 029	[illegible] THERMO CCLT 1				
890622 ~~031~~ 030	[illegible] THERMO CCLT 2				
890622 ~~032~~ ~~030~~ 031	[illegible] BLANK CCLT				

Rec'd by: RBA
Submitted by / Phone: WH Griest

*Field Halfield Name(No Char)
To arrange E trans of data send E-mail to ... or ... on OA VAX
REV 5/90

2C

WATER SEMIVOLATILE SURROGATE RECOVERY

Lab Name: OAK RIDGE NATIONAL LAB   Contract: NR

Lab Code: OR   Case No.: ORNL   SAS No.: 92905   SDG No.: [illegible]

	EPA SAMPLE NO.	S1 (NBZ) #	S2 (FBP) #	S3 (TPH) #	S4 (PHL) #	S5 (2FP) #	S6 (TBP) #	OTHER	TOT OUT
01	890622-027	42	42 *	42	44	46	[illegible]		[illegible]
02	890622-028	37	39 *	48	26	29	[illegible]		1
03	890622-029	43 *	46 *	50	27	40	45		[illegible]
04	890622-030	31 *	35 *	49	29	33	34		2
05	890622-031	44 *	43 *	49	41	44	46		2
06									
07									
08									
09									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

		QC LIMITS
S1 (NBZ)	= Nitrobenzene-d5	(35-114)
S2 (FBP)	= 2-Fluorobiphenyl	(43-116)
S3 (TPH)	= Terphenyl-d14	(33-141)
S4 (PHL)	= Phenol-d5	(10-94)
S5 (2FP)	= 2-Fluorophenol	(21-100)
S6 (TBP)	= 2,4,6-Tribromophenol	(10-123)

\# Column to be used to flag recovery values

* Values outside of contract required QC limits

D Surrogates diluted out

page 1 of 1

FORM II SV-1   1/87 Rev.

EPA SAMPLE NO.

Semivolatile Organic Analysis Data

MESO CCLT 1

Lab Name: Oak Ridge National Lab   Contract: NR

Lab Code: Case no: ORNL   SAS No: 92805   SDG No: C713

Matrix: (soil/water) WATER   Lab Sample ID: 890622-027

Sample wt/vol: 900 ML   Lab File ID: >C1498

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.79   Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	53.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	53.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	53.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

By Wachter

Date 8/8/89

EPA SAMPLE NO.

MESO CCLT 1

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab   Contract: NR

Lab Code: Case no: ORNL   SAS No: 92805   SDG No: C713

Matrix: (soil/water) WATER   Lab Sample ID: 890622-027

Sample wt/vol: 900 ML   Lab File ID: >C1498

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.79   Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	53.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	53.00	U
100-02-7	4-nitrophenol	53.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	53.00	U
534-52-1	4,6-dinitro-2-methylphenol	53.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	53.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	21.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

REVIEWED
By df Wachter
Date 8/8/89

EPA SAMPLE NO.

MESO CCLT 1

Semivolatile Organic Analysis Data

Request Number: OAL92805

Procedure Number: 8270 Matrix: WATER

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/8/22/89 Lab Sample ID: 890622-027

Sample wt/vol: 900 ML Lab File ID: >C1498

Date Sampled: Date Received 22-Jun-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 13-Jul-1989

Material Description Date of Report: 20-JUL-89

Number TICs found: 9 CONCENTRATION UNITS:
(UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	UNKNOWN	7.11	5	J
2.	UNKNOWN	7.84	3	J
3.	UNKNOWN	8.85	7	J
4.	UNKNOWN	21.05	2	J
5.	TRINITROTOLUENE	24.33	300	J
6.	UNKNOWN	26.58	21	J
7.	UNKNOWN	27.50	4	J
8.	UNKNOWN	28.20	4	J
9.	UNKNOWN	28.27	12	J

REVIEWED
By: dJ Wachte
Date: 8/8/89

EPA SAMPLE NO.

MESO CCLT 2

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab   Contract: NR

Lab Code: Case no: ORNL   SAS No: 92805   SDG No: C713

Matrix: (soil/water) WATER   Lab Sample ID: 890622-028

Sample wt/vol: 900 ML   Lab File ID: >C1499

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.79   Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	53.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	53.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	53.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

B: AJ Wachter

8/8/89

EPA SAMPLE NO.

MESO CCLT 2

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab Contract: NR

Lab Code: Case no: ORNL SAS No: 92805 SDG No: C713

Matrix: (soil/water) WATER Lab Sample ID: 890622-028

Sample wt/vol: 900 ML Lab File ID: >C1499

Level: (low/med) LOW Date Received 22-Jun-1989

% Moisture: not dec. dec. Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N pH: 7.79 Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	53.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	53.00	U
100-02-7	4-nitrophenol	53.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	53.00	U
534-52-1	4,6-dinitro-2-methylphenol	53.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	53.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	21.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	6.00	J
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

Wachter
8/8/89

EPA SAMPLE NO.

MESO CCLT 2

Semivolatile Organic Analysis Data

Request Number: OAL92805

Procedure Number: 8270 Matrix: WATER

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/8/22/89 Lab Sample ID: 890622-028

Sample wt/vol: 900 ML Lab File ID: >C1499

Date Sampled: Date Received 22-Jun-1989 C9:10

% Moisture: not dec. dec: Date Analyzed: 13-Jul-1989

Material Description Date of Report: 20-JUL-89

Number TICs found: 8 CONCENTRATION UNITS:
(UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	UNKNOWN	7.09	30	J
2.	UNKNOWN	7.83	3	J
3.	UNKNOWN	8.83	11	J
4.	UNKNOWN	14.20	3	J
5.	TRINITROTOLUENE	24.31	350	J
6.	UNKNOWN	26.56	24	J
7.	UNKNOWN Amino dinitrotoluene	28.18	4	J
8.	UNKNOWN	28.25	12	J

WHG
1-25-90

REVIEWED
S J Wachter
8/8/89

EPA SAMPLE NO

THERMO CCLT 1

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab   Contract: NR

Lab Code: Case no: ORNL   SAS No: 92805   SDG No: C/13

Matrix: (soil/water) WATER   Lab Sample ID: 890622-029

Sample wt/vol: 900 ML   Lab File ID: >C1500

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.83   Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	53.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	53.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	53.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

8/8/89

EPA SAMPLE NO.

THERMO CCLT 1

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab Contract: NR

Lab Code: Case no: ORNL SAS No: 92805 SDG No: C713

Matrix: (soil/water) WATER Lab Sample ID: 890622-029

Sample wt/vol: 900 ML Lab File ID: >C1500

Level: (low/med) LOW Date Received 22-Jun-1989

% Moisture: not dec. dec. Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N pH: 7.83 Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	53.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	53.00	U
100-02-7	4-nitrophenol	53.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	53.00	U
534-52-1	4,6-dinitro-2-methylphenol	53.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	53.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	21.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	[illegible]00	U

(1) - Cannot be separated from Diphenylamine

REVIEWED

By: AJ Wachter

Date 8/8/89

EPA SAMPLE NO.

| THERMO CCLT 1 |

Semivolatile Organic Analysis Data

Request Number: OAL92805

Procedure Number: 8270 Matrix: WATER

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/8/22/89 Lab Sample ID: 890622-029

Sample wt/vol: 900 ML Lab File ID: >C1500

Date Sampled: Date Received 22-Jun-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 13-Jul-1989

Material Description Date of Report: 20-JUL-89

Number TICs found: 5 CONCENTRATION UNITS:
(UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	UNKNOWN	7.08	21	J
2.	UNKNOWN	7.83	2	J
3.	TRINITROTOLUENE	24.27	120	J
4.	UNKNOWN	26.54	7	J
5.	UNKNOWN Aminodinitrotoluene	27.46	4	J

WHG
1-28-90

REVIEWED
BY Af Wachter
8/8/89

EPA SAMPLE NO.

THERMO CCLT 2

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab   Contract: NR

Lab Code: Case no: ORNL   SAS No: 92805   SDG No: C713

Matrix: (soil/water) WATER   Lab Sample ID: 890622-030

Sample wt/vol: 900 ML   Lab File ID: >C1501

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.91   Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	53.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	53.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	53.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

By

Date 8/8/89

EPA SAMPLE NO.

THERMO CCLT 2

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab Contract: NR

Lab Code: Case no: ORNL SAS No: 92805 SDG No: C713

Matrix: (soil/water) WATER Lab Sample ID: 890622-030

Sample wt/vol: 900 ML Lab File ID: >C1501

Level: (low/med) LOW Date Received 22-Jun-1989

% Moisture: not dec. dec. Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N pH: 7.91 Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	53.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	53.00	U
100-02-7	4-nitrophenol	53.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	53.00	U
534-52-1	4,6-dinitro-2-methylphenol	53.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	53.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	21.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

REVIEWED

AJ Wachter

8/8/89

EPA SAMPLE NO.

THERMO CCLT 2

Semivolatile Organic Analysis Data

Request Number: OAL92805

Procedure Number: 8270 Matrix: WATER

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/8/22/89 Lab Sample ID: 890622-030

Sample wt/vol: 900 ML Lab File ID: >C1501

Date Sampled: Date Received 22-Jun-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 13-Jul-1989

Material Description Date of Report: 20-JUL-89

Number TICs found: 6 CONCENTRATION UNITS:
(UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	UNKNOWN	7.09	40	J
2.	UNKNOWN	7.82	3	J
3.	TRINITROTOLUENE	24.27	85	J
4.	UNKNOWN	26.53	6	J
5.	UNKNOWN Aminodinitrotoluene	27.46	3	J
6.	UNKNOWN	29.06	3	J

W46
1-28-90

REVIEWED
Wachter
8/8/89

EPA SAMPLE NO.

BLANK CCLT

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab Contract: NR

Lab Code: Case no: ORNL SAS No: 92805 SDG No: C713

Matrix: (soil/water) WATER Lab Sample ID: 890622-031

Sample wt/vol: 900 ML Lab File ID: >C1502

Level: (low/med) LOW Date Received 22-Jun-1989

% Moisture: not dec. dec. Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N pH: 7.21 Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
108-95-2	phenol	11.00	U
111-44-4	bis(2-chloroethyl)ether	11.00	U
95-57-8	2-chlorophenol	11.00	U
541-73-1	1,3-dichlorobenzene	11.00	U
106-46-7	1,4-dichlorobenzene	11.00	U
100-51-6	benzyl alcohol	11.00	U
95-50-1	1,2-dichlorobenzene	11.00	U
95-48-7	2-methylphenol	11.00	U
108-60-1	bis(2-chloroisopropyl)ether	11.00	U
106-44-5	4-methylphenol	11.00	U
621-64-7	n-nitroso-di-n-propylamine	11.00	U
67-72-1	hexachloroethane	11.00	U
98-95-3	nitrobenzene	11.00	U
78-59-1	isophorone	11.00	U
88-75-5	2-nitrophenol	11.00	U
105-67-9	2,4-dimethylphenol	11.00	U
65-85-0	benzoic acid	53.00	U
111-91-1	bis(2-chloroethoxy)methane	11.00	U
120-83-2	2,4-dichlorophenol	11.00	U
120-82-1	1,2,4-trichlorobenzene	11.00	U
91-20-3	naphthalene	11.00	U
106-47-8	4-chloroaniline	11.00	U
87-68-3	hexachlorobutadiene	11.00	U
59-50-7	4-chloro-3-methylphenol	11.00	U
91-57-6	2-methylnaphthalene	11.00	U
77-47-4	hexachlorocyclopentadiene	11.00	U
88-06-2	2,4,6-trichlorophenol	11.00	U
95-95-4	2,4,5-trichlorophenol	53.00	U
91-58-7	2-chloronaphthalene	11.00	U
88-74-4	2-nitroaniline	53.00	U
131-11-3	dimethylphthalate	11.00	U
208-96-8	acenaphthylene	11.00	U
606-20-2	2,6-dinitrotoluene	11.00	U

REVIEWED

By

Date 8/8/89

EPA SAMPLE NO.

BLANK CCLT

Semivolatile Organic Analysis Data

Lab Name: Oak Ridge National Lab Contract: NR

Lab Code: Case no: ORNL SAS No: 92805 SDG No: C713

Matrix: (soil/water) WATER Lab Sample ID: 890622-031

Sample wt/vol: 900 ML Lab File ID: >C1502

Level: (low/med) LOW Date Received 22-Jun-1989

% Moisture: not dec. dec. Date Analyzed: 13-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N pH: 7.21 Dilution Factor: 1.05

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
99-09-2	3-nitroaniline	53.00	U
83-32-9	acenaphthene	11.00	U
51-28-5	2,4-dinitrophenol	53.00	U
100-02-7	4-nitrophenol	53.00	U
132-64-9	dibenzofuran	11.00	U
121-14-2	2,4-dinitrotoluene	11.00	U
84-66-2	diethylphthalate	11.00	U
7005-72-3	4-chlorophenyl-phenylether	11.00	U
86-73-7	fluorene	11.00	U
100-01-6	4-nitroaniline	53.00	U
534-52-1	4,6-dinitro-2-methylphenol	53.00	U
86-30-6	n-nitrosodiphenylamine (1)	11.00	U
101-55-3	4-bromophenyl-phenylether	11.00	U
118-74-1	hexachlorobenzene	11.00	U
87-86-5	pentachlorophenol	53.00	U
85-01-8	phenanthrene	11.00	U
120-12-7	anthracene	11.00	U
84-74-2	di-n-butylphthalate	11.00	U
206-44-0	fluoranthene	11.00	U
129-00-0	pyrene	11.00	U
85-68-7	butylbenzylphthalate	11.00	U
91-94-1	3,3'-dichlorobenzidine	21.00	U
56-55-3	benzo(a)anthracene	11.00	U
218-01-9	chrysene	11.00	U
117-81-7	bis(2-ethylhexyl)phthalate	11.00	U
117-84-0	di-n-octylphthalate	11.00	U
205-99-2	benzo(b)fluoranthene	11.00	U
207-08-9	benzo(k)fluoranthene	11.00	U
50-32-8	benzo(a)pyrene	11.00	U
193-39-5	indeno(1,2,3-cd)pyrene	11.00	U
53-70-3	dibenz(a,h)anthracene	11.00	U
191-24-2	benzo(g,h,i)perylene	11.00	U

(1) - Cannot be separated from Diphenylamine

REVIEWED
By Wachter
Date 8/8/89

EPA SAMPLE NO.

BLANK CCLT

Semivolatile Organic Analysis Data

Request Number: 0AL92805

Procedure Number: 8270 Matrix: WATER

Series: Frequency: Charge Number: 33900213

Customer Name: GRIEST/8/22/89 Lab Sample ID: 890622-031

Sample wt/vol: 900 ML Lab File ID: >C1502

Date Sampled: Date Received 22-Jun-1989 09:10

% Moisture: not dec. dec: Date Analyzed: 13-Jul-1989

Material Description Date of Report: 20-JUL-89

Number TICs found: 2 CONCENTRATION UNITS: (UG/L or UG/KG) UG/L

CAS NO.	COMPOUND NAME	RT	CONC	Q
1.	UNKNOWN	7.10	9	J
2.	UNKNOWN	7.82	3	J

REVIEWED

Wachter

8/8/89

2E

WATER PESTICIDE SURROGATE RECOVERY

LAB NAME: OAK RIDGE NATIONAL LABORATORY CONTRACT: NA

LAB CODE: ORNL CASE NO.: NA SAS NO.:NA SDG NO.: 2805R

	EPA SAMPLE NO.	S1 (DCBP)	#	OTHER	#
1	MESO CCLT1	83			
2	MESO CCLT 2	77			
3	THERMO CCLT 1	87			
4	THERMO CCLT 2	71			
5	BLANK CCLT	71			
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

ADVISORY QC LIMITS (20-150)

S1 (DCBP)= Decachlorobiphenyl
Column used to flag recovery values
* Value outside QC limits
+ No surrogate detected in sample
D Surrogates diluted out

EPA SAMPLE NO.

MESO CCLT 1

CCLT Leachate
of NR
Mesophilic Compost
Aliquot 1

LWNG
5-24-8

Lab Name: Oak Ridge National Lab   Contract: ORNL

Lab Code: Case no: 92805   SAS No: 2805R   SDG No: ✓

Matrix: (soil/water) WATER   Lab Sample ID: 890622-027

Sample wt/vol: 900 ML   Lab File ID: NR

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 14-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.8   Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	ALPHA-BHC	0.06	U
319-85-7	BETA-BHC	0.24	J
319-86-8	DELTA-BHC	0.06	U
58-89-9	GAMMA-BHC (LINDANE)	0.19	
76-44-8	HEPTACHLOR	0.06	U
309-00-2	ALDRIN	0.06	U
1024-57-3	HEPTACHLOR EPOXIDE	0.06	U
959-98-8	ENDOSULFAN I	0.06	U
60-57-1	DIELDRIN	0.01	J
72-55-9	4,4'-DDE	0.11	U
72-20-8	ENDRIN	0.11	U
33213-65-9	ENDOSULFAN II	0.11	U
72-54-8	4,4'-DDD	0.11	U
1031-07-8	ENDOSULFAN SULFATE	0.11	U
50-29-3	4,4'-DDT	0.11	U
72-43-5	METHOXYCHLOR	0.60	U
53494-70-5	ENDRIN KETONE	0.11	U
5103-71-9	ALPHA CHLORDANE	0.60	U
5103-74-2	GAMMA CHLORDANE	0.12	
8001-35-2	TOXAPHENE	1.10	U
12674-11-2	AROCLOR-1016	0.60	U
11104-28-2	AROCLOR-1221	0.60	U
11141-16-5	AROCLOR-1232	0.60	U
53469-21-9	AROCLOR-1242	0.60	U
12672-29-6	AROCLOR-1248	0.60	U
11097-69-1	AROCLOR-1254	1.10	U
11096-82-5	AROCLOR-1260	1.10	U

REVIEWED
By: S J Wachter
Date 8/8/89

EPA SAMPLE NO.

MESO CCLT 2

CCLT Leachate of NR
Mesophilic Compost
(Aliquot 2)
wh16
5-21-90

Lab Name: Oak Ridge National Lab   Contract: ORNL

Lab Code: Case no: 92805   SAS No: 2805R   SDG No:

Matrix: (soil/water) WATER   Lab Sample ID: 890622-028

Sample wt/vol: 900 ML   Lab File ID: NR

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 14-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.8   Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	ALPHA-BHC	0.06	U
319-85-7	BETA-BHC	0.40	
319-86-8	DELTA-BHC	0.06	U
58-89-9	GAMMA-BHC (LINDANE)	0.30	
76-44-8	HEPTACHLOR	0.02	J
309-00-2	ALDRIN	0.06	U
1024-57-3	HEPTACHLOR EPOXIDE	0.06	U
959-98-8	ENDOSULFAN I	0.06	U
60-57-1	DIELDRIN	0.01	J
72-55-9	4,4'-DDE	0.11	U
72-20-8	ENDRIN	0.11	U
33213-65-9	ENDOSULFAN II	0.11	U
72-54-8	4,4'-DDD	0.11	U
1031-07-8	ENDOSULFAN SULFATE	0.11	U
50-29-3	4,4'-DDT	0.11	U
72-43-5	METHOXYCHLOR	0.60	U
53494-70-5	ENDRIN KETONE	0.11	U
5103-71-9	ALPHA CHLORDANE	0.60	U
5103-74-2	GAMMA CHLORDANE	0.12	
8001-35-2	TOXAPHENE	1.10	U
12674-11-2	AROCLOR-1016	0.60	U
11104-28-2	AROCLOR-1221	0.60	U
11141-16-5	AROCLOR-1232	0.60	U
53469-21-9	AROCLOR-1242	0.60	U
12672-29-6	AROCLOR-1248	0.60	U
11097-69-1	AROCLOR-1254	1.10	U
11096-82-5	AROCLOR-1260	1.10	U

REVIEWED

Wachter

DATE 8/8/89

EPA SAMPLE NO.

THERMO CCLT 1

CCLT Leachate
of NR
Thermophilic Compost
(Aliquot 1)
WHG
5-24-90

Lab Name: Oak Ridge National Lab   Contract: ORNL

Lab Code: Case no: 92805   SAS No: 2805R   SDG No:

Matrix: (soil/water) WATER   Lab Sample ID: 890622-029

Sample wt/vol: 900 ML   Lab File ID: NR

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 14-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.8   Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	ALPHA-BHC	0.06	U
319-85-7	BETA-BHC	0.33	
319-86-8	DELTA-BHC	0.06	U
58-89-9	GAMMA-BHC (LINDANE)	0.18	
76-44-8	HEPTACHLOR	0.06	U
309-00-2	ALDRIN	0.06	U
1024-57-3	HEPTACHLOR EPOXIDE	0.06	U
959-98-8	ENDOSULFAN I	0.06	U
60-57-1	DIELDRIN	0.01	J
72-55-9	4,4'-DDE	0.11	U
72-20-8	ENDRIN	0.11	U
33213-65-9	ENDOSULFAN II	0.11	U
72-54-8	4,4'-DDD	0.11	U
1031-07-8	ENDOSULFAN SULFATE	0.11	U
50-29-3	4,4'-DDT	0.11	U
72-43-5	METHOXYCHLOR	0.60	U
53494-70-5	ENDRIN KETONE	0.11	U
5103-71-9	ALPHA CHLORDANE	0.60	U
5103-74-2	GAMMA CHLORDANE	0.06	J
8001-35-2	TOXAPHENE	1.10	U
12674-11-2	AROCLOR-1016	0.60	U
11104-28-2	AROCLOR-1221	0.60	U
11141-16-5	AROCLOR-1232	0.60	U
53469-21-9	AROCLOR-1242	0.60	U
12672-29-6	AROCLOR-1248	0.60	U
11097-69-1	AROCLOR-1254	1.10	U
11096-82-5	AROCLOR-1260	1.10	U

REVIEWED
By LJ Wachter
Date 8/8/89

EPA SAMPLE NO.

THERMO CCLT 2

CCLT Leachate
of NR
Thermophilic Compost
(Aliquot C) WRG
1-18-90

Lab Name: Oak Ridge National Lab Contract: ORNL

Lab Code: Case no: 92805 SAS No: 2805R SDG No:

Matrix: (soil/water) WATER Lab Sample ID: 890622-030

Sample wt/vol: 900 ML Lab File ID: NR

Level: (low/med) LOW Date Received 22-Jun-1989

% Moisture: not dec. dec. Date Analyzed: 14-Jul-1989

Extraction: (Sepf/Cont/Sonc) CONT Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N pH: 7.9 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	ALPHA-BHC	0.06	U
319-85-7	BETA-BHC	0.30	
319-86-8	DELTA-BHC	0.06	U
58-89-9	GAMMA-BHC (LINDANE)	0.17	
76-44-8	HEPTACHLOR	0.01	J
309-00-2	ALDRIN	0.06	U
1024-57-3	HEPTACHLOR EPOXIDE	0.06	U
959-98-8	ENDOSULFAN I	0.06	U
60-57-1	DIELDRIN	0.01	J
72-55-9	4,4'-DDE	0.11	U
72-20-8	ENDRIN	0.11	U
33213-65-9	ENDOSULFAN II	0.11	U
72-54-8	4,4'-DDD	0.11	U
1031-07-8	ENDOSULFAN SULFATE	0.11	U
50-29-3	4,4'-DDT	0.11	U
72-43-5	METHOXYCHLOR	0.60	U
53494-70-5	ENDRIN KETONE	0.11	U
5103-71-9	ALPHA CHLORDANE	0.60	U
5103-74-2	GAMMA CHLORDANE	0.04	J
8001-35-2	TOXAPHENE	1.10	U
12674-11-2	AROCLOR-1016	0.60	U
11104-28-2	AROCLOR-1221	0.60	U
11141-16-5	AROCLOR-1232	0.60	U
53469-21-9	AROCLOR-1242	0.60	U
12672-29-6	AROCLOR-1248	0.60	U
11097-69-1	AROCLOR-1254	1.10	U
11096-82-5	AROCLOR-1260	1.10	U

REVIEWED

JF Wachter

Date 8/8/89

EPA SAMPLE NO.

BLANK CCLT

CCLT Blank
NR WHG
1-23-90

Lab Name: Oak Ridge National Lab   Contract: ORNL

Lab Code: Case no: 92805   SAS No: 2805R   SDG No:

Matrix: (soil/water) WATER   Lab Sample ID: 890622-031

Sample wt/vol: 900 ML   Lab File ID: NR

Level: (low/med) LOW   Date Received 22-Jun-1989

% Moisture: not dec.   dec.   Date Analyzed: 14-Jul-1989

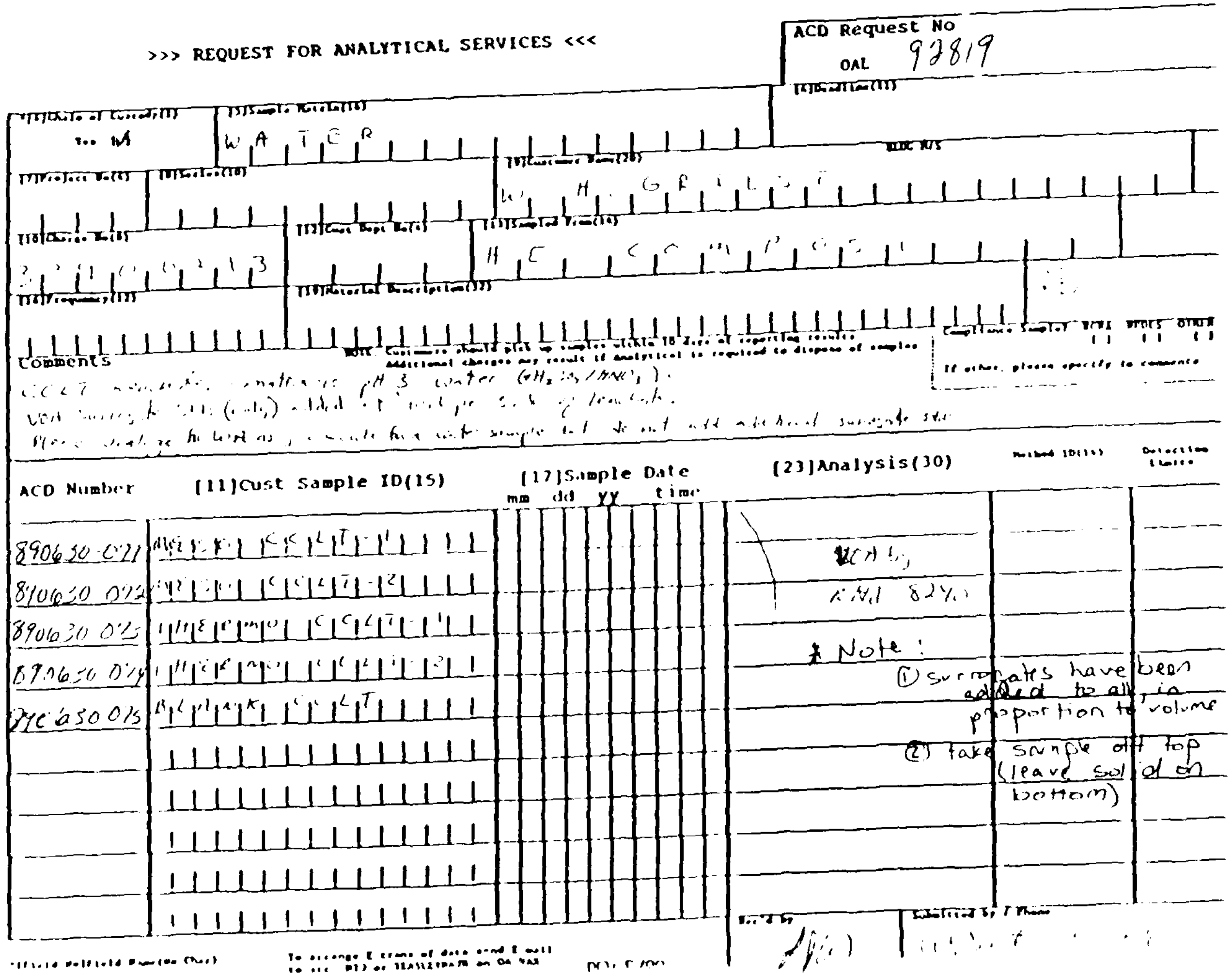
Extraction: (Sepf/Cont/Sonc) CONT   Date Extracted: 26-Jun-1989

GPC Cleanup: (Y/N) N   pH: 7.2   Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	ALPHA-BHC	0.06	U
319-85-7	BETA-BHC	0.06	U
319-86-8	DELTA-BHC	0.06	U
58-89-9	GAMMA-BHC (LINDANE)	0.06	U
76-44-8	HEPTACHLOR	0.06	U
309-00-2	ALDRIN	0.06	U
1024-57-3	HEPTACHLOR EPOXIDE	0.06	U
959-98-8	ENDOSULFAN I	0.06	U
60-57-1	DIELDRIN	0.11	U
72-55-9	4,4'-DDE	0.11	U
72-20-8	ENDRIN	0.11	U
33213-65-9	ENDOSULFAN II	0.11	U
72-54-8	4,4'-DDD	0.11	U
1031-07-8	ENDOSULFAN SULFATE	0.11	U
50-29-3	4,4'-DDT	0.11	U
72-43-5	METHOXYCHLOR	0.60	U
53494-70-5	ENDRIN KETONE	0.11	U
5103-71-9	ALPHA CHLORDANE	0.60	U
5103-74-2	GAMMA CHLORDANE	0.60	U
8001-35-2	TOXAPHENE	1.10	U
12674-11-2	AROCLOR-1016	0.60	U
11104-28-2	AROCLOR-1221	0.60	U
11141-16-5	AROCLOR-1232	0.60	U
53469-21-9	AROCLOR-1242	0.60	U
12672-29-6	AROCLOR-1248	0.60	U
11097-69-1	AROCLOR-1254	1.10	U
11096-82-5	AROCLOR-1260	1.10	U

REVIEWED

Date 8/8/89



>>> REQUEST FOR ANALYTICAL SERVICES <<<

ACD Request No
OAL 92819

[4]Deadline(11)

[5]Sample Matrix(15) WATER

[7]Project No(5)

[8]Section(10)

[9]Customer Name(20) W H GRIL[illegible]

BLDG R/S

[10]Charge No(8) [illegible]3

[12]Cust Dept No(4)

[13]Sampled From(14) H C COMPOS[illegible]

[14]Frequency(12)

[19]Material Description(32)

NOTE: Customers should pick up samples within 10 days of reporting results. Additional charges may result if analytical is required to dispose of samples

Compliance Sample? RCRA [ ] NPDES [ ] OTHER [ ]

If other, please specify in comments

Comments
[illegible] pH 3 water (+H₂SO₄/HNO₃).
VOA [illegible] added [illegible]
Please analyze [illegible] surrogate std

ACD Number	[11]Cust Sample ID(15)	[17]Sample Date mm dd yy time	[23]Analysis(30)	Method ID(15)	Detection Limits
890630-021	[illegible] CCLT-1				
890630-022	[illegible] CCLT-2		[illegible]		
890630-023	[illegible] CCLT-1		[illegible] 82%		
890630-024	[illegible] CCLT-2		* Note:		
890630-025	BLANK CCLT		① surrogates have been added to all, in proportion to volume		
			② take sample off top (leave solid on bottom)		

Rec'd by

Submitted by / Phone

[illegible]

To arrange E trans of data send E mail to [illegible] on OA VAX

2A
WATER VOLATILE SURROGATE RECOVERY

b Name:OAK RIDGE NATIONAL LAB　　Contract:1.0

b Code: NR　　Case No.: ORNL　　SAS No.: NR　　SDG No.: G711

	EPA SAMPLE NO.	S1 (TOL) #	S2 (BFB) #	S3 (DCE) #	OTHER	TOT OUT
01	VBLK630	94	101	94		0
02	890707-033	106	99	106		0
03	890630-071	35 ~~84~~ *	38 *	84		2
04	890630-072	39 ~~87~~ *	44 *	87		2
05	890630-074	7 ~~86~~ *	46 *	86		2
06	890630-075	88	86 ~~*~~	88		~~1~~ 0
07						
08						
09						
10						
11						
12						
13						
14						
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30						

*NOTE:SAMPLES THAT ARE OUT OF CONTROL WERE PRESPIKED BY CUSTOMER.

MDG
7/17/94

		QC LIMITS
S1 (TOL)	= Toluene-d8	(88-110)
S2 (BFB)	= Bromofluorobenzene	(86-115)
S3 (DCE)	= 1,2-Dichloroethane-d4	(76-114)

\# Column to be used to flag recovery values

* Values outside of contract required QC limits

D Surrogates diluted out

ge 1 of 1

FORM II VOA-1　　1/87 Rev.

MDG
[illegible]

2A

WATER VOLATILE SURROGATE RECOVERY

Lab Name:OAK RIDGE NATIONAL LAB Contract:16667

Lab Code: NR Case No.: ORNL SAS No.: NR SDG No.: G712

	EPA SAMPLE NO.	S1 (TOL) #	S2 (BFB) #	S3 (DCE) #	OTHER	TOT OUT
01	VBLK630	99	99	98		0
02	890630-073	11 *	37 *	79		2
03	890629-051	99	95	100		0
04	890706-105	109	101	92		0
05						
06						
07						
08						
09						
10						
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17						
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24						
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26						
27						
28						
29						
30						

*SAMPLE WAS PRESPIKED BY CUSTOMER.

		QC LIMITS
S1 (TOL)	= Toluene-d8	(88-110)
S2 (BFB)	= Bromofluorobenzene	(86-115)
S3 (DCE)	= 1,2-Dichloroethane-d4	(76-114)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D Surrogates diluted out

age 1 of 1

FORM II VOA-1 1/87 Rev.

MOE
7/17/89

EPA SAMPLE NO.

MESO CCLT-1

VOLATILE ORGANICS ANALYSIS DATA SHEET

Lab Name: Oak Ridge National Lab   Contract: NR

Lab Code: Case no: ORNL   SAS No: 92819   SDG No: G711

Matrix: (soil/water) WATER   Lab Sample ID: 890630-071

Sample wt/vol: 5 ML   Lab File ID: >G0004

Level: (low/med) LOW   Date Received 30-Jun-1989

% Moisture: not dec.   Date Analyzed: 11-Jul-1989

Column: (pack/cap) PACK   Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
74-87-3	chloromethane	10.00	U
74-83-9	bromomethane	10.00	U
75-01-4	vinyl chloride	10.00	U
75-00-3	chloroethane	10.00	U
75-09-2	methylene chloride	9.00	B
67-64-1	acetone	15.00	B
75-15-0	carbon disulfide	5.00	U
75-35-4	1,1-dichloroethene	5.00	U
75-34-3	1,1-dichloroethane	5.00	U
540-59-0	1,2-dichloroethene (total)	5.00	U
67-66-3	chloroform	2.00	J
107-06-2	1,2-dichloroethane	5.00	U
78-93-3	2-butanone	10.00	U
71-55-6	1,1,1-trichloroethane	5.00	U
56-23-5	carbon tetrachloride	5.00	U
108-05-4	vinyl acetate	10.00	U
75-27-4	bromodichloromethane	5.00	U
78-87-5	1,2-dichloropropane	5.00	U
10061-01-5	cis-1,3-dichloropropene	5.00	U
79-01-6	trichloroethene	5.00	U
124-48-1	dibromochloromethane	5.00	U
79-00-5	1,1,2-trichloroethane	5.00	U
71-43-2	benzene	5.00	U
10061-02-06	trans-1,3-dichloropropene	5.00	U
75-25-2	bromoform	5.00	U
108-10-1	4-methyl-2-pentanone	10.00	U
591-78-6	2-hexanone	10.00	U
127-18-4	tetrachloroethene	5.00	U
79-34-5	1,1,2,2-tetrachloroethane	5.00	U
108-88-3	toluene	5.00	U
108-90-7	chlorobenzene	5.00	U
100-41-4	ethylbenzene	5.00	U
100-42-5	styrene	5.00	U
1330-20-7	xylene (total)	5.00	U

REVIEWED

By

Date 8/8/89

EPA SAMPLE NO.

VOLATILE ORGANICS ANALYSIS DATA SHEET

MESO CCLT-2

Lab Name: Oak Ridge National Lab Contract: NR

Lab Code: Case no: ORNL SAS No: 92819 SDG No: G711

Matrix: (soil/water) WATER Lab Sample ID: 890630-072

Sample wt/vol: 5 ML Lab File ID: >G0005

Level: (low/med) LOW Date Received 30-Jun-1989

% Moisture: not dec. Date Analyzed: 11-Jul-1989

Column: (pack/cap) PACK Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
74-87-3	chloromethane	10.00	U
74-83-9	bromomethane	10.00	U
75-01-4	vinyl chloride	10.00	U
75-00-3	chloroethane	10.00	U
75-09-2	methylene chloride	35.00	B
67-64-1	acetone	19.00	B
75-15-0	carbon disulfide	5.00	U
75-35-4	1,1-dichloroethene	5.00	U
75-34-3	1,1-dichloroethane	5.00	U
540-59-0	1,2-dichloroethene (total)	5.00	U
67-66-3	chloroform	2.00	J
107-06-2	1,2-dichloroethane	5.00	U
78-93-3	2-butanone	10.00	U
71-55-6	1,1,1-trichloroethane	5.00	U
56-23-5	carbon tetrachloride	5.00	U
108-05-4	vinyl acetate	10.00	U
75-27-4	bromodichloromethane	5.00	U
78-87-5	1,2-dichloropropane	5.00	U
10061-01-5	cis-1,3-dichloropropene	5.00	U
79-01-6	trichloroethene	5.00	U
124-48-1	dibromochloromethane	5.00	U
79-00-5	1,1,2-trichloroethane	5.00	U
71-43-2	benzene	5.00	U
10061-02-06	trans-1,3-dichloropropene	5.00	U
75-25-2	bromoform	5.00	U
108-10-1	4-methyl-2-pentanone	10.00	U
591-78-6	2-hexanone	10.00	U
127-18-4	tetrachloroethene	5.00	U
79-34-5	1,1,2,2-tetrachloroethane	5.00	U
108-88-3	toluene	5.00	U
108-90-7	chlorobenzene	5.00	U
100-41-4	ethylbenzene	5.00	U
100-42-5	styrene	5.00	U
1330-20-7	xylene (total)	5.00	U

REVIEWED

By AJ Wachter

Date 8/8/89

EPA SAMPLE NO.

VOLATILE ORGANICS ANALYSIS DATA SHEET

THERMO CCLT-1

Lab Name: Oak Ridge National Lab   Contract: NR

Lab Code: Case no: ORNL   SAS No: 92819   SDG No: G712

Matrix: (soil/water) WATER   Lab Sample ID: 890630-073

Sample wt/vol: 5 ML   Lab File ID: >G0012

Level: (low/med) LOW   Date Received 30-Jun-1989

% Moisture: not dec.   Date Analyzed: 12-Jul-1989

Column: (pack/cap) PACK   Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
74-87-3	chloromethane	10.00	U
74-83-9	bromomethane	10.00	U
75-01-4	vinyl chloride	10.00	U
75-00-3	chloroethane	10.00	U
75-09-2	methylene chloride	13.00	B
67-64-1	acetone	9.00	JB
75-15-0	carbon disulfide	5.00	U
75-35-4	1,1-dichloroethene	5.00	U
75-34-3	1,1-dichloroethane	5.00	U
540-59-0	1,2-dichloroethene (total)	5.00	U
67-66-3	chloroform	1.00	J
107-06-2	1,2-dichloroethane	5.00	U
78-93-3	2-butanone	10.00	U
71-55-6	1,1,1-trichloroethane	5.00	U
56-23-5	carbon tetrachloride	5.00	U
108-05-4	vinyl acetate	10.00	U
75-27-4	bromodichloromethane	5.00	U
78-87-5	1,2-dichloropropane	5.00	U
10061-01-5	cis-1,3-dichloropropene	5.00	U
79-01-6	trichloroethene	5.00	U
124-48-1	dibromochloromethane	5.00	U
79-00-5	1,1,2-trichloroethane	5.00	U
71-43-2	benzene	5.00	U
10061-02-06	trans-1,3-dichloropropene	5.00	U
75-25-2	bromoform	5.00	U
108-10-1	4-methyl-2-pentanone	10.00	U
591-78-6	2-hexanone	10.00	U
127-18-4	tetrachloroethene	5.00	U
79-34-5	1,1,2,2-tetrachloroethane	5.00	U
108-88-3	toluene	5.00	U
108-90-7	chlorobenzene	5.00	U
100-41-4	ethylbenzene	5.00	U
100-42-5	styrene	5.00	U
1330-20-7	xylene (total)	5.00	U

REVIEWED

By:

Date 8/8/89

EPA SAMPLE NO.

THERMO CCLT-2

VOLATILE ORGANICS ANALYSIS DATA SHEET

Lab Name: Oak Ridge National Lab   Contract: NR

Lab Code: Case no: ORNL   SAS No: 92819   SDG No: G711

Matrix: (soil/water) WATER   Lab Sample ID: 890630-074

Sample wt/vol: 5 ML   Lab File ID: >G0007

Level: (low/med) LOW   Date Received 30-Jun-1989

% Moisture: not dec.   Date Analyzed: 11-Jul-1989

Column: (pack/cap) PACK   Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
74-87-3	chloromethane	10.00	U
74-83-9	bromomethane	10.00	U
75-01-4	vinyl chloride	10.00	U
75-00-3	chloroethane	10.00	U
75-09-2	methylene chloride	13.00	B
67-64-1	acetone	19.00	B
75-15-0	carbon disulfide	5.00	U
75-35-4	1,1-dichloroethene	5.00	U
75-34-3	1,1-dichloroethane	5.00	U
540-59-0	1,2-dichloroethene (total)	5.00	U
67-66-3	chloroform	1.00	J
107-06-2	1,2-dichloroethane	5.00	U
78-93-3	2-butanone	10.00	U
71-55-6	1,1,1-trichloroethane	5.00	U
56-23-5	carbon tetrachloride	5.00	U
108-05-4	vinyl acetate	10.00	U
75-27-4	bromodichloromethane	5.00	U
78-87-5	1,2-dichloropropane	5.00	U
10061-01-5	cis-1,3-dichloropropene	5.00	U
79-01-6	trichloroethene	5.00	U
124-48-1	dibromochloromethane	5.00	U
79-00-5	1,1,2-trichloroethane	5.00	U
71-43-2	benzene	5.00	U
10061-02-06	trans-1,3-dichloropropene	5.00	U
75-25-2	bromoform	5.00	U
108-10-1	4-methyl-2-pentanone	10.00	U
591-78-6	2-hexanone	10.00	U
127-18-4	tetrachloroethene	5.00	U
79-34-5	1,1,2,2-tetrachloroethane	5.00	U
108-88-3	toluene	5.00	U
108-90-7	chlorobenzene	5.00	U
100-41-4	ethylbenzene	5.00	U
100-42-5	styrene	5.00	U
1330-20-7	xylene (total)	5.00	U

REVIEWED

By

Date 8/8/89

EPA SAMPLE NO.

VOLATILE ORGANICS ANALYSIS DATA SHEET

BLANK CCLT

Lab Name: Oak Ridge National Lab Contract: NR

Lab Code: Case no: ORNL SAS No: 92819 SDG No: G711

Matrix: (soil/water) WATER Lab Sample ID: 890630-075

Sample wt/vol: 5 ML Lab File ID: >G0008

Level: (low/med) LOW Date Received 30-Jun-1989

% Moisture: not dec. Date Analyzed: 11-Jul-1989

Column: (pack/cap) PACK Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L or UG/KG) UG/L	Q
74-87-3	chloromethane	10.00	U
74-83-9	bromomethane	10.00	U
75-01-4	vinyl chloride	10.00	U
75-00-3	chloroethane	10.00	U
75-09-2	methylene chloride	8.00	B
67-64-1	acetone	23.00	B
75-15-0	carbon disulfide	5.00	U
75-35-4	1,1-dichloroethene	5.00	U
75-34-3	1,1-dichloroethane	5.00	U
540-59-0	1,2-dichloroethene (total)	5.00	U
67-66-3	chloroform	2.00	J
107-06-2	1,2-dichloroethane	5.00	U
78-93-3	2-butanone	10.00	U
71-55-6	1,1,1-trichloroethane	5.00	U
56-23-5	carbon tetrachloride	5.00	U
108-05-4	vinyl acetate	10.00	U
75-27-4	bromodichloromethane	5.00	U
78-87-5	1,2-dichloropropane	5.00	U
10061-01-5	cis-1,3-dichloropropene	5.00	U
79-01-6	trichloroethene	5.00	U
124-48-1	dibromochloromethane	5.00	U
79-00-5	1,1,2-trichloroethane	5.00	U
71-43-2	benzene	5.00	U
10061-02-06	trans-1,3-dichloropropene	5.00	U
75-25-2	bromoform	5.00	U
108-10-1	4-methyl-2-pentanone	10.00	U
591-78-6	2-hexanone	10.00	U
127-18-4	tetrachloroethene	5.00	U
79-34-5	1,1,2,2-tetrachloroethane	5.00	U
108-88-3	toluene	5.00	U
108-90-7	chlorobenzene	5.00	U
100-41-4	ethylbenzene	5.00	U
100-42-5	styrene	5.00	U
1330-20-7	xylene (total)	5.00	U

REVIEWED

By

Date 8/8/89

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                  Oak Ridge National Laboratory                                   CPA9711        Page    1
                  Analytical Chemistry Division
                       Results of Analyses
                 Chemical and Physical Analysis

Customer Name      W.M. GRIEST                Date Received       22-Jun-1989 09:45
Request Number     CPA9711                    Charge Number       339002:3       Approved By J.C. Price
Project Number                                Dept Number         3390
Series                                        Date of Report       9-AUG-89             Date 8-9-89

|Analy No. Customers Id   Date/Time Sampled  |
|Matrix       Material Desc.                 |
|Frequency                                   | Analysis                          Result    Units      Procedure No     Completed
-----------------------------------------------------------------------------------------------------------------------------------
|890622-036 MESO CCLT 1                      |
|WATER                                       |
|                                            |
                                               AG                              < 1.0E-02   MG/L       EPA 200.7        14-Jul-1989
                                               AL                                4.5E+01   MG/L       EPA 200.7        14-Jul-1989
                                               AS                              < 1.0E-01   MG/L       EPA 200.7        14-Jul-1989
                                               BA                                6.8E-01   MG/L       EPA 200.7        14-Jul-1989
                                               BE                              < 8.0E-04   MG/L       EPA 200.7        14-Jul-1989
                                               CA                                7.2E+00   MG/L       EPA 200.7        14-Jul-1989
                                               CD                              < 4.0E-03   MG/L       EPA 200.7        14-Jul-1989
                                               CO                                6.1E-03   MG/L       EPA 200.7        14-Jul-1989
                                               CR                                4.8E-02   MG/L       EPA 200.7        14-Jul-1989
                                               CU                                4.7E-02   MG/L       EPA 200.7        14-Jul-1989
                                               FE                                7.3E+00   MG/L       EPA 200.7        14-Jul-1989
                                               LI                              < 3.0E+01   MG/L       EPA 200.7        14-Jul-1989
                                               MG                                6.3E+00   MG/L       EPA 200.7        14-Jul-1989
                                               MN                                2.2E-01   MG/L       EPA 200.7        14-Jul-1989
                                               MO                              < 8.0E-02   MG/L       EPA 200.7        14-Jul-1989
                                               NA                                2.9E+01   MG/L       EPA 200.7        14-Jul-1989
                                               NI                                2.5E-02   MG/L       EPA 200.7        14-Jul-1989
                                               P                                 1.1E+01   MG/L       EPA 200.7        14-Jul-1989
                                               PB                              < 6.0E-02   MG/L       EPA 200.7        14-Jul-1989
                                               SB                                1.4E-01   MG/L       EPA 200.7        14-Jul-1989
                                               SE                              < 1.6E-01   MG/L       EPA 200.7        14-Jul-1989
                                               SI                                1.2E+02   MG/L       EPA 200.7        14-Jul-1989
                                               SN                              < 1.0E-01   MG/L       EPA 200.7        14-Jul-1989
                                               SR                                5.2E-02   MG/L       EPA 200.7        14-Jul-1989
                                               TI                                1.1E+00   MG/L       EPA 200.7        14-Jul-1989
                                               V                                 7.3E-02   MG/L       EPA 200.7        14-Jul-1989
                                               ZN                                4.5E-01   MG/L       EPA 200.7        14-Jul-1989
                                               ZR                                6.0E-02   MG/L       EPA 200.7        14-Jul-1989
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                                                                                CPA9711       Page     2

|Analy No. Customers Id   Date/Time Sampled  |
|Matrix       Material Desc.                 |
|Frequency                                   | Analysis                      Result    Units       Procedure No    Completed
----------------------------------------------------------------   --------------------------------------------------------
|890622-037 MESO CCLT 2                      |
|WATER                                       |
|                                            |
                                              AG                        < 1.0E-02   MG/L        EPA 200.7       14-Jul-1989
                                              AL                          3.5E+01   MG/L        EPA 200.7       14-Jul-1989
                                              AS                        < 1.0E-01   MG/L        EPA 200.7       14-Jul-1989
                                              BA                          5.8E-01   MG/L        EPA 200.7       14-Jul-1989
                                              BE                        < 8.0E-04   MG/L        EPA 200.7       14-Jul-1989
                                              CA                          6.4E+00   MG/L        EPA 200.7       14-Jul-1989
                                              CD                        < 4.0E-03   MG/L        EPA 200.7       14-Jul-1989
                                              CO                        < 6.0E-03   MG/L        EPA 200.7       14-Jul-1989
                                              CR                          3.3E-02   MG/L        EPA 200.7       14-Jul-1989
                                              CU                          4.3E-02   MG/L        EPA 200.7       14-Jul-1989
                                              FE                          2.3E+01   MG/L        EPA 200.7       14-Jul-1989
                                              LI                        < 3.0E+01   MG/L        EPA 200.7       14-Jul-1989
                                              MG                          5.3E+00   MG/L        EPA 200.7       14-Jul-1989
                                              MN                          1.8E-01   MG/L        EPA 200.7       14-Jul-1989
                                              MO                        < 8.0E-02   MG/L        EPA 200.7       14-Jul-1989
                                              NA                          2.9E+01   MG/L        EPA 200.7       14-Jul-1989
                                              NI                          1.8E-02   MG/L        EPA 200.7       14-Jul-1989
                                              P                           1.0E+01   MG/L        EPA 200.7       14-Jul-1989
                                              PB                        < 6.0E-02   MG/L        EPA 200.7       14-Jul-1989
                                              SB                          1.3E-01   MG/L        EPA 200.7       14-Jul-1989
                                              SE                        < 1.6E-01   MG/L        EPA 200.7       14-Jul-1989
                                              SI                          1.0E+02   MG/L        EPA 200.7       14-Jul-1989
                                              SN                        < 1.0E-01   MG/L        EPA 200.7       14-Jul-1989
                                              SR                          4.2E-02   MG/L        EPA 200.7       14-Jul-1989
                                              TI                          7.7E-01   MG/L        EPA 200.7       14-Jul-1989
                                              V                           6.1E-02   MG/L        EPA 200.7       14-Jul-1989
                                              ZN                          4.1E-01   MG/L        EPA 200.7       14-Jul-1989
                                              ZR                          5.1E-02   MG/L        EPA 200.7       14-Jul-1989
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Analy No. Customers Id Date/Time Sampled Matrix Material Desc. Frequency	Analysis	Result	Units	Procedure No	Completed
890622-038 THERMO CCLT 1 WATER	AG	1.0E-02	MG/L	EPA 200.7	14-Jul-1989
	AL	5.6E+01	MG/L	EPA 200.7	14-Jul-1989
	AS	< 1.0E-01	MG/L	EPA 200.7	14-Jul-1989
	BA	7.0E-01	MG/L	EPA 200.7	14-Jul-1989
	BE	< 8.0E-04	MG/L	EPA 200.7	14-Jul-1989
	CA	1.1E+01	MG/L	EPA 200.7	14-Jul-1989
	CD	< 4.0E-03	MG/L	EPA 200.7	14-Jul-1989
	CO	1.1E-02	MG/L	EPA 200.7	14-Jul-1989
	CR	6.0E-02	MG/L	EPA 200.7	14-Jul-1989
	CU	7.0E-02	MG/L	EPA 200.7	14-Jul-1989
	FE	1.6E+01	MG/L	EPA 200.7	14-Jul-1989
	LI	< 3.0E+01	MG/L	EPA 200.7	14-Jul-1989
	MG	7.4E+00	MG/L	EPA 200.7	14-Jul-1989
	MN	5.6E-01	MG/L	EPA 200.7	14-Jul-1989
	MO	< 8.0E-02	MG/L	EPA 200.7	14-Jul-1989
	NA	2.5E+01	MG/L	EPA 200.7	14-Jul-1989
	NI	3.4E-02	MG/L	EPA 200.7	14-Jul-1989
	P	8.4E+00	MG/L	EPA 200.7	14-Jul-1989
	PB	6.4E-02	MG/L	EPA 200.7	14-Jul-1989
	SB	2.0E-01	MG/L	EPA 200.7	14-Jul-1989
	SE	< 1.6E-01	MG/L	EPA 200.7	14-Jul-1989
	SI	1.5E+02	MG/L	EPA 200.7	14-Jul-1989
	SN	< 1.0E-01	MG/L	EPA 200.7	14-Jul-1989
	SR	8.3E-02	MG/L	EPA 200.7	14-Jul-1989
	TI	1.1E+00	MG/L	EPA 200.7	14-Jul-1989
	V	7.8E-02	MG/L	EPA 200.7	14-Jul-1989
	ZN	5.1E-01	MG/L	EPA 200.7	14-Jul-1989
	ZR	6 7E-02	MG/L	EPA 200.7	14-Jul-1989

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|Analy No. Customers Id   Date/Time Sampled  |
|Matrix       Material Desc.                 |
|Frequency                                   | Analysis                          Result    Units       Procedure No    Completed
-------------------------------------------------------------------------------------------------------------------------------------
|890622-039 THERMO CCLT 2                    |
|WATER                                       |
|                                            |
                                               AG                              < 1.0E-02  MG/L        EPA 200.7       14-Jul-1989
                                               AL                                6.4E+01  MG/L        EPA 200.7       14-Jul-1989
                                               AS                              < 1.0E-01  MG/L        EPA 200.7       14-Jul-1989
                                               BA                                6.9E-01  MG/L        EPA 200.7       14-Jul-1989
                                               BE                              < 8.0E-04  MG/L        EPA 200.7       14-Jul-1989
                                               CA                                1.2E+01  MG/L        EPA 200.7       14-Jul-1989
                                               CD                              < 4.0E-03  MG/L        EPA 200.7       14-Jul-1989
                                               CO                                9.3E-03  MG/L        EPA 200.7       14-Jul-1989
                                               CR                                7.1E-02  MG/L        EPA 200.7       14-Jul-1989
                                               CU                                7.5E-02  MG/L        EPA 200.7       14-Jul-1989
                                               FE                                2.0E+01  MG/L        EPA 200.7       14-Jul-1989
                                               LI                              < 3.0E+01  MG/L        EPA 200.7       14-Jul-1989
                                               MG                                8.1E+00  MG/L        EPA 200.7       14-Jul-1989
                                               MN                                6.1E-01  MG/L        EPA 200.7       14-Jul-1989
                                               MO                              < 8.0E-02  MG/L        EPA 200.7       14-Jul-1989
                                               NA                                2.4E+01  MG/L        EPA 200.7       14-Jul-1989
                                               NI                                2.8E-02  MG/L        EPA 200.7       14-Jul-1989
                                               P                                 8.8E+00  MG/L        EPA 200.7       14-Jul-1989
                                               PB                                6.5E-02  MG/L        EPA 200.7       14-Jul-1989
                                               SB                                2.0E-01  MG/L        EPA 200.7       14-Jul-1989
                                               SE                              < 1.6E-01  MG/L        EPA 200.7       14-Jul-1989
                                               SI                                1.6E+02  MG/L        EPA 200.7       14-Jul-1989
                                               SN                              < 1.0E-01  MG/L        EPA 200.7       14-Jul-1989
                                               SR                                9.2E-02  MG/L        EPA 200.7       14-Jul-1989
                                               TI                                1.4E+00  MG/L        EPA 200.7       14-Jul-1989
                                               V                                 8.5E-02  MG/L        EPA 200.7       14-Jul-1989
                                               ZN                                5.7E-01  MG/L        EPA 200.7       14-Jul-1989
                                               ZR                                7.6E-02  MG/L        EPA 200.7       14-Jul-1989
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Analy No. Customers Id Date/Time Sampled Matrix Material Desc. Frequency	Analysis	Result	Units	Procedure No	Completed
890622-040 BLANK CCLT WATER					
	AG	< 1.0E-02	MG/L	EPA 200.7	14-Jul-1989
	AL	< 1.0E-01	MG/L	EPA 200.7	14-Jul-1989
	AS	< 1.0E-01	MG/L	EPA 200.7	14-Jul-1989
	BA	< 4.0E-03	MG/L	EPA 200.7	14-Jul-1989
	BE	< 8.0E-04	MG/L	EPA 200.7	14-Jul-1989
	CA	< 1.2E-01	MG/L	EPA 200.7	14-Jul-1989
	CD	< 4.0E-03	MG/L	EPA 200.7	14-Jul-1989
	CO	< 6.0E-03	MG/L	EPA 200.7	14-Jul-1989
	CR	< 6.0E-03	MG/L	EPA 200.7	14-Jul-1989
	CU	< 2.0E-02	MG/L	EPA 200.7	14-Jul-1989
	FE	< 2.0E-02	MG/L	EPA 200.7	14-Jul-1989
	LI	< 3.0E+01	MG/L	EPA 200.7	14-Jul-1989
	MG	< 2.0E-02	MG/L	EPA 200.7	14-Jul-1989
	MN	< 6.0E-03	MG/L	EPA 200.7	14-Jul-1989
	MO	< 8.0E-02	MG/L	EPA 200.7	14-Jul-1989
	NA	< 4.0E+00	MG/L	EPA 200.7	14-Jul-1989
	NI	< 1.2E-02	MG/L	EPA 200.7	14-Jul-1989
	P	< 6.0E-01	MG/L	EPA 200.7	14-Jul-1989
	PB	< 6.0E-02	MG/L	EPA 200.7	14-Jul-1989
	SB	< 8.0E-02	MG/L	EPA 200.7	14-Jul-1989
	SE	< 1.6E-01	MG/L	EPA 200.7	14-Jul-1989
	SI	< 4.0E-01	MG/L	EPA 200.7	14-Jul-1989
	SN	< 1.0E-01	MG/L	EPA 200.7	14-Jul-1989
	SR	< 1.0E-02	MG/L	EPA 200.7	14-Jul-1989
	TI	< 4.0E-02	MG/L	EPA 200.7	14-Jul-1989
	V	< 8.0E-03	MG/L	EPA 200.7	14-Jul-1989
	ZN	< 1.6E-02	MG/L	EPA 200.7	14-Jul-1989
	ZR	< 4.0E-02	MG/L	EPA 200.7	14-Jul-1989

End of data for Request Number CPA9711 Total pages = 5 Cust. Copy ✓ File Copy ___

APPENDIX A-5

TOXICOLOGY LABORTORY REPORTS FOR FATHEAD MINNOW LARVAE AND <u>CERIODAPHNIA DUBIA</u> TESTS

TOXICITY TEST REPORT

TOXICOLOGY LABORATORY

ENVIRONMENTAL SCIENCES DIVISION
OAK RIDGE NATIONAL LABORATORY
P.O. BOX 2008, MS 6351
OAK RIDGE, TN 37831-6351

EXPERIMENT NO. C-431

Clean Closure Leachate Test
of
Thermophilic and Mesophilic Explosives-Contaminated Compost

June 22-29, 1989

STANDARD REPORT FORM

CERIODAPHNIA 7-DAY SURVIVAL AND REPRODUCTION TEST

Experiment no. C-431 Starting date: June 22, 1989.

Ending date: June 29, 1989.

1. SAMPLE

1.1 Sample description: Clean Closure Leachate Test leachates of thermophilic and mesophilic explosives-contaminated compost, and of artificial rainwater (AR) used to prepare the leachates.

1.2 Sampling point: Not applicable: Samples were collected from the laboratory where they were prepared.

1.3 Sampling date: Samples were picked up from the analytical chemistry laboratory laboratory on the morining of June 22, 1989, by A. J. Stewart.

1.4 Sampling method: Does not apply.

1.5 Sample was received at Environmental Sciences Division's toxicology laboratory on June 22, 1989 at 9:25 a.m., by A. J. Stewart; Registered Water Log Book A-103384, pp. 32.

1.6 Sample was used immediately.

1.7 Pretreatment: None.

2. TEST ORGANISMS

2.1 Species: Ceriodaphnia dubia.

2.2 Source: Environmental Sciences Division cultures.

2.3 Incubation water for cultures: Well/spring water.

2.4 Temperature of cultures: 25 ± 2°C (mean ± SD)

3. TEST METHODS

3.1 Toxicity test method: Ceriodaphnia survival and reproduction test. Reference: EPA Test Method 1002.0, in W. B. Horning and C. I. Weber (eds.), Short-Term Methods for Estimating the Chronic Toxicity of Effluent and Receiving Water to Freshwater Organisms, EPA/600/4-85/014 (December 1985).

3.2 Deviations from reference: None.

3.3 Date/time test started: June 22, 1989; 12:40 p.m.
3.4 Date/time test terminated: June 29, 1989; 11:45 a.m.

3.5 Type of test chambers: 12 mm diameter x 75 mm borosilicate test tubes. Previous tests (C-416) showed that the 12 x 75 mm test chambers yielded results that were virtually identical to those for Ceriodaphnia in 17-mL polystyrene test chambers.

Volume per chamber: 2.5 mL.

3.6 Number of Ceriodaphnia per test chamber: 1.

3.7 Number of replicates per treatment: 12.

3.8 Dilution/Control water: 1:9 (v:v) ratio of degassed mineral water to deionized distilled water.

3.9 Renewal period: 24 h.

3.10 Test temperature: Mean = 24.7°C; range = 24.5-24.9°C.

3.11 Treatment groups/concentrations: Control; Thermophillic 100%, 80%, 60%, 40%; Mesophillic 100%, 80%, 60%, 40%; and artifical rainwater 100%, 60%, and 40% of full--strength effluent.

3.12 Feeding regime during test: 35 uL of trout chow-yeast-cerophyl (TCO) mixture (EPA-600/4-85-014; section 7.10.6.2) per 15 mL of test solution every 24 h. The TCO mixture was augmented with the green alga, Ankistrodesmus falcatus (TCA lot TCA1-24-89; TCO lot 1-24-89).

4. QUALITY ASSURANCE

4.1 Standard toxicant used: Sodium lauryl sulfate (SLS).

Source: Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

4.2 Date/time of most recent test: June 14-15, 1989; 9:23 a.m.

4.3 Dilution water used: 1:9 (v:v) ratio of degassed mineral water to deionized distilled water augmented with trace metals.

4.4 24-h LC_{50}: 15.50 mg/L SLS; 95% C.L. = 12.35 - 18.17 mg/L SLS.

The LC_{50} was calculated by the moving average method. Reference: SAS User's Guide: Statistics, Version 5. Cary, NC: SAS Institute Inc., 1985, 956p. Raw data for the reference test is given in section 7.0.

4.5 Data from control chart prepared from standard toxicity tests:

Number of standard SLS reference tests completed by laboratory: 9. Central tendency: 10.00 ± 8.02 mg/L SLS (mean ± 2 SD; moving average method).

4.6 Physical and chemical methods

The pH was measured by EPA method 150.1 with an Orion 700 pH meter. The meter was calibrated with pH 4.0 and pH 10.0 buffers.

Conductance (umho/cm) was measured by EPA method 120.1 with a YSI model 31 meter. All values were corrected to 25°C.

Dissolved oxygen (mg/L) was measured by EPA method 360.1 with a YSI model 54AR dissolved oxygen meter. The meter was air calibrated.

Alkalinity was measured by titrating 50-mL samples with 0.01 N HCl to an endpoint pH of 4.5 (EPA method 130.1).

Hardness was determined by titrating 50-mL samples with EDTA to a colorimetric endpoint using Eriochrome Black T (EPA method 130.2).

Instruments were calibrated and standardized according to manufacturer's instructions.

All measurements were made on fresh samples before daily water replacement.

5. CERIODAPHNIA SURVIVAL AND FECUNDITY TEST RESULTS

5.1 Daily results from the *Ceriodaphnia* toxicity test:

Dilution	Day	Replicate[a]												Number of live Adults	Total live Young
		1	2	3	4	5	6	7	8	9	10	11	12		
Control	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	3	4	4	4	-	4	4	3	4	5	-	-	12	35
	4	0	x	6	0	8	8	8	6	0	7	6	2	11	51
	5	6	x	0	6	8	0	0	6	1	0	0	6	11	33
	6	6	x	9	7	2	4	8	6	10	8	9	8	11	77
	7	0	x	0	0	7	8	3	0	0	8	7	1	11	34
Total		15	4	19	17	25	24	23	21	15	28	22	17		230

5.1 Daily results from the Ceriodaphnia toxicity test (continued):

						Replicate[a]									
Dilution	Day	1	2	3	4	5	6	7	8	9	10	11	12	Number of live Adults	Total live Young
T-100%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	4	3	0	0	1	1	0	0	1	0	2	0	0	12	8
	5	0	0	0	0	3	0	x	0	0	0	0	0	11	3
	6	0	0	0	0	2	2	x	2	2	2	10	5	11	25
	7	4	5	0	5	0	3	x	4	0	2	3	8	11	34
	Total	7	5	0	6	6	5	0	7	2	6	13	13		70
T-80%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	1	1	-	-	-	-	-	3	x	-	-	x	10	5
	4	3	3	3	2	0	4	2	1	x	2x	0	x	9	20
	5	0	4	0	0	3	2	x	0	x	x	0	x	8	9
	6	0	0	8	2	6	0	x	5	x	x	0	x	8	21
	7	3	1	3	5	6	3	x	7	x	x	3	x	8	31
	Total	7	9	14	9	15	9	2	16	0	2	3	0		86
T-60%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	4	-	3	3	1	-	3	-	-	4	2	-	12	20
	4	4	1	4	1	4	6	5	5	7	4	1	0	12	42
	5	4	6	5	7	1	0	2	4	1	1	4	1	12	36
	6	0	0	0	9	7	4	0	8	6	6	6	0	12	46
	7	8	15	0	0	9	8	11	19	16	0	16	10	12	112
	Total	20	22	12	20	22	18	21	36	30	15	29	11		256
T-40%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	4	4	2	4	3	3	2	4	2	M	4	-	12	32
	4	6	6	4	5	8	5	7	4	0	M	7	3	12	55
	5	0	11	5	5	0	0	0	0	8	M	0	6	12	35
	6	12	0	0	0	8	6	4	8	8	M	68	0	12	54
	7	5	11	11	0	11	16	15	16	14	M	14	0	12	113
	Total		27	32	22	14	30	30	28	32	32	0	33	9	289

Dilution	Day	Replicate[a] 1	2	3	4	5	6	7	8	9	10	11	12	Number of live Adults	Total live Young
M-100%	1	x	-	-	x	-	-	x	-	-	-	-	x	8	0
	2	x	-	-	x	x	-	x	-	-	-	-	x	7	0
	3	x	0	x	x	x	x	x	x	x	0	0	x	3	0
	4	x	x	x	x	x	x	x	x	x	x	x	x	0	0
	5	x	x	x	x	x	x	x	x	x	x	x	x	0	0
	6	x	x	x	x	x	x	x	x	x	x	x	x	0	0
	7	x	x	x	x	x	x	x	x	x	x	x	x	0	0
Total			0	0	0	0	0	0	0	0	0	0	0	0	0
M-80%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	2	-	-	-	-	-	-	-	-	-	-	-	12	2
	4	0	0	0	0	x	0	0	0	0	0	0	0	11	0
	5	0	0	0	0	x	0	0	0	0	0	0	0	11	0
	6	5	0	0	0	x	0	0	0	0	0	0	0	11	5
	7	7	0	0	0	x	0	0	0	0	0	0	0	11	7
Total		14	0	0	0	0	0	0	0	0	0	0	0		14
M-60%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	1	2	-	1	-	1	1	-	-	-	-	-	12	6
	4	0	2x	x	0	0	0	0	0	0	0	0	x	9	2
	5	0	x	x	0	0	0	0	0	0	0	0	x	9	0
	6	0	x	x	0	0	0	0	x	0	0	0	x	8	0
	7	3	x	x	0	1	6	x	x	0	0	0	x	7	10
Total		4	4	0	1	1	7	1	0	0	0	0	0		18
M-40%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	-	2	-	4	2	1	1	2	2	0	0	1	12	15
	4	0	0	0	0	0	3	0	4	x	0	3	0	11	10
	5	4	5	5	6	3	3	5	0	x	3	0	6	11	40
	6	2	0	0	8	6	6	x	4	x	5	5	8	10	44
	7	0	0	7	9	0	0	x	0	x	6	0	3	10	25
Total		6	7	12	27	11	13	6	10	2	14	8	18		134
AR-60%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	3	4	2	3	4	4	4	3	4	4	4	4	3	12	43
	4	8	6	8	0	0	0	0	0	0	0	6	x	11	28
	5	0	0	0	6	7	8	4	4	8	8	4	x	11	49
	6	4	6	7	7	6	4	7	6	6	6	4	x	11	63
	7	6	0	5	0	0	0	0	0	0	0	0	x	11	11
Total		22	14	23	17	17	16	14	14	18	18	18	3		194

		Replicate[a]												Number of live	Total live
Dilution	Day	1	2	3	4	5	6	7	8	9	10	11	12	Adults	Young
AR-40%	1	-	-	-	-	-	-	-	-	-	-	-	-	12	0
	2	-	-	-	-	-	-	-	4	1	-	-	-	12	5
	3	2	4	3	0	3	5	2	1	0	4	2	4	12	30
	4	5	9	0	0	0	0	5	8	1	0	6	x	11	34
	5	0	0	8	M	6	6	0	5	6	7	5	x	11	43
	6	6	8	6	M	9	5	3	6	4	4	0	x	11	51
	7	0	8	1	M	0	6	9	2	0	8	4	x	11	38
Total		13	29	18	0	18	22	19	26	12	23	17	4		201

[a] - = live female too young to produce offspring;
x = dead adult, no young produced before death;
Nx = Dead adult, with no young produced before death;
M = Male.

5.2 Summary of results from the Ceriodaphnia toxicity tests:

Effluent concentration	Number of replicates	Number of females surviving for 7 d	Mean number of offspring per female (± SD)
Control	12	11	20.6 ± 4.3
Thermophillic			
100%	12	11	6.4 ± 3.9 [a]
80%	12	8	10.3.± 4.4 [a]
60%	12	12	21.3 ± 7.4
40%	12	11	26.3 ± 8.0
Mesophillic			
100%	12	0[*]	-- ± --
80%	12	11	1.3 ± 4.2 [a]
60%	12	7	1.9 ± 2.7 [a,c]
40%	12	10	12.6 ± 6.2 [a,b]
Artifical Rainwater			
60%	12	11	17.4 ± 3.0
40%	12	11	19.7 ± 5.4

[*] Survival significantly lower than control, based on Fisher's Exact test.

[a] Fecundity is significantly lower than control.

[b] Fecundity is significantly lower than control and the 40% concentration of the thermophilic leachate and the 40% concentration of the artificial rainwater.

[c] Fecundity is significantly lower than control, the 60% concentration of the thermophilic leachate, and the 60% concentration of the artificial rainwater.

5.3 Statistical analyses: Control vs thermophilic leachate.

The data were first analyzed by using Fisher's Exact Test (for survival), followed by SAS-GLM (General Linear Models) procedure and Dunnett's Test (for reproduction), as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Asterisks in the summary table (section 5.2) show concentrations significantly reducing survivorship of Ceriodaphnia based on Fisher's Exact Test, and/or concentrations significantly lowering fecundity based on Dunnett's test ($p = 0.05$, one tailed, $t_d = 2.22$).

For the data above, the mean number of offspring per female was computed for all surviving females. The least significant difference in fecundity at the 5% level ($LSD_{0.05}$) is 5.83 offspring per female, using the error MS value obtained with the GLM analysis (below). The LSD is a 28.3% reduction in fecundity compared to the control.

GLM Analysis of Ceriodaphnia Fecundity

Variance Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	4	3796.287	949.072	22.92	2.59
Within	54	2235.848		41.405	
Total	58	6032.135		(Pr > F = 0.0001)	

5.3 Statistical analyses: Control vs mesophillic leachate (all concentrations except for 100%, where survival was zero).

The data were first analyzed by using Fisher's Exact Test (for survival), followed by SAS-GLM (General Linear Models) procedure and Dunnett's Test (for reproduction), as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Asterisks in the summary table (section 5.2, above), show concentrations significantly reducing survivorship of Ceriodaphnia based on Fisher's Exact Test, and/or concentrations significantly lowering fecundity based on Dunnett's test ($p = 0.05$, one tailed, $t_d = 2.12$).

For the data above, the mean number of offspring per female was computed for all surviving females. The least significant difference in fecundity at the 5% level ($LSD_{0.05}$) is 4.42 offspring per female, using the error MS value obtained with the GLM analysis (below). The LSD is a 21.5% reduction in fecundity compared to the control.

GLM Analysis of Ceriodaphnia Fecundity

Variance Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	3	2681.000	893.667	34.25	2.82
Within	44	1148.000	26.091		
Total	47	3829.000		(Pr > F = 0.0001)	

5.3 Statistical analyses: Control vs artifical rainwater (all concentrations).

The data were first analyzed by using Fisher's Exact Test (for survival), followed by SAS-GLM (General Linear Models) procedure and Dunnett's Test (for reproduction), as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Asterisks in the summary table (section 5.2, above), show concen- trations significantly reducing survivorship of *Ceriodaphnia* based on Fisher's Exact Test, and/or concentrations significantly lowering fecundity based on Dunnett's test ($p = 0.05$, one tailed, $t_d = 1.99$).

For the data set above, the mean number of offspring per female was computed for all surviving females. The least significant difference in fecundity at the 5% level ($LSD_{0.05}$) is 4.97 offspring per female, using the error MS value obtained with the GLM procedure (below). The LSD is a 24.1% reduction in fecundity relative to the control.

GLM Analysis of *Ceriodaphnia* Fecundity

Variance Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	2	56.771	28.385	0.76	3.32
Within	32	1199.515	37.484		
Total	34	1256.286		($Pr > F = 0.4772$)	

5.3 Statistical analyses: Control vs 40% concentrations of the thermophilic leachate, the mesophilic leachate, and the artificial rainwater used to produce the two leachates.

The data were first analyzed by using Fisher's Exact Test (for survival), followed by SAS-GLM (General Linear Models) procedure and Dunnett's Test (for reproduction), as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Asterisks in the summary table (section 5.2, above), show concen- trations significantly reducing survivorship of *Ceriodaphnia* based on Fisher's Exact Test, and/or concentrations significantly lowering fecundity based on Dunnett's test ($p = 0.05$, one tailed, $t_d = 2.13$).

For the data above, the mean number of offspring per female was computed for all surviving females. The least significant difference in fecundity at the 5% level ($LSD_{0.05}$) is 6.06 offspring per female, using the error MS value from the GLM procedure (below). The LSD is a 29.4% reduction in fecundity relative to the control.

GLM Analysis of *Ceriodaphnia* Fecundity

Variance Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	3	1315.607	438.536	9.04	2.84
Within	42	2037.697	48.516		
Total	45	3353.304		(Pr > F = 0.0001)	

5.3 Statistical analyses: Control vs 60% concentrations of the thermophilic leachate, the mesophilic leachate, and the artificial rainwater used to produce the two leachates.

The data were first analyzed by using Fisher's Exact Test (for survival), followed by SAS-GLM (General Linear Models) procedure and Dunnett's Test (for reproduction), as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Asterisks in the summary table (section 5.2, above), show concen- trations significantly reducing survivorship of *Ceriodaphnia* based on Fisher's Exact Test, and/or concentrations significantly lowering fecundity based on Dunnett's test (p = 0.05, one tailed, t_d = 2.12).

For the data above, the mean number of offspring per female is computed for all surviving females. The least significant difference in fecundity at the 5% level ($LSD_{0.05}$) is 4.83 offspring per female, using the error MS value from the GLM procedure (below). The LSD is a 23.5% reduction in fecundity relative to the control.

GLM Analysis of *Ceriodaphnia* Fecundity

Variance Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	3	2882.917	960.972	30.84	2.82
Within	44	1371.000	31.159		
Total	47	4253.917		(Pr > F = 0.0001)	

5.4 Summary of Ceriodaphnia toxicity test results:

A direct comparison between leachates from the mesophilic and thermophilic composts is possible because the same concentration series and type of water was used in the tests. This comparison shows that the mesophilic leachate is about twice as toxic as the thermophilic leachate: Fecundity of Ceriodaphnia in the 40% concentration of the mesophilic leachate, for example, was similar to fecundity of the Ceriodaphnia in the 80% concentration of the thermophilic leachate (Summary Table, section 5.2).

The No-observed-effect concentration (NOEC) for the thermophilic leachate was 60% (relative to the control); the lowest-observed-effect concentration (LOEC) for this leachate was 80%.

The NOEC for the mesophilic leachate was <40% (relative to the control). Because 40% was the lowest concentration tested, the NOEC and LOEC for this leachate could not be more accurately determined. Because Ceriodaphnia fecundity was moderately high in the 40% concentration of the mesophilic leachate, it is reasonable to suppose that the "true" NOEC for this material would be about 15-25% of full-strength.

Based on visual appearance, both leachates contained very high concentrations of dissolved and/or colloidal organic matter. This material could have interferred mechanically with the Ceriodaphnia's capacity to filter food items from the water or adversely affected the "taste" of the items that they captured (cf. [1-3]). Either of these situations would have tended to increase the apparent toxicity of the leachates, for rate of food supply and reproduction are closely linked for Ceriodaphnia dubia.

6. CHEMICAL ANALYSES

6.1 Results of the daily chemical analyses:

Day	Concentration	pH	Cond.[a]	Alk.[b]	Hardness[c]	New D.O.[d]
1	Control	7.53	88	30.0	44	8.4
	T-100%	7.90	312	78.0	40	8.3
	T-40%	7.79	185	48.0	---	8.3
	M-100%	7.87	335	78.0	40	8.3
	M-40%	7.80	176	52.0	---	8.3
	AR-100%	5.84	4	1.5	≤ 2	8.3
	AR-40%	6.98	54	18.0	22	8.3
2	Control	7.78	87	30.0	38	8.2
	AR-40%	7.14	52	19.0	6	8.0
	T-100%	8.01	310	---	---	---
	T-80%	7.81	266	---	---	---
	T-60%	7.78	220	---	---	---
	T-40%	7.80	152	---	---	---
	M-100%	7.89	325	---	---	---
	M-80%	7.76	282	---	---	---
	M-60%	7.78	235	---	---	---
	M-40%	7.78	182	---	---	---
3	Control	7.26	86	34.0	38	8.4
	AR-40%	7.11	54	20.0	26	8.4
	T-100%	7.92	311	---	---	---
	T-80%	7.90	266	---	---	---
	T-60%	7.88	218	---	---	---
	T-40%	7.84	175	---	---	---
	M-100%	7.92	336	---	---	---
	M-80%	7.86	286	---	---	---
	M-60%	7.84	236	---	---	---
	M-40%	7.82	186	---	---	---
4	Control	7.66	87	29.0	40	8.2
	AR-40%	7.12	55	18.5	24	8.2
	T-100%	7.87	314	---	---	---
	T-80%	7.86	272	---	---	---
	T-60%	7.80	225	---	---	---
	T-40%	7.77	179	---	---	---
	M-100%	7.84	334	---	---	---
	M-80%	7.78	291	---	---	---
	M-60%	7.75	239	---	---	---
	M-40%	7.74	187	---	---	---

(continued)

6.1 Results of the daily chemical analyses (continued):

Day	Concentration	pH	Cond.[a]	Alk.[b]	Hardness[c]	New D.O.[d]
5	Control	7.63	83	29.0	42	8.2
	AR-40%	7.48	56	19.0	24	8.2
	T-100%	7.67	310	---	---	---
	T-80%	7.73	266	---	---	---
	T-60%	7.70	218	---	---	---
	T-40%	7.73	175	---	---	---
	M-100%	7.83	301	---	---	---
	M-80%	7.77	280	---	---	---
	M-60%	7.72	225	---	---	---
	M-40%	7.69	182	---	---	---
6	Control	7.92	87	30.0	44	8.4
	AR-40%	7.41	54	18.0	26	8.2
	T-100%	7.90	299	---	---	---
	T-80%	7.82	267	---	---	---
	T-60%	7.80	222	---	---	---
	T-40%	7.75	178	---	---	---
	M-100%	7.82	338	---	---	---
	M-80%	7.80	287	---	---	---
	M-60%	7.74	235	---	---	---
	M-40%	7.74	187	---	---	---
7	Control	8.12	87	29.0	42	8.3
	AR-40%	7.00	55	17.0	26	8.2
	T-100%	7.87	313	---	---	---
	T-80%	7.80	268	---	---	---
	T-60%	7.77	226	---	---	---
	T-40%	7.72	178	---	---	---
	M-100%	7.73	339	---	---	---
	M-80%	7.69	292	---	---	---
	M-60%	7.69	239	---	---	---
	M-40%	7.69	189	---	---	---

[a] Cond. = conductivity expressed as umho/cm, corrected to 25 °C.

[b] Alk. = alkalinity expressed as mg/L $CaCO_3$.

[c] Hardness expressed as mg/L $CaCO_3$.

[d] D.O. = mg/L dissolved oxygen.

6.2 Comments regarding chemical analysis data

The high concentrations of dissolved and/or colloidal organic matter seriously interferred with the colorimetric endpoint of the hardness assay. The accuracy of alkalinity measurements can be compromised by the presence of high concentrations of recalcitrant dissolved organic matter, as well [4]. Thus, the hardness and alkalinity values for in the table above may not be correct for the mesophilic and thermophilic leachates.

7. STANDARD REFERENCE TOXICANT TEST RESULTS

7.1 Date test conducted: June 14-15, 1989.

Time test initiated: 9:23 a.m.

7.2 Record of survival for 24-h test:

Concentration SLS (mg/L)	Replicate	Number at beginning	Number of dead
Control	1	6	0
	2	6	0
	3	6	0
	4	6	0
10 mg/L	1	6	1
	2	6	2
	3	6	1
	4	6	2
15 mg/L	1	6	3
	2	6	3
	3	6	3
	4	6	3
20 mg/L	1	6	4
	2	6	4
	3	6	4
	4	6	3
25 mg/L	1	6	4
	2	6	6
	3	6	6
	4	6	4
30 mg/L	1	6	6
	2	6	6
	3	6	6
	4	6	6

8. REFERENCES

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[2] DeMott, W. R. 1986. The role of taste in food selection by freshwater zooplankton. Oecologia 69:334-340.

[3] Gerritsen, J. and K. G. Porter. 1982. The role of surface chemistry in filter feeding by zooplankton. Science 216: 225-227.

[4] Wilson, D. E. 1979. The influence of humic compounds on titrimetric determinations of total inorganic carbon in freshwater. Arch. Hydrobiol. 87:379-384.

Report prepared by: L. F. Wicker and A. J. Stewart

TOXICITY TEST REPORT

TOXICOLOGY LABORATORY

ENVIRONMENTAL SCIENCES DIVISION
OAK RIDGE NATIONAL LABORATORY
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EXPERIMENT NO. 340

Clean Closure Leachate Test of Thermophilic and Mesophilic Explosives-Contaminated Compost

June 22-29, 1989

STANDARD REPORT FORM

FATHEAD MINNOW LARVAL SURVIVAL AND GROWTH TEST

Experiment No. 340 Starting date: June 22, 1989.

Ending date: June 29, 1989.

1. SAMPLE

1.1 Sample description: Clean Closure Leachate Test leachates of thermophilic and mesophilic explosives-contaminated compost, and of artificial rainwater (AR) used to prepare the leachates.

1.2 Sampling point: Not applicable: Samples were collected from the laboratory where they were prepared.

1.3 Sampling date: Samples were picked up from the analytical chemistry laboratory on the morning of June 22, 1989, by A. J. Stewart.

1.4 Sampling method: Does not apply.

1.5 Sample was received at Environmental Sciences Division's toxicology laboratory on June 22, 1989 at 9:25 a.m. by A. J. Stewart; Registered Water Log Book A-103384, pp. 32.

1.6 Sample was used immediately.

1.7 Pretreatment: None.

2. TEST ORGANISMS

2.1 Species: Fathead minnow (Pimephales promelas).

2.2 Hatching date: June 21, 1989.

2.3 Incubation water: Dechlorinated tap water.
Incubation temperature: 25.0°C (mean ± S).

2.4 Source: Environmental Sciences Division cultures.

2.5 Mean dry weight at start of test: 0.0937 ± 0.0065 mg (mean ± S)

2.6 Diseases and Treatment: none

3. TEST METHODS

3.1 Toxicity test method used: Fathead minnow larval survival and growth test. Reference: EPA Test Method 1000.0, in W. B. Horning and C. I. Weber (eds.), Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA/600/4-85/014 (December 1985).

3.2 Deviations from reference: none.

3.3 Date test started: June 22, 1989.

Time test started: 1:10 p.m.

3.4 Date test terminated: June 29, 1989.

Time test terminated: 12:50 p.m.

3.5 Type of test chambers: Borosilicate 600-mL beakers.

Volume per chamber: 250 mL.

3.6 Number of organisms per test chamber: 10.

3.7 Number of replicates per treatment: 4.

3.8 Dilution/Control water: 1:9 (v:v) ratio of degassed mineral water to deionized distilled water.

3.9 Renewal period: 24 h.

3.10 Test temperature: Mean = 24.7°C; range = 24.6 - 24.8°C.

3.11 Treatment groups/concentrations: Control; Thermophilic 100%, 80%, 60%, 40%; Mesophilic 100%, 80%, 60%, 40%; and artifical rainwater 60%, and 40% of full-strength effluent.

3.12 Feeding Regime During Test: Brine shrimp (Artemia) nauplii less than 24 hours old; fed 600 ± 100 per beaker twice daily.

4. QUALITY ASSURANCE

4.1 Standard toxicant used: Sodium lauryl sulfate.

Source: Sigma Chemical Company.

4.2 Date of most recent test: June 14-15, 1989.

Time of most recent test: 9:49 a.m.

4.3 Dilution water used: 1:9 (v:v) ratio of degassed mineral water to deionized distilled water.

4.4 24-h LC_{50}: 23.053 mg/L SLS; 95% C.L. = 21.75 - 24.52 mg/L SLS.

6 The LC_{50} was calculated by the Moving Average method.

Reference: SAS User's Guide: Statistics, Version 5. Cary, NC: SAS Institute Inc., 1985, 956p.

Raw data for this reference test is provided in section 6.2.

4.5 Data from control chart prepared from standard toxicity tests:

Number of SLS standard tests completed by laboratory: 2.

Central Tendency: 25.7 ± 7.5 mg/L SLS (mean ± 2 $\underline{S}$) mg/L.

4.6 Physical and chemical methods

The pH was measured by EPA method 150.1 with an Orion 700 pH meter. The meter was calibrated with pH 4 and pH 10 buffers.

Conductance (umho/cm) was measured by EPA method 120.1 with a YSI model 31 meter. All values were corrected to 25°C.

Dissolved oxygen (mg/L) was measured by EPA method 360.1 with a YSI model 54AR dissolved oxygen meter. The meter was air calibrated.

Alkalinity was measured by titrating 50-mL samples with 0.1 $\underline{N}$ HCl to an endpoint pH of 4.5 (EPA method 130.1).

Hardness was determined by titrating 50-mL samples with EDTA to a colorimetric endpoint using Eriochrome Black T (EPA method 130.2).

Instruments were calibrated and standardized according to manufacturer's instructions.

All measurements were made on fresh samples before daily water replacement, except for oxygen (old), which was measured in the test solutions at the end of the replacement period.

5. FATHEAD MINNOW SURVIVAL TEST RESULTS

5.1 Daily results of the fathead minnow toxicity test:

		Number of Larvae Surviving Each Day						
Concentration	Replicate	1	2	3	4	5	6	7
Control	1	10	10	10	10	10	10	10
	2	9	9	9	9	9	9	9
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
T-100%	1	9	9	8	8	7	7	6
	2	9	9	8	7	7	6	6
	3	9	9	9	9	9	9	8
T-80%	1	10	10	9	9	9	9	9
	2	9	9	9	9	9	9	9
	3	10	10	10	10	9	9	9
T-60%	1	10	10	10	10	10	10	9
	2	10	10	10	9	9	9	9
	3	10	10	10	10	10	10	10
T-40%	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
M-100%	1	2	0	0	0	0	0	0
	2	3	0	0	0	0	0	0
	3	3	1	0	0	0	0	0
M-80%	1	8	5	2	0	0	0	0
	2	7	3	0	0	0	0	0
	3	6	5	1	0	0	0	0
M-60%	1	9	7	7	5	3	3	2
	2	10	10	7	4	3	3	3
	3	8	8	7	7	4	4	3
M-40%	1	10	9	9	9	9	9	7
	2	10	10	10	10	9	9	9
	3	10	9	8	8	8	7	6

(continued

5.1 Daily results of the fathead minnow toxicity test (continued):

		Number of Larvae Surviving Each Day						
Concentration	Replicate	1	2	3	4	5	6	7
AR-60%	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	9	9	9	9	9
AR-40%	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	9	9	9	9	9	8	8

5.2 Summary of results from the fathead minnow toxicity test:

Survival (%)

Sample Concentration	Survival (%) per Replicate 1	2	3	4	Mean
Control	100	90	100	100	97.5
T-100%	60	60	80	---	66.7
T- 80%	90	90	90	---	90.0
T- 60%	90	90	100	---	93.3
T- 40%	100	100	100	---	100.0
M-100%	0	0	0	---	0.0
M- 80%	0	0	0	---	0.0
M- 60%	20	30	30	---	26.7
M- 40%	70	90	60	---	73.3
AR-60%	100	100	90	---	96.7
AR-40%	100	100	80	---	93.3

Growth (Dry Weight)

Sample Concentration	Weight (mg) per Replicate 1	2	3	4	Mean ± S
Control	0.34	0.39	0.36	0.36	0.36 ± 0.021
T-100%	0.53	0.57	0.46	---	0.52 ± 0.051
T- 80%	0.41	0.36	0.46	---	0.41 ± 0.049
T- 60%	0.39	0.47	0.39	---	0.41 ± 0.042
T- 40%	0.48	0.43	0.49	---	0.47 ± 0.027
M-100%	---	---	---	---	--- ± ---
M- 80%	---	---	---	---	--- ± ---
M- 60%	0.39	0.26	0.23	---	0.30 ± 0.081
M- 40%	0.36	0.40	0.44	---	0.40 ± 0.039
AR-60%	0.43	0.50	0.44	---	0.45 ± 0.036
AR-40%	0.35	0.51	0.38	---	0.41 ± 0.082

5.3 Statistical analyses of survival data: Control vs thermophilic leachate.

The data were analyzed using the SAS-GLM (General Linear Models) procedure and Dunnett's Test, as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1). Arcsin transformation of the data was used before analysis of survival. For this set of data, the least significant difference is 12.6 (arcsin transformed). This represents a 14.8% reduction in survival. t_d = 2.44, $p = 0.05$ (one-tailed test). Asterisks in the summary table (section 5.2, above), show concentrations significantly reducing survival of fathead minnows based on Dunnett's Test.

GLM Analysis of Fathead Minnow Survival

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	4	2328.390	582.097	10.88	3.36
Within	11	588.414	53.492		
Total	15	2916.804		(Pr > F = 0.0008)	

5.4 Statistical Analyses of Dry Weight Data: Control vs thermophilic leachate.

The data were analyzed by using the SAS-GLM (General Linear Models) procedure and Dunnett's Test, as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

No transformation was used before data analysis. For this set of data, the least significant difference is 0.071 mg. This represents a 19.8% reduction in dry weight. $\underline{t}_d = 2.44$, $\underline{p} = 0.05$ (one-tailed test). The mean dry weight of larvae at the start of the test was 0.094 mg/fish.

GLM Analysis of Fathead Minnow Dry Weight

Source	D.F.	Sum of Squares	Mean Square	$\underline{F}$	$\underline{F}_{(0.05)}$
Among	4	0.0483	0.0121	7.06	3.36
Within	11	0.0188	0.0017		
Total	15	0.0671		(Pr > $\underline{F}$ = 0.0045)	

5.3 Statistical analyses of survival data: Control vs mesophilic leachate.

The data were analyzed using the SAS-GLM (General Linear Models) procedure and Dunnett's Test, as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Arcsin transformation of the data was used before analysis of survival. For this set of data, the least significant difference is 11.6 (arcsin transformed). This represents a 13.6% reduction in survival. $\underline{t}_d = 2.37$, $\underline{p} = 0.05$ (one-tailed test). Asterisks in the summary table (section 5.2, above), show concentrations significantly reducing survival of fathead minnows based on Dunnett's Test.

GLM Analysis of Fathead Minnow Survival

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	3	14405.868	4801.956	100.53	4.35
Within	9	429.886	47.765		
Total	12	14835.754		(Pr > F = 0.0001)	

5.4 Statistical Analyses of Dry Weight Data: Control vs mesophilic leachate.

The data were analyzed by using the SAS-GLM (General Linear Models) procedure and Dunnett's Test, as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

No transformation was used before data analysis. For this set of data, the least significant difference is 0.083 mg. This represents a 23.2% reduction in dry weight. $t_d = 2.27$, $p = 0.05$ (one-tailed test). The mean dry weight of larvae at the start of the test was 0.094 mg/fish.

GLM Analysis of Fathead Minnow Dry Weight

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	2	0.0177	0.0088	3.26	4.74
Within	7	0.0189	0.0027		
Total	9	0.0366		(Pr > F = 0.0996)	

5.3 Statistical analyses of survival data: Control vs artifical rainwater.

The data were analyzed using the SAS-GLM (General Linear Models) procedure and Dunnett's Test (Horning and Weber, 1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Arcsin transformation of the data was used before analysis of survival. For this set of data, the least significant difference is 18.7 (arcsin transformed). This represents a 21.9% reduction in survival. t_d = 2.27, p = 0.05 (one-tailed test). Asterisks in the summary table (section 5.2, above), show concentrations significantly reducing survival of fathead minnows based on Dunnett's Test.

GLM Analysis of Fathead Minnow Survival

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	2	31.079	15.539	0.11	4.74
Within	7	951.926	135.989		
Total	9	983.005		(Pr > F = 0.8936)	

5.4 Statistical Analyses of Dry Weight Data: Control vs artifical rainwater.

The data were analyzed by using the SAS-GLM (General Linear Models) procedure and Dunnett's Test, as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

No transformation was used before data analysis. For this set of data, the least significant difference is 0.083 mg. This represents a 23.2% reduction in dry weight. t_d = 2.27, p = 0.05 (one-tailed test). The mean dry weight of larvae at the start of the test was 0.094 mg/fish.

GLM Analysis of Fathead Minnow Dry Weight

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	2	0.0154	0.0077	2.90	4.74
Within	7	0.0186	0.0026		
Total	9	0.0340		(Pr > F = 0.1208)	

5.3 Statistical analyses of survival data: Control vs 40% concentrations of the thermophilic leachate, the mesophilic leachate, and the artifical rainwater used to produce the two leachates.

The data were analyzed using the SAS-GLM (General Linear Models) procedure and Dunnett's Test, as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Arcsin transformation of the data was used before analysis of survival. For this set of data, the least significant difference is 17.3 (arcsin transformed). This represents a 20.2% reduction survival. $t_d = 2.37$, $p = 0.05$ (one-tailed test). Asterisks in the summary table (section 5.2, above), show concentrations significantly reducing survival of fathead minnows based on Dunnett's Test.

GLM Analysis of Fathead Minnow Survival

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	3	1652.903	550.968	5.20	3.86
Within	9	954.386	106.043		
Total	12	2607.289		(Pr > F = 0.0235)	

5.4 Statistical Analyses of Dry Weight Data: Control vs 40% concentrations of the thermophilic leachate, the mesophilic leachate, and the artificial rainwater used to prepare the two leachates.

The data were analyzed by using the SAS-GLM (General Linear Models) procedure and Dunnett's Test, as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

No transformation was used before data analysis. For this set of data, the least significant difference is 0.080 mg. This represents a 22.3% reduction in dry weight. $t_d = 2.37$, $p = 0.05$ (one-tailed test). The mean dry weight of larvae at the start of the test was 0.094 mg/fish.

GLM Analysis of Fathead Minnow Dry Weight

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	3	0.0189	0.0063	2.69	3.86
Within	9	0.0210	0.0023		
Total	12	0.0399		(Pr > F = 0.1089)	

5.3 Statistical analyses of survival data: Control vs 60% concentrations of the thermophilic leachate, the mesophilic leachate, and the artifical rainwater used to produce the two leachates.

The data were analyzed using the SAS-GLM (General Linear Models) procedure and Dunnett's Test, as recommended by Horning and Weber (1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

Arcsin transformation of the data was used before analysis of survival. For this set of data, the least significant difference is 15.2 (arcsin transformed). This represents a 17.8% reduction in survival. $t_d = 2.37$, $p = 0.05$ (one-tailed test). Asterisks in the summary table (section 5.2, above), show concentrations significantly reducing survival of fathead minnows based on Dunnett's Test.

GLM Analysis of Fathead Minnow Survival

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	3	6259.277	2086.426	25.46	3.86
Within	9	737.466	81.941		
Total	12	6996.743		(Pr > F = 0.0001)	

5.4 Statistical Analyses of Dry Weight Data: Control vs 60% concentrations of the thermophilic leachate, the mesophilic leachate, and the artificial rainwater used to produce the two leachates.

The data were analyzed by using the SAS-GLM (General Linear Models) procedure and Dunnett's Test (Horning and Weber, 1985). The GLM procedure is recommended over ANOVA when the data set contains missing values (note table in section 5.1).

No transformation was used before data analysis. For this set of data, the least significant difference is 0.084 mg. This represents a 23.3% reduction in dry weight. $t_d = 2.37$, $p = 0.05$ (one-tailed test). The mean dry weight of larvae at the start of the test was 0.094 mg/fish.

GLM Analysis of Fathead Minnow Dry Weight

Source	D.F.	Sum of Squares	Mean Square	F	$F_{(0.05)}$
Among	3	0.0454	0.0151	5.96	3.86
Within	9	0.0229	0.0025		
Total	12	0.0683		(Pr > F = 0.0160)	

5.5 Summary of toxicity test results:

No-observed-effect concentration (NOEC):
80% concentration for thermophilic leachate, <40% for mesophilic leachate, based on survival of the fish relative to controls.

Lowest-observed-effect-concentration (LOEC):
100% concentration for thermophilic leachate, 40% for mesophilic leachate, based on survival of the fish relative to controls.

48-h LC_{50} concentration (by graphic interpolation):
>100% concentration for thermophilic leachate, 77% for mesophilic leachate, >100% for artificial rainwater.

7-d median lethal concentration (LC_{50}) (by graphic interpolation):
>100% for thermophilic leachatge, 50% for mesophilic leachate, >100% for artificial rainwater.

7-d effective concentration (EC_{50}): Not determined.

6. CHEMICAL ANANLYSES

6.1 Results of the daily chemical analyses:

Day	Concentration	pH	Cond.[a]	Alk.[b]	Hardness[c]	Oxygen[d]	
						New	Old
1	Control	7.53	88	30.0	44	8.4	7.8
	T-100%	7.90	312	78.0	40	8.3	7.6
	T-40%	7.79	185	48.0	---	8.3	7.5
	M-100%	7.87	335	78.0	40	8.3	7.6
	M-40%	7.80	176	52.0	---	8.3	7.6
	AR-100%	5.84	4	1.5	≤2	8.3	---
	AR-40%	6.98	54	18.0	22	8.3	7.6
2	Control	7.78	87	30.0	38	8.2	8.0
	AR-40%	7.14	52	19.0	6	8.0	7.2
	T-100%	8.01	310	---	---	---	7.6
	T-80%	7.81	266	---	---	---	---
	T-60%	7.78	220	---	---	---	---
	T-40%	7.80	152	---	---	---	7.4
	M-100%	7.89	325	---	---	---	7.3
	M-80%	7.76	282	---	---	---	---
	M-60%	7.78	235	---	---	---	---
	M-40%	7.78	182	---	---	---	7.2
3	Control	7.26	86	34.0	38	8.4	7.6
	AR-40%	7.11	54	20.0	26	8.4	6.7
	T-100%	7.92	311	---	---	---	6.8
	T-80%	7.90	266	---	---	---	---
	T-60%	7.88	218	---	---	---	---
	T-40%	7.84	175	---	---	---	6.8
	M-100%	7.92	336	---	---	---	6.8
	M-80%	7.86	286	---	---	---	---
	M-60%	7.84	236	---	---	---	---
	M-40%	7.82	186	---	---	---	6.8
4	Control	7.66	87	29.0	40	8.2	7.5
	AR-40%	7.12	55	18.5	24	8.2	7.4
	T-100%	7.87	314	---	---	---	7.1
	T-80%	7.86	272	---	---	---	---
	T-60%	7.80	225	---	---	---	---
	T-40%	7.77	179	---	---	---	7.1
	M-100%	7.84	334	---	---	---	---
	M-80%	7.78	291	---	---	---	---
	M-60%	7.75	239	---	---	---	---
	M-40%	7.74	187	---	---	---	7.5

(continued)

6.1 Results of the daily chemical analyses (continued):

Day	Concentration	pH	Cond.[a]	Alk.[b]	Hardness[c]	Oxygen[d]	
						New	Old
5	Control	7.63	83	29.0	42	8.2	7.6
	AR-40%	7.48	56	19.0	24	8.2	7.5
	T-100%	7.67	310	---	---	---	7.7
	T-80%	7.73	266	---	---	---	---
	T-60%	7.70	218	---	---	---	---
	T-40%	7.73	175	---	---	---	7.7
	M-100%	7.83	301	---	---	---	---
	M-80%	7.77	280	---	---	---	---
	M-60%	7.72	225	---	---	---	---
	M-40%	7.69	182	---	---	---	7.7
6	Control	7.92	87	30.0	44	8.4	7.7
	AR-40%	7.41	54	18.0	26	8.2	7.3
	T-100%	7.90	299	---	---	---	7.1
	T-80%	7.82	267	---	---	---	---
	T-60%	7.80	222	---	---	---	---
	T-40%	7.75	178	---	---	---	---
	M-100%	7.82	338	---	---	---	---
	M-80%	7.80	287	---	---	---	---
	M-60%	7.74	235	---	---	---	---
	M-40%	7.7	187	---	---	---	7.3
7	Control	8.12	87	29.0	42	8.3	7.7
	AR-40%	7.00	55	17.0	26	8.2	7.4
	T-100%	7.87	313	---	---	---	7.4
	T-80%	7.80	268	---	---	---	---
	T-60%	7.77	226	---	---	---	---
	T-40%	7.72	178	---	---	---	7.4
	M-100%	7.73	339	---	---	---	---
	M-80%	7.69	292	---	---	---	---
	M-60%	7.69	239	---	---	---	---
	M-40%	7.69	189	---	---	---	7.4

[a]Cond. = conductivity expressed as umho/cm, corrected to 25 °C. [b]Alk. = alkalinity expressed as mg/L $CaCO_3$. [c]Hardness expressed as mg/L $CaCO_3$. [d]D.0. = mg/L dissolved oxygen.

7. STANDARD REFERENCE TOXICANT TEST RESULTS

7.1 Date test conducted: June 14-15, 1989.

Time test initiated: 9:49 a.m.

7.2 Record of survival for 24-h test (sodium lauryl sulfate):

Concentration SLS (mg/L)	Rep.	Number at Beginning	Number of Dead
Control	1	6	0
	2	6	0
	3	6	0
	4	6	0
15	1	6	0
	2	6	0
	3	6	0
	4	6	0
20	1	6	1
	2	6	1
	3	6	1
	4	6	0
25	1	6	5
	2	6	4
	3	6	4
	4	6	4
30	1	6	6
	2	6	6
	3	6	6
	4	6	5
40	1	6	6
	2	6	6
	3	6	6
	4	6	6

Report prepared by: L. F. Wicker and A. J. Stewart

APPENDIX A-6

AMES TEST DATA

TABLE 6A-1. AMES TEST OF TNT AND TETRYL

	μg/plate	TA 98 Revertants/plate	TA 100 Revertants/plate
Control[a]	-	15	68
Nitrofluorene	5	536	-
Sodium azide	1	-	603
	20	98	238
	50	222	544
TNT	100	290	921
	150	343	1266
	200[b]	381	1318
	2	30	142
	5	47	178
Tetryl	10	89	305
	15[b]	146	419
	20[b]	175	722

[a] DMSO solvent.

[b] Toxicity toward Salmonella tester strain observed.

TABLE 6A-2. AMES TEST OF TNT, 2-4-DA,6-NT AND 2-6-DA,4-NT

Sample	μg/plate	Revertants/Plate TA98	 TA100
Control[a]	60	6	117
Nitrofluorene	5	551	NT
Sodium Azide	0.5	NT	506
TNT	20	88	232
	40	172	366
	80	290	577
	120	399	932
2,4-DA-6-NT	50	15	134
	100	16	131
	150	18	120
	200	15	131
	250	22	148
2,6-DA-4-NT	50	26	173
	100	49	178
	150	56	228
	200	72	241
	250	83	247

[a] DMSO

NT = Not tested

TABLE 6A-3. AMES TEST OF TNT, 2-A-4,6-DNT AND 6-A-2,6-DNT

Sample	μg/plate	Revertants/Plate	
		TA98	TA100
Control[a]	100	22	98
Nitrofluorene	5	590	NT
Sodium azide	0.5	NT	506
TNT	20	155	209
	40	303	371
	80	501	777
	120	653	890
	160	679	1112
	200	644	774
2-A-4,6-DNT	20	27	141
	40	30	169
	80	63	279
	120	71	334
	160	83	495
	200	129	545
4-A-2,6-DNT	20	40	106
	40	60	131
	80	103	138
	120	138	138
	160	161	176
	200	202	198

[a] Acetonitrile solvent

NT = Not tested

TABLE 6A-4. RESULTS FROM AMES TESTING OF CONTROLS AND PRELIMINARY CCLT LEACHATES

Sample	TA98[c] revertants/plate -S9	+S9	TA100[c] revertants/plate -S9	+S9
1. Control	24	28	117	111
2. Nitrofluorene[a]	874	NT	NT	NT
3. Acetylaminofluorene[a]	NT	533	NT	227
4. Sodium Azide[a]	NT[b]	NT	586	NT
5. 50 μL Mesophilic Leachate	26	24	109	109
6. 200 μL Mesophilic Leachate	29	35	113	107
7. 350 μL Mesophilic Leachate	45	NT	108	NT
8. 700 μL Mesophilic Leachate	56	NT	97	NT
9. 50 μL Thermophilic Leachate	19	29	101	103
10. 200 μL Thermophilic Leachate	30	33	95	106
11. 350 μL Thermophilic Leachate	32	NT	111	NT
12. 700 μL Thermophillic Leachate	35	NT	NT	NT

[a] Positive controls. Nitrofluorene (10 μg/plate). Acetylaminofluorene (10 μg/plate). Sodium azide (2 μg/plate).

[b] NT - not tested

[c] Salmonella overnight culture ~ 2 x 10^9 cells/ml. Ampicillin resistant, UV sensitive, crystal violet sensitive.

TABLE 6A-5. AMES TEST OF CCLT LEACHATES OF THE MESOPHILIC AND THERMOPHILIC COMPOSTS

	μg/plate	TA 98 Revertants/plate	TA 100 Revertants/plate
Control[a]	1800	30	147
Nitrofluorene	5[b]	348	NT
Sodium azide	0.5[b]	NT	262
Mesophilic	200	44	141
Leachate	600	35	150
	1000	86	174
	1400	105	202
	1800	95	152
Thermophilic	200	26	128
Leachate	600	39	116
	1000	33	177
	1400	38	187
	1800	41	146

[a] CCLT solvent.
[b] Number of μg/plate.
NT = Not tested.

TABLE 6A-6. AMES TEST OF THE DMSO CONCENTRATE OFTHE MESOPHILIC AND THERMOPHILIC COMPOST CCLT EXTRACTS

Sample	µg/plate	Revertants/Plate TA98	TA100
Control[a]	50	34	74
Nitrofluorene	5[b]	722	NT
Sodium azide	0.5[b]	NT	480
Mesophilic	10	623	219
	20	1106	344
	30	2160	504
	40	2880	703
	50	3552	607
Thermophilic	10	185	126
	20	340	172
	30	540	201
	40	678	252
	50	862	278

[a] DMSO solvent

[b] µg/plate

NT = Not tested

TABLE 6A-7. AMES TEST OF THE DMSO CONCENTRATE OF THE MESOPHILIC AND THERMOPHILIC COMPOST CCLT EXTRACT

Sample	µL	µg	Revertants	
			TA-98	TA-100
Spontaneous	-	-	27	119
DMSO Control	320	-	23	75
Sodium Azide	-	0.5	-	520
Nitrofluorene	-	5	709	-
	20	-	47	129
Mesophilic	40	-	51	127
Compost	80	-	60	157
Leachate	160	-	101	184
	320	-	169	196
	20	-	55	124
DMSO	40	-	79	143
Extract of	80	-	173	169
Particles	160	-	305	195
	320	-	496	299
Spontaneous	-	-	24	97
DMSO Control	320	-	19	89
Sodium Azide	-	0.5	-	550
Nitro fluorene	-	5	920	-
Centrifuged	20	-	16	117
Mesophilic	40	-	15	115
Compost	80	-	33	123
Leachate	160	-	34	130
	320	-	49	136

TABLE 6A-8. AMES TEST OF PRELIMINARY ACETONITRILE EXTRACTS OF MESOPHILIC AND THERMOPHILIC COMPOSTS

Sample	μg/plate	Revertants/Plate TA98	Revertants/Plate TA100
Control[a]	100	12	88
Nitrofluorene	5	308	NT
Sodium azide	0.5	NT	342
	10	40	107
Mesophilic	100	351	230
	200	441	340
	10	41	95
Thermophilic	100	266	195
	200	327	275

[a] Acetonitrile solvent

NT = Not tested

TABLE 6A-9. AMES TEST OF FINAL ACETONITRILE EXTRACTS OF MESOPHILIC AND THERMOPHILIC COMPOSTS

Sample	μg/plate	Revertants/Plate	
		TA98	TA100
Control[a]	80	11	106
Nitrofluorene	5	911	NT
Sodium Azide	0.5	NT	575
	40	418	232
Mesophilic	80	723	311
	120	1084	364
	160	1227	450
	40	1458	197
Thermophilic	80	2190	296
	120	2976	363
	160	2780	450

[a] DMSO

NT = Not tested

TABLE 6A-10. AMES TEST OF FINAL ETHYL ACETATE EXTRACTS OF MESOPHILIC AND THERMOPHILIC COMPOSTS

Sample	µg/plate	Revertants/Plate	
		TA98	TA100
Control[a]	80	11	106
Nitrofluorene	5	911	NT
Sodium Azide	0.5	NT	575
Mesophilic	40	464	209
	80	781	286
	120	984	345
	160	1266	364
Thermophilic	40	3408	357
	80	TNTC	594
	120	TNTC	878
	160	TNTC	982

DMSO

NT = Not tested
TNTC = Too numerous to count, i.e. greater than 4,000.

TABLE 6A-11. AMES TEST OF ORGANIC SOLVENT EXTRACTS: SECOND SET 12/89

Sample/Solvent	μL	μg	Revertants TA-98	TA-100
Spontaneous	-	-	27	98
Sodium Azide	5	0.5	-	551
Nitrofluorene	5	5	962	-
	10	-	616	592
	20	-	1258	1198
Mesophilic	40	-	1972	1830
Acetonitrile	80	-	2112	1672
	160	-	T*	851*
	10	-	626	476
Mesophilic	20	-	1108	668
Ethylacetate	40	-	1831	1438
	80	-	2201	1600
	160	-	3949	2368
	10	-	1874	369
Thermophilic	20	-	2894	640
Acetonitrile	40	-	3528	1067
	80	-	4060	1544
	160	-	7056	2352
	10	-	4364	721
Thermophilic	20	-	4177	1304
Ethylacetate	40	-	5820	1756
	80	-	TNTC	2480
	160	-	TNTC	2832

*Toxic

TNTC > 6000

TABLE 6A-12. AMES TEST OF ACID HYDROLYSATES OF BOUND FRACTION RESULTING FROM MESOPHILIC AND THERMOPHILIC COMPOSTS

		Revertants/Plate	
Sample	µg/plate	TA98	TA100
Control[a]	NA	33	109
Nitrofluorene	5	894	1180
Sodium Azide	0.5	27	538
Mesophilic	360	42	113
	720	49	128
	1440	61	121
	2880	53	138
	5760	36	147
Thermophilic	292	38	123
	584	49	127
	1168	42	151
	2336	45	147
	4672	46	142
Blank[b]	32	165	133

[a] Spontaneous revertants, not treated
NA = Not applicable

[b] Acid hydrolysate reagents in the absence of compost
NT = Not tested

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