REPORT ON TREATABILITY STUDIES USING SOIL SOLIDIFICATION/STABILIZATION PROCESSES FOR REMEDIATION OF THE 93RD STREET SCHOOL SITE

LOUREIRO ENGINEERING ASSOCIATES, P.C.

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A. INTRODUCTION

1. Purpose of Treatability Studies

This report covers the treatability studies conducted on soils at the 93rd Street School site in Niagara Falls, NY. The site is located within the Love Canal Emergency Declaration Area. Remediation of the site has been found necessary because of contaminated fill deposited on the site between 1938 and 1951. Several studies have been conducted on the site; a Remedial Investigation/Feasibility Study (RI/FS) was completed in 1988 and a Record of Decision (ROD) was issued by EPA in September, 1988.

In the ROD, soil solidification/stabilization was selected as the key element of the site remediation. The performance of treatability studies was one of the requirements of the ROD.

The treatability study program started with public solicitation of Pre-Qualification Submittals (PQSs). This solicitation of PQSs was the first step in a two step process to develop a list of vendors qualified to perform soil solidification/stabilization services at the 93rd Street School site. The submission of a Pre-Qualification Submittal was advertised as a mandatory first step for any vendor wishing to perform subsequent soil solidification/stabilization services required for the remediation of the 93rd Street School site. The solicitation also specified that, following acceptance of a PQS, the vendor would be required to perform successful bench-scale treatability studies as the second step in the procedure for selection of an acceptable treatment process.

The purpose of this report is to describe the treatability study program and to make recommendations on vendor selection. These recommendations will be used to develop a list of vendors who will be eligible to participate in the site remediation work. A contract for the

remediation of the 93rd Street School site requiring the excavation and treatment of soil using a solidification/stabilization technology, backfilling, installation of a low permeability cover and other restoration construction services will be awarded to the lowest responsible and responsive bider pursuant to a bid solicitation and contract documents describing the work. Successful vendors will be allowed to submit a bid as a prime contractor pursuant to the bid solicitation. Alternatively, a third party may bid the contract on the condition that they enter into a contractual relationship with a successful listed vendor to perform the stabilization/solidification services required by the contract.

2. Pre-Qualification Submittals

Ten PQSs were received and five vendors were selected to participate in the treatability study program. These five vendors are identified in Appendix A. The basis for the selection of vendors is covered in detail in the report titled "Review and Evaluation of PQSs of Soil Solidification/Stabilization Vendors". The major considerations in this review were:

- Directly Related Corporate Experiences
- Management Approach
- Quality Assurance/Quality Control
- Operations Plan
- Description of Soil Solidification/Stabilization Process
- Materials Handling Procedures
- Sampling and Analytical Protocols
- Process Limitations
- Project Schedule
- Treatability Study Information
- Health and Safety

3. Evaluation Criteria for Treatability Studies

To form a basis for evaluation of the treatability studies performed by the vendors, a study was carried out to identify available test procedures and to select those appropriate to the 93rd Street School site. The study also included development of a set of acceptable test results by which the treatability studies would be evaluated. A report on these considerations is titled "Evaluation of Test Procedures and Acceptable Test Results", (July 31, 1989), highlights of which are referred to in this report.

B. PREPARATION OF SAMPLES

1. General Procedure

A sample processing schematic is shown in Appendix B. This schematic outlines the collection, mixing, spiking and distribution of the samples and indicates the points in the processing when aliquots were collected for laboratory examination. Chronologically the sample preparation program proceeded as follows:

August 1989	Obtained samples from several augered holes, mixed, removed aliquots for analysis (sample A1) and stored the soil in containers
October 1989	Reviewed data on Sample A1 and prepared a spiking plan.
November, December 1989	Prepared spiking solutions; remixed the soil mass and removed aliquots for analysis (Sample A2); spiked and mixed and removed aliquots for analysis (Sample B).
December 1989	Shipped soil to vendors
January, February 1990	Received samples of treated soil from vendors for analysis (Samples C, D, E and F).

2. Sample Collection

The sample collection program was designed to produce a sufficient mass of soil to conduct treatability studies under sub-contract with five different vendors, estimated to require a volume of about 50 gallons. The actual sample collection points were limited to two areas which, generally, showed the highest contaminant levels for the principal parameters of concern (metals and polynuclear aromatic hydrocarbons (PAHs)). Since it was planned to spike the untreated soil before performing treatability studies, it was not considered necessary to seek out and sample the soils exactly where maximum concentrations were found in the Remedial Investigation.

Samples of soil were collected with a powered post hole auger on August 22 and 23, 1989. The locations of the sample points and depths of the bore holes are shown on a plan in Appendix C. All soil samples removed from the bore holes were placed in a 100-gallon tub and mixed with the power auger, rake, shovel and hoe. After mixing, the blended soil was sampled for laboratory analysis by collecting aliquots from the mixing tub (Sample A1). The mixed soil was then transferred into twelve 22-gallon containers, each with about five gallons of soil. One of these containers was designated for archiving and the other eleven were used to prepare spiked soil portions. The total weight of soil in these eleven containers was 240 kilograms.

3. Characteristics of Untreated Unspiked Soil (Sample A1)

The required mass of soil for treatability studies was obtained from augered holes in selected areas of the site. The entire mass was thoroughly mixed and aliquots were removed to make composite Sample A1, which was subjected to laboratory examinations. The detailed results of these examinations are included in Appendix D; these are summarized as follows:

Volatile Compounds	-	no significant concentrations
Semi-volatile compounds	-	no significant concentrations
Pesticides/PCBs	-	none detected
Dioxins	-	no significant concentrations
Metals	-	Some high values for some metals which were not considered to be a health risk on the site; some moderately elevated values for metals which were identified

as a potential health risk, chiefly arsenic and lead.

Permeability	-	$1x10^{-5}$ cm/sec
Particle size distribution	-	100% passing 3/4" sieve 67.8% passing #200 sieve
TCLP (for PAHs)	-	no significant concentrations
TCLP (for metals)	-	all below detection limits

The laboratory data for Sample A1 shows low contaminant levels compared to some of the levels of contamination found in some of the samples during the Remedial Investigation. This was expected because of the diluting effect resulting from mixing the entire mass of soil into one batch before sampling; thus any contaminant which may have been present in high concentration at any given point would be redistributed at lower concentration throughout the mass. This was not of concern because spiking of the mass of soil was planned to achieve the necessary concentration of contaminant for evaluation of the effectiveness of the treatment processes.

With respect to the volatile compounds, the mixing of the mass of soil obviously resulted in significant loss of volatiles which may have been present. This was also not of concern in the treatability studies because the levels of volatile compound contamination were not found to be significantly high in the Remedial Investigation. The risk assessment did not identify any volatile compounds as health risks for the remediated site, although some releases of volatiles might occur during remediation.

4. Characteristics of Untreated Unspiked Soil (Sample A2)

Sample A2 was collected from the mixed soil mass just prior to spiking. Laboratory results on this sample were as follows:

Parameter	Total (mg/kg)	TCLP Extract (ug/l)
Arsenic	28.0	30.2
Lead	18.7	6.2
Anthracene	No significant concentration	No significant concentration
Benzo(a)anthracene	None detected	None detected

The values for arsenic were higher than that for Sample A1 but the other results were all consistent with Sample A1. The four parameters shown were those selected for evaluation of the treatability studies.

5. Spiking

Because the mixed soil sample (A1) exhibited relatively low levels of most contaminants, spiking of the soil was carried out to introduce sufficient amounts of selected contaminants to adequately test the effectiveness of the soil solidification/stabilization processes. The contaminants selected for spiking were arsenic, lead, and benzo(a)anthracene, which were found to be among the contaminants with the highest health risk on the site. In addition, anthracene was used for spiking to provide a second organic compound with somewhat different characteristics (vapor pressure, etc.) than benzo(a)anthracene.

The spiking plan in Appendix E presents the details of the rationale for the spiking levels and the preparation of the spiking solutions.

The spiking was conducted on December 1, 1989. Eleven soil portions (240 kilograms) were transferred to a powered cement mixer. The mass was mixed for about 30 minutes and Sample A2 of the unspiked soil was collected for re-examination for selected contaminants. Sample A2 was obtained by collecting aliquots from the cement mixer. Mixing was then resumed, the spiking solutions were added and mixing continued for four hours. Sample B of the spiked soil was obtained by collecting aliquots from the cement mixer. The soil mass was then transferred into seven 10-gallon containers; five were shipped to vendors to perform treatability studies, one was shipped to NYSDEC and one was archived.

6. Characteristics of Untreated Spiked Soil (Sample B)

Sample B was collected from the mixed soil mass after spiking and after four hours of mixing. This sample was analyzed for total contaminant concentration in the soil and for TCLP for the parameters arsenic, lead, benzo(a)anthracene and anthracene. The following tabulation shows these results as well as the theoretical calculated total contaminant level which was expected based on the sum of (1) the total contaminant level found in Sample A1 and (2) the total contaminant added to the soil in the spiking process:

Parameter	Total Contaminant in Soil (mg/kg) By Theoretical Calculation	By Laboratory Determination On Sample B *	TCLP Extract Concentration (ug/l) By Laboratory Determination on Sample B
Arsenic	284	277 (230)	3040
Lead	538	589 (706)	1,960
Benzo(a)anthracene	40.0	38.0 (12.0)	Not detected
Anthracene	40.0	38.0 (19.0)	0.3

* Values in ( ) are those determined by the NYSDEC laboratory on spiked soil samples. See laborabory data in Appendix D.

7. Distribution of Samples

As shown on the sample processing schematic in Appendix B, the spiked soil was sub-divided into seven portions. These were placed in 10-gallon containers for storage and/or shipment. Each of the five vendors was supplied with about 36 kilograms of spiked soil sample (total 180 kg), and the remaining 60 kilograms was placed in two 10-gallon containers, one for use by NYSDEC laboratories and one for archiving. The samples were shipped to the vendors on December 1, 1989.

C. STUDIES BY VENDORS

1. Requirements of the Treatability Studies

Sub-contract letters of agreement and a general scope of work were sent to the five pre-qualified vendors. The basic provisions of these treatability study agreements were as follows:

a. Using the untreated soil sample furnished, each vendor shall conduct bench-scale treatability studies for the purpose of defining an acceptable treatment process which will produce a treated soil have acceptable characteristics as defined by NYSDEC.

b. Unused sample and sample treatment products shall be shipped to a designated facility in Niagara Falls, NY.

c. Each vendor shall submit a complete report on the treatability studies conducted. The report shall include all necessary process data, test results, etc. to provide NYSDEC with necessary information to (a) judge the suitability of the process and (b) prepare designs for site remediation using the process.

d. Each vendor shall submit samples of treated soil for analysis to York Laboratories, Monroe, CT and to Independent Materials Testing Laboratories, Inc., Plainville, CT. The samples shall be prepared to perform the following tests:

Total contaminants (SW-846); provide 400 grams

- Arsenic
- Lead
- Benzo(a)anthracene
- Anthracene

TCLP (SW-846); provide 400 grams

- Arsenic
- Lead
- Benzo(a)anthracene
- Anthracene

- Free Liquids (SW-846); provide 400 grams

- Unconfined compressive strength (ASTM C109); provide two 2-inch cubes

- Permeability (SW-846 Method 9100-2.8); provide two cylinders each 2.5 to 2.72 inches in diameter by 4.75 inches high.

- Freeze-thaw weathering (ASTM D560); provide two 2-inch cubes

2. Acceptable Treatability Study Results

The following criteria were established for use as a guide by NYSDEC in determining the acceptability of the treatment process:

		Values Considered to be Acceptable
a.	Total contaminants	Not applicable
b.	TCLP	
	- Arsenic	Max. 0.3 mg/l
	- Lead	Max. 0.1
	- Benzo(a)anthracene	Max. 0.5
	- Anthracene	Max. 0.5
c.	Free Liquids	None
d.	Unconfined compressive strength	Min. 50 psi
e.	Permeability	Max. 10^{-7} cm/sec
f.	Freeze thaw weathering	Max. weight loss 10%

The vendors were advised that, although reasonable compliance with all the above values would be considered necessary, the greatest emphasis would be on meeting the TCLP maximum limits.

3. Information on Untreated Sample Characteristics Provided to Vendors

Each vendor was provided with the results of the laboratory

examination conducted on Sample A1 (untreated and unspiked soil), except that the data was adjusted to reflect the soil characteristics for the spiked soil which would be subjected to treatability studies. The vendors were not informed that the soil had been spiked; however, laboratory data on Sample A1 for the parameters arsenic, lead, benzo(a)anthracene and anthracene was deleted and the following was substituted for these four parameters:

- total contaminant value given to the vendors was the theoretical calculated value based on the sum of the values found in Sample A1 plus the spiked amount.
- The TCLP extract concentrations given to the vendors were for Sample B (spiked soil as determined in the laboratory).

A full copy of these data as given to the vendors is included in the Appendix D, except that the starred foot notes have been added for purposes of this report.

4. Treated Samples Returned by Vendors

Four vendors submitted treated soil samples to York Laboratories and to Independent Materials Testing Laboratories, Inc. (IMTL) for analysis. The fifth vendor reported the loss of their treated sample; this vendor was disqualified from being named as a successful vendor because additional untreated soil could not be made available for more testing without introducing serious delays into the project schedule. The samples returned by the vendors are referred to as Samples C, D, E, and F as shown in the list of vendors in Appendix A. Laboratory reports on the analyses of these samples are included in Appendices F, G, H and I. Each of the samples was examined for total contaminant to verify that the sample returned was the same

material as that shipped to the vendor for the treatability study. These results were as follows:

Parameter	Total Contaminant (mg/kg) in Untreated Spiked Samples Sent to Vendors (Sample B)	Total Contaminant (mg/kg) In Treated Samples Returned by Vendors			
		Sample C	Sample D	Sample E	Sample F*
Arsenic	284	201	145	197	179
Lead	538	487	256	134	381
Benzo(a) anthracene	38.0	30.0	13.0	13.0	17.4
Anthracene	38.0	27.0	17.0	14.0	21.6

*Average of 5 samples

These results on total contaminant concentrations indicate that the samples sent to the vendors were in fact treated and returned. This is supported further by the absence of significant concentrations of other semi-volatile compounds in the treated samples which correspond to the characteristics of Sample B.

Each of the samples returned by the vendors was also analyzed for leachability of contaminants by TCLP. These results were as follows:

Parameter	TCLP Extract (ug/l) From Untreated Spiked Samples Sent to Vendors (Sample B)	TCLP Extracts (ug/l) From Treated Samples Returned by Vendors				Maximum Considered Acceptable in TCLP Extract (ug/l)**
		Sample C	Sample D	Sample E	Sample F*	
Arsenic	3040	173	11.2	9.4	34.6	300
Lead	1960	1.5	ND	180	2.1	100
Benzo(a) anthracene	ND	ND	ND	ND	ND	500
Anthracene	ND	ND	ND	ND	ND	500

* Averge of 5 samples
**See Section C-2

ND = not detected (see detection limits in Appendices D, F, G, H and I)

The analyses of all four samples indicate that, except for lead in Sample E, the contaminant levels in the TCLP extracts were below the maximum considered acceptable as developed in the report "Evaluation of Test Procedures and Acceptable Test Results".

Each of the four vendors submitted two specimens to IMTL for testing for permeability, unconfined compressive strength and weight loss by freeze-thaw. Detailed laboratory reports are included in Appendices F, G, H and I; the results in summary form were as follows:

Sample	Permeability (cm/sec)	Unconfined Compressive Strength (PSI)	Freeze Thaw Weight Loss (%)
Value Considered Acceptable*	Max 10^{-7}	Min 50	Max 10
A1	$1x10^{-5}$	-	-
C	1.3×10^{-6} 4.0×10^{-7}	550 650	54.1 56.9
D	3.2×10^{-8} 5.4×10^{-8}	800 950	0.02 0.07
E	$<5 \times 10^{-10}$ $<5 \times 10^{-10}$	573 446	0.06 0.54
F	1.3×10^{-7} 7.4×10^{-6}	650 700	49.6 42.0

*See Section C-2

These results indicate that vendors D and E met all of the physical criteria established as discussed in Section C-2. Vendors C and F met the criteria for unconfined compressive strength but did

not meet the permeability and freeze-thaw criteria. In all cases the treatment resulted in a reduction of permeability by comparison to Sample A1 (untreated soil). Most of the weight loss in Samples C and F appeared to be due to a lack of cohesiveness in the samples submitted.

5. Reports Submitted by Vendors

Each vendor submitted a report on the work performed and a copy of the reports is included in Appendices J, K, L and M. In some cases the vendors responded to questions on their reports and these comments are also included in the appropriate Appendix. Documentation on the lost sample (Vendor G) is included in Appendix N.

6. Summary of Findings

The following tabulation summarizes the findings of the treatability studies:

	VENDORS			
	C	D	E	F
Appearance	Soil-like	Pourable grout	Firm clay-like	Soil-like
Color	Gray with orange/rust coloration	Gray	Gray	Gray with rust coloration
% Expansion	25	Proprietary	15-30	25
Formulation	10% portland Cement 6% Ferrous Sulfate		Proprietary	Proprietary
Curing & Redeposition		Treat and deposit before curing	Cure 24-48 hours before before re-deposition	Treat, re-deposit immediately, compact and cure in place
Met Testing Criteria per Section C-2:				
- TCLP - As	Yes	Yes	Yes	Yes
- Pb	Yes	Yes	No	Yes
- Benz(a) anth	Yes	Yes	Yes	Yes
- Anth	Yes	Yes	Yes	Yes
- Free Liquids	Yes	Yes	Yes	Yes
- UCS	Yes	Yes	Yes	Yes
- Permeability	No	Yes	Yes	No
- Freeze-thaw	No	Yes	Yes	No

D. DISCUSSION AND RECOMMENDATIONS

1. Discussion of Results

All four vendors successfully processed the spiked soil to produce a treated soil with significant reductions in metals in the TCLP extract as compared to the untreated soil. Three of the four vendors also met the criteria established as discussed in Section C-2 for maximum concentration of metals in the TCLP extract. Sample E showed a lead concentration in the TCLP extract of 180 ug/l compared to 100 mg/l established as a maximum level. This vendor indicated that a change in their formulation would readily reduce lead to the desired level.

Of the six criteria established in Section C-2, the TCLP extract is by far the most important to the measurement and evaluation of processes to meet the overall objectives of the remediation, namely to immobilize contaminants. For this reason all four of the vendors should be accepted for inclusion in the contract documents as having acceptable processes for the remediation work.

Although two of the vendors did not meet the criteria in Section C-2 for permeability and weight loss due to freeze thaw, these parameters are of relatively minor importance by comparison to the TCLP extract values. Both of these vendors indicated that a change in formulation would readily improve these characterisitics. Also, it should be noted that poorly prepared samples may have been responsible for the failure to meet the criteria. The successful unconfined compressive strength tests on all four samples indicates that any one of the vendors can produce a treated soil which will have good structural properties after burial.

2. Recommendations

It is recommended that Vendors C, D, E and F be named as acceptable vendors to perform the soil treatment process to be specified in the contract documents for site remediation.

It is further recommended that the requirement for a pilot test be deleted from the contract documents and that the successful bidder be required to perform a more extensive treatability studies as the first activity under the remediation contract. This would be adequate to provide the basis for the treatment formulation, would take less time to perform and would be less costly by comparison to a full-scale pilot testing program.

E. REFERENCE DOCUMENTS

The following documents are referenced in this report:

1. Remedial Investigation/Feasibility Study Report for the 93rd Street School Site (Site No. 9-32-078), City of Niagara Falls, New York, by Loureiro Engineering Associates, 1988.

2. Declaration for the Record of Decision and ROD Decision Summary, USEPA, 1988.

3. Requirements For Pre-Qualification Submittals For Soil Solidification/Stabilization Vendors For Remediation Of The 93rd Street School Site, City of Niagara Falls, New York, Site No. 9-32-078, by Loureiro Engineering Associates, 1989.

4. Review And Evaluation Of Pre-Qualification Submittals Of Soil Solidification/Stabilization Vendors For Remediation Of The 93rd Street School Site, City of Niagara Falls, New York, Site No. 9-32-078, by Loureiro Engineering Associates, 1989.

5. Evaluation Of Test Procedures And Acceptable Test Results For Remediation Of The 93rd Street School Site, City of Niagara Falls, New York, Site No. 9-32-078, by Loureiro Engineering Associates, 1989.

APPENDICES

A. TREATABILITY STUDY VENDORS

B. SAMPLE PROCESSING SCHEMATIC

C. TREATABILITY STUDY SAMPLE POINTS

D. LABORATORY DATA - CHARACTERISTICS OF UNTREATED SOIL

E. SPIKING PLAN

F. LABORATORY DATA - CHARACTERISTICS OF TREATED SOIL - VENDOR C - ENRECO

G. LABORATORY DATA - CHARACTERISTICS OF TREATED SOIL - VENDOR D - WASTECH

H. LABORATORY DATA - CHARACTERISTICS OF TREATED SOIL - VENDOR E - CHEMFIX

I. LABORATORY DATA - CHARACTERISTICS OF TREATED SOIL - VENDOR F - TRICIL

J. VENDORS TREATABILITY STUDY REPORT VENDOR C - ENRECO

K. VENDORS TREATABILITY STUDY REPORT VENDOR D - WASTECH

L. VENDORS TREATABILITY STUDY REPORT VENDOR E - CHEMFIX

M. VENDORS TREATABILITY STUDY REPORT VENDOR F - TRICIL

N. DOCUMENTATION ON LOST SAMPLE VENDOR G - ENVIROSAFE

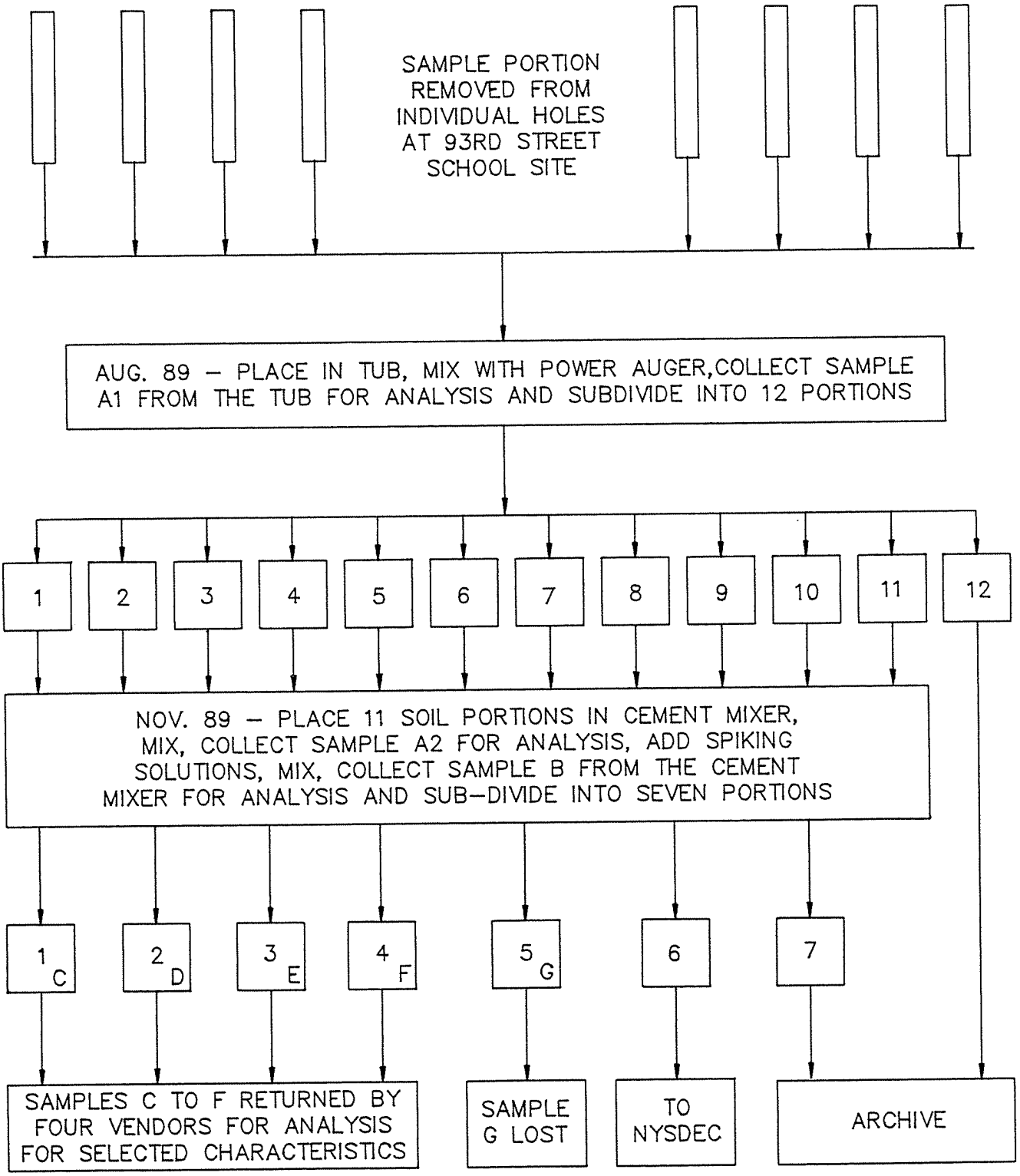
APPENDIX A
TREATABILITY STUDY VENDORS

TREATABILITY STUDY VENDORS

DESIGNATION	PRIMARY CONTACTS	COPIES TO
C	ENRECO 724 South Polk, Ste. 450 Amarillo, TX 79109 Attn: Dwight M. Rueter 806-379-6424 806-379-7319 (FAX)	ENRECO 2431 Crofton Lane, Ste. 13a Crofton, MD 21114 Attn: Steven M. Erlanson 301-721-5005
D	WASTECH, Inc. 114 Tulsa Road P.O. Box 1213 Oak Ridge, TN 37831-1213 Attn: E. Benjamin Peacock (Admin) Kathleen Manning (Tech) 615-483-6515 615-483-4239 (FAX)	Sevenson Environmental Services, Inc. 2749 Lockport Road Niagara Falls, NY 14302 Attn: Michael A. Elia 716-284-0431
E	CHEMFIX Environmental Services, Inc. 2424 Edenborn Ave., Suite 230 Metairie, LA 70001 Attn: Wayne A. Brown (Tech) Phil Baldwin, Jr. (Admin) 504-831-3600 504-833-4615 (FAX)	
F	TRICIL Environmental Response, Inc. 1123 Lumpkin Road P.O. Box 19529 Houston, TX 77224-9529 Attn: C.H. Orwig 713-467-3433 713-467-5935 (FAX)	TRICIL Environmental Response, Inc. 249 Ayer Road, Ste. 204 Harvard, MA 01451-1108 Attn: Henry A. Morgan, Jr. 508-772-6693
G	ENVIROSAFE TECHNOLOGIES, Inc. P.O. Box 833 Valley Forge, PA 19482-0833 Attn: Robert A. West 215-962-0800 215-962-0727 (FAX)	

APPENDIX B

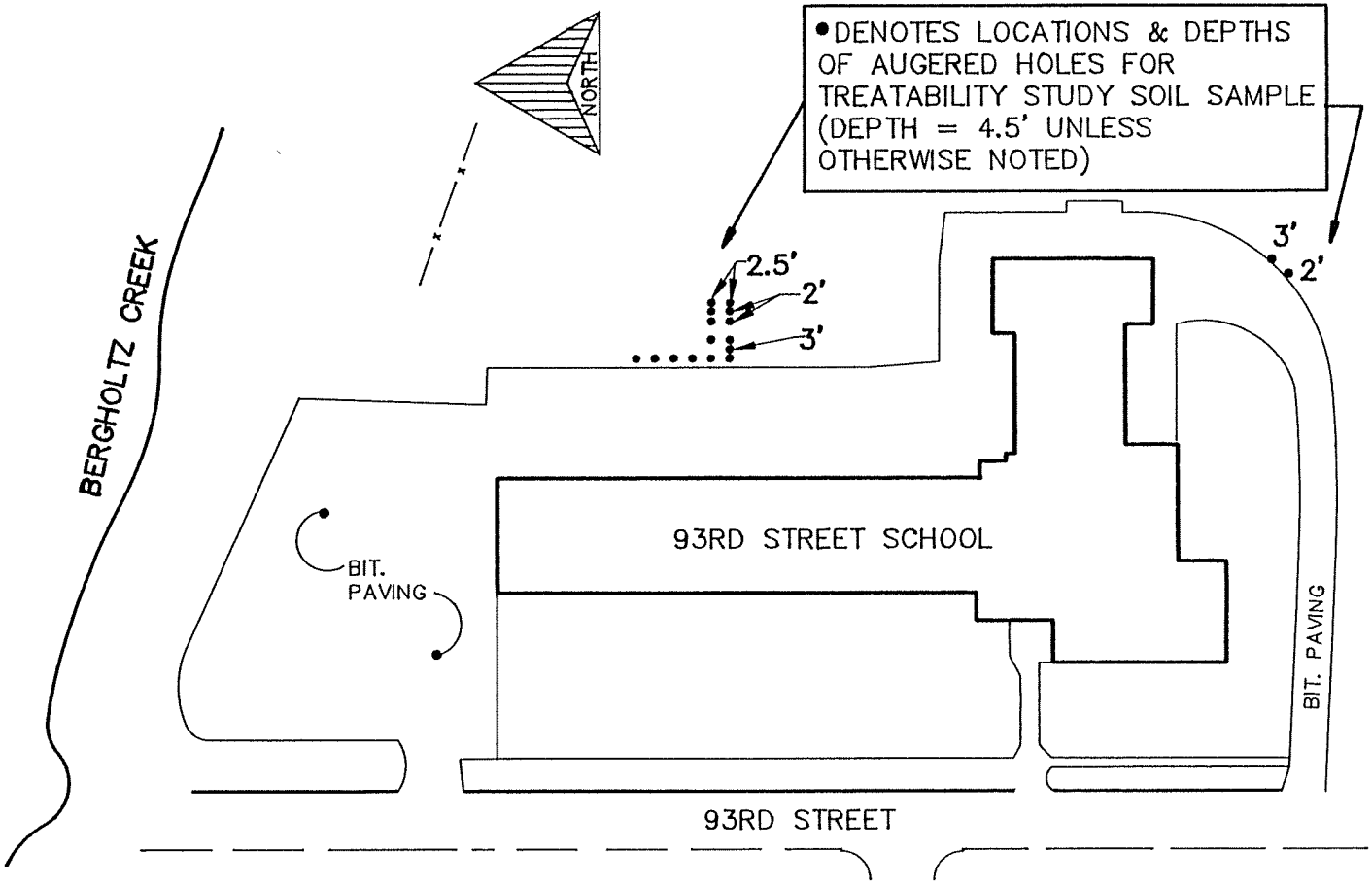
SAMPLE PROCESSING SCHEMATIC



APPENDIX B
SAMPLE PROCESSING SCHEMATIC

APPENDIX C

TREATABILITY STUDY SAMPLE POINTS



APPENDIX C
TREATABILITY STUDY SAMPLE POINTS

93RD STREET SCHOOL SITE
NIAGARA FALLS, N.Y.

SAMPLES COLLECTED: AUGUST 1989
SCALE: 1" = 100'

LOURIERO ENGINEERING ASSOCIATES PLAINVILLE, CT.

APPENDIX D

LABORATORY DATA - CHARACTERISTICS OF UNTREATED SOIL

APPENDIX D
LABORATORY DATA

NOTE:

The data in this Appendix gives the characteristics of the untreated spiked soil sent to the Vendors. The data was derived from:

Sample A1 - Composited on-site after mixing (August 1989) - untreated and unspiked.

Sample A2 - Composited after re-mixing of soil (December 1989) - untreated and unspiked.

Sample B - Composited after re-mixing and spiking of soil (December 1989) - untreated and spiked.

Theoretical Calculated Concentration - sum of the concentration found in Sample A1 plus the spiked amount.

Unless otherwise noted the values given in this Appendix were furnished to the Vendors; starred footnotes have been added to indicate related data or other clarification.

TAL VOLATILE COMPOUNDS*

All Values are ug/Kg

Chloromethane	U
Bromomethane	U
Vinyl Chloride	U
Chloroethane	U
Methylene Chloride	U
Acetone	11JB
Carbon Disulfide	U
1,1-Dichloroethene	U
1,1-Dichloroethane	U
1,2-Dichloroethene (total)	U
Chloroform	U
1,2-Dichloroethane	U
2-Butanone	U
1,1,1-Trichloroethane	U
Carbon Tetrachloride	U
Vinyl Acetate	U
Bromodichloromethane	U
1,1,2,2-Tetrachloroethane	U
1,2-Dichloropropane	U
cis-1,3-Dichloropropene	U
Trichloroethene	U
Dibromochloromethane	U
1,1,2-Trichloroethane	U
Benzene	U
trans-1,3-Dichloropropene	U
Bromoform	U
4-Methyl-2-pentanone	U
2-Hexanone	U
Tetrachloroethene	U
Toluene	U
Chlorobenzene	U
Ethylbenzene	U
Styrene	U
Xylene (total)	U

*All data on this page based on Sample A1.

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

EPA TCL SEMI-VOLATILE COMPOUNDS*

All values are ug/Kg

Phenol	U	Acenaphthene	20J
bis(2-Chloroethyl)ether	U	2,4-Dinitrophenol	U
2-Chlorophenol	U	4-Nitrophenol	U
1,3-Dichlorobenzene	U	Dibenzofuran	U
1,4-Dichlorobenzene	U	2,4-Dinitrotoluene	U
Benzyl alcohol	U	2,6-Dinitrotoluene	U
1,2-Dichlorobenzene	14J	Diethylphthalate	U
2-Methylphenol	U	4-Chlorophenyl-phenylether	U
bis(2-Chloroisopropyl)ether	U	Fluorene	22J
4-Methylphenol	U	4-Nitroaniline	U
N-Nitroso-di-n-propylamine	U	4,6-Dinitro-2-methylphenol	U
Hexachloroethane	U	N-Nitrosodiphenylamine (1)	U
Nitrobenzene	U	4-Bromophenyl-phenylether	U
Isophorone	U	Hexachlorobenzene	U
2-Nitrophenol	U	Pentachlorophenol	U
2,4-Dimethylphenol	U	Phenanthrene	160J
Benzoic acid	U	Anthracene	40000*
bis(2-Chloroethoxy)methane	U	Di-n-butylphthalate	43JB
2,4-Dichlorophenol	U	Fluoranthene	230J
1,2,4-Trichlorobenzene	U	Pyrene	180J
Napthalene	16J	Butylbenzylphthalate	14J
4-Chloroaniline	U	3,3'-Dichlorobenzidine	U
Hexachlorobutadiene	U	Benzo(a)anthracene	40000*
4-Chloro-3-methylphenol	U	bis(2-Ethylhexyl)phthalate	490B
2-Methylnaphthalene	10J	Chrysene	85J
Hexachlorocyclopentadiene	U	Di-n-octylphthalate	U
2,4,6-Trichlorophenol	U	Benzo(b)fluoranthene	71J
2,4,5-Trichlorophenol	U	Benzo(k)fluoranthene	58J
2-Chloronaphthalene	U	Benzo(a)pyrene	53J
2-Nitroaniline	U	Indeno(1,2,3-cd)pyrene	25J
Dimethylphthalate	U	Dibenzo(a,h)anthracene	10J
Acenaphthylene	U	Benzo(g,h,i)perylene	27J
3-Nitroaniline	U		

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

* All data on this page based on sample A1 except anthracene and benzo(a)anthracene are the theoretical calculated spiked concentrations; for samples A1, A2 and B, anthracene was 300 J, 2600 and 38000, respectively and benzo(a)anthracene was U, 6000, and 38000, respectively.

EPA TCL PESTICIDES/PCB's*

All values are ug/Kg

alpha-BHC	U
beta-BHC	U
gamma-BHC	U
delta-BHC	U
Hetachlor	U
Aldrin	U
4,4'-DDE	U
Dieldrin	U
4,4'-DDD	U
Methoxychlor	U
Endrin-Ketone	U
4,4'-DDT	U
alpha-Chlordane	U
gamma-Chlordane	U
Endosulfan I	U
Endolfan II	U
Endosulfan Sulfate	U
Endrin	U
Heptachlor Epoxide	U
Toxaphene	U
PCB - 1016	U
PCB - 1221	U
PCB - 1232	U
PCB - 1242	U
PCB - 1248	
PCB - 1254	U
PCB - 1260	U

U - Indicates that the compound was analyzed for but not detected.

* All data on this page based on Sample A1.

POLYCHLORINATED DIOXINS/FURANS
HIGH RESOLUTION

Parameter	Result	Units
Furans		
TCDFs (total)	16	pg/g
PeCDFs (total)	7.8	pg/g
HxCDFs (total)	14	pg/g
HpCDFs (total)	24	pg/g
OCDF	67	pg/g
Dioxins		
TCDDs (total)	1.6	pg/g
PeCDDs (total)	1.7	pg/g
HxCDDs (total)	6.3	pg/g
HpCDDs	19	pg/g
OCDD	390	
	% Recovery	
13C-2,3,7,8-TCDF	59	
13C-2,3,7,8-TCDD	66	
13C-1,2,3,7,8-PeCDD	77	
13C-1,2,3,6,7,8-HxCDD	82	
13C-1,2,3,4,6,7,8-HpCDD	52	
13C-OCDD	18	

* All data on this page based on Sample A1.

TAL METALS*
All values are mg/Kg.

Aluminum	8,760
Antimony	<15.6
Arsenic	284
Barium	97.0
Beryllium	2.5
Cadmium	<2.0
Calcium	8,260
Chromium	38.1
Cobalt	15.9
Copper	40.6
Iron	24,100
Lead	538
Magnesium	3,080
Manganese	201
Mercury	0.43
Nickel	17.4
Potassium	829
Selenium	<1.0
Silver	<2.0
Sodium	221
Thallium	<2.0
Vanadium	24.1
Zinc	50.8

* All data on this page based on Sample A1 accept arsenic and lead are the theoretical calculated spiked concentrations; for samples A1, A2 and B, arsenic was 23.0, 28.0 and 277, respectively and lead was 15.5, 18.7 and 589, respectively.

MISCELLANEOUS*

Total Cyanide	<0.10 mg/Kg
Percent Moisture	23.5 percent
pH	8.18 S.U.
Permeability	1×10^{-5} cm/sec

Particle Size Distribution:

Sieve	% Passing
3/4"	100
1/4"	99.4
#10	94.3
#40	85.9
#100	80.2
#200	67.8

	TCLP EXTRACT ANALYSIS* (ug/l)	METHOD DETECTION LIMIT
Arsenic	3040	10
Lead	1960	5
Anthracene	0.3J	10
Benzo(a)anthracene	Not detected	10

* All data on this page based on Sample A1 except that TCLP is for Sample B. TCLP extract analysis was as follows for Samples A1 and A2 (ug/l):

	A1	A2
Arsenic	<20	30.2
Lead	<100	6.2
Anthracene	1J	0.4J
Benzo(a)anthracene	U	U

NYSDEC LABORATORY

Report - 93rd Street School Soil Spiking Experiment
February 7, 1990

ANALYTE	SPIKING LEVEL (PPM)	RECOVERY DATA (PPM) RUN #1	RUN #2	RUN #3	AVE.
Arsenic	200.00	206.00	254.00	232.00	230.00
Lead	400.00	680.00	740.00	696.00	706.00
Anthracene	40.00	20.00	19.00	19.00	19.00
Benzo(a)Anthracene	40.00	11.00	12.00	13.00	12.00

APPENDIX E

SPIKING PLAN

APPENDIX E
SPIKING PLAN FOR UNTREATED SOILS

DETERMINATION OF SPIKING CONCENTRATIONS

In August 1989 samples were collected for treatability studies essentially as described in Section 2 of the Work Plan at the locations shown on Drawing WP-1. Except for certain metals, there were no significant levels of contaminants found. The dioxin level was below the detection limit.

To prepare samples to send to vendors for treatability studies it is necessary to spike the samples with selected contaminants to provide a base level against which the effectiveness of the treatment process can be evaluated. The parameters of concern for the remediation work have been identified in the report "Evaluation of Test Procedures and Acceptable Test Results", July 31, 1989 by LEA. This report also gave the maximum TCLP extract concentration levels to be considered acceptable in a sample of treated soil. These values are shown in Table C-1.

Also shown on Table C-1 is the rationale for the proposed spiking program. The basic criteria for spiking were:

1. That spiking be limited to a few compounds and only metals and PAHs. Spiking will be limited to arsenic, lead, benzo (a) anthracene and anthracene and these contaminants will serve as the basis for evaluating the treatability studies.

2. That the concentration of any one of the spiked compounds in the soil be high enough so that it would be impossible to meet the TCLP concentration limitation unless the treatment process is actually effective in immobilizing the contaminant (if the numerical value of the concentration (mg/kg) of a contaminant in soil is less than 20 times the numerical value of the permissible concentration (mg/l) in the TCLP extract, then the extract concentration will not exceed the permissible concentration because of dilution by the extraction solution even if the treatment process is totally ineffective). To insure that sufficient contaminant is present in the samples subjected to treatability studies the minimum required soil:extract ratio of 40 was used as shown in Table C-1.

3. That the total concentration of any one contaminant in the soil of after spiking not exceed the highest concentration of that contaminant found in any sample during the 1986-87 remedial investigation. This would minimize the possibility of creating a sample with unrealistically high contaminant levels.

TABLE C-1
RATIONALE FOR SPIKING LEVELS

CONTAMINANT (1)	Proposed Max. Concentration in TCLP Extract (mg/l) (2)	Required Minimum Soil Concentration For a Soil:Extract Ratio = 40 (mg/kg) (3)	Highest Concentration in Soil in Samples of 1986-7 for RI (mg/kg) (4)	Concentration in Soil Sample of Aug 1989 (mg/kg) (5)	**Propose Spiking (mg/kg) (6)
Arsenic	0.3	12	350	23	200
Antimony	0.1	4	209	15.6	0
Lead	0.1	4	843	15.5	400
Mercury	0.0002	0.008	23	0.43	0
Cadmium	0.2	8	133	<2	0
1000Cobalt	1.0	40	52	15.9	0
Benzo(a)-anthracene	0.5	20	26	ND	40
Chrysene	0.5	20	24	ND	0
Anthracene	0.5	20	22	ND	40
Benzo(b)-fluoranthene	0.6	24	31	ND	0
Benzo(a)pyrene	0.4	16	19	ND	0
Indeno (1,2,3-cd) pyrene	0.2	8	8.2	ND	0
Dioxin	0.001		2.3	ND	0***

* Soil:Extract ratio is the concentration in the soil (mg/kg) divided by the concentration in the extract (mg/l). Values in column (3) are 40 times those in column (2). If a TCLP extraction removes 100 per cent of the contaminant in a sample, the concentration in the extract (mg/l) will be approximately 1/20 the concentration in the soil sample (expressed in mg/kg) for a ratio of 20. If a minimum ratio of 40 is used as a guide for the spiking amount, then the treatment must immobilize the contaminant (at least partially) to meet the maximum allowable concentration limit in column (2).

** Spiking will be only for the four contaminants shown; for each of the metals, the sum of columns (5) and (6) is greater than column (3) and approximately equal to or less than column (4). For the PAHs the total spiking amounts are lower than the total for all PAHs in column (4).

*** Due to the low dioxin concentrations found, the hazards in handling dioxins, and the extremely high cost of dioxin surrogate compounds, dioxin spiking is not considered to be advisable.

SPIKING PROCEDURE

The soil samples collected in August 1989 were mixed together and then sub-divided into ten approximately equal-sized portions. One of these portions will be archived and the other nine will be mixed together, spiked, mixed and subdivided into seven portions, one to each vendor, one to NYSDEC, and one to be archived.

Spiking solutions will be prepared in accordance with Table C-2.

The quantities of spiking solutions to be added will be determined in the field based on the concentrations of the spiking solutions, the spiking requirement (Column (6) of Table C-1) and the actual weight of soil being spiked. The spiking of each portion will be done by slowly pouring the spiking solutions into the soil while the soil is being mixed with a mechancial mixer.

TABLE C-2
SPIKING SOLUTIONS

CONTAMINANT		SPIKING COMPOUND				SPIKING AMOUNT FOR 240 KG OF SOIL			
NAME	PROPOSED SPIKE (mg/kg)	CHEMICAL NAME	CHEMICAL STATE S - SOLID L = LIQUID	CONC. OF CONTAMINANT IN SPIKING COMPOUND		CHEMICAL STATE S = SOLID L = LIQUID	REQD WEIGHT OF CONTAM (GM)	CONC. IN SPIKING SOLUTION (mg/l)	REQ'D SOLUTION VOLUME (liters)
				SOLIDS (% bywt)	LIQUIDS (gm/l)				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ARSENIC	200	Sodium Arsenite	S	57.66		L*	48	81000	0.590
LEAD	400	Lead Nitrate	S	62.55		L*	96	162,000	0.59
Benzo (a) Anthracene	40	1,2 benz(a) anthracene	S	99		L**	9.6	32,000	0.3
Anthracene	40	Anthracene	S	99		L**	9.6	32,000	0.3

* Arsenic and lead will be spiked with separate water solutions
** BNAs will be spiked with separate methanol suspensions

APPENDIX F

LABORATORY DATA - CHARACTERISTICS OF TREATED SOIL

VENDOR C - ENRECO

YORK LABORATORIES

REPORT TRANSMITTAL

REPORT NUMBER 30900-0538

DATE February 27, 1990

CLIENT YWC/Engineering
200 Monroe Turnpike
Monroe, CT 06468

ATTENTION Mr. Brian Armet

The above referenced report is enclosed. Copies of this report and supporting data will be retained in our files in the event they are required for future reference.

If there are any questions concerning this report, please do not hesitate to contact us.

Any samples submitted to our Laboratory will be retained for a maximum of sixty (60) days from receipt of this report, unless other arrangements are desired.

February 27, 1990

30900-0538
YWC/ENGINEERING
200 Monroe Turnpike
Monroe, Connecticut 06468

Re: LEA 6282-01

Attention: Ms. Joan Thomas

PURPOSE

One soil sample was submitted to York Laboratories Division of YWC, Inc. by Enreco Laboratories. The sample was analyzed for total and TCLP arsenic, lead, anthracene and benzo(a)anthracene. The sample was also analyzed for Free Liquids (Paint Filter Test).

METHODOLOGY

Semi-volatile organics were determined using capillary GC/MS. The instrumentation used was a Hewlett-Packard Model 5890 gas chromatograph interfaced with a Model 5970 Mass Selective Detector.

Metals were determined by ICP using either a JA61 simultaneous ICAP or a PE 6500XR sequential ICP. Graphite furnace elements were determined using either a PE Zeeman 5100 or PE Zeeman 3030 GFAAS.

TCLP extracts were prepared according to Appendix I to 40 CFR Part 268. Analysis was conducted according to NYS-DEC CLP Protocols, 1987.

DISCUSSION

The following items were noted in the course of analysis:

Metals - The sample name with the prefix "T" designates the TCLP leachate sample. The numerical sample name alone designates the intact soil sample.

The TCLP sample required three digestions for the following reasons:

Prep #1 - The LCS for this prep apparently was made improperly. The arsenic LCS was within the control limits. We, therefore, used this data. However, the lead LCS was outside the limits, which required re-digestion of the samples.

Prep #2 - The analyst erroneously brought the samples to an incorrect volume. This prep was therefore voided and a third prep for lead was performed.

Prep #3 - This prep was employed for lead analysis.

All other data appears consistent.

There was no free liquid in the sample.

Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designate, as verified by the following signature.

Mary A. McCann
Project Manager

February 27, 1990
Date

The liability of YWC, Inc. is limited to the actual dollar value of this project.

Soil

TABLE 1.0
30900-0538
YWC/ENGINEERING
EPA TCL SEMI-VOLATILE ORGANICS

All values are ug/Kg.

	Sample Identification		
Dilution Factor	1.00	5.00	
Method Blank I.D.	>C6052	>C6052	
Compound	Method Blank	S89-1451	Method Detection Limits with no Dilution
Anthracene	U	27,000	330
Benzo(a)anthracene	U	30,000	330

U, J, B - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

Soil

TABLE 1.1
30900-0538
YWC/ENGINEERING
EPA TCL SEMI-VOLATILE ORGANICS

All values are ug/L.

	Sample Identification		
Dilution Factor	1.00	1.00	
Method Blank I.D.	>C6078	>C6078	
Compound	Method Blank	S89-1451 TCLP	Method Detection Limits with no Dilution
Anthracene	U	U	10
Benzo(a)anthracene	U	U	10

J, J, B - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

TABLE 2.0
30900-0538
YWC/ENGINEERING
INORGANICS

All values are ug/L.

Parameter	S89-1451 TCLP
Arsenic	173
Lead	1.5UW

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-4458

TABLE 2.1
30900-0538
YWC/ENGINEERING
INORGANICS

All values are mg/Kg.

Parameter	S89-1451
Arsenic	201
Lead	487

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-4458
629 ROUTE 10 • WHIPPANY, NEW JERSEY 07981 • (201) 428-8181
126 WEST CENTER COURT • SCHAUMBURG, ILLINOIS 60195 • (312) 705-0740

TABLE 3.0
30900-0538
YWC/ENGINEERING
FREE LIQUIDS

Sample Identification	Results
S89-1451	Sample Contained No Free Liquids

APPENDIX

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

N - Indicates that the compound was analyzed for but not requested as an analyte. Value will not be listed on tabular result sheet.

X - Matrix spike compound.

(1) - Cannot be separated from diphenylamine.

(2) - Decomposes to azobenzene. Measured and calibrated as azobenzene.

A - This flag indicates that a TIC is a suspected aldol condensation product.

E - Indicates that it exceeds calibration curve range.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

April 4, 1990

Mr. Brian Armet
York Wastewater Consultants
200 Monroe Turnpike
Monroe, CT 06468

Re: 93rd Street School Site Niagara Falls, N.Y., Treated Soil Analysis
Attachments: see reports 5 through 16

Dear Mr. Armet:

On December 21, 1989 Independent Materials Testing Laboratories, Inc. (IMTL) was requested to perform tests on chemically treated soils samples from five vendors that would send samples to IMTL. Four vendors submitted samples in January thru February of 1990. The following tests were performed:

(1) ASTM C-109 Compressive Strength Tests.
(2) SW-846 Method 9100-2.8 Triaxial Permeability.
(3) ASTM D-560 Freeze-Thaw Weathering.

IMTL provided two thick walled machined, copper molds to each vendor in insulated shipping boxes to be returned in same with the permeability samples. Each vendor additionally submitted four 2x2x2 inch cube samples in disposable molds, with the exception of Chemfix which submitted permeability specimens in plastic molds and additional specimens not in a cube formation but in metal cylindrical mold containers measuring 2 1/16" (D) X 1 1/4" (H). The samples were received within the next two and one half months during which time the testing program was in progress. Copies of the information submitted with each group of samples is attached.

Upon receipt it was noted that the consolidation of some of the samples received varied considerably. The permeability samples were consolidated enough to obtain a sample that appeared uniform in consistency. Some of the cube type samples however were not carefully consolidated. The least well consolidated samples were used for the freeze thaw weathering tests while the samples appearing better consolidated were used for compression tests.

Permeability sample molds from Tricil and Enreco were machine cut to remove them from the specimens due to some expansion of the material. These samples including the cubes had the appearance of being mixed with a material that may have caused oxidation or discoloration as apparent in an orange/rust coloration in Enreco samples and a rust colored and white banding in Tricil samples. Neither of these samples appeared completely homogenous.

The samples from Chemfix and Wastech each appeared to be of a homogenous grey color. They may have been made from a slurry type mix.

The permeability samples were each trimmed square at the ends to sufficient height. The portion chosen was to obtain the most uniform specimen in terms of consolidation. This condition as well as the condition of the original soil consistency (ie, grain sizing) has an effect on the permeability of the sample. The specimens were then mounted in the triaxial apparatus for testing.

The compressive strength samples were chosen from two of the four specimens submitted by each vendor. For this test the most uniform samples were chosen, leaving the remaining samples for freeze thaw weathering tests. The samples were thinly capped with a high strength gypsum plaster. They were then mounted in the apparatus for testing. Despite the differences in appearance of the samples the compressive strength was within a narrow range with no sample below 50% of the strength of any other. It was not evident that the results were strongly affected by improper consolidation in this test.

The remaining two samples from each of the four vendors were subjected to the freeze thaw weathering tests. All samples were placed in exactly the same conditions for each cycle during the test duration. The homogenous specimens performed extremely well in comparison to the others in this test. Note that the Chemfix sample was split on receipt at the laboratory. The test did not cause the splitting. It was not evident that the results were strongly affected by improper consolidation in this test.

Sincerely,

David P. Aiudi
Director of Testing

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust No.: 1114
Client: York Wastewater Consultants, Inc
Project: 93rd Street School Site, Niagara Falls, N. Y.
Subject: Triaxial Permeability Test
Date: 2-14-90
Report No. 5

Treatment Vendor: Enreco ELS 89-0265, S89-1451

Laboratory Sample: 2243A

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.:	5.14	cm
Sample Ht.:	6.94	cm
Dry Density:	96.1	pcf
Water Content:	24.6	%
B-Value:	.57*	

Type of Test: Constant Head
Gradient: 17

Pore Fluid: Distilled Water
Effective Stress: .5 kg/cm2

TEST RESULTS

Permeability:
1.3 X 10 -6 cm/sec

Laboratory Sample: 2243B

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.:	5.14	cm
Sample Ht.:	7.27	cm
Dry Density:	94.5	pcf
Water Content:	24.6	%
B-Value:	.65*	

Type of Test: Constant Head
Gradient: 20

Pore Fluid: Distilled Water
Effective Stress: 0.5 kg/cm2

TEST RESULT

Permeability:
4.0 X 10 -7 cm/sec

*Note: Saturation assumed due to stoppage of volume change with back pressure change.

Procedure: EPA - SW - 846 Method 9100 - 2.8
September 1986

1114prm.#5

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls, N.Y.
Subject: ASTM C-109 Compressive Strength Testing
Date: 2-17-90
Report: 9

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2" X 2" cemented cubes

Vendor: Enreco ELS 89-0265, S89-1451

Sample Number	Wet Density pcf	Total Load	Unit Strength PSI
2247	105.9	2200	550
2248	105.9	2600	650

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#9

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls N. Y.
Subject: ASTM D560 Freeze Thaw Weathering Tests
Date: 3-15-90
Report: 13

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2" X 2" cubes

Vendor: Enreco ELS 89-0265,1451

Sample Number	Percent Moisture as Received	Percent Moisture at Test	Percent Lost Due to (12) Freeze Thaw Cycles
2459	12.8	14.9	54.1
2246	12.1	14.9	56.9

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#13

APPENDIX G

LABORATORY DATA - CAHRACTERISTICS OF TREATED SOIL

VENDOR D - WASTECH

YORK LABORATORIES

REPORT TRANSMITTAL

REPORT NUMBER 30900-0592

DATE February 27, 1990

CLIENT LEA
100 Northwest Drive
Plainville, CT 06082

ATTENTION Mr. Charles Jaworski

The above referenced report is enclosed. Copies of this report and supporting data will be retained in our files in the event they are required for future reference.

If there are any questions concerning this report, please do not hesitate to contact us.

Any samples submitted to our Laboratory will be retained for a maximum of sixty (60) days from receipt of this report, unless other arrangements are desired.

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-4458

February 27, 1990

30900-0592
LEA
100 Northwest Drive
Plainville, Connecticut 06082

Attention: Mr. Charles Jaworski

PURPOSE

One sample was submitted to York Laboratories Division of YWC, Inc. by LEA the samples were analyzed for anthracene and benzo(a)anthracene, arsenic and lead. The analyses were performed both on the intact sample and on the TCLP leachate. The client also requested free liquid analysis on the sample.

METHODOLOGY

Semi-volatile organics and metals analyses were conducted according to NYSDEC Contract Laboratory Program Protocols, November 1987.

Free liquid analysis was performed by filtration/visual inspection.

Metals were determined by ICP using either a JA61 simultaneous ICAP or a PE 6500XR sequential ICP. Graphite furnace elements were determined using either a PE Zeeman 5100 or PE Zeeman 3030 GFAAS.

TCLP extracts were prepared in accordance with Appendix I to 40 CFR Part 268.

RESULTS

The results are presented in the following Tables. Also enclosed are the organics and inorganics data packages containing all relevant QA/QC and raw data.

Prepared by:

Jeffrey C. Curran
Laboratory Manager

JCC/tma

The liability of YWC, Inc. is limited to the actual dollar value of this project.

Soil

TABLE 1.0
30900-0592
LEA
EPA TCL SEMI-VOLATILE ORGANICS (TCLP)

All values are ug/L.

	Sample Identification		
ilution Factor	1.00	1.00	
Method Blank I.D.	>C6078	>C6078	
Compound	Method Blank	8966 HL1-Y1-1	Method Detection Limits with no Dilution
nthracene	U	U	10
Benzo(a)anthracene	U	U	10

U, J, B - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

Soil

TABLE 1.0
30900-0592
LEA
EPA TCL SEMI-VOLATILE ORGANICS (INTACT)

All values are ug/Kg.

	Sample Identification		
Dilution Factor	1.00	3.00	
Method Blank I.D.	>C6068	>C6068	
Compound	Method Blank	8966 HLY1 -1	Method Detection Limits with no Dilution
Anthracene	U	17,000	330
Benzo(a)anthracene	U	13,000	330

U, J, B - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

TABLE 2.0
30900-0592
LEA
MISCELLANEOUS METALS (INTACT)

All values are mg/Kg.

Parameter	8966HL1-Y1-1
Arsenic	145
Lead	256

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-4458

TABLE 2.1
30900-0592
LEA
MISCELLANEOUS METALS (TCLP)

All values are ug/L.

Parameter	8966HL1-Y1-1
Arsenic	11.2
Lead	1.5U

TABLE 3.0
30900-0592
LEA
FREE LIQUIDS

Sample Identification	Results
8966HL1-Y-1	Sample Contained No Free Liquids

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-1458

APPENDIX

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

N - Indicates that the compound was analyzed for but not requested as an analyte. Value will not be listed on tabular result sheet.

X - Matrix spike compound.

(1) - Cannot be separated from diphenylamine.

(2) - Decomposes to azobenzene. Measured and calibrated as azobenzene.

A - This flag indicates that a TIC is a suspected aldol condensation product.

E - Indicates that it exceeds calibration curve range.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

April 4, 1990

Mr. Brian Armet
York Wastewater Consultants
200 Monroe Turnpike
Monroe, CT 06468

Re: 93rd Street School Site Niagara Falls, N.Y., Treated Soil Analysis
Attachments: see reports 5 through 16

Dear Mr. Armet:

On December 21, 1989 Independent Materials Testing Laboratories, Inc. (IMTL) was requested to perform tests on chemically treated soils samples from five vendors that would send samples to IMTL. Four vendors submitted samples in January thru February of 1990. The following tests were performed:

(1) ASTM C-109 Compressive Strength Tests.
(2) SW-846 Method 9100-2.8 Triaxial Permeability.
(3) ASTM D-560 Freeze-Thaw Weathering.

IMTL provided two thick walled machined, copper molds to each vendor in insulated shipping boxes to be returned in same with the permeability samples. Each vendor additionally submitted four 2x2x2 inch cube samples in disposable molds, with the exception of Chemfix which submitted permeability specimens in plastic molds and additional specimens not in a cube formation but in metal cylindrical mold containers measuring 2 1/16" (D) X 1 1/4" (H). The samples were received within the next two and one half months during which time the testing program was in progress. Copies of the information submitted with each group of samples is attached.

Upon receipt it was noted that the consolidation of some of the samples received varied considerably. The permeability samples were consolidated enough to obtain a sample that appeared uniform in consistency. Some of the cube type samples however were not carefully consolidated. The least well consolidated samples were used for the freeze thaw weathering tests while the samples appearing better consolidated were used for compression tests.

INDEPENDENT TESTING

Permeability sample molds from Tricil and Enreco were machine cut to remove them from the specimens due to some expansion of the material. These samples including the cubes had the appearance of being mixed with a material that may have caused oxidation or discoloration as apparent in an orange/rust coloration in Enreco samples and a rust colored and white banding in Tricil samples. Neither of these samples appeared completely homogenous.

The samples from Chemfix and Wastech each appeared to be of a homogenous grey color. They may have been made from a slurry type mix.

The permeability samples were each trimmed square at the ends to sufficient height. The portion chosen was to obtain the most uniform specimen in terms of consolidation. This condition as well as the condition of the original soil consistency (ie, grain sizing) has an effect on the permeability of the sample. The specimens were then mounted in the triaxial apparatus for testing.

The compressive strength samples were chosen from two of the four specimens submitted by each vendor. For this test the most uniform samples were chosen, leaving the remaining samples for freeze thaw weathering tests. The samples were thinly capped with a high strength gypsum plaster. They were then mounted in the apparatus for testing. Despite the differences in appearance of the samples the compressive strength was within a narrow range with no sample below 50% of the strength of any other. It was not evident that the results were strongly affected by improper consolidation in this test.

The remaining two samples from each of the four vendors were subjected to the freeze thaw weathering tests. All samples were placed in exactly the same conditions for each cycle during the test duration. The homogenous specimens performed extremely well in comparison to the others in this test. Note that the Chemfix sample was split on receipt at the laboratory. The test did not cause the splitting. It was not evident that the results were strongly affected by improper consolidation in this test.

Sincerely,

David P. Aiudi
Director of Testing

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust No.: 1114
Client: York Wastewater Consultants, Inc
Project: 93rd Street School Site, Niagara Falls, N. Y.
Subject: Triaxial Permeability Test
Date: 2-14-90
Report No. 6

Treatment Vendor: Wastech, Inc. 8966HL1

Laboratory Sample: 2251 (Y1-22)

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.:	5.14	cm
Sample Ht.:	12.53	cm
Dry Density:	67.6	pcf
Water Content:	49.5	%
B-Value:	.57	

Type of Test: Constant Head
Gradient: 17
Pore Fluid: Distilled Water
Effective Stress: .5 kg/cm2

TEST RESULTS

Permeability:
3.2 X 10 -8 cm/sec

Laboratory Sample: 2250 (Y1-21)

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.:	5.10	cm
Sample Ht.:	12.20	cm
Dry Density:	67.0	pcf
Water Content:	51.9	%
B-Value:	.65*	

Type of Test: Constant Head
Gradient: 20
Pore Fluid: Distilled Water
Effective Stress: .5 kg/cm2

TEST RESULT

Permeability:
5.4 X 10 -8 cm/sec

*Note: Saturation assumed due to stoppage of volume change with back pressure change.

Procedure: EPA - SW - 846 Method 9100 - 2.8
September 1986

1114prm.#6

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls, N. Y.
Subject: ASTM C-109 Compressive Strength Testing
Date: 2-17-90
Report: 10

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2" X 2" cemented cubes

Vendor: Wastech, Inc. 8966HL1

Sample Number		Wet Density pcf	Total Load	Unit Strength PSI
2254	Y1-19	74.6	3200	800
2255	Y1-20	74.6	3800	950

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#10

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls N. Y.
Subject: ASTM D560 Freeze Thaw Weathering Tests
Date: 3-15-90
Report: 14

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2" X 2" cubes

Vendor: Wastech, Inc. 8966HL1

Sample Number	Percent Moisture as Received	Percent Moisture at Test	Percent Lost Due to (12) Freeze Thaw Cycles
2252 Y1-15	26.3	34.4	.02
2253 Y1-16	24.9	34.4	.07

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#14

APPENDIX H

LABORATORY DATA - CAHRACTERISTICS OF TREATED SOIL

VENDOR E - CHEMIFIX

YORK LABORATORIES

REPORT TRANSMITTAL

REPORT NUMBER 30900-0642

DATE February 28, 1990

CLIENT LEA
100 Northwest Drive
Plainville, CT 06082

ATTENTION Mr. Charles Jaworski

The above referenced report is enclosed. Copies of this report and supporting data will be retained in our files in the event they are required for future reference.

If there are any questions concerning this report, please do not hesitate to contact us.

Any samples submitted to our Laboratory will be retained for a maximum of sixty (60) days from receipt of this report, unless other arrangements are desired.

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-1458

February 28, 1990

30900-0642
LEA
100 Northwest Drive
Plainville, Connecticut 06082

Attention: Mr. Charles Jaworski

PURPOSE

One sample was submitted to York Laboratories Division of YWC, Inc. by Chemfix Technologies, Inc. The client requested the samples be analyzed for anthracene, benzo (a) anthracene, arsenic and lead both on the intact samples and on the TCLP leachate. The client also requested free determination on the sample.

METHODOLOGY

Semi-volatiles and metal analyses were conducted according to NYSDEC Contract Laboratory Program Protocols, November, 1987.

Free liquid analysis was performed by filtration/visual inspection.

Metals were determined by ICP using either a JA61 simultaneous ICAP or a PE6500XR sequential ICP. Graphite furnace elements were determined using either a PEZ5100 or a PEZ3030 GFAAS.

RESULTS

The results are presented in the following Tables. Also enclosed are the organic and inorganic data packages containing all relevant QA/QC and raw data.

Prepared by: _____
Jeffrey C. Curran
Laboratory Manager

JCC/pw

cc: B. W. Armet, P.E.

The liability of YWC, Inc. is limited to the actual dollar value of this project.

Soil

TABLE 1.0
30900-0642
LEA
MISCELLANEOUS VOLATILE ORGANICS (INTACT)

All values are ug/Kg.

	Sample Identification		
Dilution Factor	1.0	4.0	
Method Blank I.D.	>H7718	>H7718	
Compound	Method Blank	Chemfix Treated Soil	Method Detection Limits with no Dilution
Anthracene	U	14,000	330
Benzo(a)anthracene	U	13,000	330

U - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

TABLE 2.0
30900-0642
LEA
MISCELLANEOUS BASE-NEUTRAL EXTRACTABLE ORGANICS (TCLP)

All values are ug/L.

	Sample Identification		
Dilution Factor	1.0	1.0	
Method Blank I.D.	>H7733	>H7733	
Compound	Method Blank	Chemfix Treated Soil	Method Detection Limits with no Dilution
Nitroaniline	U	U	50
Acenaphthene	U	U	10
2,4-Dinitrophenol	U	U	50
4-Nitrophenol	U	U	50
Dibenzofuran	U	U	10
2,4-Dinitrotoluene	U	U	10
Diethylphthalate	U	U	10
4-Chlorophenyl-phenylether	U	U	10
Fluorene	U	U	10
4-Nitroaniline	U	U	50
4,6-Dinitro-2-methylphenol	U	U	50
N-Nitrosodiphenylamine (1)	U	U	10
4-Bromophenyl-phenylether	U	U	10
Hexachlorobenzene	U	U	10
Pentachlorophenol	U	U	50
Phenanthrene	U	U	10
Anthracene	U	U	10
Di-n-butylphthalate	U	U	10
Fluoranthene	U	U	10
Pyrene	U	U	10
Butylbenzylphthalate	U	U	10
3,3'-Dichlorobenzidine	U	U	20
Benzo(a)anthracene	U	U	10
Chrysene	U	U	10
bis(2-Ethylhexyl)phthalate	U	U	10
Di-n-octylphthalate	U	U	10
Benzo(b)fluoranthene	U	U	10
Benzo(k)fluoranthene	U	U	10
Benzo(a)pyrene	U	U	10
Indeno(1,2,3-cd)pyrene	U	U	10
Dibenzo(a,h)anthracene	U	U	10
Benzo(g,h,i)perylene	U	U	10

U - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

TABLE 3.0
30900-0642
LEA
MISCELLANEOUS METALS

All values are mg/kg.

Parameter	Chemfix Treated Soil	Method Detection Limits with no Dilution
Arsenic	197	2
Lead	134	0.6

TABLE 3.1
30900-0642
LEA
MISCELLANEOUS METALS (TCLP)

All values are ug/L.

Parameter	Chemfix Treated Soil	Leachate Blank	Method Detection Limits with no Dilution
Arsenic	9.4B	0.7U	10
Lead	180	2.4B	3

TABLE 4.0
30900-0642
LEA
MISCELLANEOUS

Parameter	Chemfix Treated Soil
Free Liquid	None Detected

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-1458

APPENDIX

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B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

N - Indicates that the compound was analyzed for but not requested as an analyte. Value will not be listed on tabular result sheet.

X - Matrix spike compound.

(1) - Cannot be separated from diphenylamine.

(2) - Decomposes to azobenzene. Measured and calibrated as azobenzene.

A - This flag indicates that a TIC is a suspected aldol condensation product.

E - Indicates that it exceeds calibration curve range.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

INDEPENDENT MATERIALS TESTING
NEAL COURT IND. PARK
P.O. BOX 745
LABORATORIES, INC.
PLAINVILLE, CONNECTICUT 06062 TELEPHONE (203) 525-7193

April 4, 1990

Mr. Brian Armet
York Wastewater Consultants
200 Monroe Turnpike
Monroe, CT 06468

Re: 93rd Street School Site Niagara Falls, N.Y., Treated Soil Analysis
Attachments: see reports 5 through 16

Dear Mr. Armet:

On December 21, 1989 Independent Materials Testing Laboratories, Inc. (IMTL) was requested to perform tests on chemically treated soils samples from five vendors that would send samples to IMTL. Four vendors submitted samples in January thru February of 1990. The following tests were performed:

(1) ASTM C-109 Compressive Strength Tests.
(2) SW-846 Method 9100-2.8 Triaxial Permeability.
(3) ASTM D-560 Freeze-Thaw Weathering.

IMTL provided two thick walled machined, copper molds to each vendor in insulated shipping boxes to be returned in same with the permeability samples. Each vendor additionally submitted four 2x2x2 inch cube samples in disposable molds, with the exception of Chemfix which submitted permeability specimens in plastic molds and additional specimens not in a cube formation but in metal cylindrical mold containers measuring 2 1/16" (D) X 1 1/4" (H). The samples were received within the next two and one half months during which time the testing program was in progress. Copies of the information submitted with each group of samples is attached.

Upon receipt it was noted that the consolidation of some of the samples received varied considerably. The permeability samples were consolidated enough to obtain a sample that appeared uniform in consistency. Some of the cube type samples however were not carefully consolidated. The least well consolidated samples were used for the freeze thaw weathering tests while the samples appearing better consolidated were used for compression tests.

INDEPENDENT TESTING

Permeability sample molds from Tricil and Enreco were machine cut to remove them from the specimens due to some expansion of the material. These samples including the cubes had the appearance of being mixed with a material that may have caused oxidation or discoloration as apparent in an orange/rust coloration in Enreco samples and a rust colored and white banding in Tricil samples. Neither of these samples appeared completely homogenous.

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The permeability samples were each trimmed square at the ends to sufficient height. The portion chosen was to obtain the most uniform specimen in terms of consolidation. This condition as well as the condition of the original soil consistency (ie, grain sizing) has an effect on the permeability of the sample. The specimens were then mounted in the triaxial apparatus for testing.

The compressive strength samples were chosen from two of the four specimens submitted by each vendor. For this test the most uniform samples were chosen, leaving the remaining samples for freeze thaw weathering tests. The samples were thinly capped with a high strength gypsum plaster. They were then mounted in the apparatus for testing. Despite the differences in appearance of the samples the compressive strength was within a narrow range with no sample below 50% of the strength of any other. It was not evident that the results were strongly affected by improper consolidation in this test.

The remaining two samples from each of the four vendors were subjected to the freeze thaw weathering tests. All samples were placed in exactly the same conditions for each cycle during the test duration. The homogenous specimens performed extremely well in comparison to the others in this test. Note that the Chemfix sample was split on receipt at the laboratory. The test did not cause the splitting. It was not evident that the results were strongly affected by improper consolidation in this test.

Sincerely,

David P. Aiudi
Director of Testing

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust No.: 1114
Client: York Wastewater Consultants, Inc
Project: 93rd Street School Site, Niagara Falls, N. Y.
Subject: Triaxial Permeability Test
Date: 3-21-90
Report No. 8

Treatment Vendor: Chemfix Technologies, Inc.

Laboratory Sample: 2266

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.:	5.08	cm
Sample Ht.:	9.52	cm
Dry Density:	74.5	pcf
Water Content:	44.6	%

Type of Test: Constant Head
Gradient: 100*
Pore Fluid: Distilled Water
Effective Stress: 1.1 kg/cm2

TEST RESULTS

Permeability:**
<5 X 10-10 cm/sec

Laboratory Sample: 2265

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.:	5.11	cm
Sample Ht.:	9.15	cm
Dry Density:	79.3	pcf
Water Content:	42.8	%

Type of Test: Constant Head
Gradient: 100*
Pore Fluid: Distilled Water
Effective Stress: 1.1 kg/cm2

TEST RESULT

Permeability:**
<5 X 10-10 cm/sec

** Note: Unable to establish saturation.
* Note: Unable to establish equal flow in and out. Permeability determined from inflow only.

Procedure: EPA - SW - 846 Method 9100 - 2.8
September 1986

1114prm.#8

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls N. Y.
Subject: ASTM C-109 Compressive Strength Testing
Date: 2-17-90
Report: 12

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2 1/16" X 1 1/4" cemented cubes

Vendor: Chemfix Technologies, Inc.

Sample Number	Wet Density pcf	Total Load	Unit Strength PSI
2269	87.4	1800	573
2270	87.4	1400	446

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#12

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls N. Y.
Subject: ASTM D560 Freeze Thaw Weathering Tests
Date: 3-15-90
Report: 16

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2 1/16" X 1 1/4" cemented cylinders

Vendor: Chemfix Technologies, Inc.

Sample Number	Percent Moisture as Received	Percent Moisture at Test	Percent Lost Due to (12) Freeze Thaw Cycles
2267	24.2	26.5	.06
2268	24.2	26.5	.54

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#16

APPENDIX I

LABORATORY DATA - CAHRACTERISTICS OF TREATED SOIL

VENDOR F - TRICIL

YORK LABORATORIES

REPORT TRANSMITTAL

REPORT NUMBER 30900-0580

DATE February 22, 1990

CLIENT LEA
100 Northwest Drive
Plainville, CT 06082

ATTENTION Mr. Charles Jaworski

The above referenced report is enclosed. Copies of this report and supporting data will be retained in our files in the event they are required for future reference.

If there are any questions concerning this report, please do not hesitate to contact us.

Any samples submitted to our Laboratory will be retained for a maximum of sixty (60) days from receipt of this report, unless other arrangements are desired.

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-4458

February 22, 1990

30900-0580
LEA
100 Northwest Drive
Plainville, Connecticut 06082

Attention: Mr. Charles Jaworski

PURPOSE

Five (5) samples were submitted to York Laboratories Division of YWC, Inc. by Tricil Environmental Response, Inc. the samples were analyzed for anthracene and benzo(a)anthracene, arsenic and lead. The analyses were performed both on the intact sample and on the TCLP leachate. The samples were also analyzed for Free Liquids (Paint Filter Test).

METHODOLOGY

Semi-volatile organics and metals analyses were conducted according to NYSDEC Contract Laboratory Program Protocols, November 1987.

Metals were determined by ICP using either a JA61 simultaneous ICAP or a PE 6500XR sequential ICP. Graphite furnace elements were determined using either a PE Zeeman 5100 or PE Zeeman 3030 GFAAS.

TCLP extracts were prepared in accordance with Appendix I to 40 CFR Part 268.

RESULTS

The results are presented in the following Tables. Also enclosed are the organics and inorganics data packages containing all relevant QA/QC and raw data.

Prepared by: _____
Jeffrey C. Curran
Laboratory Manager

JCC/tma

The liability of YWC, Inc. is limited to the actual dollar value of this project.

Soil

TABLE 1.0
30900-0580
LEA
MISCELLANEOUS TCL SEMI-VOLATILE ORGANICS

All values are ug/L.

	Sample Identification						
ilution Factor	1.0	1.0	1.0	1.0	1.0	1.0	
Method Blank I.D.	>C6078	>C6078	>C6078	>C6078	>C6078	>C6078	
Compound	Method Blank	#1 TCLP	#2 TCLP	#3 TCLP	#4 TCLP	#5 TCLP	Method Detection Limits with no Dilution
nthracene	U	U	U	U	U	U	330
Benzo(a)anthracene	U	U	U	U	U	U	330

J - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

Soil

TABLE 1.1
30900-0580
LEA
MISCELLANEOUS TCL SEMI-VOLATILE ORGANICS

All values are ug/Kg.

	Sample Identification						
Dilution Factor	1.0	1.0	1.0	1.0	1.0	1.0	
Method Blank I.D.	>C6110	>C6110	>C6110	>C6110	>C6110	>C6110	
Compound	Method Blank	#1	#2	#3	#4	#5	Method Detection Limits with no Dilution
Anthracene	U	18,000	20,000	26,000	19,000	25,000	330
Benzo(a)anthracene	U	16,000	15,000	22,000	15,000	19,000	330

J - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

TABLE 2.0
30900-0580
LEA
MISCELLANEOUS METALS (INTACT)

All values are mg/Kg, dry basis.

Parameter	#1	#2	#3	#4	#5
Arsenic	190	180	161	155	208
Lead	363	358	406	399	380

TABLE 2.1
30900-0580
LEA
MISCELLANEOUS METALS (TCLP)

All values are ug/L.

Parameter	#1	#2	#3	#4	#5
Arsenic	33.1	31.6	34.1	36.3	37.7
Lead	2.1B	2.8B	2.3B	2.0B	0.9B

B - See Appendix for Definition.

TABLE 3.0
30900-0580
LEA
FREE LIQUIDS

Sample Identification	Free Liquids
#1	<1.0%
#2	<1.0%
#3	<1.0%
#4	<1.0%
#5	<1.0%

APPENDIX

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

N - Indicates that the compound was analyzed for but not requested as an analyte. Value will not be listed on tabular result sheet.

X - Matrix spike compound.

(1) - Cannot be separated from diphenylamine.

(2) - Decomposes to azobenzene. Measured and calibrated as azobenzene.

A - This flag indicates that a TIC is a suspected aldol condensation product.

E - Indicates that it exceeds calibration curve range.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

April 4, 1990

Mr. Brian Armet
York Wastewater Consultants
200 Monroe Turnpike
Monroe, CT 06468

Re: 93rd Street School Site Niagara Falls, N.Y., Treated Soil Analysis
Attachments: see reports 5 through 16

Dear Mr. Armet:

On December 21, 1989 Independent Materials Testing Laboratories, Inc. (IMTL) was requested to perform tests on chemically treated soils samples from five vendors that would send samples to IMTL. Four vendors submitted samples in January thru February of 1990. The following tests were performed:

(1) ASTM C-109 Compressive Strength Tests.
(2) SW-846 Method 9100-2.8 Triaxial Permeability.
(3) ASTM D-560 Freeze-Thaw Weathering.

IMTL provided two thick walled machined, copper molds to each vendor in insulated shipping boxes to be returned in same with the permeability samples. Each vendor additionally submitted four 2x2x2 inch cube samples in disposable molds, with the exception of Chemfix which submitted permeability specimens in plastic molds and additional specimens not in a cube formation but in metal cylindrical mold containers measuring 2 1/16" (D) X 1 1/4" (H). The samples were received within the next two and one half months during which time the testing program was in progress. Copies of the information submitted with each group of samples is attached.

Upon receipt it was noted that the consolidation of some of the samples received varied considerably. The permeability samples were consolidated enough to obtain a sample that appeared uniform in consistency. Some of the cube type samples however were not carefully consolidated. The least well consolidated samples were used for the freeze thaw weathering tests while the samples appearing better consolidated were used for compression tests.

INDEPENDENT TESTING

Permeability sample molds from Tricil and Enreco were machine cut to remove them from the specimens due to some expansion of the material. These samples including the cubes had the appearance of being mixed with a material that may have caused oxidation or discoloration as apparent in an orange/rust coloration in Enreco samples and a rust colored and white banding in Tricil samples. Neither of these samples appeared completely homogenous.

The samples from Chemfix and Wastech each appeared to be of a homogenous grey color. They may have been made from a slurry type mix.

The permeability samples were each trimmed square at the ends to sufficient height. The portion chosen was to obtain the most uniform specimen in terms of consolidation. This condition as well as the condition of the original soil consistency (ie, grain sizing) has an effect on the permeability of the sample. The specimens were then mounted in the triaxial apparatus for testing.

The compressive strength samples were chosen from two of the four specimens submitted by each vendor. For this test the most uniform samples were chosen, leaving the remaining samples for freeze thaw weathering tests. The samples were thinly capped with a high strength gypsum plaster. They were then mounted in the apparatus for testing. Despite the differences in appearance of the samples the compressive strength was within a narrow range with no sample below 50% of the strength of any other. It was not evident that the results were strongly affected by improper consolidation in this test.

The remaining two samples from each of the four vendors were subjected to the freeze thaw weathering tests. All samples were placed in exactly the same conditions for each cycle during the test duration. The homogenous specimens performed extremely well in comparison to the others in this test. Note that the Chemfix sample was split on receipt at the laboratory. The test did not cause the splitting. It was not evident that the results were strongly affected by improper consolidation in this test.

Sincerely,

David P. Aiudi
Director of Testing

INDEPENDENT MATERIALS TESTING
NEAL COURT IND. PARK
P.O. BOX 745
LABORATORIES, INC.
PLAINVILLE, CONNECTICUT 06062 TELEPHONE (203) 525-7193

Cust No.: 1114
Client: York Wastewater Consultants, Inc
Project: 93rd Street School Site, Niagara Falls, N. Y.
Subject: Triaxial Permeability Test
Date: 3-1-90
Report No. 7

Treatment Vendor: Tricil Environmental Responses, Inc.

Laboratory Sample: 2256

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.: 5.13 cm
Sample Ht.: 12.46 cm
Dry Density: 90.4 pcf
Water Content: 30.5 %

Type of Test: Constant Head
Gradient: 17
Pore Fluid: Distilled Water
Effective Stress: 0.5 kg/cm2

TEST RESULTS

Permeability:
1.3 X 10 -7 cm/sec

Laboratory Sample: 2257

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.: 5.12 cm
Sample Ht.: 12.19 cm
Dry Density: 90.9 pcf
Water Content: 30.1 %

Type of Test: Constant Head
Gradient: 17
Pore Fluid: Distilled Water
Effective Stress: 0.5 kg/cm2

TEST RESULT

Permeability:
7.4 X 10 -6 cm/sec

*Note: Saturation assumed due to stoppage of volume change with back pressure change.

Procedure: EPA - SW - 846 Method 9100 - 2.8
September 1986

1114prm.#7

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls N. Y.
Subject: ASTM C-109 Compressive Strength Testing
Date: 2-17-90
Report: 11

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2" X 2" cemented cubes

Vendor: Tricil Environmental Responses, Inc.

Sample Number	Wet Density pcf	Total Load	Unit Strength PSI
2260	95.1	2600	650
2261	95.1	2800	700

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#11

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls N. Y.
Subject: ASTM D560 Freeze Thaw Weathering Tests
Date: 3-15-90
Report: 15

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2" X 2" cubes

Vendor: Tricil Environmental Responses, Inc.

Sample Number	Percent Moisture as Received	Percent Moisture at Test	Percent Lost Due to (12) Freeze Thaw Cycles
2258	26.5	21.4	49.6
2259	16.9	21.4	42.0

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#15

APPENDIX J

VENDORS TREATABILITY STUDY REPORT

VENDOR C - ENRECO

Loureiro Engineering Associates - 93rd Street School Site

Revised Treatability Study Report

Prepared for:

Loureiro Engineering Associates
100 Northwest Drive
Plainville, Connecticut 06062

Submitted By:

ENRECO Technologies Group
P.O. Box 9838
Amarillo, Texas 79105
(806) 379-6424

15 March 1990

ENRECO

Loureiro Engineering Associates - 93rd Street School Site

Revised Treatability Study Report

Table of Contents

- Executive Summary
- Sample Identification
- Scope
- Procedure
- Conclusions
- Recommendations
- Attachments
  - Reagent List
  - Physical Properties
  - Chemical Properties

Loureiro Engineering Associates - 93rd Street School Site

Revised Treatability Study Report

Executive Summary

The New York State Department of Environmental Conservation is proceeding with a remediation program for the 93rd Street School site. The principal part of the remediation program is on-site solidification/stabilization of approximately 7500 cubic yards of contaminated soil by excavation, treatment, re-deposition of treated soil and placement of a low permeability cover. The acceptable treatment process is required to produce a treated soil having acceptable characteristics as defined by NYSDEC. The purpose of this treatment is to immobilize certain contaminants found in the soil and to provide stability to the treated soil. The primary contaminants of conern in this study are arsenic, lead, anthracene and benzo(a)anthracene.

This treatability study was conducted to test the efficacy of solidification/stabilization on the wastes. Bench scale testing was conducted to determine the formulation of reagent(s) that would reduce the toxicity or mobility of contaminants in the wastes. A formulation was developed to provide a stabilized product suitable for final deposition at the site.

Sample Identification

Loureiro Engineering Associates supplied ENRECO Laboratories with a representative 5-gallon soil sample to be investigated in the treatability study. The sample was a composite of several sampling points on the site.

The primary contaminants contributing to unacceptable health risks are arsenic, polynuclear aromatic hydrocarbons (PAHs) and dioxin, although the following contaminants were also considered to be of some concern: antimony, lead, mercury, cadmium and cobalt.

Scope

The New York State Department of Environmental Conservation is

Revised Treatability Study Report

proceeding with a remediation program for the 93rd Street School site in Niagara Falls, New York. ENRECO Laboratories provided research and analytical services for the treatability study on contaminated soil from site. The purpose of the study was to test the efficacy of solidification/stabilization on the wastes and to determine the formulation of reagents that will reduce the toxicity or mobility of contaminants. Bench scale testing was conducted to define an acceptable treatment process which will produce a treated soil having acceptable characteristics as defined by NYSDEC.

Procedure

An initial literature and data search identified specific reagents for the testing program. The search examined current literature including books, journals, conference proceedings, etc. for information about stabilization technologies. We will also examined our proprietary data base of stabilization reagents and utilized our past experience with treatability studies. Based upon this information, a group of reagents was selected for the treatability study. The reagents were selected based upon efficacy, cost, and proximity to the project. The selected reagents include:

- Portland Cement (as solidification agent)
- Organophilic Clay (as organic fixation agent)
- Coal Dust (as organic fixation agent)
- Ferrous Sulfate - 30% solution (as complexing agent).

In this study, ENRECO implemented a three stage approach to evaluate the efficacy of selected stabilization/fixation reagents. This iterative process involved gross screening techniques in the early stages, refining the formulation in intermediate stages, and providing a final stabized product in the last stage. However, due to the findings of the analytical testing during the first stage, the original proposed testing process was altered.

The testing consisted of mixing small volumes of waste with several reagents at varying mix ratios. The mixtures were allowed to cure and then were evaluated according to physical and chemical criteria. Formulations

Revised Treatability Study Report

that produced favorable results underwent additional testing. The recommended mix design was required to have strength and leachability characteristics that demonstrate the reduction of toxicity and mobility of contaminants to meet regulatory requirements.

The actual testing protocol for this study is outlined below.

Initial Mixing and Testing

The sample was mixed with selected reagent(s) at varying mix ratios. The mixtures were allowed to cure for three days and were then tested for compliance with the Initial Performance Specifications. We tested five different reagents or combinations of reagents at two mix ratios (a total of ten mixtures) for our screening test. The mixtures were subjected to a TCLP extraction and were analyzed for the arsenic, lead, anthracene and benzo(a)anthracene. Following the receipt of these analytical results, ENRECO was notified of lower treatment standards. Selected formulations were extracted a second time and were analyzed with the lower detection limits to determine their leachability characteristics.

After a review of the test results and an economic analysis, a recommendation was made for the final mix design.

Final Mixing and Testing

Using the optimal reagent(s) and mix ratio, a sufficient volume of waste was stabilized for final performance tests. Samples of the recommended stabilized material were sent to an LEA-specified laboratory for complete chemical and physical testing.

Laboratory Methods

ENRECO Laboratories performed all analyses in accordance with federal, state and local approved procedures. All analytical tests were conducted in accordance with written Standard Operating Procedures. The

Revised Treatability Study Report

primary references for specific procedures were EPA Reference SW-846, EPA Methods for Evaluating Solid Waste, Annual Book of ASTM Standards and the Federal Register.

The specific analyses used during mixing and testing are presented below.

Activity	Determination
Mixing and Testing	
▪ Strength	Unconfined Compressive Strength (measured by penetrometer)
▪ Density	Volumetric Determination
▪ Volume Increase	Displacement
▪ Leachability	TCLP (Federal Register, Vol. 51, No. 174, p. 21648) - Analysis for As, Pb, Benzo(a)anthracene, Anthracene

Conclusions

Due to the nature of the untreated soil, all of the mixtures prepared in the Initial Mixing and Testing phase exhibited acceptable physical properties. The compressive strengths of the stabilized samples exceeded 62.5 psi (4.5 tsf).

The initial results of the leachability testing showed no detectable levels of the contaminants of concern in the extracts of any of the mixtures. Later, however, it was determined that the required leachate characteristics were lower than the detection limits of the initial analyses. Therefore, three of the most promising formulations were selected to undergo further testing. Aliquots of the stabilized samples were again extracted according to the TCLP and were analyzed for lead and arsenic with the lower dection limits. The results of these analyses showed no dectectable levels of lead and only low levels of arsenic.

Revised Treatability Study Report

Only one of the three formulations (Mix # A1-10-B137-3) had levels of arsenic in the extract that exceeded the acceptable level. However, the analytical results for arsenic seem to be inconsistent with the quantity of fixation reagent used in the mix designs. These variations are likely due to sample variations and the difficulties involved with replicating results using the TCLP.

Recommendations

Of the two formulations that exhibited acceptable leachate characteristics, the formulation that provided the greatest level of confidence in achieving the project objectives was selected for Final Mixing and Testing. The recommended formulation is comprised of 0.10 parts of portland cement and 0.06 parts of ferrous sulfate per part of waste, by weight. This formulation (Mix # A1-10-B137-6) will produce a stabilized material that will achieve the project objectives of strength and leachability.

Treatment of the contaminated soils using the recommended formulation will result in a stabilized product of soil-like consistency. The material can easily be handled and compacted using conventional earth-moving equipment.

The recommended mix design will result in an estimated volume increase of approximately 25 percent. The material could be readily compacted at final deposition to greatly reduce this increase.

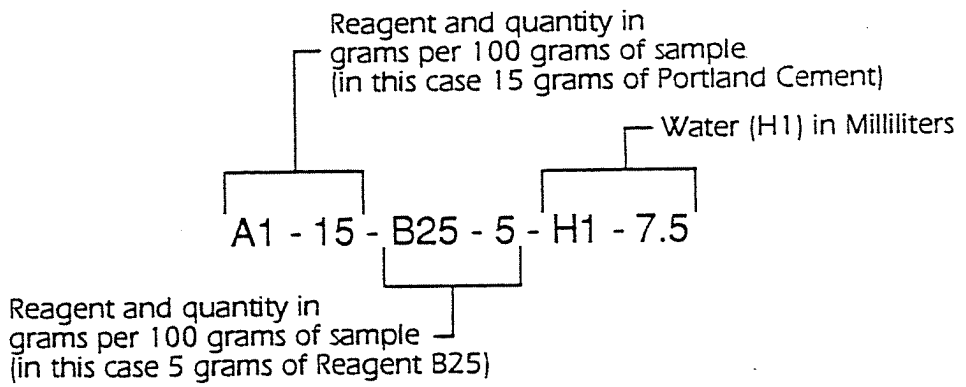
Full scale treatment of the contaminated soil could be performed for approximately $45 to $50 per ton of waste. This budgetary estimate includes material, equipment and personnel for stabilization and limited material handling requirements.

Reagent List

ENRECO Chemical Reagent Formulation Code

Typical Code Number

A1 - 15 - B25 - 5 - H1 - 7.5



Components

A1 - Portland Cement
B45 - Organophillic Clay
B75 - Coal Dust
B137 - Ferrous Sulfate

Stabilization Study

ENRECO

Project 93rd Street School Site Project Number 8002-89

Client Loureiro Engineering Associates

Sample Description Contaminated Soil; Initial Mixing and Testing

Physical Properties

Mix Number	Strength, psi 1 Day	3 Days	7 Days	Volume Expansion, %	Wet Weight Density, pcf
A1-10	>62.5	>62.5		11.2	110.3
A1-10-B45-1	>62.5	>62.5		22.3	101.1
A1-10-B45-2	>62.5	>62.5		15.7	107.9
A1-10-B137-3 *	>62.5	>62.5		23.2	102.2
A1-10-B137-6 *	>62.5	>62.5		24.7	103.6
A1-10-B75-5	>62.5	>62.5		22.7	104.4
A1-10-B75-10	>62.5	>62.5		24.7	107.2
A1-10-B75-5-B137-3 *	>62.5	>62.5		18.0	111.4
A1-10-B75-10-B137-3 *	>62.5	>62.5		28.2	109.5
A1-10-B75-10-B137-6 *	>62.5	>62.5		22.9	111.5

Components

A1 - Portland Cement
B45 - Organophillic Clay
B137 - Ferrous Sulfate
B75 - Coal Dust

Comments

* Iron oxide material observed on surface of samples as reddish brown spots.

Stabilization Study

ENRECO

Project 93rd Street School Site Project Number 8002-89

Client Loureiro Engineering Associates

Sample Description Contaminated Soil; Initial Testing

Chemical Properties

Mix Number	Analyte (in TCLP extract)			
	Arsenic (mg/L)	Lead (mg/L)	Anthrac.(ug/L)	Benzo(a)(ug/L)
A1-10	<1.0	<0.2	<10	<10
A1-10-B45-1	<1.0	<0.2	<10	<10
A1-10-B45-2	<1.0	<0.2	<10	<10
A1-10-B137-3	<1.0	<0.2	<10	<10
A1-10-B137-6	<1.0	<0.2	<10	<10
A1-10-B75-5	<1.0	<0.2	<10	<10
A1-10-B75-10	<1.0	<0.2	<10	<10
A1-10-B75-5-B137-3	<1.0	<0.2	<10	<10
A1-10-B75-10-B137-3	<1.0	<0.2	<10	<10
A1-10-B75-10-B137-6	<1.0	<0.2	<10	<10

Components

A1 - Portland Cement
B45 - Organophillic Clay
B137 - Ferrous Sulfate
B75 - Coal Dust

Comments

Anthrac. - Anthracene
Benzo(a) - Benzo(a)anthracene

Stabilization Study

ENRECO

Project 93rd Street School Site Project Number 8002-89

Client Loureiro Engineering Associates

Sample Description Contaminated Soil; Interim Testing

Chemical Properties

Mix Number	Analyte (in TCLP extract)			
	Arsenic (mg/L)	Lead (mg/L)	Anthrac.(ug/L)	Benzo(a)(ug/L)
A1-10	0.22	<0.05		
A1-10-B137-3	0.38	<0.05		
A1-10-B137-6	0.12	<0.05		

Components

A1 - Portland Cement
B45 - Organophillic Clay
B137 - Ferrous Sulfate
B75 - Coal Dust

Comments

Anthrac. - Anthracene
Benzo(a) - Benzo(a)anthracene

APPENDIX K

VENDORS TREATABILITY STUDY REPORT

VENDOR D - WASTECH

WASTECH, INC.

SUMMARY REPORT FOR CHEMICAL FIXATION BENCH SCALE TESTING OF WASTE SAMPLES FROM THE 93RD STREET SCHOOL SITE IN NIAGARA FALLS, NEW YORK FOR LOUREIRO ENGINEERING ASSOCIATES

PREPARED BY:
WASTECH, INC.
May 16, 1990
8966HL1

114 Tulsa Road • Post Office Box 1213 • Oak Ridge, Tennessee 37831-1213 • (615) 483-6515 • Fax: (615) 483-4239

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ATTACHMENT 1: LABORATORY TESTING RESULTS

FORWARD

WASTECH, INC., a waste engineering/management firm specializing in the treatment and disposal of hazardous waste, uses proprietary processes for chemical fixation and stabilization of organic and inorganic materials. These processes provide the necessary factor for WASTECH, INC. to become a leader in the industry through performance. WASTECH, INC. was issued its initial patent in November, 1983 by the U. S. Trademark and Patent Office. These processes, coupled with strong management, and an understanding of the clients' needs have resulted in WASTECH, INC. becoming a unique organization, in comparison with competitive companies.

WASTECH, INC. is a specialist in adapting high quality and conventional technology to the often-times unconventional needs of the hazardous waste industry. WASTECH, INC. provides technical and operational services, including unique products to both the nuclear and industrial arenas. These products can be applied to an array of organic and inorganic waste streams.

I. BACKGROUND OF WASTECH, INC.'S TECHNOLOGY

As the need for a permanent treatment solution forced the nuclear industry to re-evaluate its disposal techniques, the leading researchers of this country initiated the use of innovative treatment technologies including immobilization.

In the nuclear industry, the use of a nuclear chemistry method referred to as Liquid Scintillation Counting, produced a radioactive waste containing light aromatic solvents (benzene, toluene, etc.). The disposal of liquid wastes was prohibited at the available radioactive waste disposal landfills. The reason for this prohibition was due to the toxicity of the materials, and not due to the radioactivity (usually less than 1 millicurie per milliliter). An additional concern was the migratory nature of these solvents. These spent solvents are in their simplest molecular forms and readily form bonds with other pollutants, accelerating their migration. Eventually, the spent solvents breach the barriers of the landfill, entering the ground water supplies.

Past attempts at stabilizing these materials proved unsuccessful. The organic pollutants would coat the particles of cement and prevent any reactions with water. This phase separation prevented any crystallization and ultimate hydration of the cement.

Through research it was determined that benign reagents could be added to the solvents and a molecular bonding take place spontaneously. These reagents are non-hazardous materials. The reagents have a hydrophobic carbon chain. The addition of this reagent decreases the toxicity of the waste materials.

As a second phase, an additive, having hydrophobic and hydrophilic chains, is applied and mixed with the materials. These compound additives form bonds with the treated materials. These bonds are formed with the hydrophilic carbon chains in the reagents. The result is the formation of micelles. Prior art has shown that the formation of micelles is easily accomplished using shelf items. However, these micelles could be easily broken by several physical and chemical interferences. Therefore it is necessary to create stabilized bonds that would sustain moderate changes in temperature and/or the physical chemistry.

This final stabilized mixture is placed into a cementitious monolithic matrix. The matrix is composed of a mixture of pozzolans and Portland Cement. The pozzolans are adsorptive binders, and the cement creates a crystalline barrier. The longer the barrier can hydrate the more dense and impermeable they become. These barriers assist in preventing corrosive contaminants from coming into contact with the chemically bonded pollutants. By reducing the possibility of interference, the bonded pollutants will remain in their detoxified state.

Following many testing protocols it was determined that this chemical fixation procedure was effective. All papers were filed with the Trademark and Patent Office on July 30, 1981, and Letters of Patent were issued on November 22, 1983, Patent Number 4,416,810.[1]

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[1] "A Study of a Method for Solid Waste Encapsulation of Liquid Scintillation Solvents," performed by the Center for Applied Isotope Studies, University of Georgia; July 16, 1980.

Studies of both hazardous and radioactive wastes have developed data comparing the commercially available binders used to make impermeable monolithic solids[2]. The currently applied materials are 1) hydraulic cements, pozzolanics, and gypsum, which harden by reacting with water, 2) thermoplastic bitumen, polyethylene, and sulfur, which melt and freeze encapsulating the waste solids, and 3) polyesters, epoxies, poly-urethanes, and urea-formaldahydes whose monomers react to form cross-linked polymer chains around the waste. The most widely used of these are the hydraulic based binders, because they are 1) the least expensive, 2) the most durable when properly formulated, 3) the least sensitive to fluctuation in the waste streams, and 4) easily processed with "off-the-shelf" equipment at ambient temperatures. The hydraulic based binders are readily blended with hydrophilic liquids as well as "chemically fixed" hydrophobic materials which have been bonded with water molecules.

SELECTION OF THE WASTECH, INC. BONDING MEDIA

WASTECH, INC. has developed several medias for use with a variety of organic/inorganic waste streams. These medias are derivatives of WASTECH, INC.'s original patented work with light aromatics.[3]

The medias are "bonded" with the waste materials and create a co-valent bond between the hydrophobic materials and water molecules. The media, having the capability of bonding with hydrophobic and hydrophilic materials simultaneously forms into micelles during the bonding phase. The emulsified waste products are then placed into

---

[2] Neilson, R.M., Jr. et al, Chapter 8, Chemical Considerations for the Immobilization of Low-Level Radioactive Wastes. "Radioactive Waste Technology," Moghisse, A.A., et al., Editors, American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017, pp. 317-349, 1986.

[3] Seven additional patent applications have been filed.

a predetermined binder matrix. The waste products have been "chemically fixed" to the water additives which allows the bonded solution to react with a cementitious matrix. Historically, the mixing of organic compounds coats cement based materials and allows little or no reaction with water to take place. These WASTECH, INC. "bonding" processes prohibit this coating effect allowing the binder reactions to proceed.

WASTE SPECIFIC WASTEFORM DEVELOPMENT AND TESTING

Because waste stream components interact with the cement and pozzolan chemistries, it is not usually possible to predict "a priori" the acceleration or retardation[4]. Formulations have been developed and tested for specific waste streams, in order to ensure 1) chemical compatibility with binder curing, 2) physical properties, such as compressive strength and permeability, are acceptable, and 3) the leach behavior is acceptable for the range of chemical variations expected within a particular waste class.

ADVANTAGES OVER SIMILAR TECHNOLOGIES

WASTECH, INC. attempts to bring the concepts of organic chemistry to the hazardous waste industry. The pollutants themselves must be treated rather than the soils and/or sludges acting as their hosts.

Several technologies apply the use of silicates as a treatment mixture. This technique has proven to be unsuccessful in working with organics. The resulting product uses the effects of molesieve partitions, which alone will not be durable enough for a permanent remedy.

---

[4] Neilson et al., ibid., pp. 320-324.

In the past, there have been a great many sites "closed" with the use of kilndust, flyash, and quicklime. This operation allows the pH to continue to move upwardly until even the metals become soluble and breach the boundaries.

Several firms are employing the use of organophilio-clays. This technology is very effective for the adsorption of organics. However, in our research we have been unable to conclude the overall durability of the materials. The organizations which follow through with secondary stabilization do not appear to use sufficient pozz-cement binder for long term weathering effects.

POZZ-CEMENTS AS BINDERS FOR SOILS CONTAMINATED WITH WASTE MATERIALS

Pozzolanic hydraulic based binders are one of the oldest building materials developed by man[5]. There are Greek structures and Roman harbors that were made of these cements, which have endured wind and sea for over 2,000 to 5,000 years[6]. Therefore, the duration of their engineering and environmental case histories, as solidifying materials are second only to natural rocks. The "pozz" cements have resisted sulfate and chloride attack, magnesium for calcium substitution, and impact from the environs for millennia. Remarkably, the trace metals that were components of the original volcanic pozzolana were retained so well in the monoliths that their "trace metal" finger prints allowed tracing them to sites where they were mined in antiquity.

---

[5] Roy, D.M. and Langton, C.A., "Characterization of Cement-Based Ancient Building Materials in Support of Repository Seal Materials Study," BMI/ONWI-523, Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH 43201-2693, December, 1983.

[6] Lea, F.M., Chapter 14, Pozzolanas and Pozzolanic Cements, "Chemistry of Cement and Concrete," Chemical Publishing Co., New York, NY, 1971.

Studies reviewed used fly ash as the "pozzolanic." The results of these demonstrations reaffirm the evidence given by the more ancient Greek and Roman construction. This is consistent with the very low effective diffusion coefficients (10^{-13} to 10^{-15} cm^2/s) for lead, cadmium, and arsenic measured in the Pepper's Steel and Alloys (PSA) Site wasteform study for FPL[7].

[7]"Fixation/Stabilization Final Report on Pepper's Steel and Alloys Site, Medley, Florida", Volume 1 and 2, Florida Power & Light Company, Juno Beach, FL, November, 1985.

II. INTRODUCTION

WASTECH, INC. was contracted by Loureiro Engineering Associates (LEA) to perform a treatability study on a waste sample from the 93rd Street School Site in Niagara Falls, New York.

WASTECH, INC. received a representative sample from LEA on December 4, 1989. The soil arrived by Federal Express in a 15-gallon drum. The sample consisted of brown clay-like soil with no apparent odor. WASTECH, INC. received approximately 46 kg of the waste sample. LEA provided a waste analysis which is presented in Table 1: "Waste Characterization Analysis."

WASTECH, INC. first evaluated the specific contaminants and their concentrations. After this was completed, a series of reagent additives were selected to form co-valent bonds with the organic contaminants and act as a "carrier solution" in holding these materials in a molecular state. The binder matrices used by WASTECH, INC. created an adsorbent ion exchange with the inorganic contaminants and immobilized their materials. A flow chart describing the steps used can be found on page 21.

After reviewing the soil characterization analysis and properties of our various SuperSet™ reagents, WASTECH, INC. developed twelve formulas to use in the solidification/encapsulation process with the 93rd Street School Site waste sample. Of these twelve formulations, one was chosen for the final product to be submitted for testing and evaluation.

III. TREATABILITY STUDIES

In order to provide us with several possible formulas to consider when evaluating the initial physical characteristics of the treated specimens, twelve formulas were developed.

When mixing the twelve investigative trial mixes, modifications in the ratio of the admixture to waste were made in an effort to maximize the chemical fixation of the arsenic and lead.

Of the twelve fixation/solidification mixing formulations, we used four binder to soil ratios and three mix to reagent ratios on the soil sample supplied. Each of twelve mixes was performed by measuring an aliquot amount of sample material. The sample was placed into a clean stainless steel mixing bowl. To the soil, WASTECH, INC.'s bonding agent, SuperSet™, was added and mixing initiated with a Hobart equivalent mixer as a measured amount of potable water was added. Mixing continued for two (2) minutes. A "whip" utensil was used to continue the mixing action. Over a period of approximately one half minute a predetermined amount of cementitious/pozzolanic binder was added to the mix. The procedure used can be found in ASTM C305-82 (modified). Mixing continued for an additional two (2) minutes. The grout mixture showed a smooth homogeneous consistency.

The grout mixture was poured into sample vials for curing and testing. The sample vials were placed into a closed container with a water vapor blanket for hydration. A continuous procedure of checking the penetration resistance was begun and continued over the next few days. The physical testing provides the necessary data to determine the set time of the grouted blends. This procedure was performed following ASTM C191-82.

MIX Y

By evaluating the physical characteristics and general appearance of the solidified specimens from the twelve different formulations, Mix Y was selected on basis of set times, bleed water, structural integrity, and general appearance of homogeneity. Following forty-eight (48) hours of hydration the specimens were solid and showed penetration resistance of >700 psi.

A measured aliquot of sample material was placed into a clean stainless steel mixing bowl. At this time, the temperature of the raw soil was 23°C. Mixing of the soil was initiated with a Hobart equivalent mixer and continued for one minute while WASTECH, INC.'s bonding agent and a measured amount of potable water was added. A "whip" utensil was used during the mixing operation. Over a period of one minute a predetermined amount of cementitious/pozzolanic binder was added to the mix. The grout mixture showed a smooth homogeneous medium consistency. The only odor detectable was that of the pozzolanic additives. The grout temperature following mixing was 26°C. The admixture ratios for Mix 8966HL1-Y are shown in Table 2.

The grout mixture was immediately poured into teflon molds supplied by LEA. Each mold was layered one third full and tapped on a clean hard horizontal surface ten (10) times from a 3 inch to 4 inch height to ensure that the mixture was settled. This procedure was repeated until each mold was filled. The temperature of a spare specimen was monitored for 3 hours at 30 minute intervals. Please refer to the temperature graph on page 19.

After the molds were filled, they were placed in a closed container where they continued to cure in 100 percent humidity for the balance of twenty-eight (28) days.

TABLE 1

WASTE CHARACTERIZATION

TAL VOLATILE COMPOUNDS

All Values are ug/Kg

Chloromethane	U
Bromomethane	U
Vinyl Chloride	U
Chloroethane	U
Methylene Chloride	U
Acetone	11JB
Carbon Disulfide	U
1,1-Dichloroethene	U
1,1-Dichloroethane	U
1,2-Dichloroethene (total)	U
Chloroform	U
1,2-Dichloroethane	U
2-Butanone	U
1,1,1-Trichloroethane	U
Carbon Tetrachloride	U
Vinyl Acetate	U
Bromodichloromethane	U
1,1,2,2-Tetrachloroethane	U
1,2-Dichloropropane	U
cis-1,3-Dichloropropene	U
Trichloroethene	U
Dibromochloromethane	U
1,1,2-Trichloroethane	U
Benzene	U
trans-1,3-Dichloropropene	U
Bromoform	U
4-Methyl-2-pentanone	U
2-Hexanone	U
Tetrachloroethene	U
Toluene	U
Chlorobenzene	U
Ethylbenzene	U
Styrene	U
Xylene (total)	U

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

EPA TCL SEMI-VOLATILE COMPOUNDS

All values are ug/Kg

Phenol	U	Acenaphthene	20J
bis(2-Chloroethyl)ether	U	2,4-Dinitrophenol	U
2-Chlorophenol	U	4-Nitrophenol	U
1,3-Dichlorobenzene	U	Dibenzofuran	U
1,4-Dichlorobenzene	U	2,4-Dinitrotoluene	U
Benzyl alcohol	U	2,6-Dinitrotoluene	U
1,2-Dichlorobenzene	14J	Diethylphthalate	U
2-Methylphenol	U	4-Chlorophenyl-phenylether	U
bis(2-Chloroisopropyl)ether	U	Fluorene	22J
4-Methylphenol	U	4-Nitroaniline	U
N-Nitroso-di-n-propylamine	U	4,6-Dinitro-2-methylphenol	U
Hexachloroethane	U	N-Nitrosodiphenylamine (1)	U
Nitrobenzene	U	4-Bromophenyl-phenylether	U
Isophorone	U	Hexachlorobenzene	U
2-Nitrophenol	U	Pentachlorophenol	U
2,4-Dimethylphenol	U	Phenanthrene	160J
Benzoic acid	U	Anthracene	40000
bis(2-Chloroethoxy)methane	U	Di-n-butylphthalate	43JB
2,4-Dichlorophenol	U	Fluoranthene	230J
1,2,4-Trichlorobenzene	U	Pyrene	180J
Napthalene	16J	Butylbenzylphthalate	14J
4-Chloroaniline	U	3,3'-Dichlorobenzidine	U
Hexachlorobutadiene	U	Benzo(a)anthracene	40000
4-Chloro-3-methylphenol	U	bis(2-Ethylhexyl)phthalate	490B
2-Methylnaphthalene	10J	Chrysene	85J
Hexachlorocyclopentadiene	U	Di-n-octylphthalate	U
2,4,6-Trichlorophenol	U	Benzo(b)fluoranthene	71J
2,4,5-Trichlorophenol	U	Benzo(k)fluoranthene	58J
2-Chloronaphthalene	U	Benzo(a)pyrene	53J
2-Nitroaniline	U	Indeno(1,2,3-cd)pyrene	25J
Dimethylphthalate	U	Dibenzo(a,h)anthracene	10J
Acenaphthylene	U	Benzo(g,h,i)perylene	27J
3-Nitroaniline	U		

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

EPA TCL PESTICIDES/PCB's

All values are ug/Kg

alpha-BHC	U
beta-BHC	U
gamma-BHC	U
delta-BHC	U
Hetachlor	U
Aldrin	U
4,4'-DDE	U
Dieldrin	U
4,4'-DDD	U
Methoxychlor	U
Endrin-Ketone	U
4,4'-DDT	U
alpha-Chlordane	U
gamma-Chlordane	U
Endosulfan I	U
Endolfan II	U
Endosulfan Sulfate	U
Endrin	U
Heptachlor Epoxide	U
Toxaphene	U
PCB - 1016	U
PCB - 1221	U
PCB - 1232	U
PCB - 1242	U
PCB - 1248	U
PCB - 1254	U
PCB - 1260	U

U - Indicates that the compound was analyzed for but not detected.

POLYCHLORINATED DIOXINS/FURANS
HIGH RESOLUTION

Parameter	Result	Units
Furans		
TCDFs (total)	16	pg/g
PeCDFs (total)	7.8	pg/g
HxCDFs (total)	14	pg/g
HpCDFs (total)	24	pg/g
OCDF	67	pg/g
Dioxins		
TCDDs (total)	1.6	pg/g
PeCDDs (total)	1.7	pg/g
HxCDDs (total)	6.3	pg/g
HpCDDs	19	pg/g
OCDD	390	
	% Recovery	
13C-2,3,7,8-TCDF	59	
13C-2,3,7,8-TCDD	66	
13C-1,2,3,7,8-PeCDD	77	
13C-1,2,3,6,7,8-HxCDD	82	
13C-1,2,3,4,6,7,8-HpCDD	52	
13C-OCDD	18	

TAL METALS

All values are mg/Kg.

Aluminum	8,760
Antimony	<15.6
Arsenic	284
Barium	97.0
Beryllium	2.5
Cadmium	<2.0
Calcium	8,260
Chromium	38.1
Cobalt	15.9
Copper	40.6
Iron	24,100
Lead	538
Magnesium	3,080
Manganese	201
Mercury	0.43
Nickel	17.4
Potassium	829
Selenium	<1.0
Silver	<2.0
Sodium	221
Thallium	<2.0
Vanadium	24.1
Zinc	50.8

MISCELLANEOUS

Total Cyanide	<0.10 mg/Kg
Percent Moisture	23.5 percent
pH	8.18 S.U.
Permeability	1×10^{-5} cm/sec

Particle Size Distribution:

Sieve	% Passing
3/4"	100
1/4"	99.4
#10	94.3
#40	85.9
#100	80.2
#200	67.8

TCLP EXTRACT ANALYSIS (ug/l)

Arsenic	3035
Lead	1960
Anthracene	0.3
Benzo(a)anthracene	Not detected

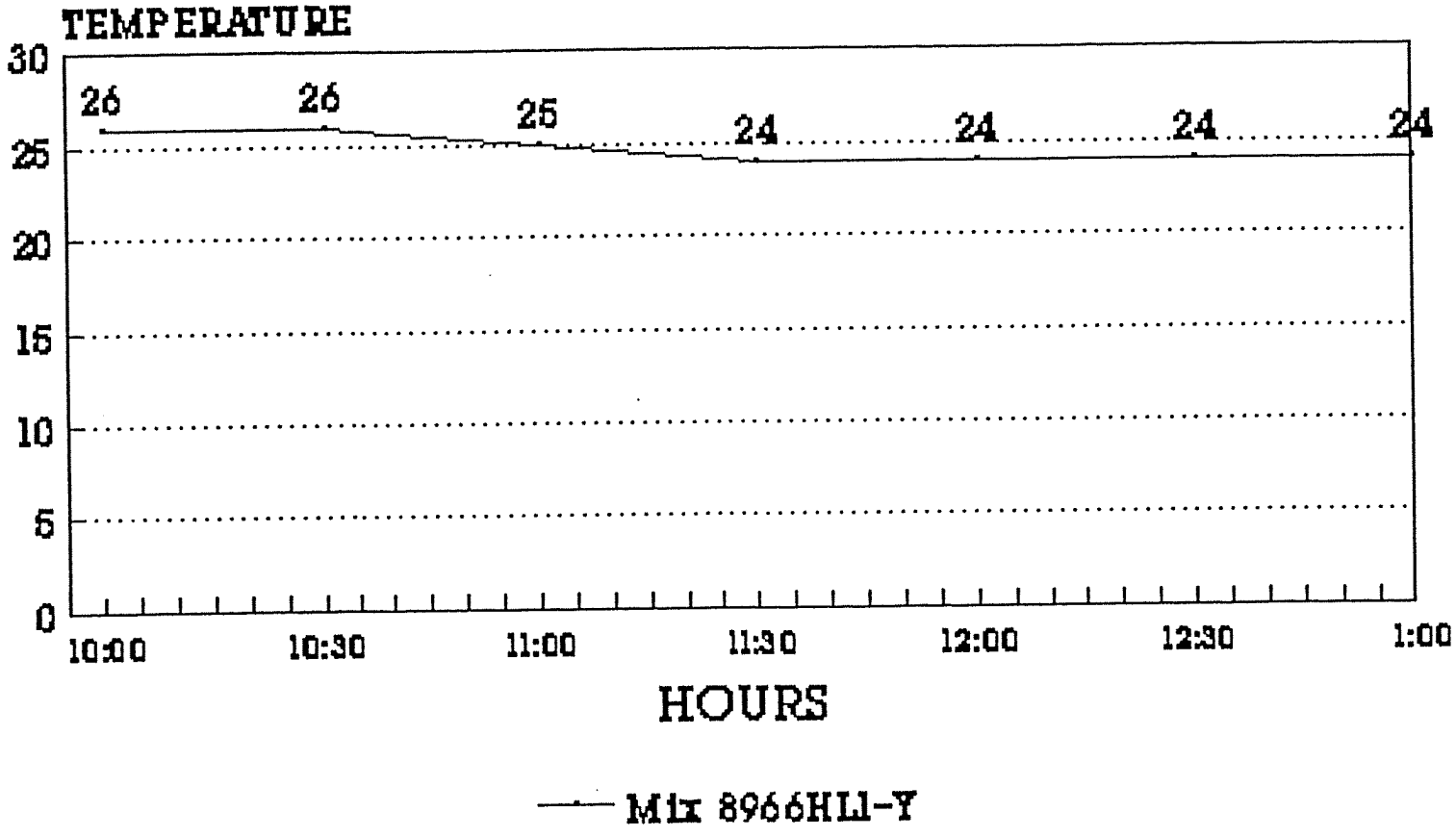
(Revised Jan 2, 19

GRAPH 1

TEMPERATURES OF GROUT

LEA/93rd Street School Site

Temperatures of Grout



Temperatures are in Celsius

TABLE 2

FORMULA - 8966HL1-Y

Waste Loading	39.2%
Reagents	
(pozzolans and proprietary SuperSet™)	38.0%
Water	22.8%

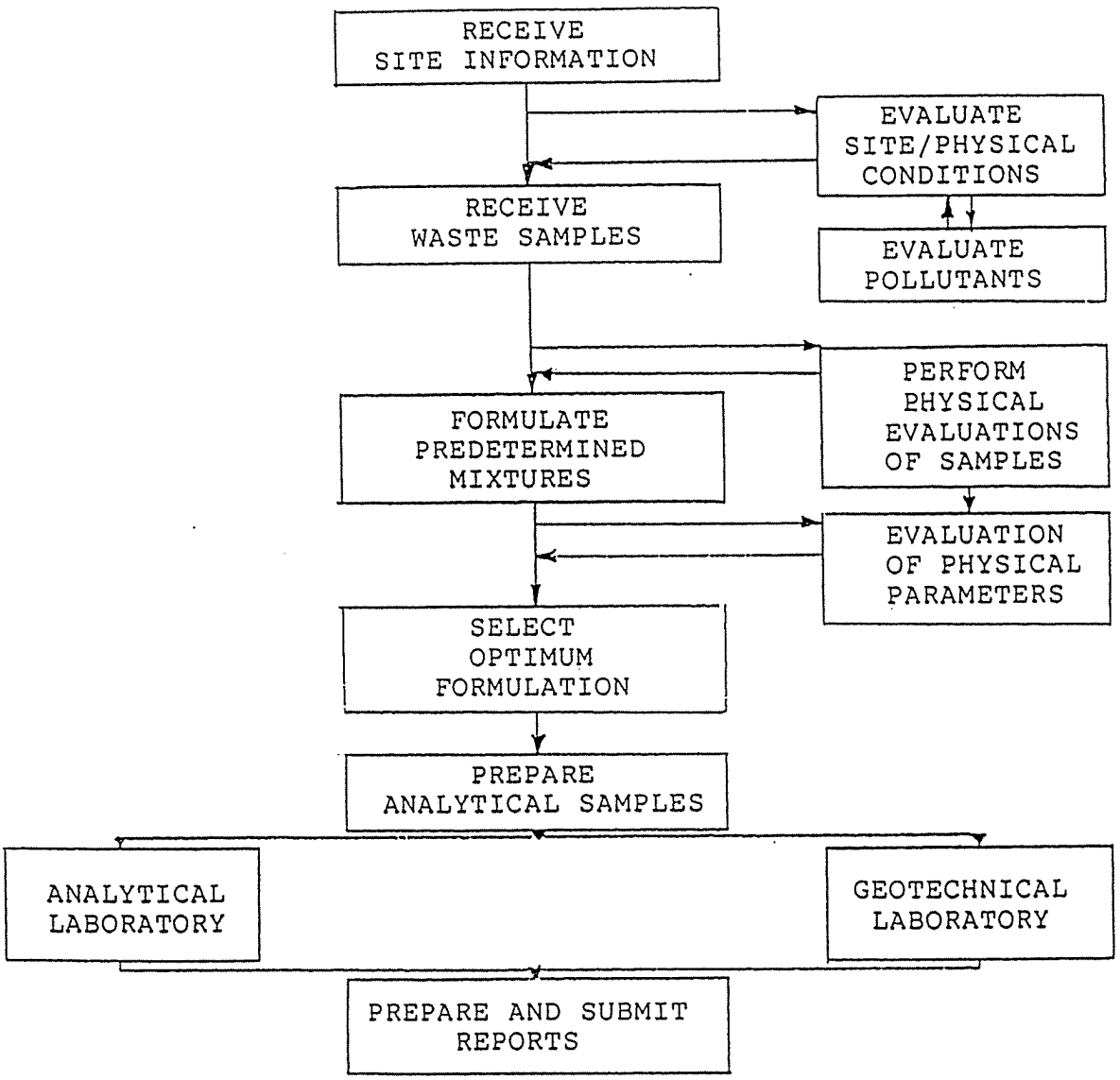
Bulking Factor: Approximately 1.20

PHYSICAL DATA ON SOIL

	PRE-TREATMENT	POST-TREATMENT
Density	1.7 g/cc	1.3 g/cc
pH	8.18	11.0
Moisture Content	23.5 Percent	32.7 Percent*

* Calculated by moisture content of soil and water added to mix

TREATABILITY STUDY FLOW DIAGRAM
WASTECH, INC.



TREATABILITY STUDY FLOW DIAGRAM EXPLANATIONS

A. Receive all available information on the site: location, conditions, known contaminants, contaminant concentration, geology, hydrology, etc.

B. Perform physical characterization of waste samples: moisture content, ASTM D2216-80; density, SW-846; oil & grease, SW-846 Method 9070; pH, SW-846 Method 9045; etc. The evaluation of the physical characteristics can provide information on interferences which may be present.

C. Characterize the contaminants and their concentrations through analyses.

D. Determine formulated mixture ratios based on historical data and past experiences.

E. Select formulated mixtures which prove to have good physical characteristics: set times using the pocket penetrometer; bleed water; whether phase separation is present; structural integrity in terms of homogeneity of mix and general appearance.

F. Perform baseline analysis on selected mixtures to verify the analytical effectiveness.

G. Select mixtures that perform the best and re-mix waste materials for full scale evaluation.

H. The analytical laboratory will analyze the wasteforms for compliance with standing regulatory guidance. The geotechnical laboratory will measure the physical parameters: unconfined compressive strength, hydraulic conductivity, etc.

IV. SET TIMES

The evaluation of the set times is used to ensure that the treated waste material will support continuous operations in the field. This evaluation is a physical parameter. WASTECH, INC.'s goal for set times during the treatability study presented no formulation problems. The goal established for this project was for the treated specimens to reach a penetration resistance of at least 100 psi in 24 hours. If the treated specimens reach this strength in 24 hours, the monolith mixed from this same formula in field operation would be of the strength required to support wheeled vehicles. In order to provide greater strength of the monolith, WASTECH, INC. recommends to continue that grout be poured and layered during field operations.

As the formulation was mixed and poured into molds, the penetration resistance was monitored on the mix using a Pocket Concrete Penetrometer. From these regular readings on the optimum mix chosen, data was compiled into a graph. Please refer to Graph 2, page 24.

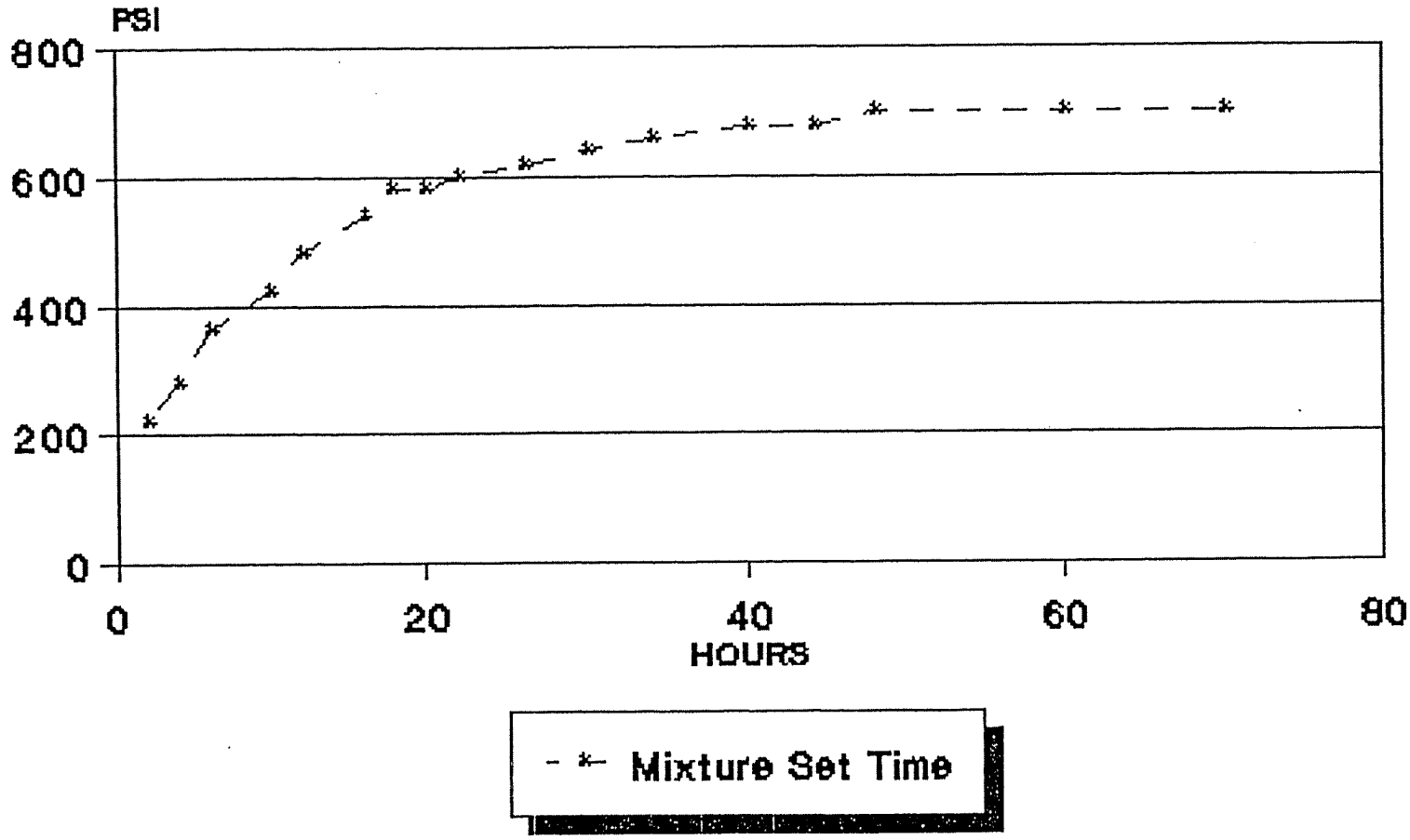
GRAPH 2

SET TIME:

MIXTURE 8966HL1-Y

LEA/93rd Street School Site

Set Time 8966HL1-Y



V. DISCUSSIONS

CHEMICAL FIXATION OF WASTE SAMPLE

During the mixing phase of the waste materials, the concentration of contaminants present in the soil and other soil characteristics were a factor in determining mix ratios. Following the addition of the WASTECH, INC. bonding media, SuperSet™, the prevalent odor of the waste material contaminants was reduced significantly to reveal an adequate bonding effect.

After making adjustments in the formulations, it was evident that the waste material readily emulsified during the mix described in this report. The specimens which were produced from this mix illustrate the compatibility of WASTECH, INC.'s process with the soil contaminants. This illustration was proven following forty-eight (48) hours of hydration and utilization of a free standing monolith.

Upon visual and physical examination of this mix, it was concluded that an equilibrium of reagent and contaminants could be achieved. This equilibrium is based upon the necessary adsorbent concentrations to adequately immobilize the contaminants. The design of those formulations is within the operating window of WASTECH, INC.'s process. WASTECH, INC.'s "operating window" is a design matrix which dictates a minimum amount of additives to effectively encapsulate and chemically stabilize the contaminants.

All monoliths produced from this formulation revealed excellent penetration resistance after 48 hours. The end grout product was the type highly desired for waste disposal. WASTECH, INC. manufactures a grout mixture which has specific physical characteristics. These characteristics are inclusive of set times, structural integrity, unconfined compressive strength, a low permeability (hydraulic conductivity), etc.

The nuclear industry has evaluated these types of wasteforms for decades in the permanent disposal of radioactive waste using similar criteria.

Loureiro Engineering Associates requested that the specimens be sent to York Laboratories for analytical testing and to Independent Materials Testing Laboratories, Inc. for physical testing protocols.

All remaining waste material will be returned to the generator according to EPA regulations within 30 days following the final report, unless otherwise specified by client.

VI. END WASTE PRODUCT ANALYSIS

At the request of LEA, WASTECH, INC. sent the solidified monoliths to York Laboratories to perform the Toxicity Characteristic Leaching Procedure (TCLP), as referenced in the Federal Register, Volume 51, dated March 19, 1990. Treated solidified samples of waste were sent by Federal Express for these analyses. The results of the TCLP Test can be found in Table 7.

The treated solidified samples for the Unconfined Compressive Strength per ASTM 4.02, C-109, September, 1986, were sent Federal Express to Independent Materials Testing Laboratories, Inc. for testing. These results may be found in Table 3. The results of the unconfined compressive strength revealed strong monoliths at 800 psi. The compressive strength of the monolithic solids can generally be fluctuated by adjustments in the binder (pozzolans and cement) to waste ratios to obtain any desired load capacity.

The treated specimens for the Hydraulic Conductivity (Permeability), per EPA SW 846, 9100-2.8, September, 1986 were also sent Federal Express to Independent Materials Testing Laboratories, Inc. for testing. These results may be found in Table 5. The permeability of the specimens tested revealed that the monoliths were not easily permeated in the 10^{-8} range. As discussed above, adjusting the ratios of the binder matrix would also affect the permeabilities in that the monoliths would be less permeable as the binder is strengthened.

The treated specimens for the Freeze-Thaw Weathering Test per ASTM D560-82 were also sent Federal Express to Independent Materials Testing Laboratories, Inc. for testing. Following stabilization, the target value for this project was to experience less than 10 percent weight loss. All WASTECH, INC. specimens passed this criteria. The results of the treated specimens can be found in Table 6.

VII. CONCLUSIONS AND RECOMMENDATIONS

WASTECH, INC. demonstrated its proprietary method for chemical fixation/stabilization of a soil sample from the 93rd Street School Site in Niagara Falls, New York. Analysis provided to WASTECH, INC. of the soil sample revealed metals, Benzo(a)anthracene, Anthracene, and Dioxin as the major contaminants to be evaluated in the analytical testing of treated waste.

WASTECH, INC. has been actively involved in designing performance and evaluation criteria for the remediation of hazardous waste sites. This experience and continuous discussion with various regulatory groups and members of the technical community provide assistance in these designs. Several parameters were selected to evaluate the end products and their potential acceptance as end wasteforms.

Following the initial mixtures, the specimens were evaluated for free standing liquids and penetration resistance. A modification of the protocols described in 10CFR61 was used in determining these results. There were no free-standing liquids observed on the specimens and the result of the penetration resistance on the optimum mix may be found in Graph 2, page 24. Sample 8966HL1-Y produced the best results in this evaluation. These specimens proved to possess the best physical characteristics in the shortest period of time. The shorter hardening time is imperative to obtain the desired effect for organic encapsulation.

WASTECH, INC.'s work with various organic materials has shown that a structurally sound wasteform produces better analytical results. The shorter hardening time initiates the decrease in overall porosity of the end product. It has been shown through research that there is a direct correlation between maintaining a chemical

bond with an organic contaminant and a solidified impermeable mass. The mole-sieve effect reduces the amount of aggressive agents from entering the stabilized mass to destroy the chemical bonds.

As WASTECH, INC. evaluates formulas and ratios during the treatability study, the optimization process can only be considered complete in the acceptance that no chemical analysis of treated wasteforms was available to review as the study progressed. Once WASTECH, INC. can observe the actual results, then we will be able to optimize our treatment process for the waste from the 93rd Street School Site. By observing the degree of success incorporated in our bonding processes, WASTECH, INC. can maximize its effort in presenting the most cost efficient and completely effective chemical fixation formula possible.

The physical state of the treated material for on site remediation will be a pourable grout which solidifies to a homogeneous impermeable free standing monolithic block. It is preferred that the material be returned to the excavated area prior to solidification. The mix design is such that it will support wheeled vehicles within a 24-36 hour period.

TABLE 3
UNCONFINED COMPRESSIVE STRENGTH
SOLIDIFIED SPECIMENS
PROJECT TARGET: MINIMUM OF 50 PSI

SAMPLE NUMBER	SAMPLE DESCRIPTION	UCS, psi
8966HL1-Y1-19	Solidified Soil	800
8966HL1-Y1-20	Solidified Soil	950

TABLE 4
FREE LIQUIDS
PROJECT TARGET: NONE

SAMPLE NUMBER	RESULTS
8966HL1-Y-1	SAMPLE CONTAINED NO FREE LIQUIDS

TABLE 5
PERMEABILITY
SOLIDIFIED SPECIMENS
PROJECT TARGET: MAXIMUM 10^{-7} CM/SEC

SAMPLE NUMBER	SAMPLE DESCRIPTION	PERMEABILITY, cm/sec
8966HL1-Y1-22	Solidified Soil	3.2×10^{-8}
8966HL1-Y1-21	Solidified Soil	5.4×10^{-8}

*Saturation assumed due to stoppage of volume change with back pressure change.

TABLE 6
FREEZE THAW WEATHERING TEST
SOLIDIFIED SPECIMENS
PROJECT TARGET: MAXIMUM WEIGHT LOSS 10%

	PERCENT MOISTURE AS RECEIVED	PERCENT MOISTURE AT TEST	PERCENT LOST
8966HL1-Y1-15	26.3	34.4	0.02
8966HL1-Y1-16	24.9	34.4	0.07

TABLE 7
TREATABILITY STUDY ANALYTICAL DATA

EPA TCL SEMI-VOLATILE ORGANICS (INTACT) UG/KG

SAMPLE ID.	DILUTION FACTOR	ANTHRACENE	BENZO(A) ANTHRACENE
METHOD BLANK	1.00	U	U
8966HL1-Y1-1	3.00	17,000	13,000

*METHOD DETECTION LIMIT FOR BOTH PARAMETERS WAS 330 UG/KG.

EPA TCL SEMI-VOLATILE ORGANICS (TCLP) UG/L

SAMPLE ID.	DILUTION FACTOR	ANTHRACENE	METHOD BENZO(A) ANTHRACENE
TARGET PROJECT VALUES	N/A	0.5	0.5
METHOD BLANK	1.00	U	U
8966HL1-Y1-1	1.00	U	U

*METHOD DETECTION LIMIT FOR BOTH PARAMETERS WAS 10 UG/L.

MISCELLANEOUS METALS (INTACT) MG/KG

PARAMETER	8966HL1-Y1-1
ARSENIC	145
LEAD	256

MISCELLANEOUS METALS (TCLP) UG/L

PARAMETER	TARGET PROJECT VALUES	8966HL1-Y1-1
ARSENIC	0.3 MG/L	11.2
LEAD	0.1 MG/L	1.5

* Please see Appendix of Attachment for definitions of letter codes.

ATTACHMENT 1

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

April 4, 1990

Mr. Brian Armet
York Wastewater Consultants
200 Monroe Turnpike
Monroe, CT 06468

Re: 93rd Street School Site Niagara Falls, N.Y., Treated Soil Analysis

Dear Mr. Armet:

On December 21, 1989 Independent Materials Testing Laboratories, Inc. (IMTL) was requested to perform tests on chemically treated soils samples from vendors that would send samples to IMTL. vendors submitted samples in January thru February of 1990. The following tests were performed:

(1) ASTM C-109 Compressive Strength Tests.
(2) SW-846 Method 9100-2.8 Triaxial Permeability.
(3) ASTM D-560 Freeze-Thaw Weathering.

IMTL provided two thick walled machined, copper molds to each vendor in insulated shipping boxes to be returned in same with the permeability samples . Each vendor additionally submitted four 2x2x2 inch cube samples in disposable molds, with the exception of which submitted permeability specimens in plastic molds and additional specimens not in a cube formation but in metal cylindrical mold containers measuring 2 1/16" (D) X 1 1/4" (H) . The samples were received within the next two and one half months during which time the testing program was in progress. Copies of the information submitted with each group of samples is attached.

Upon receipt it was noted that the consolidation of some of the samples received varied considerably. The permeability samples were consolidated enough to obtain a sample that appeared uniform in consistency. Some of the cube type samples however were not carefully consolidated. The least well consolidated samples were used for the freeze thaw weathering tests while the samples appearing better consolidated were used for compression tests.

INDEPENDENT TESTING

Permeability sample molds from were machine cut to remove them from the specimens due to some expansion of the material. These samples including the cubes had the appearance of being mixed with a material that may have caused oxidation or discoloration as apparent in an orange/rust coloration in samples and a rust colored and white banding in samples. Neither of these samples appeared completely homogenous.

The samples from and Wastech each appeared to be of a homogenous grey color. They may have been made from a slurry type mix.

The permeability samples were each trimmed square at the ends to sufficient height. The portion chosen was to obtain the most uniform specimen in terms of consolidation. This condition as well as the condition of the original soil consistency (ie, grain sizing) has an effect on the permeability of the sample. The specimens were then mounted in the triaxial apparatus for testing.

The compressive strength samples were chosen from two of the four specimens submitted by each vendor. For this test the most uniform samples were chosen, leaving the remaining samples for freeze thaw weathering tests. The samples were thinly capped with a high strength gypsum plaster. They were then mounted in the apparatus for testing. Despite the differences in appearance of the samples the compressive strength was within a narrow range with no sample below 50% of the strength of any other. It was not evident that the results were strongly affected by improper consolidation in this test.

The remaining two samples from each of the four vendors were subjected to the freeze thaw weathering tests. All samples were placed in exactly the same conditions for each cycle during the test duration. The homogenous specimens performed extremely well in comparison to the others in this test.

It was not evident that the results were strongly affected by improper consolidation in this test.

Sincerely,

David P. Aiudi
Director of Testing

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062. TELEPHONE (203) 525-7193

Cust No.: 1114
Client: York Wastewater Consultants, Inc
Project: 93rd Street School Site, Niagara Falls, N. Y.
Subject: Triaxial Permeability Test
Date: 2-14-90
Report No. 6

Treatment Vendor: Wastech, Inc. 8966HL1

Laboratory Sample: 2251 (Y1-22)

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.:	5.14	cm
Sample Ht.:	12.53	cm
Dry Density:	67.6	pcf
Water Content:	49.5	%
B-Value:	.57	

Type of Test: Constant Head
Gradient: 17
Pore Fluid: Distilled Water
Effective Stress: .5 kg/cm2

TEST RESULTS

Permeability:
3.2 X 10 -8 cm/sec

Laboratory Sample: 2250 (Y1-21)

Sample Type: Filled Tube

Description:
Cemented Silt

TEST DETAILS

Sample Dia.:	5.10	cm
Sample Ht.:	12.20	cm
Dry Density:	67.0	pcf
Water Content:	51.9	%
B-Value:	.65*	

Type of Test: Constant Head
Gradient: 20
Pore Fluid: Distilled Water
Effective Stress: .5 kg/cm2

TEST RESULT

Permeability:
5.4 X 10 -8 cm/sec

*Note: Saturation assumed due to stoppage of volume change with back pressure change.

Procedure: EPA - SW - 846 Method 9100 - 2.8
September 1986

1114prm.#6

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls, N. Y.
Subject: ASTM C-109 Compressive Strength Testing
Date: 2-17-90
Report: 10

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2" X 2" cemented cubes

Vendor: Wastech, Inc. 8966HL1

Sample Number		Wet Density pcf	Total Load	Unit Strength PSI
2254	Y1-19	74.6	3200	800
2255	Y1-20	74.6	3800	950

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#10

INDEPENDENT MATERIALS TESTING LABORATORIES, INC.
NEAL COURT IND. PARK
P.O. BOX 745
PLAINVILLE, CONNECTICUT 06062
TELEPHONE (203) 525-7193

Cust.No.: 1114
Client: York Wastewater Consultants, Inc.
Project: 93rd Street School Site, Niagara Falls N. Y.
Subject: ASTM D560 Freeze Thaw Weathering Tests
Date: 3-15-90
Report: 14

SAMPLE DESCRIPTION:

Molded Specimen, (2) 2" X 2" cubes

Vendor: Wastech, Inc. 8966HL1

Sample Number	Percent Moisture as Received	Percent Moisture at Test	Percent Lost Due to (12) Freeze Thaw Cycles
2252 Y1-15	26.3	34.4	.02
2253 Y1-16	24.9	34.4	.07

Note: Samples assumed to be fully cured. No additional instructions were supplied.

1114astm.#14

YORK LABORATORIES

REPORT TRANSMITTAL

REPORT NUMBER 30900-0592

DATE February 27, 1990

CLIENT LEA
100 Northwest Drive
Plainville, CT 06082

ATTENTION Mr. Charles Jaworski

The above referenced report is enclosed. Copies of this report and supporting data will be retained in our files in the event they are required for future reference.

If there are any questions concerning this report, please do not hesitate to contact us.

Any samples submitted to our Laboratory will be retained for a maximum of sixty (60) days from receipt of this report, unless other arrangements are desired.

February 27, 1990

30900-0592
LEA
100 Northwest Drive
Plainville, Connecticut 06082

Attention: Mr. Charles Jaworski

PURPOSE

One sample was submitted to York Laboratories Division of YWC, Inc. by LEA the samples were analyzed for anthracene and benzo(a)anthracene, arsenic and lead. The analyses were performed both on the intact sample and on the TCLP leachate. The client also requested free liquid analysis on the sample.

METHODOLOGY

Semi-volatile organics and metals analyses were conducted according to NYSDEC Contract Laboratory Program Protocols, November 1987.

Free liquid analysis was performed by filtration/visual inspection.

Metals were determined by ICP using either a JA61 simultaneous ICAP or a PE 6500XR sequential ICP. Graphite furnace elements were determined using either a PE Zeeman 5100 or PE Zeeman 3030 GFAAS.

TCLP extracts were prepared in accordance with Appendix I to 40 CFR Part 268.

RESULTS

The results are presented in the following Tables. Also enclosed are the organics and inorganics data packages containing all relevant QA/QC and raw data.

Prepared by: Jeffrey C. Curran
Laboratory Manager

JCC/tma

The liability of YWC, Inc. is limited to the actual dollar value of this project.

TABLE 1.0
30900-0592
LEA
EPA TCL SEMI-VOLATILE ORGANICS (INTACT)

All values are ug/Kg.

	Sample Identification		
Dilution Factor	1.00	3.00	
Method Blank I.D.	>C6068	>C6068	
	Method	8966 HLY1	Method Detection Limits
Compound	Blank	-1	with no Dilution
Anthracene	U	17,000	330
Benzo(a)anthracene	U	13,000	330

U, J, B - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

TABLE 1.0
30900-0592
LEA
EPA TCL SEMI-VOLATILE ORGANICS (TCLP)

All values are ug/L.

	Sample Identification		
Dilution Factor	1.00	1.00	
Method Blank I.D.	>C6078	>C6078	
Compound	Method Blank	8966 HL1-Y1-1	Method Detection Limits with no Dilution
Anthracene	U	U	10
Benzo(a)anthracene	U	U	10

U, J, B - See Appendix for definition.
Note: Sample detection limit = MDL x dilution factor.

TABLE 2.0
30900-0592
LEA
MISCELLANEOUS METALS (INTACT)

All values are mg/Kg.

Parameter	8966HL1-Y1-1
Arsenic	145
Lead	256

TABLE 2.1
30900-0592
LEA
MISCELLANEOUS METALS (TCLP)

All values are ug/L.

Parameter	8966HL1-Y1-1
Arsenic	11.2
Lead	1.5U

TABLE 3.0
30900-0592
LEA
FREE LIQUIDS

Sample Identification	Results
8966HL1-Y-1	Sample Contained No Free Liquids

200 MONROE TURNPIKE • MONROE, CONNECTICUT 06468 • (203) 261-1458

APPENDIX

U - Indicates that the compound was analyzed for but not detected.

J - Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

B - This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.

N - Indicates that the compound was analyzed for but not requested as an analyte. Value will not be listed on tabular result sheet.

X - Matrix spike compound.

(1) - Cannot be separated from diphenylamine.

(2) - Decomposes to azobenzene. Measured and calibrated as azobenzene.

A - This flag indicates that a TIC is a suspected aldol condensation product.

E - Indicates that it exceeds calibration curve range.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

APPENDIX L

VENDORS TREATABILITY STUDY REPORT

VENDOR E - CHEMFIX

CHEMFIX
TECHNOLOGIES, INC.

April 2, 1990

Mr. Charles Jaworski, P.E.
Loureiro Engineering Associates
100 Northwest Drive
Plainville, CT 06062

Dear Charles:

Due to the competitive nature of the waste treatment business, any information concerning the specific types of Chemfix® reagents that were used in treatment of your soil sample must be considered proprietary. However please note that the Volume Expansion Ratio (VER) for Niagara Falls Naturfil® is 2.43 with a relative waste/reagent ratio of 3.06:1(excluding added water). In the presently proposed formula, 43.37% by weight of total added reagents exist as water.

Naturfil® is a clay-like soil material produced through the combination and subsequent reaction of Chemfix® reagents with industrial waste. Niagara Falls Naturfil® can be categorized as a firm soil material with an average Unconfined Compressive Strength(UCS) of 4.0 tons/ft^2 (measured with a "pocket penetrometer") or greater. Before redeposition would occur, a curing time of no less than 24 hours and no more than 48 hours would prospectively be required.

As I stated in our recent conversation, variations in mixing techniques which were employed in the preparation of the York Laboratories test samples, is a most probable reason that the York TCLP extract data displayed lead appearing 0.080ppm above the acceptable standards. However, since the leachable lead level in the untreated material is relatively unalarming by Chemfix® standards, and considering that none of the Chemfix® reagents which are especially prescribed for lead treatment were used in the proposed formula, we are quite confident that our technology will surpass all goals established for this treatment study.

2424 Edenborn Ave., Suite 620
Metairie, Louisiana 70001
(504) 831-3600
(800) 992-3443 (Except La.)

Enclosed please find four copies of the Chemfix® laboratory report. For any additional information, please do not hestitate to contact me. Thank you once again for your cooperation.

Sincerely,

Wayne A. Brown

Wayne A. Brown
Technical Development Chemist

Enclosure

cc: Phil N. Baldwin, Jr.

CHEMFIX
TECHNOLOGIES, INC.

LABORATORY REPORT

Prepared for: Loureiro Engineering (for Niagara Falls 93rd St. School Site)

Laboratory Number: 000-033-
Date Received: 12/89

Additional I.D.'s: 000-035-001
000-035-002

NARRATIVE

Sample I.D.'s: -035-001 & -002

A sample of "Niagara Falls" soil waste underwent an analysis for treatability using the Chemfix® process. The goals of the analysis were to establish a treatment scheme which would be effective in the fixation of arsenic, lead, anthracene, benzo(a) anthracene, and dioxin. The subsequent Naturfil® material, a nonhazardous clay-like soil produced by the addition of Chemfix® reagents with industrial waste, was analyzed for leachable concentrations of the contaminants in question. The Toxicity Characteristic Leachate Procedure was used in producing leachate solutions that were subjected to such analyses.

Staff Technical Development Chemist

2424 Edenborn Ave., Suite 620
Metairie, Louisiana 70001
(504) 831-3600
(800) 992-3443 (Except La.)

RESULTS

000-03-002
Niagara Falls Naturfil®
TCLP Leachate

Test	Concentration	Units	PQL
Arsenic	0.009	mg/l	0.050
Lead	BQL	mg/l	0.025
Anthracene	BQL	ug/l	10
Benzo(a) Anthracene	BQL	ug/l	10
2,3,7,8-TCDD (for Dioxin Scan)	BQL	ug/l	10

QUALITY CONTROL LAB BLANK

Test	Concentration	Units	PQL
Arsenic	BQL	mg/l	0.050
Lead	BQL	mg/l	0.025
Anthracene	BQL	ug/l	10
Benzo(a) Anthracene	BQL	ug/l	10
2,3,7,8-TCDD (for Dioxin Scan)	BQL	ug/l	10

BQL: BELOW QUANTITATION LIMIT
PQL: PRACTICAL QUANTITATION LIMIT

METHODS

Test Methods for Evaluating Solid Waste
Physical/Chemical Methods, SW-846, USEPA 3rd Edition, Revised, November, 1986

Arsenic	Method 7060
Lead	Method 6010
Dioxin Scan	Method 8270
Semivolatiles	Method 8270

Technical Review/Clerical Accuracy/Report Completeness Certified By:

Staff Technical Development Chemist — Date 4/2/90

Project Coordinator

V. P. Business & Technology Development/
Director of Technical Services — Date 4/2/90

CHEMFIX
TECHNOLOGIES, INC.

May 10, 1990

Charles A. Jaworski
Loureiro Engineering Associates
100 Northwest Drive
Plainville, Ct. 06062

Dear Charles:

The following is a reagent addition analysis concerning the Chemfix® treatment of Niagara Falls soil waste:

Treatment Order

1) An 80% waste/ 20% water mixture was prepared. This mixture was considered as the total sample that would undergo treatment via the Chemfix® process.

2) To the above mixture, a total addition of 26.11% by weight of Chemfix® reagents (including water) were added with stirring. The resulting product material was allowed to cure for at least 18 hours before leachate analysis would be performed.

The additions of water and Chemfix® reagents (both solid and liquid) represent the only increases in mass that occurred during treatment. The volume expansion number which was presented to you in the CTI laboratory report was given with respect to a comparison of relative amounts of water

2424 Edenborn Ave., Suite 620
Metairie, Louisiana 70001
(504) 831-3600
(800) 992-3443 (Except La.)

for both the untreated and treated materials. There is often an increase in density and water content as a result of the Chemfix® process, with industrial wastes usually experiencing a 15-30% increase in volume which is primarily due to added water and/or Chemfix® liquid reagents. The average weight increase will range from 10 to 30% depending on the proposed treatment formula.

For any additional information, please do not hesitate to contact me.

Sincerely,

Wayne A. Brown

Wayne A. Brown
Technical Development Chemist

APPENDIX M

VENDORS TREABILITY STUDY REPORT

VENDOR F - TRICIL

February 23, 1990

Mr. Charles A. Jaworski, P.E.
Loureiro Engineering Associates
100 Northwest Drive
Plainville, CT 06062

RE: Treatability Studies, 93rd St. School Site

Dear Mr. Jaworski:

During the month of January, 1990, Tricil Environmental Response Inc., in conjunction with McBride-Ratcliff & Associates, MBA Laboratories, and TMS Analytical Services, performed a series of treatability studies to evaluate the physical and chemical effects of adding various combinations of stabilization/solidification agents to a sample of soil received from Loureiro in early December, 1989.

Upon receipt of the soil sample and a preliminary report detailing the characteristics of the untreated soil, Tricil sent a FAX (4 December 1989) to Loureiro informing you of sample receipt and requesting clarification of ASTM methods and required performance criteria for all geotechnical tests so that our evaluations would be consistent with treatability requirements. On 21 December, while I was on annual leave, Tricil received a FAX from Loureiro of a letter dated 19 December which provided the requested information. On 2 January 1990, Tricil received a FAX from Loureiro that identified information (TCLP extract analysis) supplemental to that provided in the initial untreated soil characteristics report. Tricil's treatability trials were not begun in earnest until my return from annual leave in early January.

Initial screening was performed to confirm reagent effects on TCLP and unconfined compressive strength. TCLP results from this round of testing are included as Appendix 1. Only one sample (of four tested) failed to meet the established criteria; this sample, number 1A, represented the simplest stabilization program and failed with respect to only one parameter: lead.

Based on the results from the first screening, Tricil proceeded with a full-scale geotechnical evaluation of all four design mixes. These results are included as Appendix 2. Please note that the results presented are complete, with the exception that no values are available for the

freeze-thaw test, due to its 28 day duration. The freeze-thaw results will be forwarded when received.

Because our initial lab TCLP detection limits were higher than the level of detection required, Tricil applied information from the geotechnical analyses combined with stabilization cost evaluations of the various blends to determine which sample was the most likely candidate for our final choice. Sample mix number 4A was chosen for dioxin analysis: a blended sample was delivered to MBA labs for TCLP extraction and extract transmittal to TMS Analytical Services for dioxin analysis (TMS was not capable of performing the extraction). Given the time constraints of the project, Tricil's dioxin screen was necessarily limited to evaluation of 2,3,7,8 TCDD only (more than a month was required for a full dioxin scan). Results are included as Appendix 3.

Once dioxin analysis confirmed that the treatment identified as number 4A would pass the test criteria, a final batch was blended for direct transmittal to YWC Inc. for chemical testing. A portion of this final batch blend was also sent to McBride-Ratcliff & Associates (MRA) for preparation of molded samples and their transmittal to Independent Materials Testing Laboratories, Inc. The MRA letter of transmittal is included as Appendix 4.

All samples were mixed and molded in a manner consistent with Tricil's pugmill blending system presently in place in Niagara Falls, New York.

Please contact me at (713) 467-3433 if you have any questions or require additional information. Final freeze-thaw data and the remaining soil will be transmitted to you during the week of 26 February.

Very truly yours,

TRICIL ENVIRONMENTAL RESPONSE INC.

C. H. Orwig
Manager, Technical Services

APPENDIX 1

M.B.A. LABS

MICROBIOLOGICAL AND BIOCHEMICAL ASSAY LABORATORIES

P.O. BOX 9461 340 S. 66th STREET HOUSTON, TEXAS 77261
TELEPHONE NO. (713) 928-2701

SAMPLE SUBMITTED BY: Tricil Env.

DATE RECEIVED: 1-9-1990

DATE COMPLETED: 1-15-1990

LABORATORY REPORT NUMBER: J-24016-00

SAMPLE IDENTIFICATION: Pipe Sample - 6A

RESULTS

PARAMETER	METHOD #	DATE	TIME	ANALYST	RESULTS
TCLP Arsenic	EPA 266.2	1-15-90	10:00	C.W.	0.032 mg/l
TCLP Lead	EPA 239.2	1-15-90	10:00	C.W.	0.032 mg/l

REPORTED BY _____

M.B.A. LABS

MICROBIOLOGICAL AND BIOCHEMICAL ASSAY LABORATORIES

P.O. BOX 9461 340 S. 66th STREET HOUSTON, TEXAS 77261
TELEPHONE NO. (713) 928-2701

SAMPLE SUBMITTED BY: Tricil Env.

DATE RECEIVED: 1-9-1990

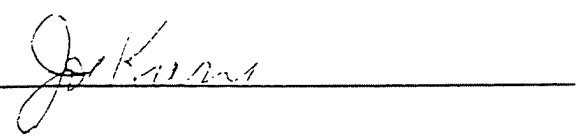
DATE COMPLETED: 1-15-1990

LABORATORY REPORT NUMBER: J-24017-00

SAMPLE IDENTIFICATION: Pipe Sample -5A

RESULTS

PARAMETER	METHOD #	DATE	TIME	ANALYST	RESULTS
TCLP Arsenic	EPA 206.2	1-15-90	5:37	C.W.	0.105 mg/l
TCLP Lead	EPA 239.2	1-15-90	5:37	C.W.	0.007 mg/l

REPORTED BY 

M.B.A. LABS

MICROBIOLOGICAL AND BIOCHEMICAL ASSAY LABORATORIES

P.O. BOX 9461 340 S. 66th STREET HOUSTON, TEXAS 77261

TELEPHONE NO. (713) 928-2701

SAMPLE SUBMITTED BY: Tricil Env.

DATE RECEIVED: 1-9-1990

DATE COMPLETED: 1-15-1990

LABORATORY REPORT NUMBER: J-24018-00

SAMPLE IDENTIFICATION: Pipe Sample-4A

RESULTS

PARAMETER	METHOD #	DATE	TIME	ANALYST	RESULTS
TCLP Arsenic	EPA 206.2	1-15-90	5:41	C.W.	0.097 mg/l
TCLP Lead	EPA 239.2	1-15-90	5:41	C.W.	0.009 mg/l

REPORTED BY _____

M.B.A. LABS

MICROBIOLOGICAL AND BIOCHEMICAL ASSAY LABORATORIES

P.O. BOX 9461 340 S. 66th STREET HOUSTON, TEXAS 77261

TELEPHONE NO. (713) 928-2701

SAMPLE SUBMITTED BY: Tricil Env.

DATE RECEIVED: 1-9-1990

DATE COMPLETED: 1-15-1990

LABORATORY REPORT NUMBER: J-24019-00

SAMPLE IDENTIFICATION: Pipe Sample-1A

RESULTS

PARAMETER	METHOD #	DATE	TIME	ANALYST	RESULTS
TCLP Arsenic	EPA 206.2	1-15-90	5:47	C.W.	0.148 mg/l
TCLP Lead	EPA 239.2	1-15-90	5:47	C.W.	0.67 mg/l

REPORTED BY _____

M.B.A LABS

MICROBIOLOGICAL AND BIOCHEMICAL ASSAY

LABORATORIES

P.O.BOX 9461
HOUSTON,TEXAS 77261

340 S.66 TH STREET
TEL (713) 928-2701

SAMPLE SUBMITTED BY:	TRICIL ENV.
DATE RECEIVED:	1-9-90
DATE COMPLETED:	1-15-90
LABORATORY REPORT NUMBER:	J-24016-19
SAMPLE IDENTIFICATION:	4 TCLP-EXTRACTS

THE SAMPLES WERE ANALYZED BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY USING HEWLETT-PACKARD MODEL # 5970 GC/MS SYSTEMS.

THE SAMPLES WERE PREPARED FOR ANALYSIS ACCORDING TO THE METHODS DESCRIBED IN:

40 CFR PART 136, FEDERAL REGISTER, FRIDAY, OCTOBER 26, 1984 ENVIRONMENTAL PROTECTION AGENCY, PART VIII.

1. BASE-NEUTRAL METHOD 625 (ON TCLP - EXTRACT)

THE SAMPLES WERE ANALYZED FOR THE FOLLOWING COMPOUNDS:

ANTHRACENE
BENZO(A)ANTHRACENE
DIOXIN

Ben Lasaman

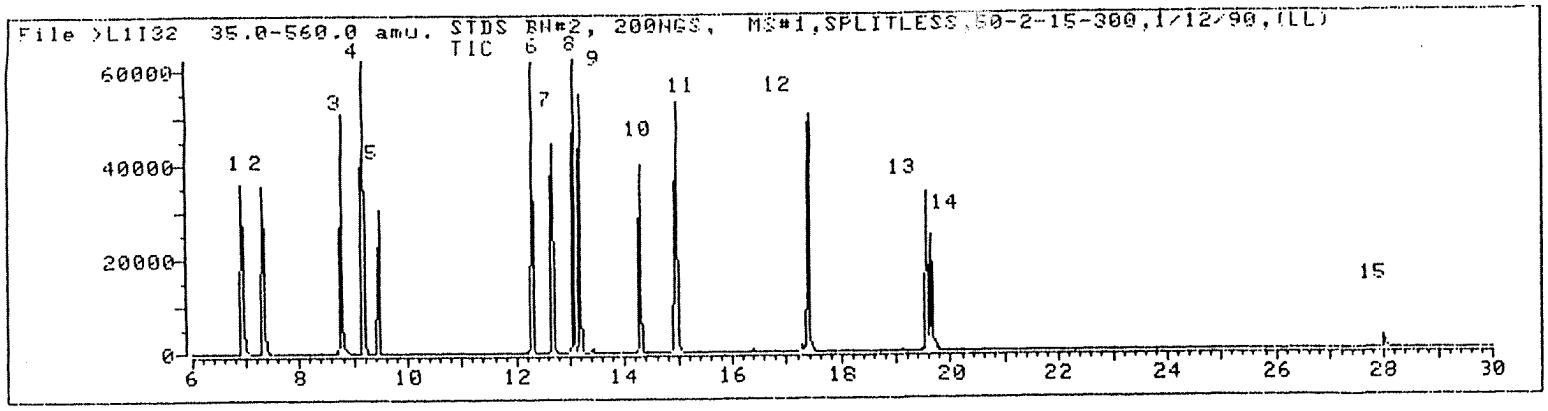
BASE NEUTRAL EXTRACTABLES

THE GC/MS PARAMETERS WERE AS FOLLOWS:

COLUMN	25 METER FUSED SILICA CAPILLARY COATED WITH SE-30
CARRIER GAS	HELIUM @ 30 CM/SEC(0.9 ML/MIN)
INJECTOR TEMP	270 DEGREES
COLUMN TEMP	5 MINUTES @ 35 DEGREES, THEN 8 DEGREES PER MINUTE TO 300 DEGREES, HOLD AT 300 DEGREES.
INJECTION MODE	SPLITLESS
SPLIT RATIO	----
GC/MS INTERFACE	DIRECT
IONIZATION MODE	ELECTRON IMPACT
ELECTRON ENERGY	70 V
MASS RANGE SCAN	35 TO 360 AMU
SCAN TIME	0.4 SEC

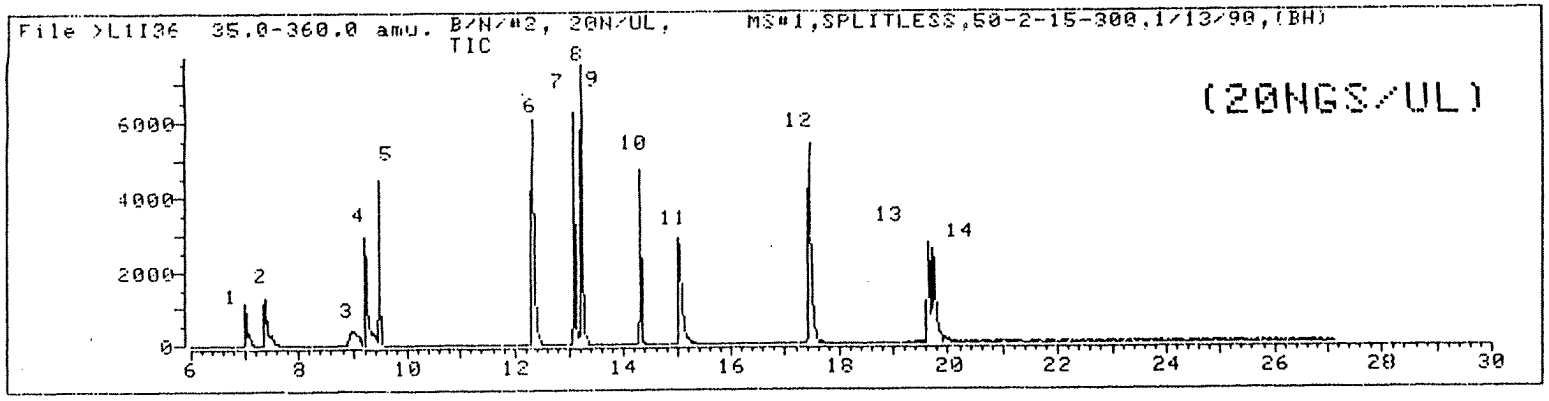
COPIES OF THE TOTAL ION CHROMATOGRAMS ARE INCLUDED WITH THIS REPORT. ALL GC/MS DATA IS PERMANENTLY STORED AT MBA LABORATORIES ON MAGNETIC MEDIA.

Ben Hasanca



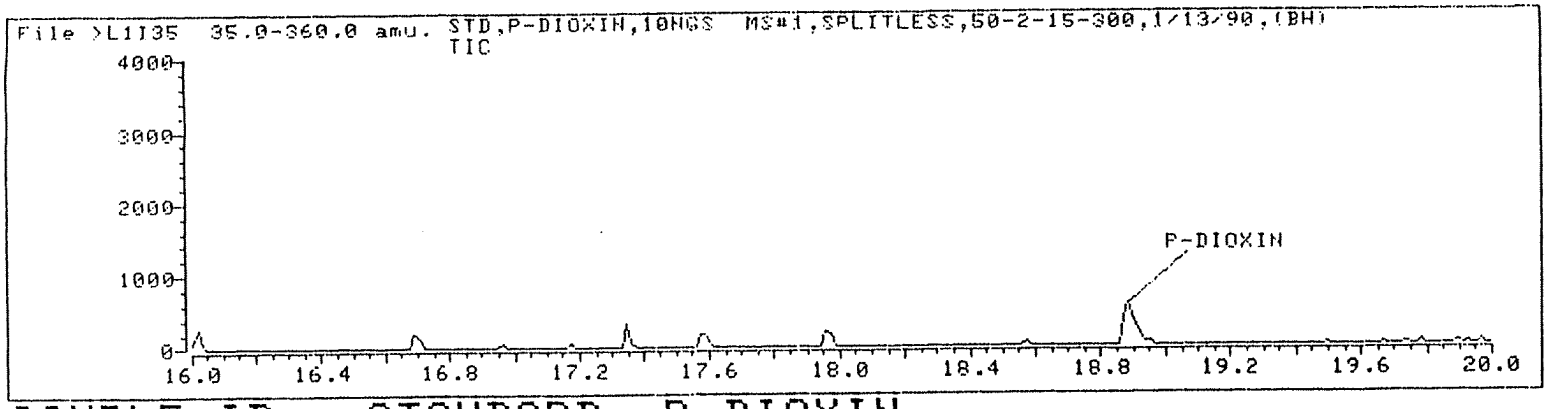
SAMPLE ID = BASE/NEUTRAL #2(0.4 %)

1- 1,3-DICHLOROBENZENE
2- 1,2-DICHLOROBENZENE
3- BIS(2-CHLOROETHOXY) METHANE
4- NAPHTHALENE
5- HEXACHLOROBUTADIENE
6- ACENAPHTHENE
7- 2,4-DINITROTOLUENE
8- DIETHYL PHTHALATE
9- FLUORENE
10- HEXACHLOROBENZENE
11- ANTHRACENE
12- FLUORANTHENE
13- CHRYSENE
14- BENZO(A)ANTHRACENE
15- DIBENZO(A,H)ANTHRACENE



SAMPLE ID = BASE/NEUTRAL #2

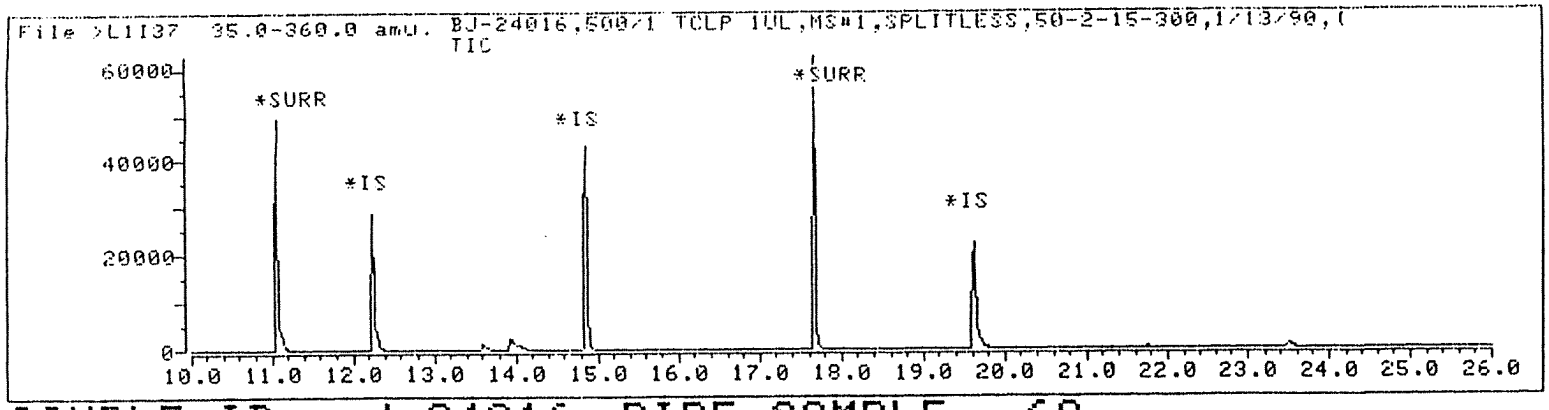
1- 1,3-DICHLOROBENZENE
2- 1,2-DICHLOROBENZENE
3- BIS(2-CHLOROETHOXY) METHANE
4- NAPHTHALENE
5- HEXACHLOROBUTADIENE
6- ACENAPHTHENE
7- 2,4-DINITROTOLUENE
8- DIETHYL PHTHALATE
9- FLUORENE
10- HEXACHLOROBENZENE
11- ANTHRACENE
12- FLUORANTHENE
13- CHRYSENE
14- BENZO(A)ANTHRACENE



SAMPLE ID = STANDARD. P-DIOXIN.

REUSULTS

1. 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	18.89	MINS	20	NG/UL

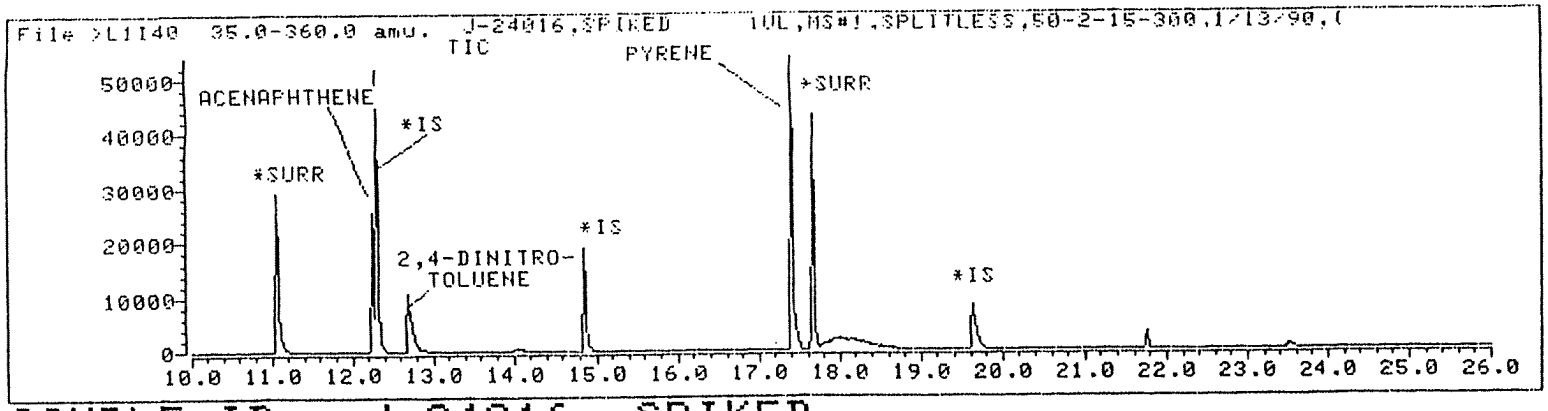


SAMPLE ID = J-24016 ,PIPE SAMPLE - 6A

RESULTS

1. ANTHRACENE	NOT	FOUND	<2	UG/L
2. BENZO(A)ANTHRACENE	NOT	FOUND	<4	UG/L
3. 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	NOT	FOUND	<10	UG/L

*THESE AR INTERNAL STANDARDS.



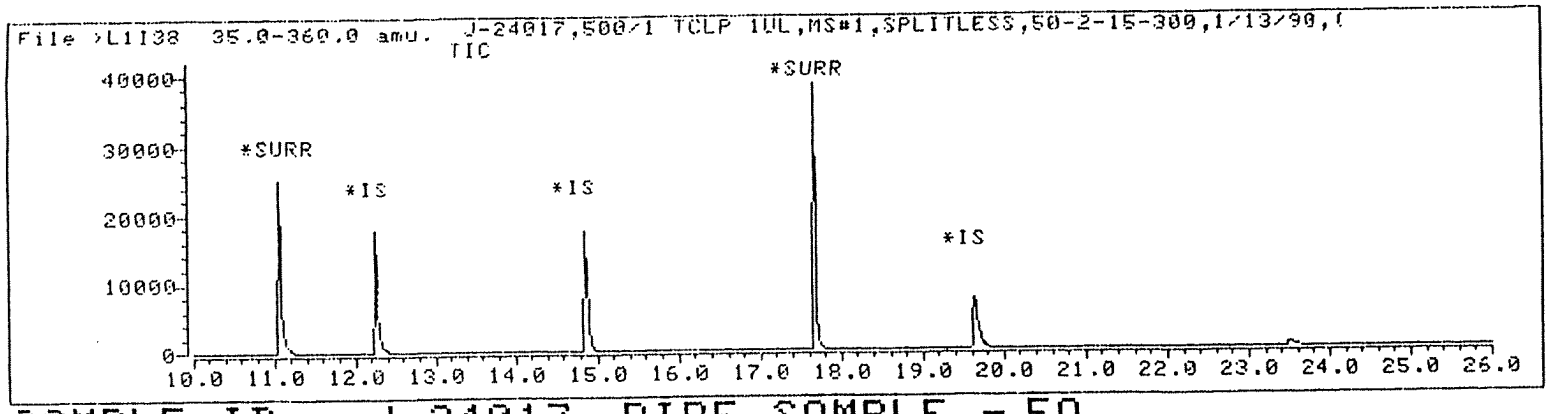
SAMPLE ID = J-24016, SPIKED.

RESULTS

1. ANTHRACENE	NOT FOUND	<2	UG/L
2. BENZO(A)ANTHRACENE	NOT FOUND	<4	UG/L
3. P-DIOXIN	NOT FOUND	<10	UG/L

COMPOUNDS NAME	RESULTS	SAMPLE +SPIKE	SPIKE	% RECOVERY
1. PYRENE	<2 UG/L	101.9 NG/UL	100 NG/UL	191.9 %
2. ACENAPHTHENE	<2 UG/L	101.6 NG/UL	100 NG/UL	101.6 %
3. 2,4-DINITROTOLUENE	<6 UG/L	77.4 NG/UL	74.4NG/UL	77.4 %

*THESE ARE INTERNAL STANDARDS.
*S(THESE ARE SURROGATE STANDARSD)

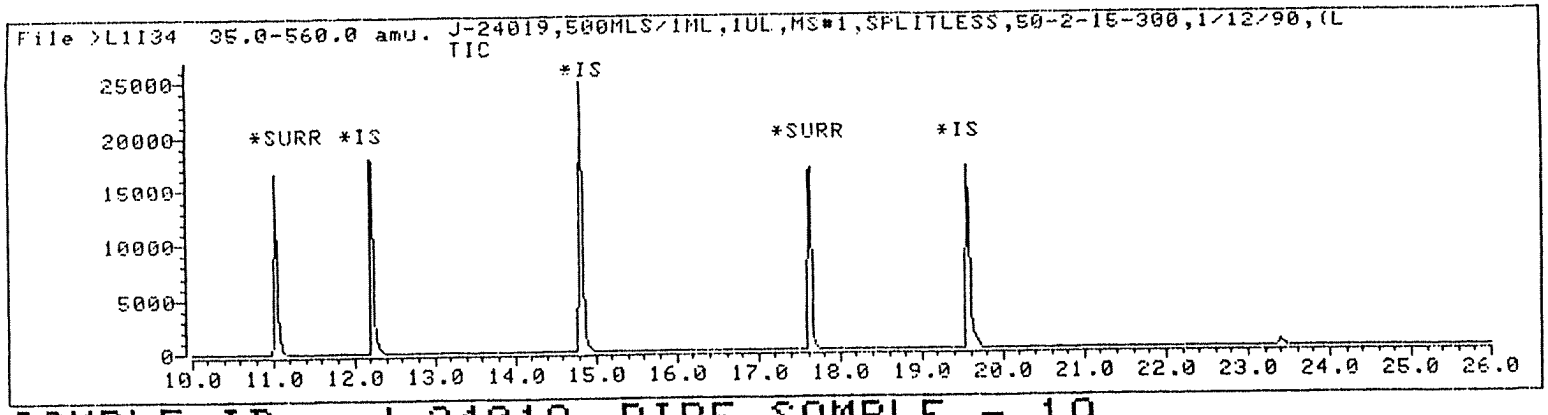


SAMPLE ID = J-24017 ,PIPE SAMPLE - 5A

RESULTS

1. ANTHRACENE	NOT	FOUND	<2	UG/L
2. BENZO(A)ANTHRACENE	NOT	FOUND	<4	UG/L
3. 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	NOT	FOUND	<10	UG/L

*THESE AR INTERNAL STANDARDS.

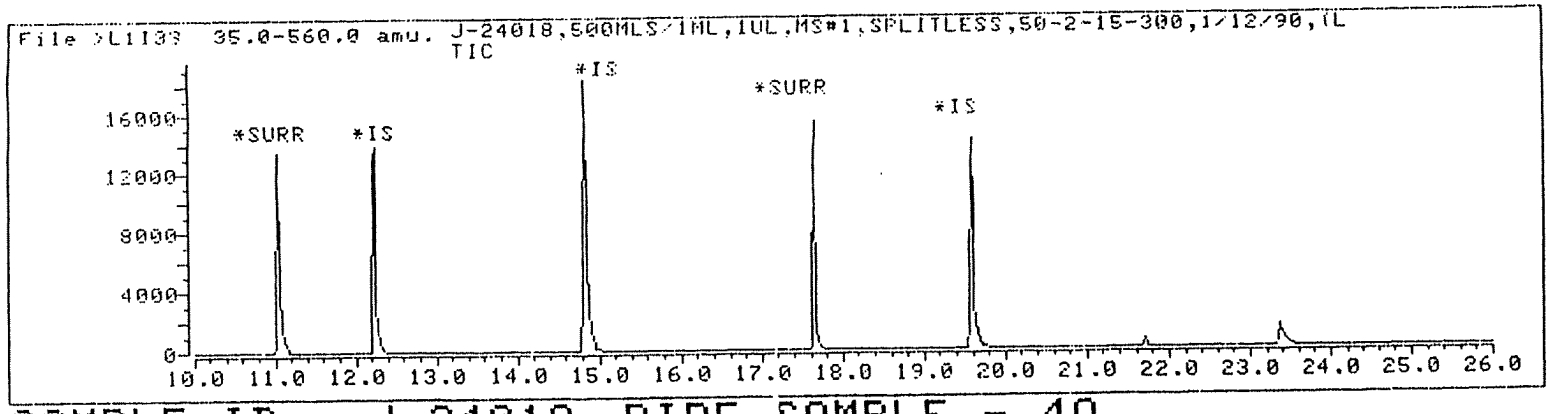


SAMPLE ID = J-24019 ,PIPE SAMPLE - 1A

RESULTS

1. ANTHRACENE	NOT	FOUND	<2	UG/L
2. BENZO(A)ANTHRACENE	NOT	FOUND	<4	UG/L
3. 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	NOT	FOUND	<10	UG/L

*THESE AR INTERNAL STANDARDS.

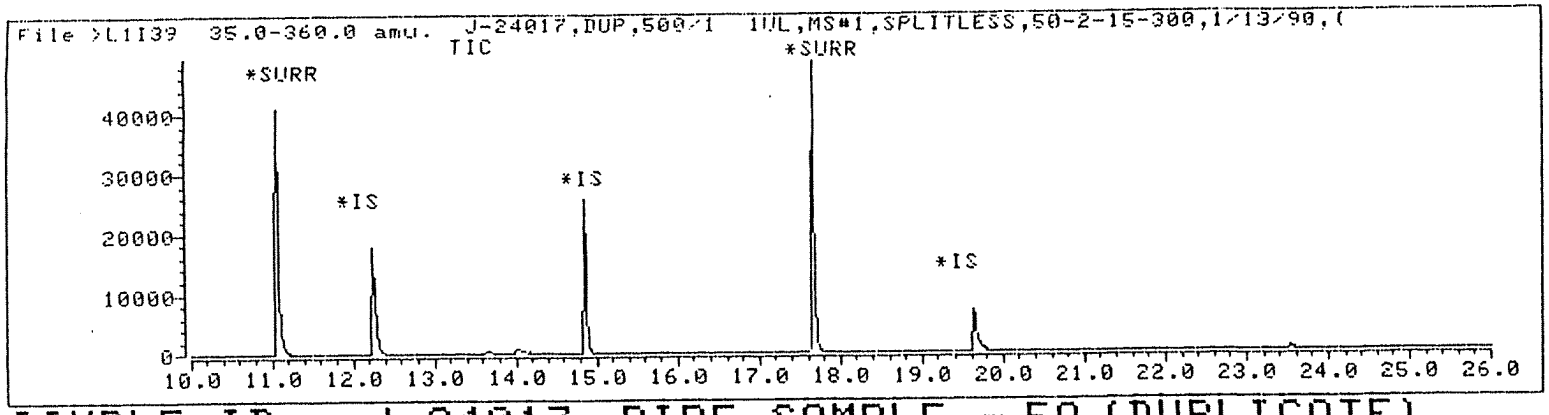


SAMPLE ID = J-24018 ,PIPE SAMPLE - 4A

RESULTS

1. ANTHRACENE	NOT	FOUND	<2	UG/L
2. BENZO(A)ANTHRACENE	NOT	FOUND	<4	UG/L
3. 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	NOT	FOUND	<10	UG/L

*THESE AR INTERNAL STANDARDS.



SAMPLE ID = J-24017 ,PIPE SAMPLE - 5A (DUPLICATE).

RESULTS

1. ANTHRACENE	NOT	FOUND	<2	UG/L
2. BENZO(A)ANTHRACENE	NOT	FOUND	<4	UG/L
3. 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	NOT	FOUND	<10	UG/L

*THESE AR INTERNAL STANDARDS.

APPENDIX 2

McBride-Ratcliff and Associates, Inc.
Geosciences and Materials Engineering Services

February 12, 1990

Tricil Environmental Response, Inc.
1123 Lumpkin Road
Houston, Texas 77224-9529

Attention: Mr. Charles Orwig

Subject: Interim Report
93rd Street School Site
MRA No. 90-0025

Dear Mr. Orwig:

In accordance with your instructions, four (4) flexible-wall permeability tests, an unconfined compression test and four (4) freeze-thaw tests have been performed on the samples that you submitted. The samples that were submitted consisted of eight (8) molded, cylindrical samples in plastic tubes, two (2) bulk samples in metal cans and three (3) additives in plastic containers. The cylindrical samples were in sets of two (2) and were marked 1A, 4A, 5A and 6A. The bulk samples were marked "93rd Street School Site". One was raw material from the referenced site and the other was pre-mixed by you. The permeability tests and the unconfined compression test have been completed. The freeze-thaw tests are still in progress.

A flexible-wall permeability test was performed on one-half of each of one set of the cylindrical samples. The results of the permeability tests are shown below:

Sample Number	1A	4A	5A	6A
Moisture Content, %	26.0	28.0	23.1	28.7
Sample Diameter, inches	2.002	2.002	2.000	2.000
Sample Height, inches	1.780	1.885	1.960	2.020
Unit Wet Weight, pcf	115.0	114.6	111.7	111.6
Unit Dry Weight, pcf	91.2	89.5	90.7	86.8
Void Ratio	0.840	0.865	0.907	0.925
Saturation, %	92.9	95.6	88.9	92.1
Cell Pressure, psi	58	58	58	58
Head Pressure, psi	54	54	54	54
Tail Pressure, psi	50	50	50	50
Gradient	62	59	56	55
Permeability, cm/sec	8.89×10^{-8}	1.42×10^{-7}	1.96×10^{-7}	1.54×10^{-7}

The unconfined compression test was performed on a cube sample prepared in general accordance with ASTM C109, as requested. The sample for the test was first prepared by mixing the prescribed percentages of additives, by total weight, with the raw bulk sample, as shown below. The cube shaped sample was then cured for 7 days in a 100% humidity room. After curing, the sample was removed from the humidity room and an unconfined compression test was performed. The results of the unconfined compression test are shown below:

Specimen Preparation
Additive A - 15%
Additive B - 5%
Additive C - 5%

Mr. Charles Orwig
February 12, 1990
MRA No. 90-0025

Unconfined Compression test	
Moisture Content -	28.2%
Unit Wet Weight -	116.5 pcf
Unit Dry Weight -	90.9 pcf
Compressive Strength -	129.6 psi

For the freeze-thaw test, each of the cylindrical specimens from one set (1A,2A,3A and 4A) was divided into two (2) pieces approximately the same length. The test is being performed in general accordance with ASTM D560, per your instructions. However, the samples being used do not conform to the size required by the standard. Also, as was discussed previously, the freezer being used is capable of -18 degrees Centigrade rather than the -23 degrees Centigrade, which is required. The duration of the freeze-thaw test is about 28 days. The test was started on January 26, 1990. Therefore, results should be available during the last week of February.

If you have any questions or need further information, please call.

Yours truly,

Floyd L. Fuqua
Laboratory Manager

Charles E. Williams, P.E.
Executive Vice President

APPENDIX 3

TMS
TANDEM MASS SPECTROMETRY

TMS ANALYTICAL SERVICES, INC.

6376 Morenci Trail
Indianapolis, Indiana 46268
317-291-5697 FAX 317-299-7159

January 29, 1990

M.B.A Labs
340 S. 66th St.
Houston, TX 77261
Attn: Joseph Kresse

Dear Mr. Kreese:

Enclosed are the analytical results for the analysis of 1 water sample for 2,3,7,8 TCDD. This sample was analyzed according to the procedures outlined in the 'EPA Contract for Laboratory Program Statement of Work for Rapid Turnaround for Dioxin Analysis Multi-Media', November, 1988. This sample was received as shipment M.B.A for analysis on January 24, 1990 at 08:40. The analytical results of Filename MBA0124A were verbally communicated to you on January 25, 1990 at 10:00.

If you should have any questions regarding this data or this report, please feel free to contact me at (317)291-5697.

Sincerely,

Stephen A. Barnett

Stephen A. Barnett
Vice President of
Operations

ENCLOSURES:

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TMS
TANDEM MASS SPECTROMETRY

TMS ANALYTICAL SERVICES, INC.

6376 Morenci Trail
Indianapolis, Indiana 46268
317-291-5697 FAX 317-299-7159

GC/MS/MS ANALYSIS REPORT FORM
ANALYSIS FOR 2,3,7,8-TCDD

CLIENT: M.B.A Labs

SHIPMENT:MBA0124A

SAMPLE DESCRIPTION	2,3,7,8-TCDD CONCENTRATION	LOD (ng/l)
Blank	ND	1.000 U
J-24334	ND	1.000 U

ND=NONE DETECTED
ng/l= parts per trillion

TCDD FINAL DATA REPORT SHEET

FILE RECEIVED DATE:
FILE RECEIVED TIME:

SITE: MBA
CASE: 0124
TRCODE: A
DATE: 01/24/90

AREA #	CLIENT SAMPLE #	ANALYSIS DATE	ANALYSIS TIME	NATIVE RATIO	SURROGATE ACC	TCDD CONC.	RERUN CODE	VALID CODE	UNITS	COMMENTS
H2O BLANK	H2OBLANK	01/24/90	1611	0.03*	89.82	1.000 U			NG/L	
J-24334	J-24334	01/24/90	1631	1.17*	88.47	1.000 U			NG/L	

QUALIFICATION FLAGS:

* 257/259 RATIO OUTSIDE OF ACCEPTABLE RANGE
** SURROGATE OUTSIDE OF ACCEPTABLE RANGE
*** HIGH DETECTION LIMIT

RERUN CODES:
A AUTOMATIC RERUN
R REQUESTED RERUN

GC/MS/MS WORKSHEET REPORT FORM

SITE: M8A
CASE: 0124
TRCODE: A
DATE: 01/24/90

SURROGATE CONC 0.06 RF NATIVE 2.296 ION RATIO: 0.952 TO 1.163
INTERNAL STD CONC 1.05 RF SURROGATE 3.407 CORRECTION FACTOR: 0.013

LAB SAMPLE #	AREA #	CLIENT SAMPLE #	ANALYSIS DATE	TIME	SAMPLE AMOUNT	ION 257	ION 259	ION 263	ION 268	RATIO 257/259	SURR ACC	RAW VALUE	UNITS
JAN2403	H2O BLANK	H2OBLANK	01/24/90	1611	1.00	47	1502	305645	609220	0.03	89.82	-0.134	NG/L
JAN2405	J-24334	J-24334	01/24/90	1631	1.00	957	819	421120	852161	1.17	88.47	-0.140	NG/L

TABLE 3 GC/MS/MS DAILY CALIBRATION CHECK

MEAN NATIVE RF 2.296
MEAN SURROGATE RF 3.407
ION RATIO RANGE 0.952 TO 1.163

NATIVE CONC. 0.20
SURROGATE CONC. 0.06
INTERNAL STD. CONC . 1.05

SITE: MBA
DATE: 01/24/90
CASE: 0124
TRCODE: A

ANALYSIS DATE	ANALYSIS TIME	ION 257	ION 259	ION 263	ION 268	RATIO 257/259	RF NATIVE	NATIVE RF %DIFF.	RF SURROGATE	SURROGATE RF % DIFFERENCE	COMMENTS
01/24/90	1546	185443	176524	136822	798586	1.051	2.380	3.66	2.954	13.30	

* ION RATIO MUST BE WITHIN ACCEPTABLE RANGE OF INITIAL CALIBRATION
** NATIVE % DIFFERENCE MUST BE LESS THAN 10% FROM INITIAL CALIBRATION

TABLE 2 BLANK SUMMARY FORM

SITE: MBA CASE : 0124 DATE: 11/14/88
TRCODE: A

SOLUTION ID	ION 257	ION 259	ION 268	BLANK RESPONSE	NATIVE CONC
1	1	2379	193164	0.012	0.027
2	893	2145	193867	0.016	0.034
3	635	2472	186905	0.017	0.036
4	1415	1705	163005	0.019	0.042
5	492	2002	168049	0.015	0.032
6	563	1169	111638	0.016	0.034
7	137	1122	105251	0.012	0.026
8	1	1369	100000	0.014	0.030
9	310	426	98150	0.007	0.016
10	930	1725	90338	0.029	0.064
11	94	1516	168523	0.010	0.021
12	47	890	153665	0.006	0.013
13	1	2137	160677	0.013	0.029
14	310	1149	140957	0.010	0.023
15	423	840	140320	0.009	0.020
16	1	882	136818	0.006	0.014
17	586	2387	144049	0.021	0.045
18	1	558	138546	0.004	0.009
19	470	1262	112220	0.015	0.034
20	1	254	122987	0.002	0.005

CORRECTION FACTOR = 0.013
LIMIT OF DETECTION = 0.047

* LIMIT OF DETECTION MUST BE LESS THAN 0.3

TABLE 1 GC/MS/MS INITIAL CALIBRATION

SITE CODE: MBA
CASE: 0124
TRCODE: A
DATE: 03/13/89

SOLUTION ID	ION 257	ION 259	ION 263	ION 268	NATIVE CONC	SURROGATE CONC	INT. STD CONC	RF NATIVE	RF SURROGATE	RATIO 257/259	COMMENTS
CC1-1	51236	46478	38671	220487	0.20	0.06	1.05	2.327	3.025	1.102	
CC1-2	50295	46310	37426	215443	0.20	0.06	1.05	2.354	2.996	1.086	
CC1-3	53421	50499	41520	237606	0.20	0.06	1.05	2.296	3.016	1.058	
							MEAN	2.326			
							STD DEV	0.029			
							% RSD	1.25			
CC2-1	289764	272960	91606	254845	1.00	0.11	1.05	2.319	3.314	1.062	
CC2-2	283330	268324	92894	250349	1.00	0.11	1.05	2.314	3.425	1.056	
CC2-3	201768	190243	64913	177745	1.00	0.11	1.05	2.316	3.369	1.061	
							MEAN	2.316			
							STD DEV	0.003			
							% RSD	0.13			
CC3-1	1387648	1310661	181296	255872	5.00	0.20	1.05	2.215	3.412	1.059	
CC3-2	1397455	1314463	178021	251613	5.00	0.20	1.05	2.263	3.400	1.063	
CC3-3	1184549	1128121	152461	215029	5.00	0.20	1.05	2.259	3.410	1.050	
							MEAN	2.246	3.407		
							STD DEV	0.027	0.006		
							% RSD	1.19	0.18		

RF NATIVE OVERALL MEAN 2.296
STD DEV 0.044
% RSD 1.905

RF SURROGATE OVERALL MEAN 3.407
STD DEV 0.006
% RSD 0.176

OVERALL RATIO 257/259 MEAN: 1.057
RANGE: 0.952 TO 1.163

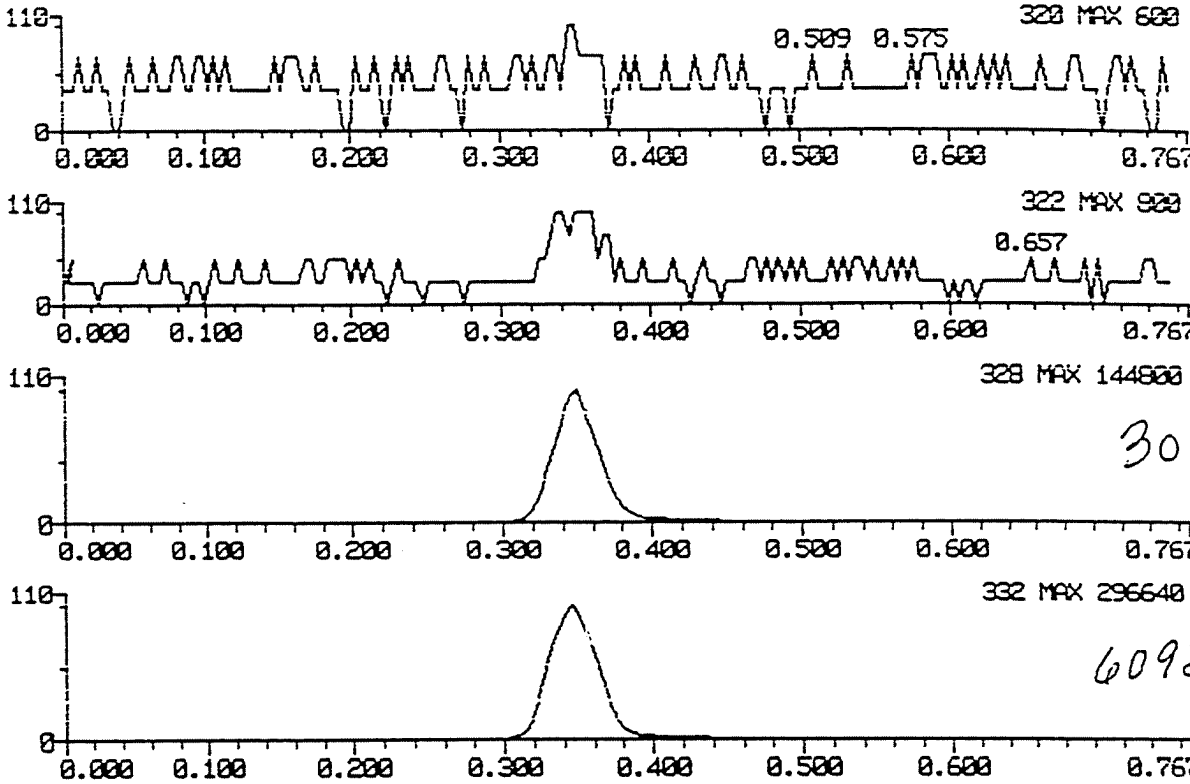
* RF NATIVE % RELATIVE STANDARD DEVIATION MUST BE LESS THAN 10%
** RATIO OF 257/259 OUTSIDE OF ACCEPTABLE RANGE

ATTACHMENT 1

SAMPLE MASS CHROMATOGRAMS

JAN2403 1 MIMI H2O BLANK IM

SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	96816

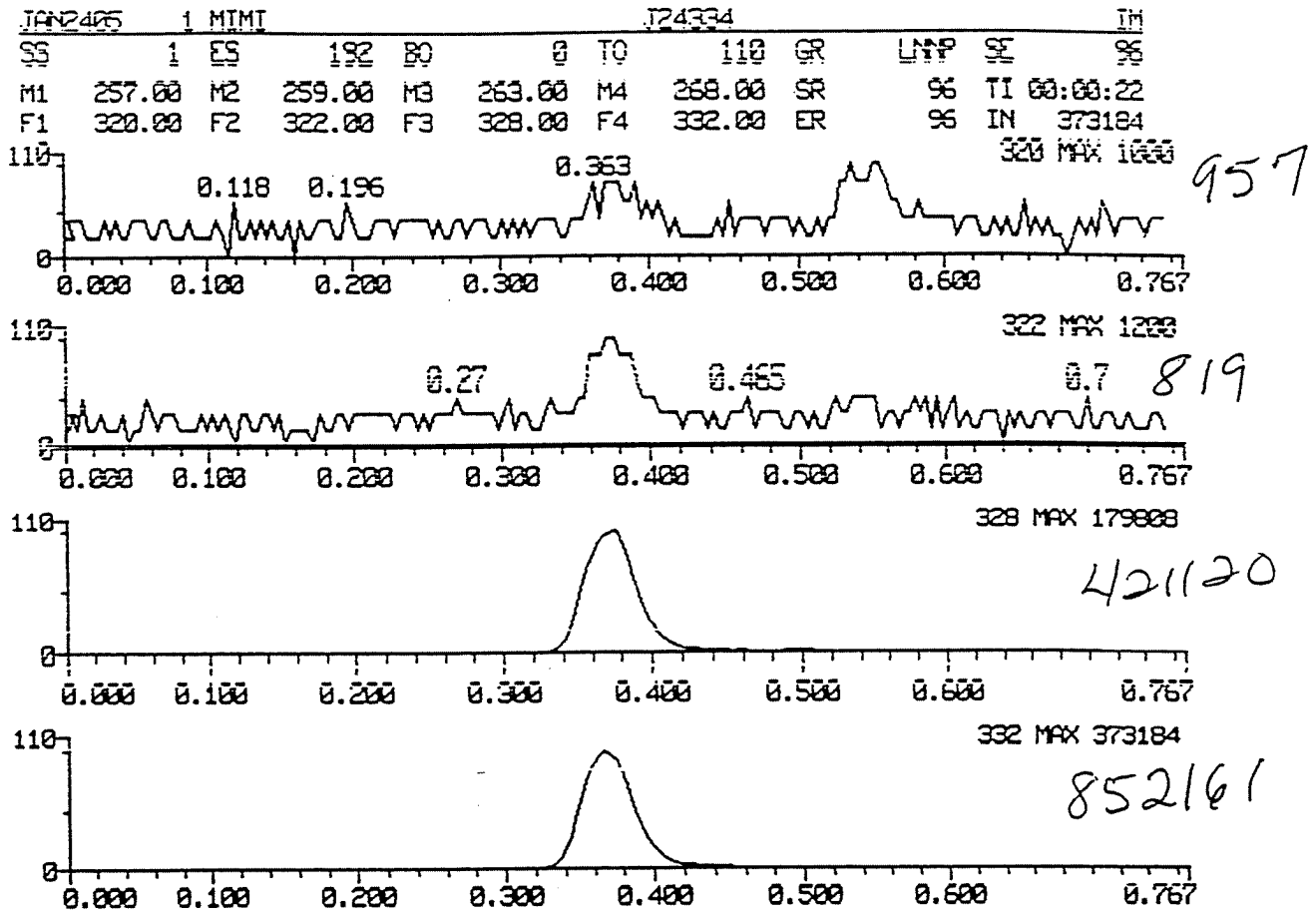


24-JAN-90		16:11:47		OP	MGD	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.200	FP	30.00
G2	31.000	LT	0.00	DIV	-0.030					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

16:11:47

DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268



24-JAN-90		16:31:42		OP		MGD	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.200	FP	30.00
G2	31.000	LT	0.00	DIV	-0.027					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

16:31:42

DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

ATTACHMENT 2

DAILY CALIBRATION MASS CHROMATOGRAMS

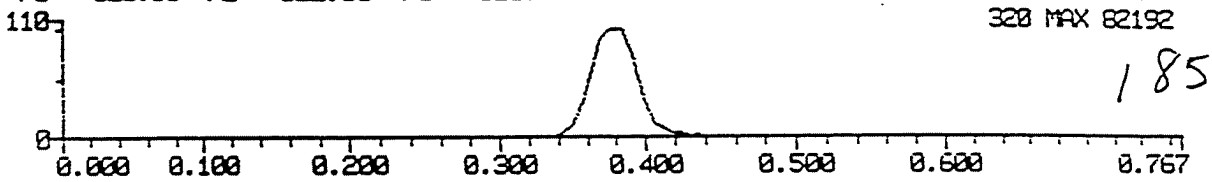
(1.05)
(98.5%)

JAN2401 1 MIMI CAL 1 IM

SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	361792

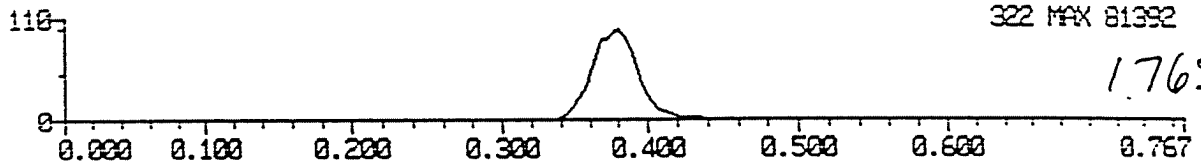
320 MAX 82192

185443



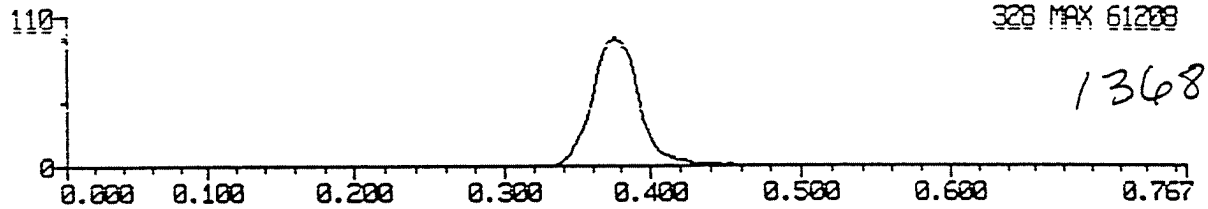
322 MAX 81392

176524



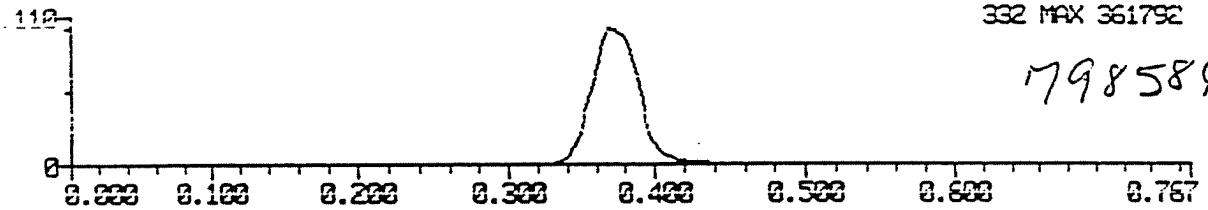
328 MAX 61208

136822



332 MAX 361792

798586



24-JAN-90 15:46:55

SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.200	FP	30.00
G2	31.000	LT	0.00	DIV	0.000					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

15:46:55

DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

$RRF_n = 2.379$

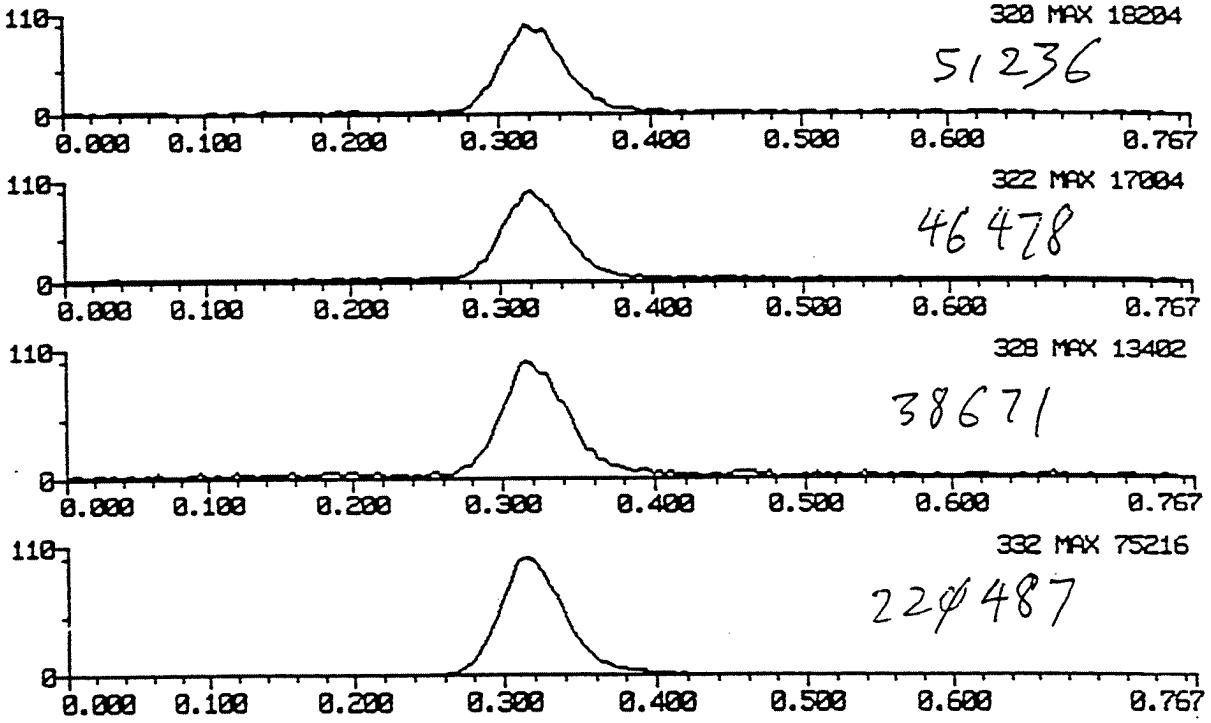
(103.6%)

ATTACHMENT 3

INITIAL CALIBRATION MASS CHROMATOGRAMS

MAR1308 1 MIMI CAL 1 TM

SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	8602



13-MAR-89		15:39:58		OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.300	FP	30.00
G2	29.000	LT	0.00	DIV	-0.274					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

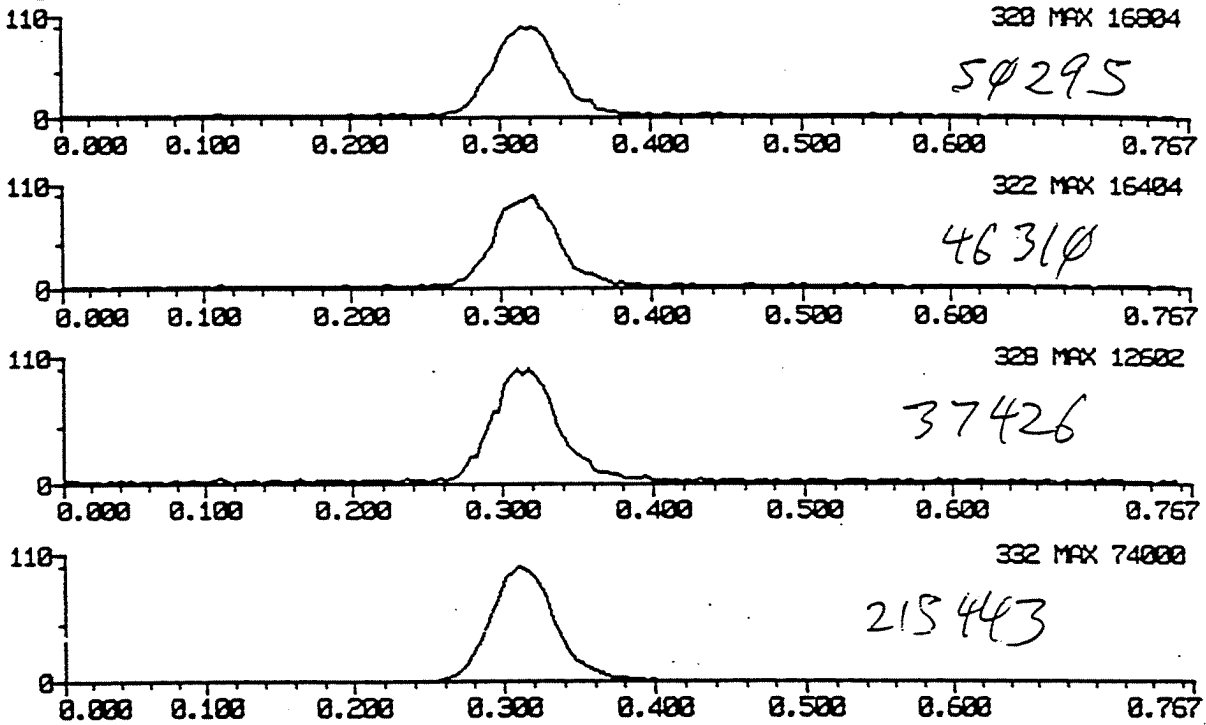
15:39:58

DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

MAR1309 1 MIMI CAL 1 IM

SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	4001



13-MAR-89		15:48:45		OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.300	FP	30.00
G2	29.000	LT	0.00	DIV	-0.002					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

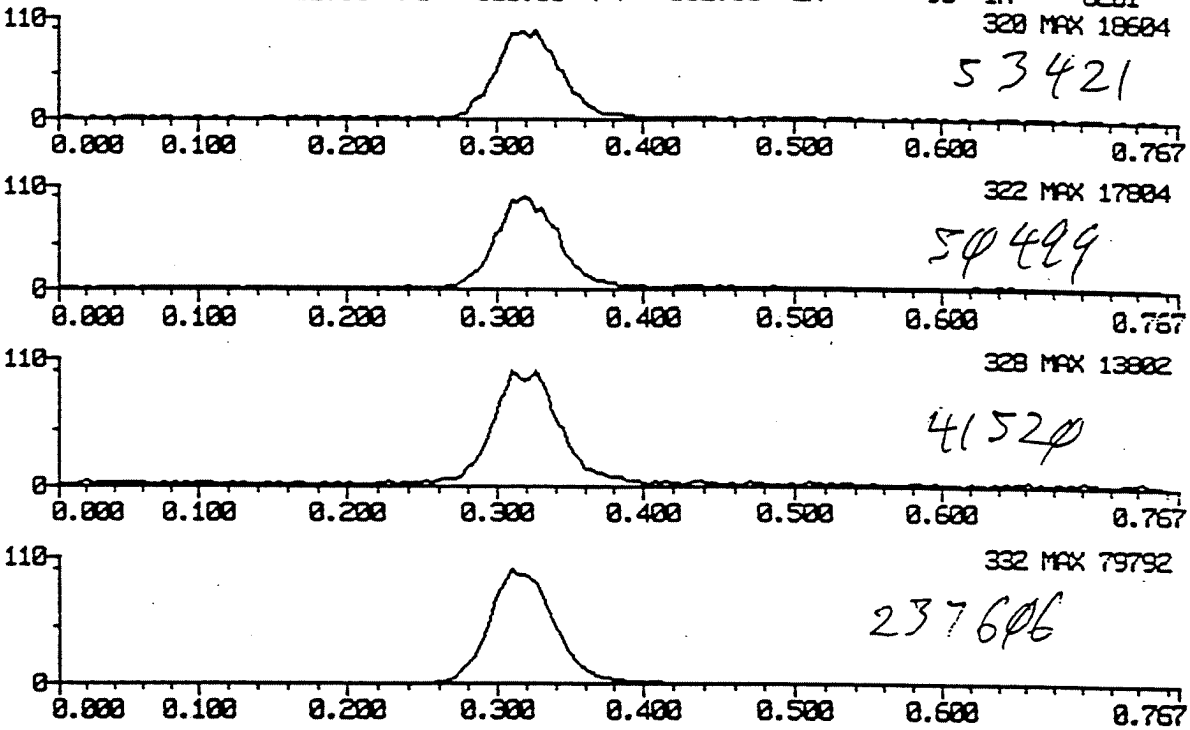
15:48:45

DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

MAR1310 1 MIMI CAL 1 IM

SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	6201



13-MAR-89 15:57:51

SY	200	SE	0	C	10	MTL	0.0500	STEP	0.1000	PE	0.00
G1	0.000	IT	0.00	DI	0.000	MCL	1250	TH	200	TT	0.75
G2	29.000	LT	0.00	DIV	-0.157			MO	-0.300	FP	30.00
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	MU	-4600.0
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	DM3	0.4000
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	RE3	100.00
										R3	-65.00

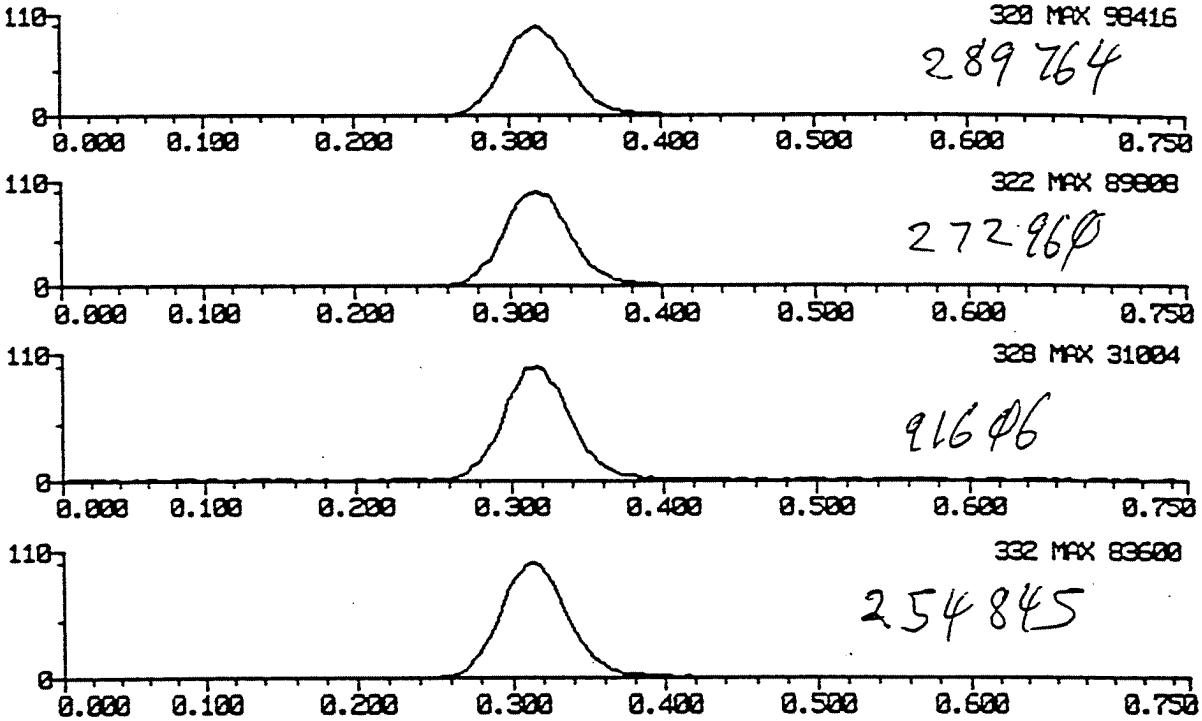
15:57:51

DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

MAR1311 1 MIMI CAL 2 IM

SS	1	ES	190	BO	0	TO	110	GR	LNNP	SE	95
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	95	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	95	IN	7001



13-MAR-89		16:07:02		OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.300	FP	30.00
G2	29.000	LT	0.00	DIV	-0.024					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

16:07:02

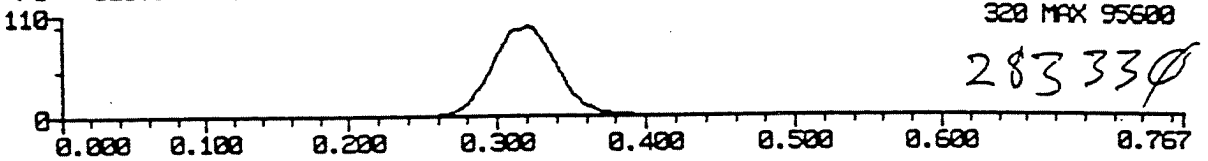
DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

MAR1312 1 MIMI CAL 2 IM

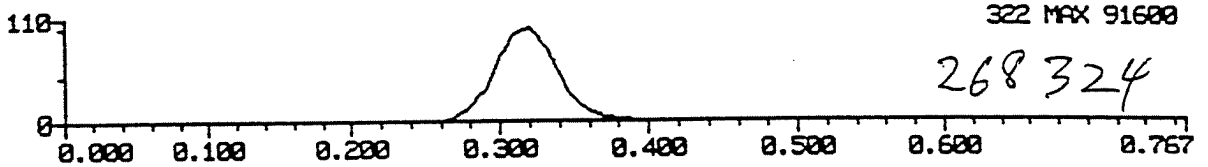
SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	65
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	65	TI	00:00:15
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	104	IN	1000

320 MAX 95600



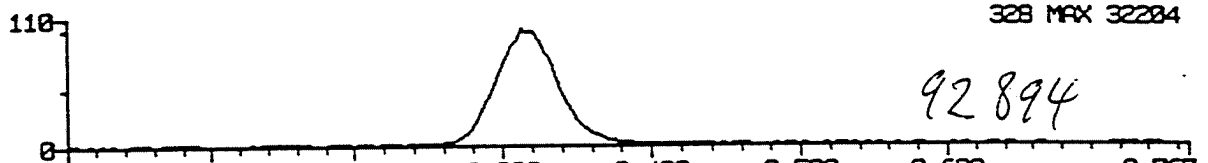
283340

322 MAX 91600



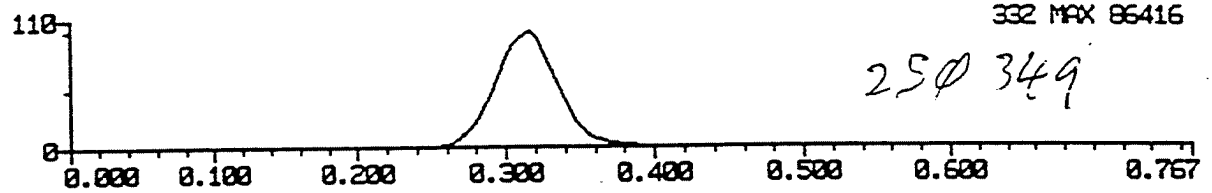
268324

328 MAX 32204



92894

332 MAX 86416



250349

13-MAR-89 16:15:59

SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.300	FP	30.00
G2	29.000	LT	0.00	DIV	0.000					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

16:15:59

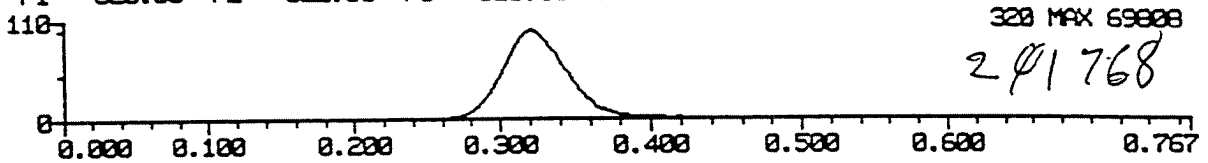
DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

MAR1313 1 MIMI CAL 2 IM

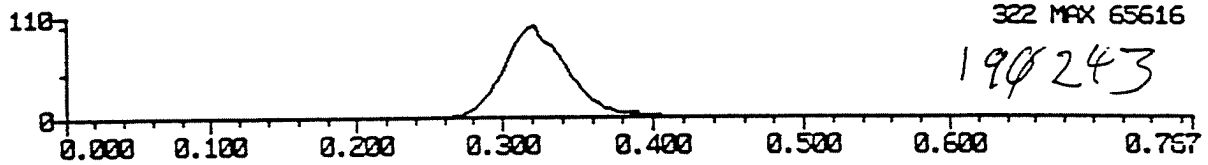
SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	269.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	5801

320 MAX 69808



201768

322 MAX 65616

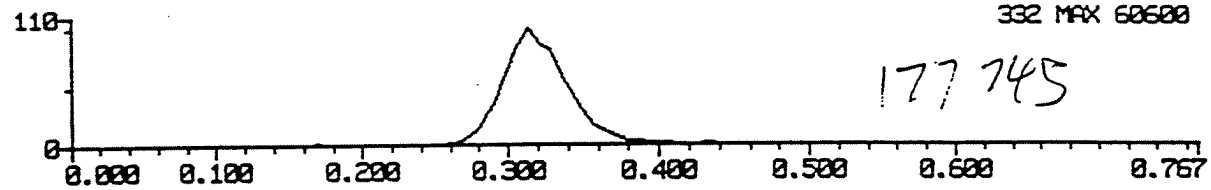


190243

328 MAX 22584

64963

332 MAX 60600



177745

13-MAR-89		16:27:20	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.300	FP	30.00
G2	29.000	LT	0.00	DIV	-0.106					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

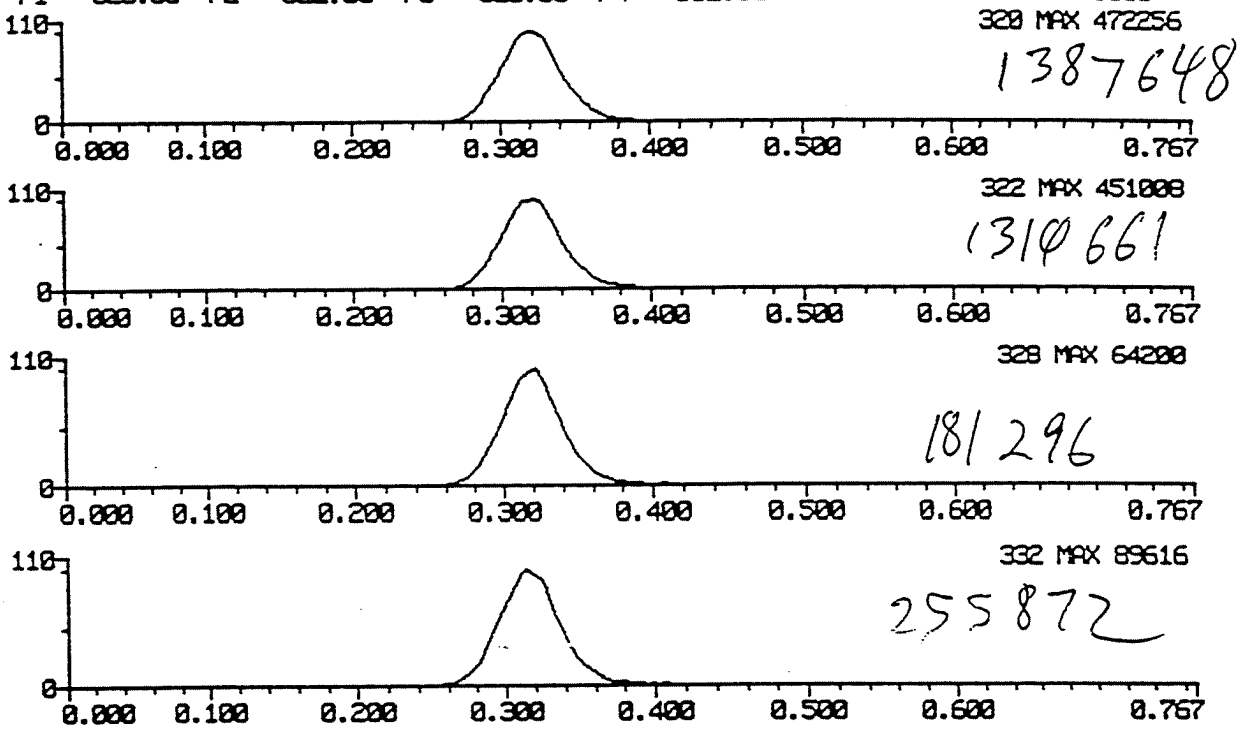
16:27:20

DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

MAR1314 1 MIMI CAL 3 TM

SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	5801



13-MAR-89		16:36:44	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.300	FP	30.00
G2	29.000	LT	0.00	DIV	-0.005					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

16:36:44

DI=-1;CG=SW

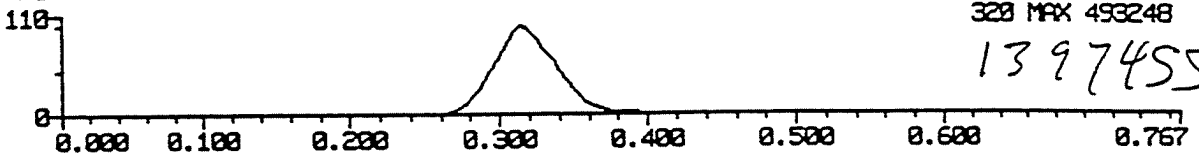
1	320	257
	322	259
	328	263
	332	268

MAR1315 1 MIMI CAL 3 IM

SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	5201

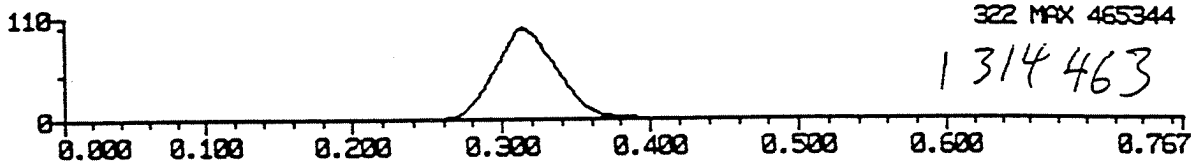
320 MAX 493248

1397455



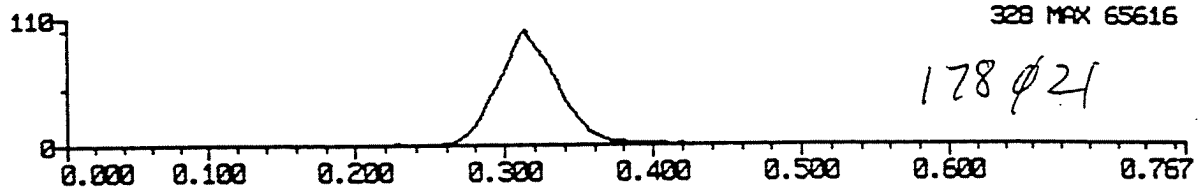
322 MAX 465344

1314463



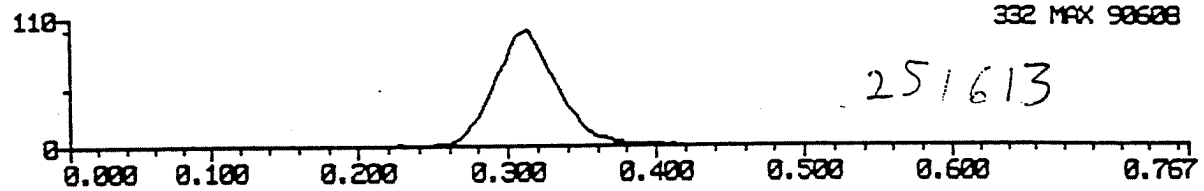
328 MAX 65616

178024



332 MAX 90608

251613



13-MAR-09 16:46:25 OP KEM MTL 0.0500 STEP 0.1000 PE 0.00

SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.300	FP	30.00
G2	29.000	LT	0.00	DIV	0.000					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

16:46:25

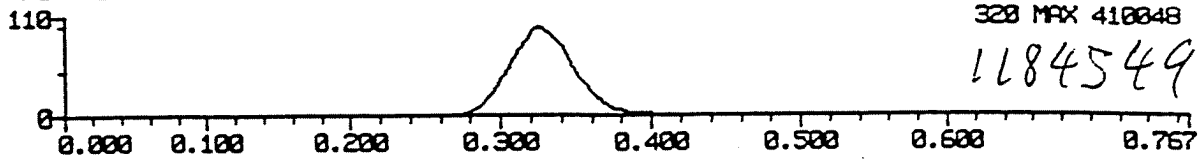
DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

MAR1316 1 MIMI CAL 3 IM

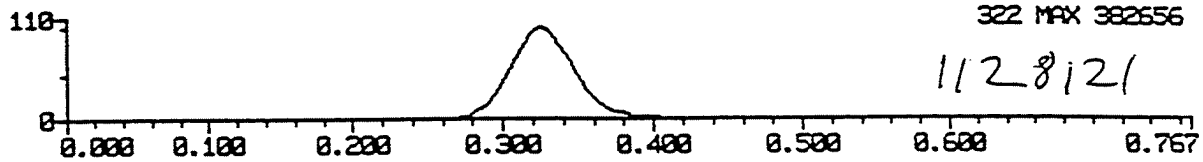
SS	1	ES	192	BO	0	TO	110	GR	LNNP	SE	96
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	96	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	96	IN	8402

320 MAX 410848



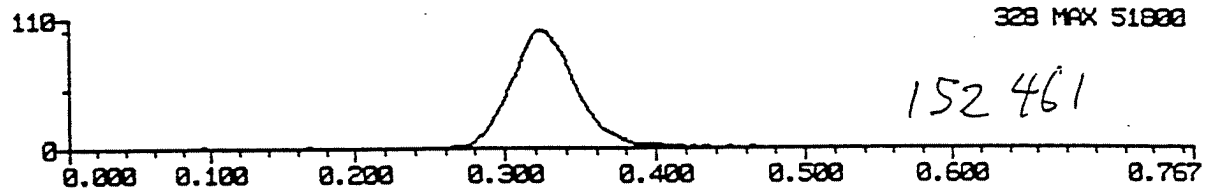
1184549

322 MAX 382656



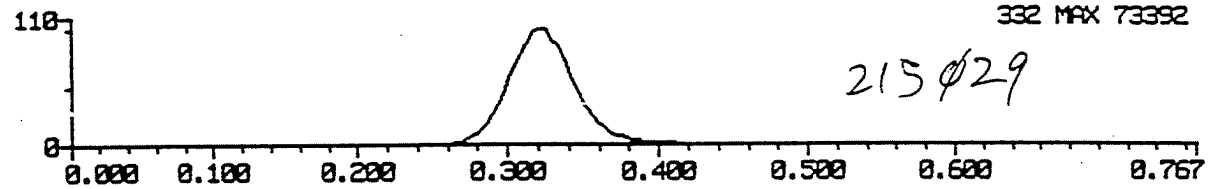
1128121

328 MAX 51800



152461

332 MAX 73392



215029

13-MAR-89		16:57:21	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.300	FP	30.00
G2	29.000	LT	0.00	DIV	0.000					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	0.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	100.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-20.00	R1	-20.00	R2	-55.00	R3	-65.00

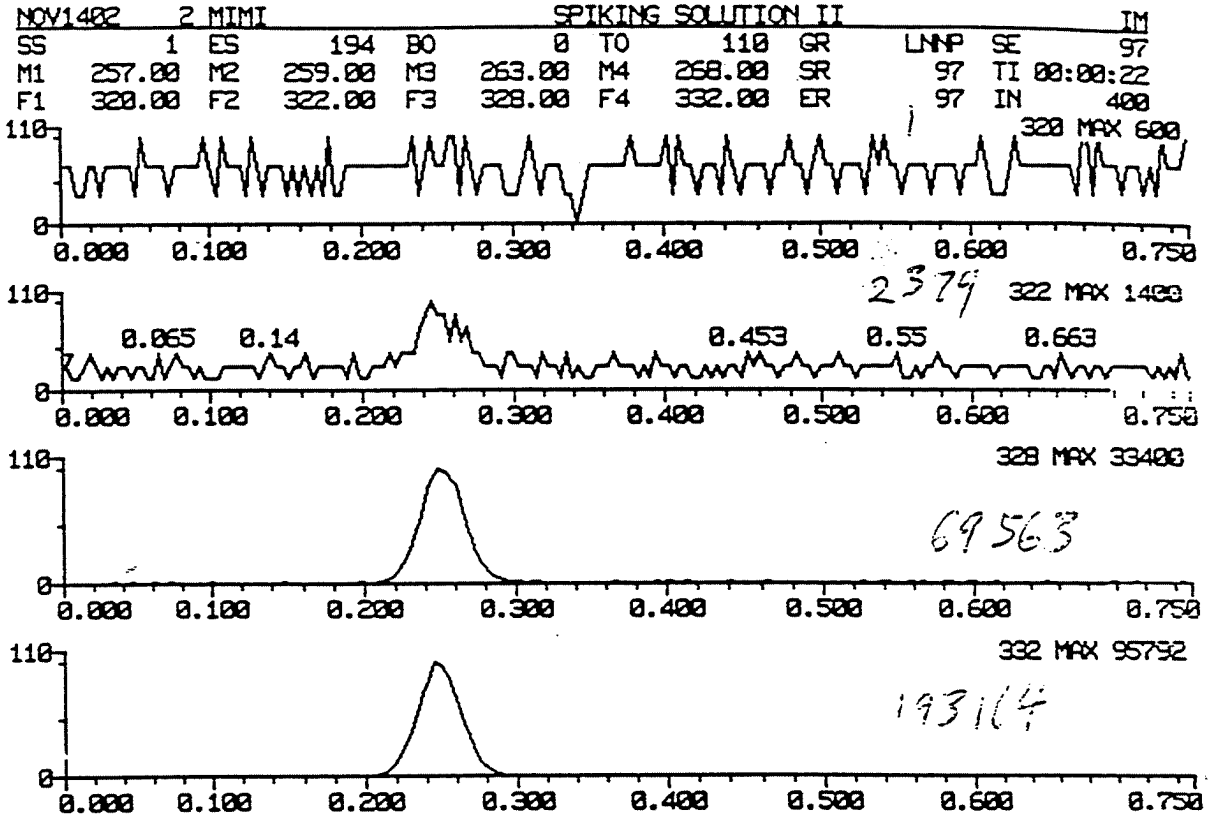
16:57:21

DI=-1;CG=SW

1	320	257
	322	259
	328	263
	332	268

ATTACHMENT 4

BLANK CALIBRATION MASS CHROMATOGRAMS



14-NOV-88		10:40:27	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.048					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	351.7	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

10:40:27

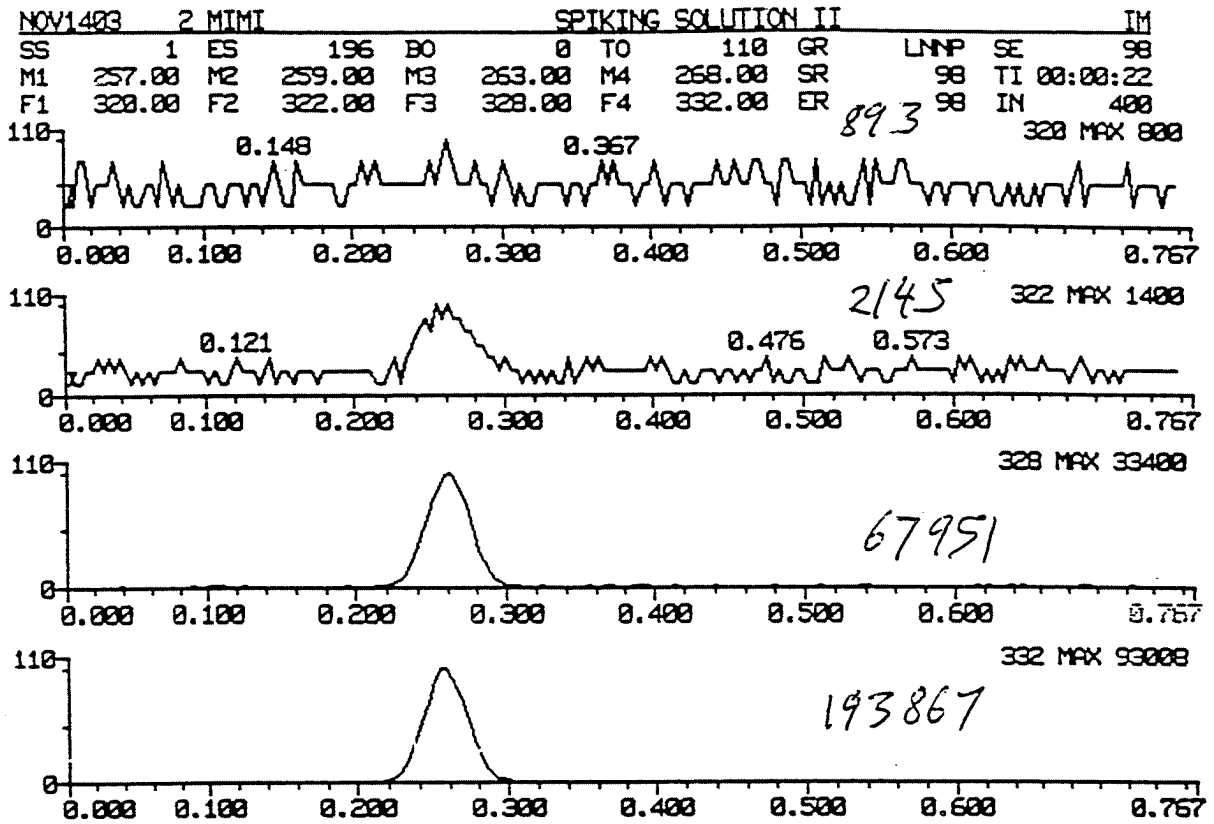
TT=.1

10:43:23

TT=.75;G2=30;DI=-1;CG=SW

2

320	257
322	259
328	263
332	268



14-NOV-88		10:48:52	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.064					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	366.6	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

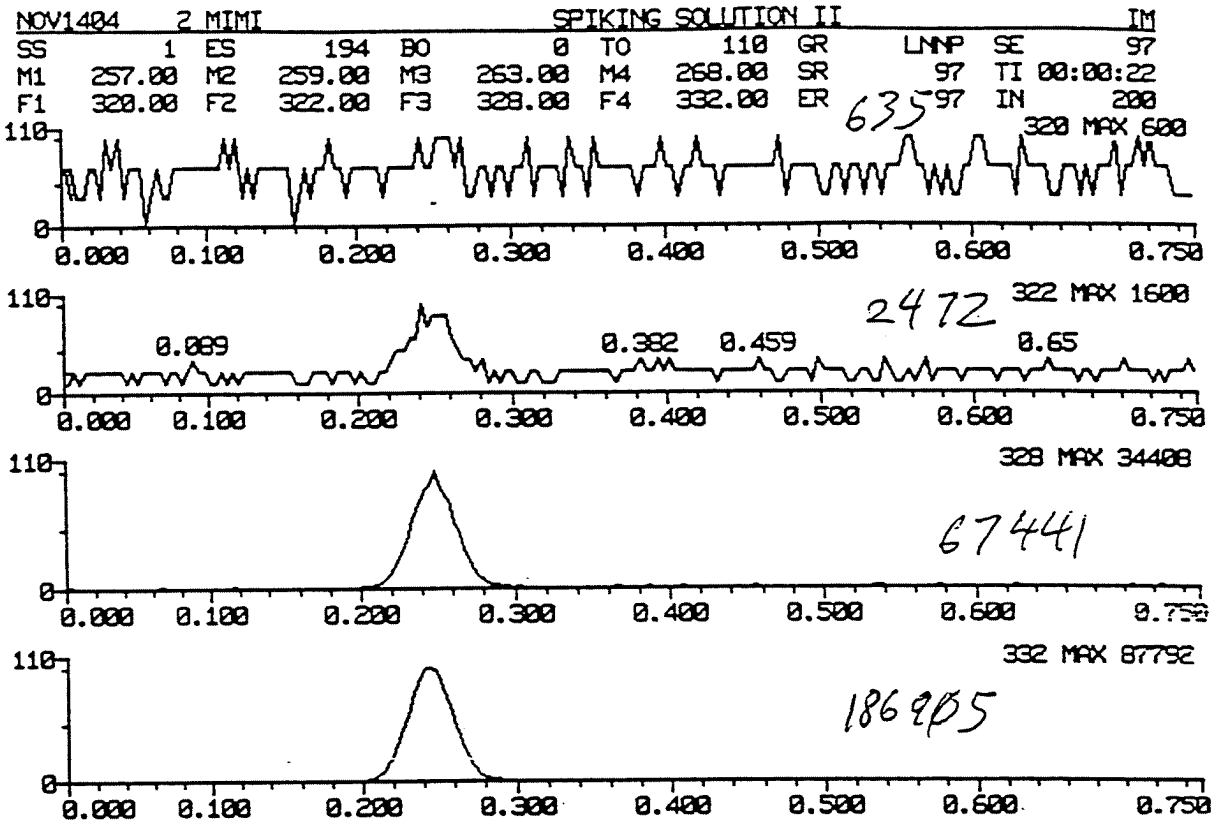
10:48:52

TT=.1

10:53:48

TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268



14-NOV-88		10:59:17	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.052					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	352.3	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

10:59:17

TT=.1

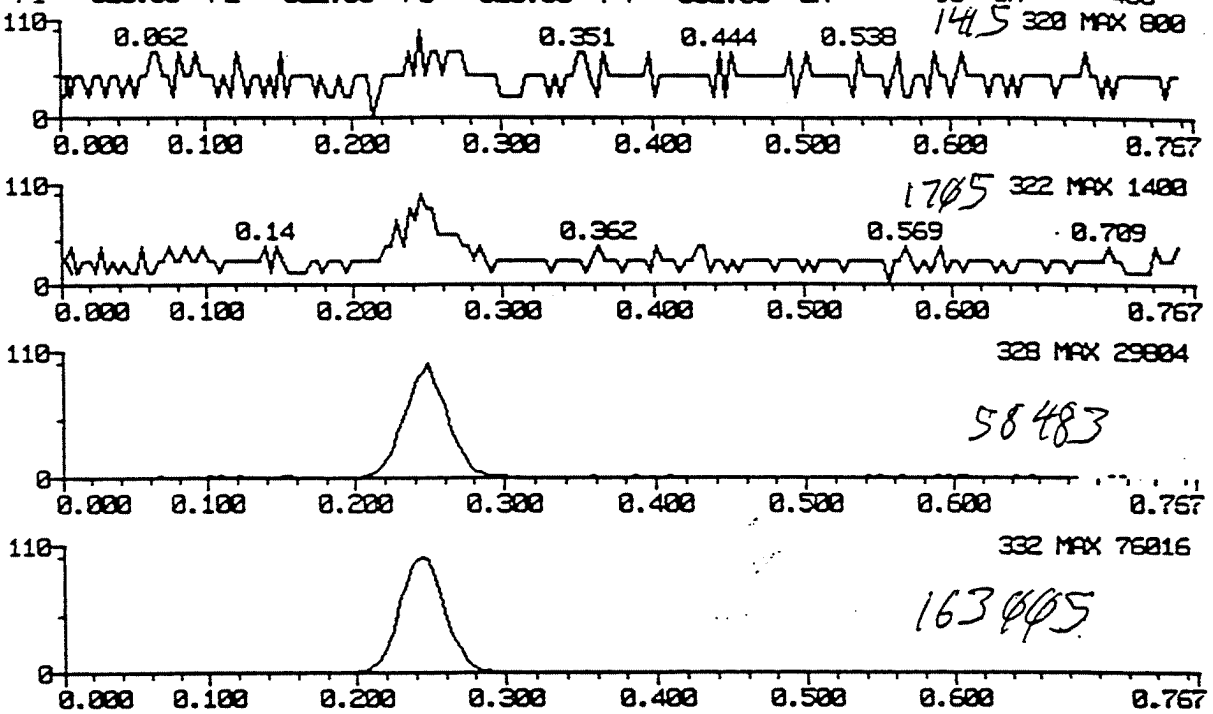
11:03:59

TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268

NOV1405 2 MIMI SPIKING SOLUTION II IM

SS	1	ES	196	BO	0	TO	110	GR	LNNP	SE	98
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	98	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	98	IN	400



14-NOV-88		11:09:28		OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.064					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	365.4	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

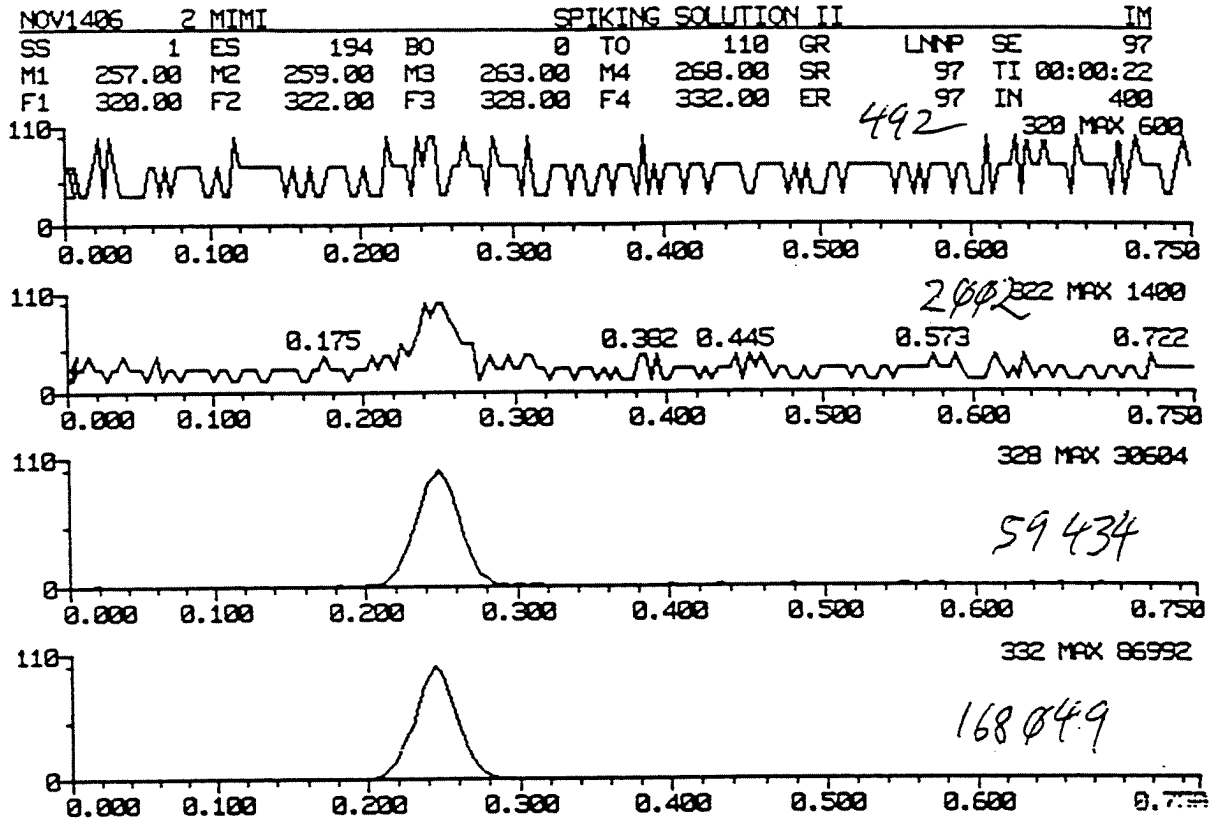
11:09:28

TT=.1

11:14:08

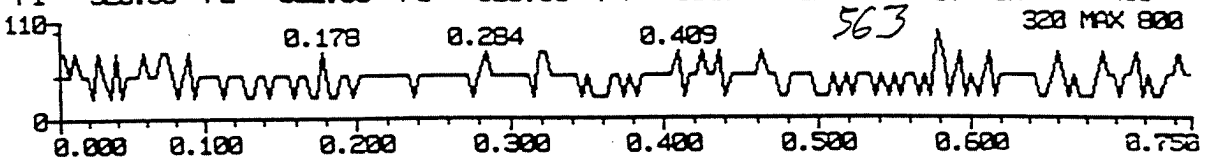
TT=.75;G2=30;DI=-1;CG=SW

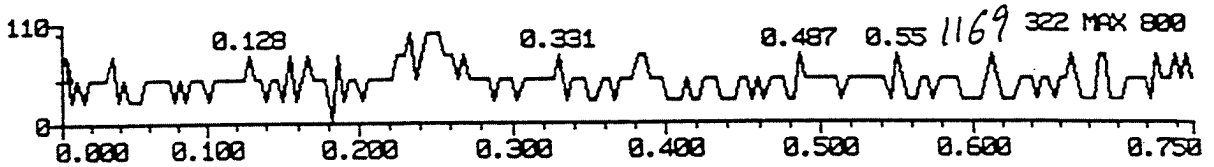
2	320	257
	322	259
	328	263
	332	268

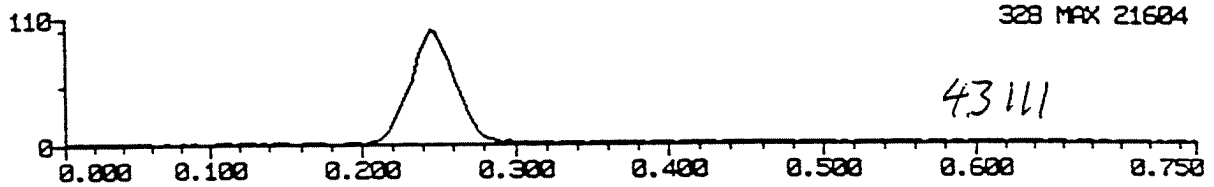

NOV1406 2 MIMI SPIKING SOLUTION II IM
SS 1 ES 194 BO 0 TO 110 GR LNNP SE 97
M1 257.00 M2 259.00 M3 263.00 M4 268.00 SR 97 TI 00:00:22
F1 320.00 F2 322.00 F3 328.00 F4 332.00 ER 97 IN 400
492
320 MAX 600
110
0
0.000 0.100 0.200 0.300 0.400 0.500 0.600 0.750
2002
322 MAX 1400
0.175 0.382 0.445 0.573 0.722
328 MAX 30604
59434
332 MAX 86992
168049
14-NOV-88 11:19:36 OP KEM MTL 0.0500 STEP 0.1000 PE 0.00
SY 200 SE 0 C 10 MCL 1250 TH 200 TT 0.75
G1 0.000 IT 0.00 DI 0.000 MO -0.600 FP 60.00
G2 0.000 LT 0.00 DIV -1.073 MU -4600.0
G3 0.0000 DT 0.000 IN 0.00 DM1 0.3000 CGT 362.9 DM3 0.4000
SAF 0.0 GR 1.00 OR 0.00 RE1 90.00 CG OFF RE3 100.00
DTV 0.000 ST 0.00 R0 -25.00 R1 -20.00 R2 -55.00 R3 -65.00
11:19:36
TT=.1
11:24:17
TT=.75;G2=30;DI=-1;CG=SW
2 320 257
322 259
328 263
332 268

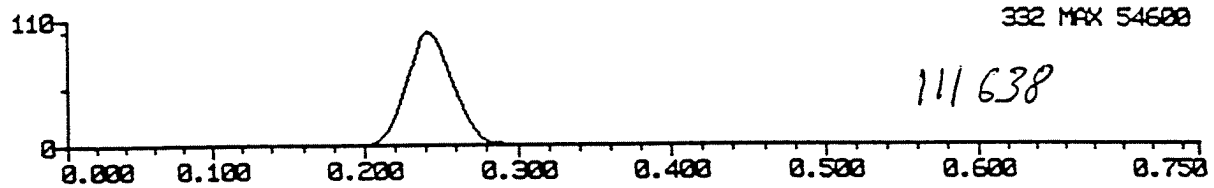
NOV1407 2 MIMI SPIKING SOLUTION II IM

SS	1	ES	194	BO	0	TO	110	GR	LNNP	SE	97
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	97	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	97	IN	400









14-NOV-88		11:29:54	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.055					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	366.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

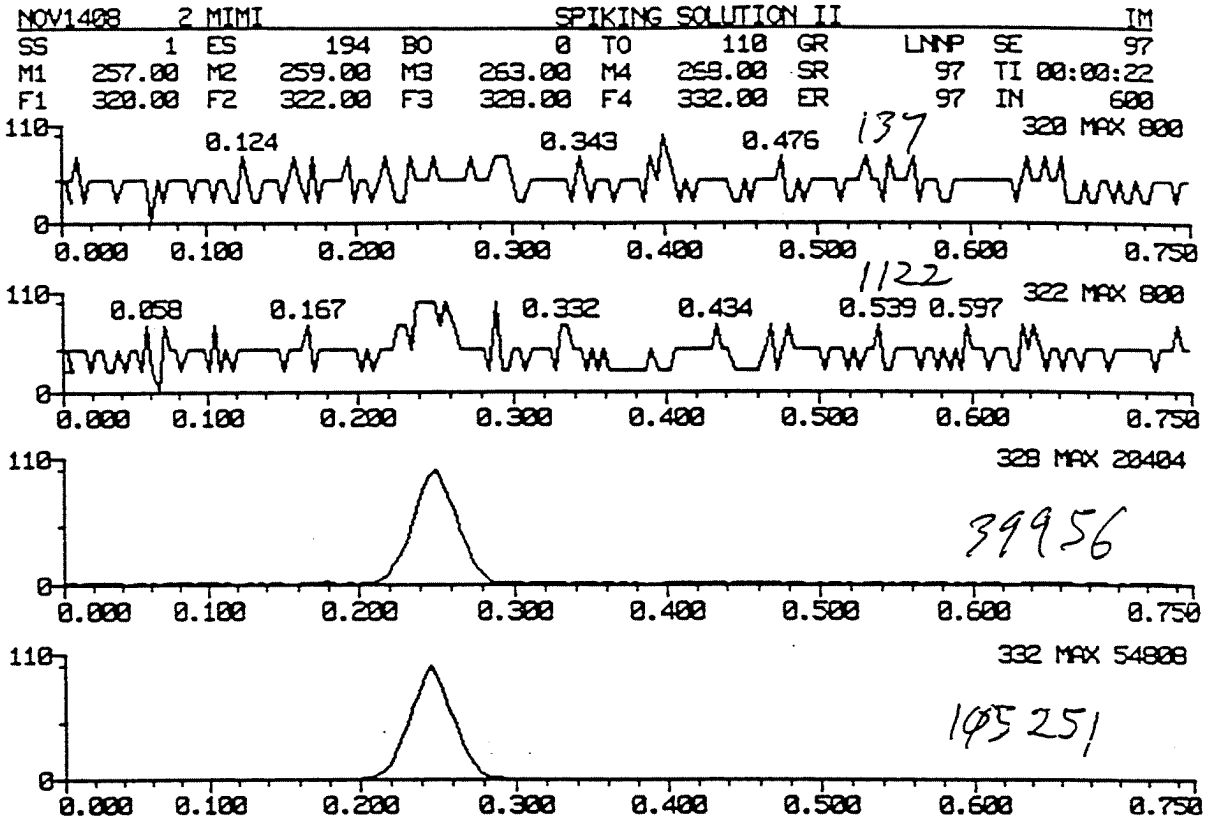
11:29:54

TT=.1

11:34:25

TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268



14-NOV-88		11:40:02		OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.061					MU	-4660.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	356.7	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

11:40:02

TT=.1

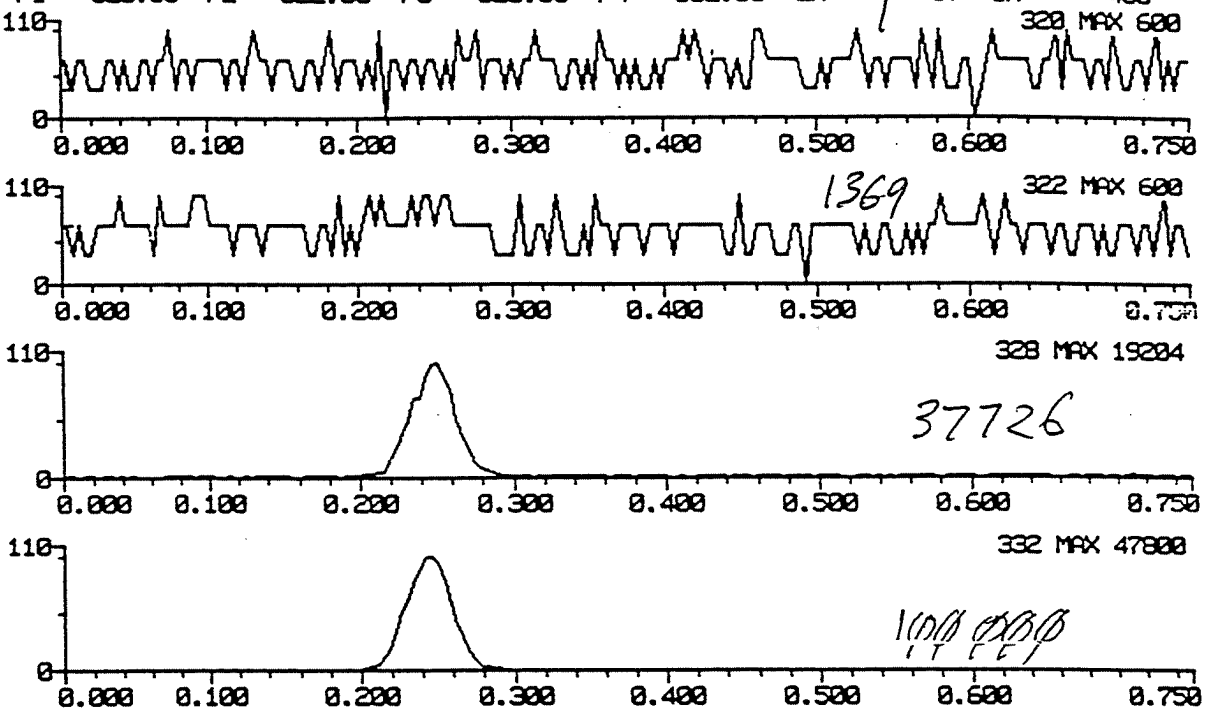
11:44:34

TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268

NOV1409 2 MIMI SPIKING SOLUTION II IM

SS	1	ES	194	BO	0	TO	110	GR	LNNP	SE	97
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	97	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	97	IN	400



14-NOV-88		11:50:11	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.045					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	349.8	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

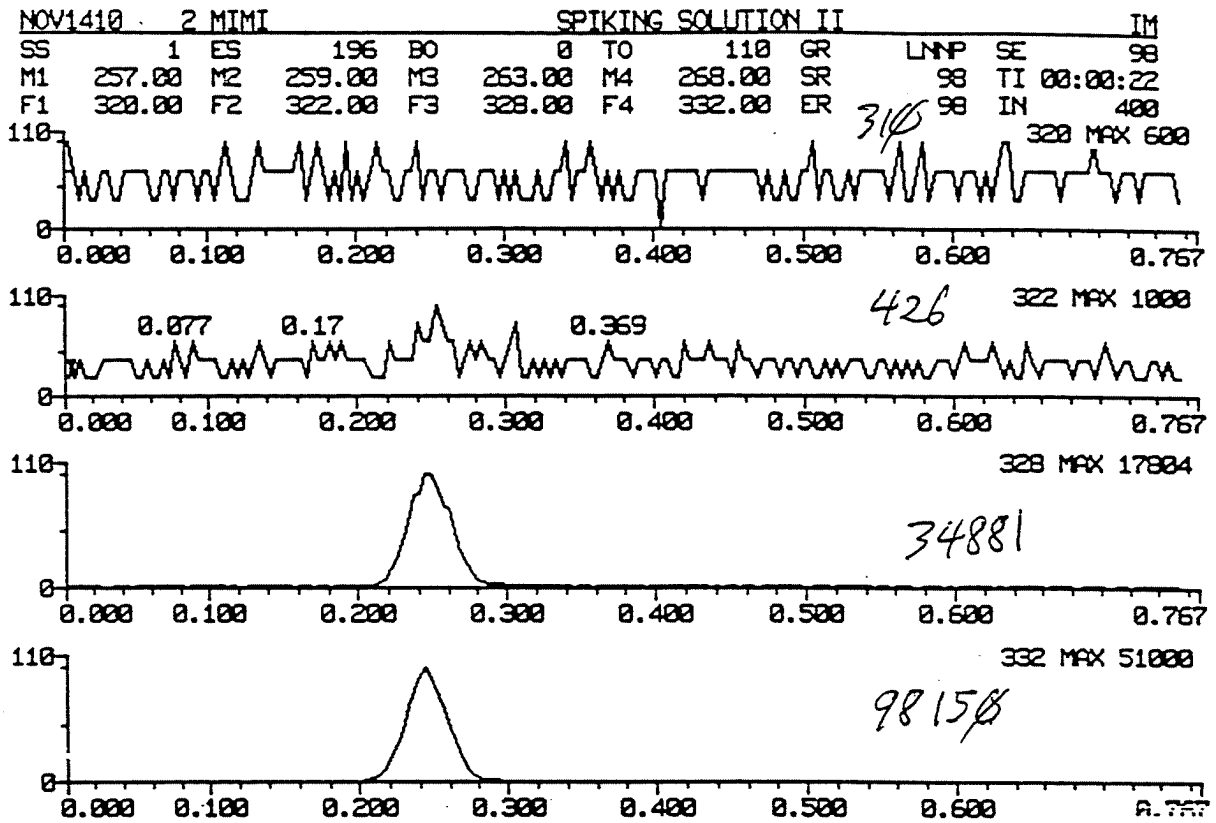
11:50:11

TT=.1

11:54:43

TT=.75;G2=30;DI=-1;CG=SW

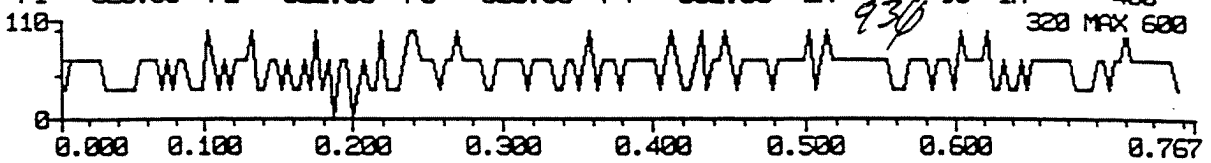
2	320	257
	322	259
	328	263
	332	268

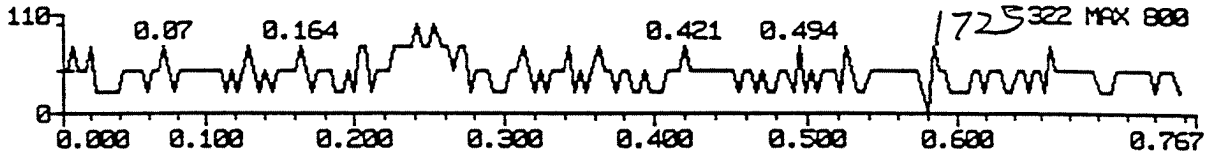

NOV1410 2 MIMI
SPIKING SOLUTION II
IM
SS 1 ES 196 BO 0 TO 110 GR LNNP SE 98
M1 257.00 M2 259.00 M3 263.00 M4 268.00 SR 98 TI 00:00:22
F1 320.00 F2 322.00 F3 328.00 F4 332.00 ER 98 IN 400
316
320 MAX 600
110
0
0.000 0.100 0.200 0.300 0.400 0.500 0.600 0.767
0.077 0.17 0.369
426
322 MAX 1000
328 MAX 17804
34881
332 MAX 51000
98158
14-NOV-88 12:00:20 OP KEM MTL 0.0500 STEP 0.1000 PE 0.00
SY 200 SE 0 C 10 MCL 1250 TH 200 TT 0.75
G1 0.000 IT 0.00 DI 0.000 MO -0.600 FP 60.00
G2 0.000 LT 0.00 DIV -1.051 MU
G3 0.0000 DT 0.000 IN 0.00 DM1 0.3000 CGT 364.8 DM3 0.4000
SAF 0.0 GR 1.00 OR 0.00 RE1 90.00 CG OFF RE3 100.00
DTV 0.000 ST 0.00 R0 -25.00 R1 -20.00 R2 -55.00 R3 -65.00
12:00:20
TT=.1
12:04:51
TT=.75;G2=30;DI=-1;CG=SW
2 320 257
322 259
328 263
332 268

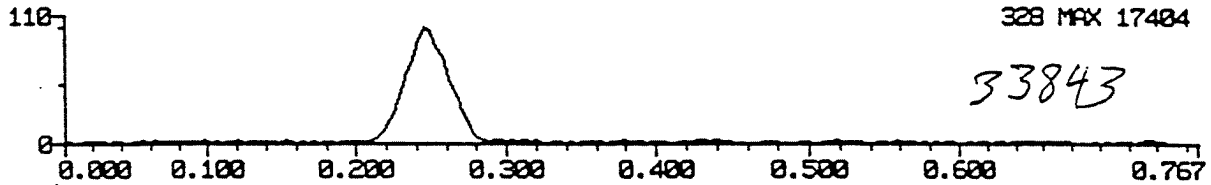
NOV1411 2 MIMI SPIKING SOLUTION II IM

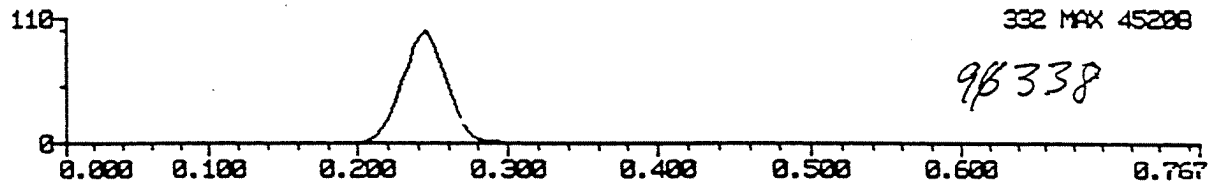
SS	1	ES	196	BO	0	TO	110	GR	LNNP	SE	98
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	98	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	98	IN	400

930









14-NOV-88		12:10:28	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.052					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	371.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

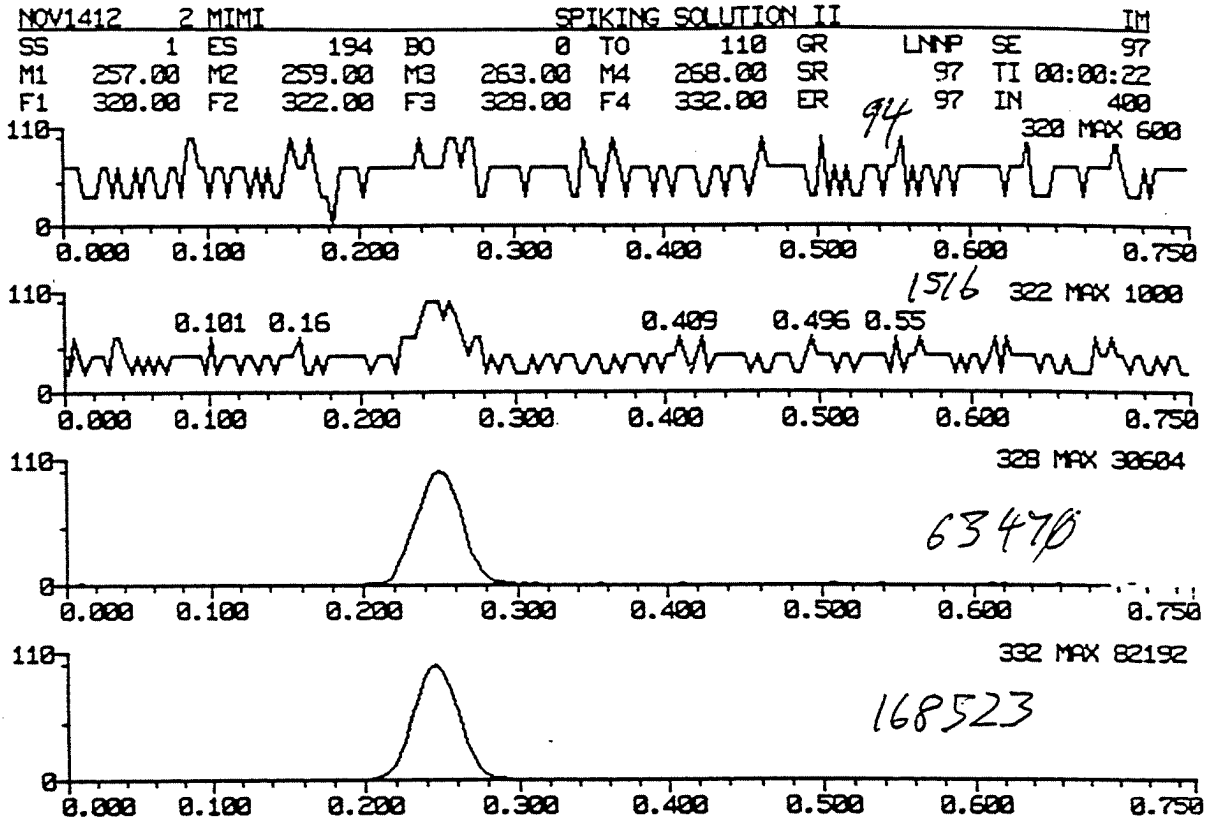
12:10:28

TT=.1

12:14:59

TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268



14-NOV-88		12:20:36	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.042					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	351.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

12:20:36

TT=.1

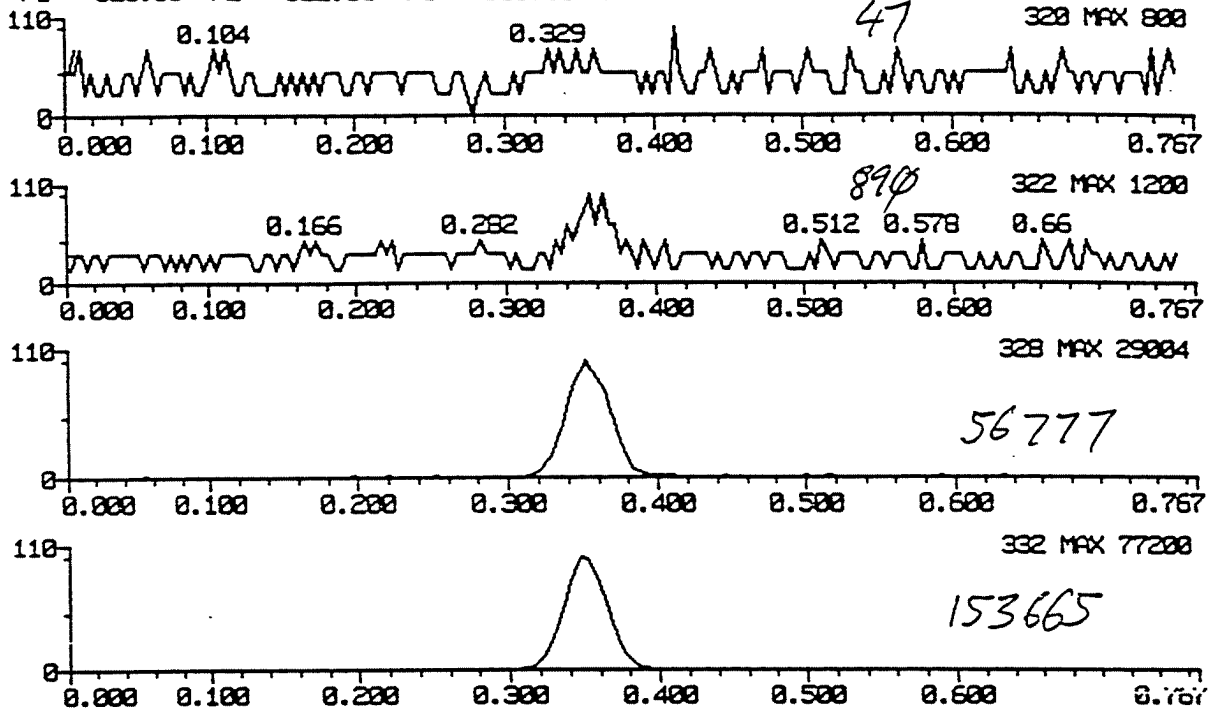
12:26:17

TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268

NOV1413 2 MIMI SPIKING SOLUTION II IM

SS	1	ES	196	BO	0	TO	110	GR	LNNP	SE	98
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	98	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	98	IN	21604



14-NOV-88		12:31:54	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.051					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	362.9	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

12:31:54

TT=.1

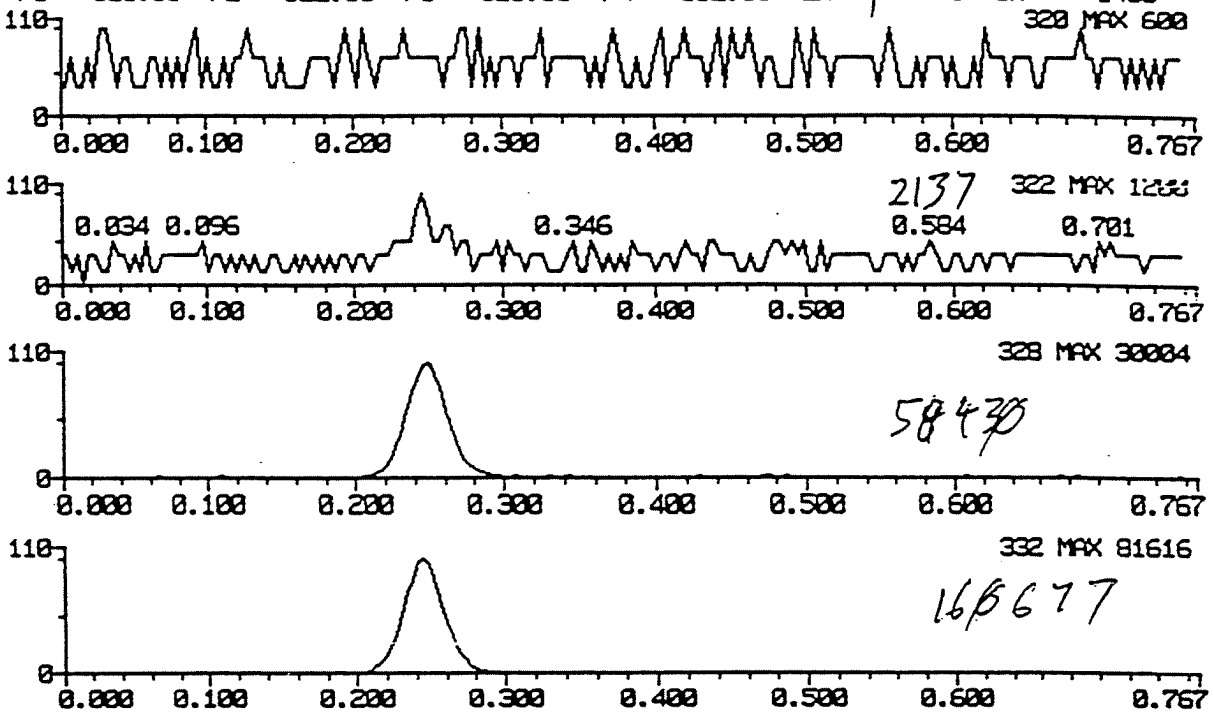
12:36:32

TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268

NOV1414 2 MIMI SPIKING SOLUTION II IM

SS	1	ES	196	BO	0	TO	110	GR	LNNP	SE	54
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	54	TI	00:00:12
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	79	IN	1400



14-NOV-88		12:42:09	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.039					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	363.5	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

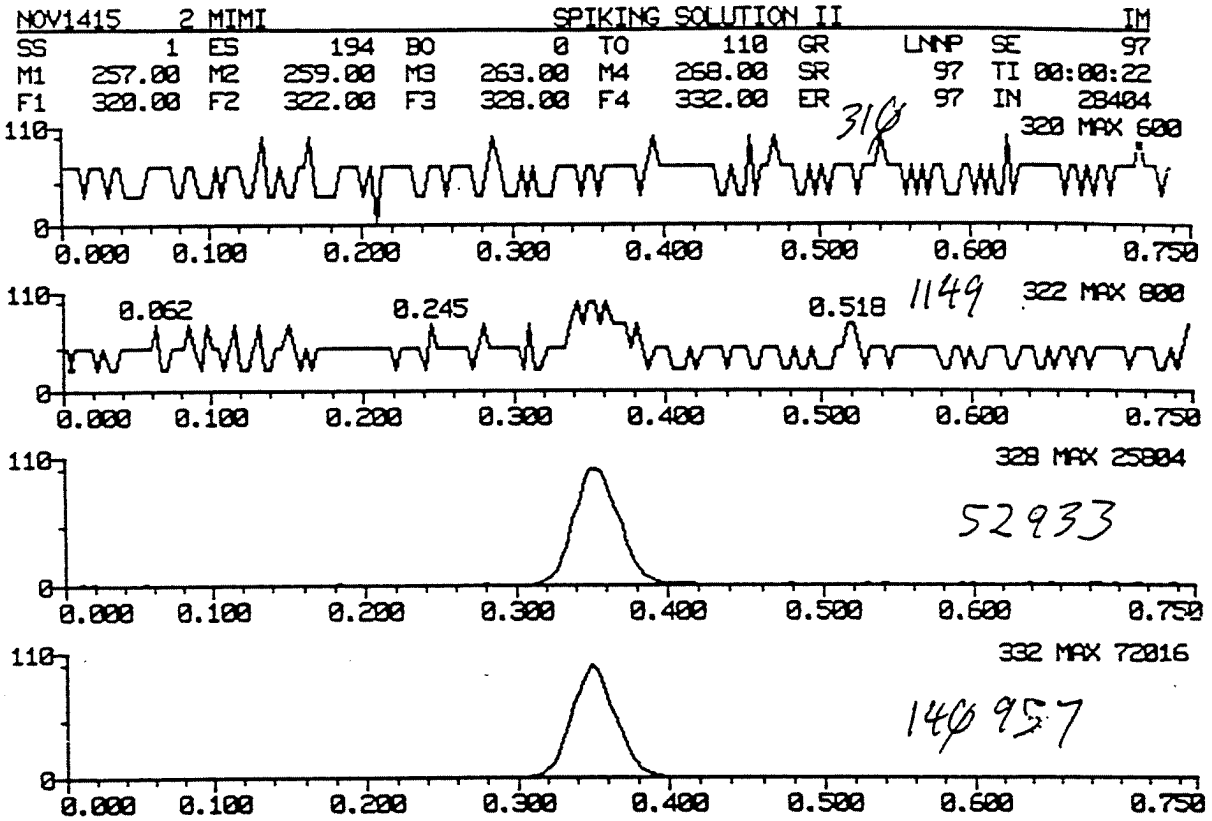
12:42:09

TT=.1

12:46:49

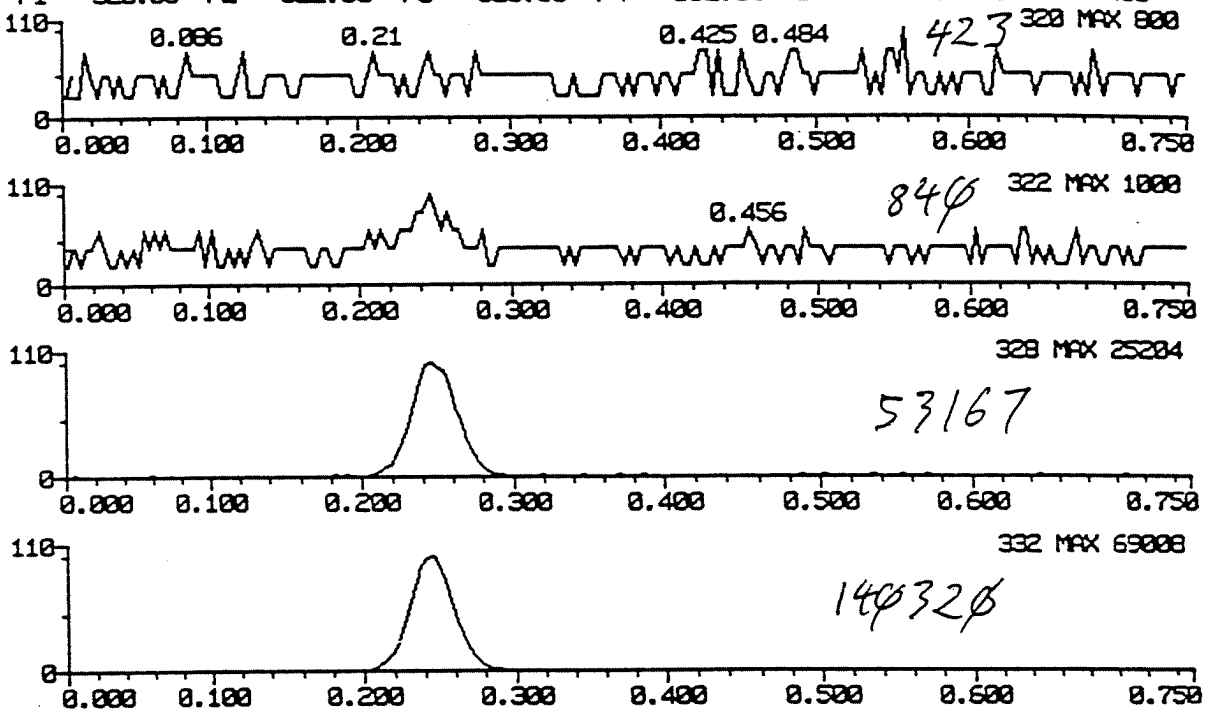
TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268


NOV1415 2 MIMI SPIKING SOLUTION II IM
SS 1 ES 194 BO 0 TO 110 GR LNNP SE 97
M1 257.00 M2 259.00 M3 263.00 M4 268.00 SR 97 TI 00:00:22
F1 320.00 F2 322.00 F3 328.00 F4 332.00 ER 97 IN 28404
316
320 MAX 600
110
0
0.000 0.100 0.200 0.300 0.400 0.500 0.600 0.750
0.062
0.245
0.518
1149
322 MAX 800
328 MAX 25804
52933
332 MAX 72016
140957
14-NOV-88 12:52:26 OP KEM MTL 0.0500 STEP 0.1000 PE 0.00
SY 200 SE 0 C 10 MCL 1260 TH 200 TT 0.75
G1 0.000 IT 0.00 DI 0.000 MO -0.600 FP 60.00
G2 0.000 LT 0.00 DIV -1.018 MU -4600.0
G3 0.0000 DT 0.000 IN 0.00 DM1 0.3000 CGT 371.0 DM3 0.4000
SAF 0.0 GR 1.00 OR 0.00 RE1 90.00 CG OFF RE3 100.00
DTV 0.000 ST 0.00 R0 -25.00 R1 -20.00 R2 -55.00 R3 -65.00
12:52:26
TT=.1
12:56:53
TT=.75;G2=30;DI=-1;CG=SW
2 320 257
322 259
328 263
332 268

NOV1417 2 MIMI SPIKING SOLUTION II IM

SS	1	ES	194	BO	0	TO	110	GR	LNNP	SE	97
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	97	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	97	IN	400



14-NOV-88		13:03:57	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.049					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	337.9	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

13:03:57

TT=.1

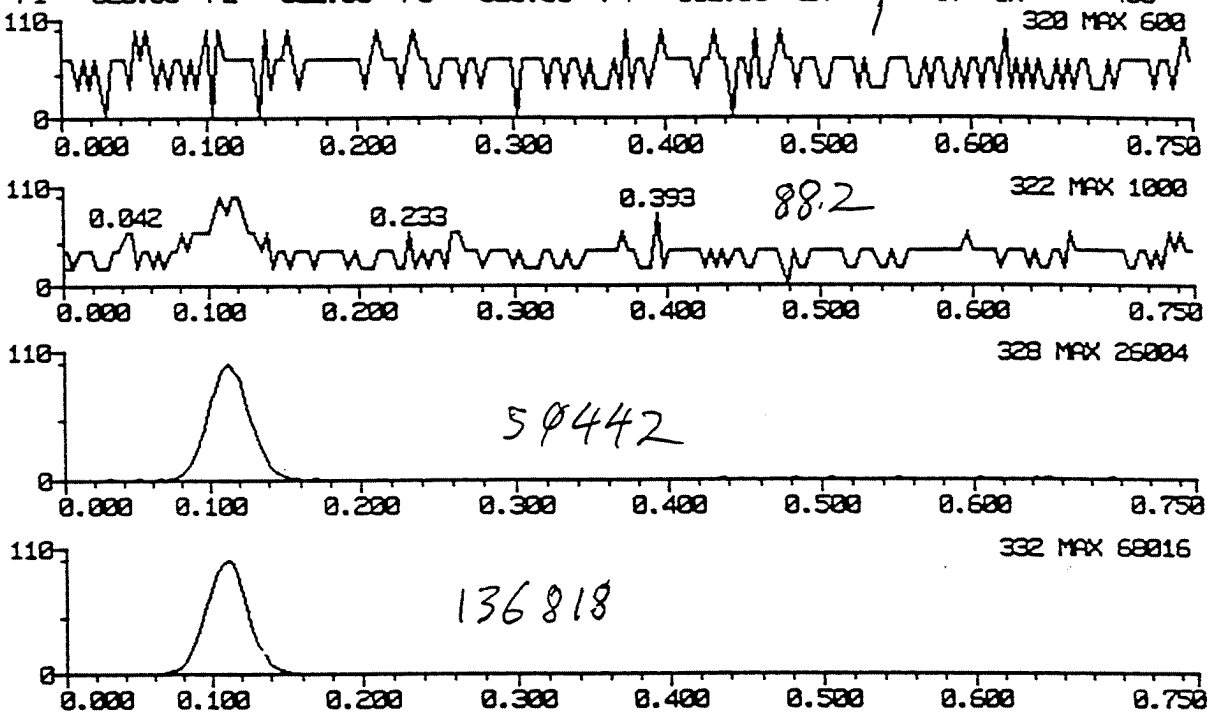
13:07:10

TT=.75;G2=30;DI=-1;CG=SW

2	320	257
	322	259
	328	263
	332	268

NOV1419 3 MIMI SPIKING SOLUTION II IM

SS	1	ES	194	BO	0	TO	110	GR	LNNP	SE	97
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	97	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	97	IN	400



14-NOV-88		13:28:14	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10!JMCL	1250	TH	200	TT	0.75	
G1	0.000	IT	0.00	DI	0.000		MO	-0.600	FP	60.00	
G2	0.000	LT	0.00	DIV	-1.054				MU	-4600.0	
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	349.2	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00			RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

13:28:14

TT=.05

13:29:57

TT=.05

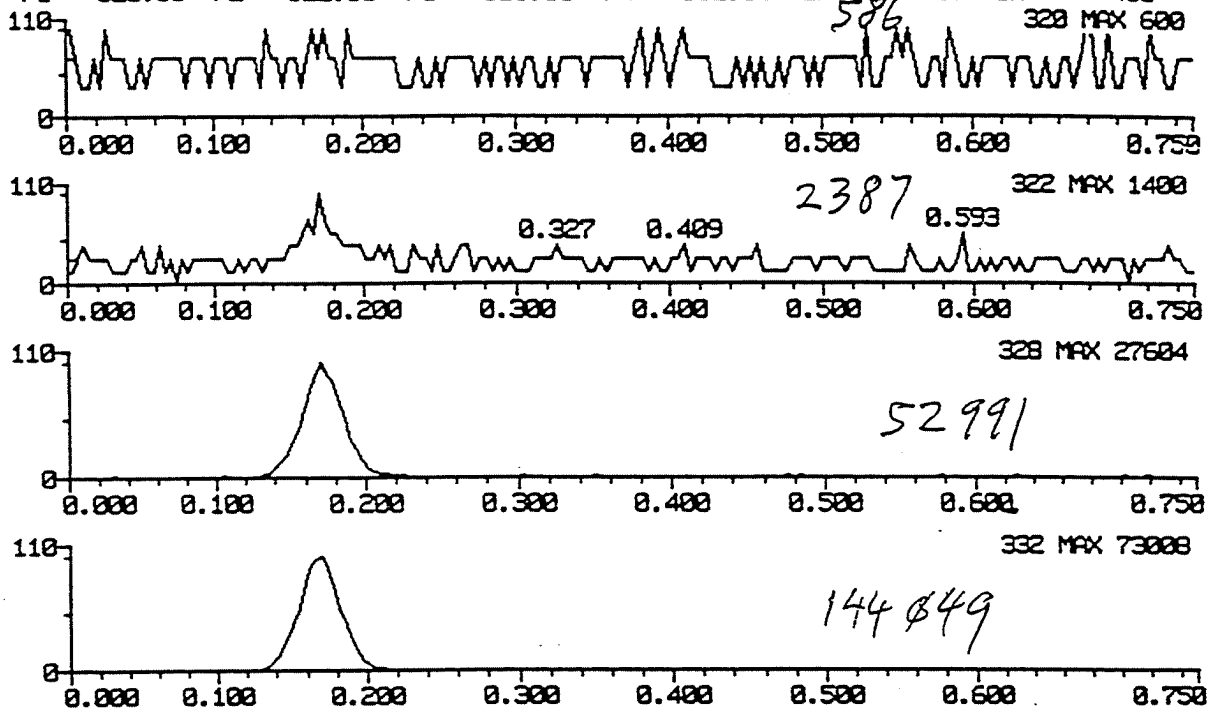
13:30:08

TT=.75;G2=30;DI=-1;CG=SW

3	320	257
	322	259
	328	263
	332	268

NOV1420 3 MIMI SPIKING SOLUTION II

SS	1	ES	194	BO	0	TO	110	GR	LNNP	SE	97
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	97	TI	00:00:22
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	97	IN	400



14-NOV-88		13:35:34	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.031					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	352.3	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

13:35:34

TT=.05

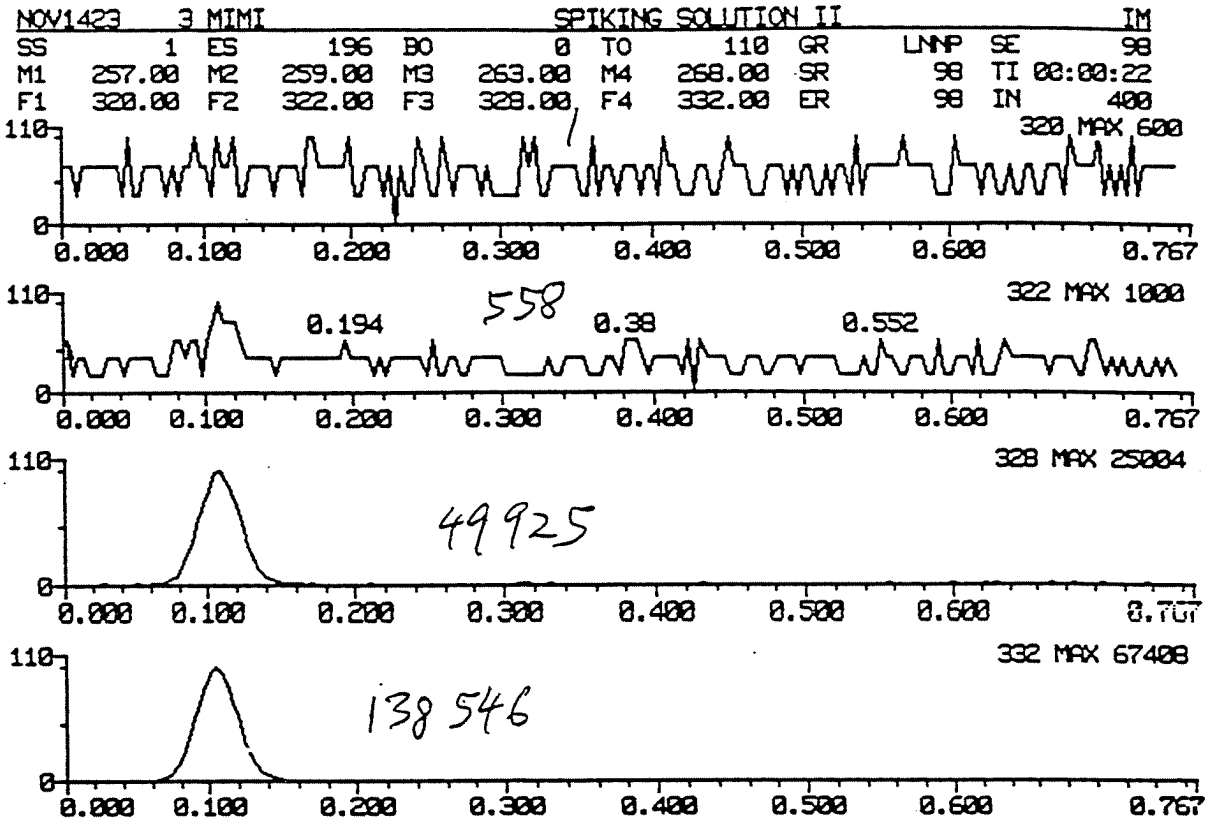
13:40:04

TT=.05

13:40:15

TT=.75;G2=30;DI=-1;CG=SW

3	320	257
	322	259
	328	263
	332	268



14-NOV-88		13:47:13	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.067					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	346.0	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

13:47:13

TT=.05

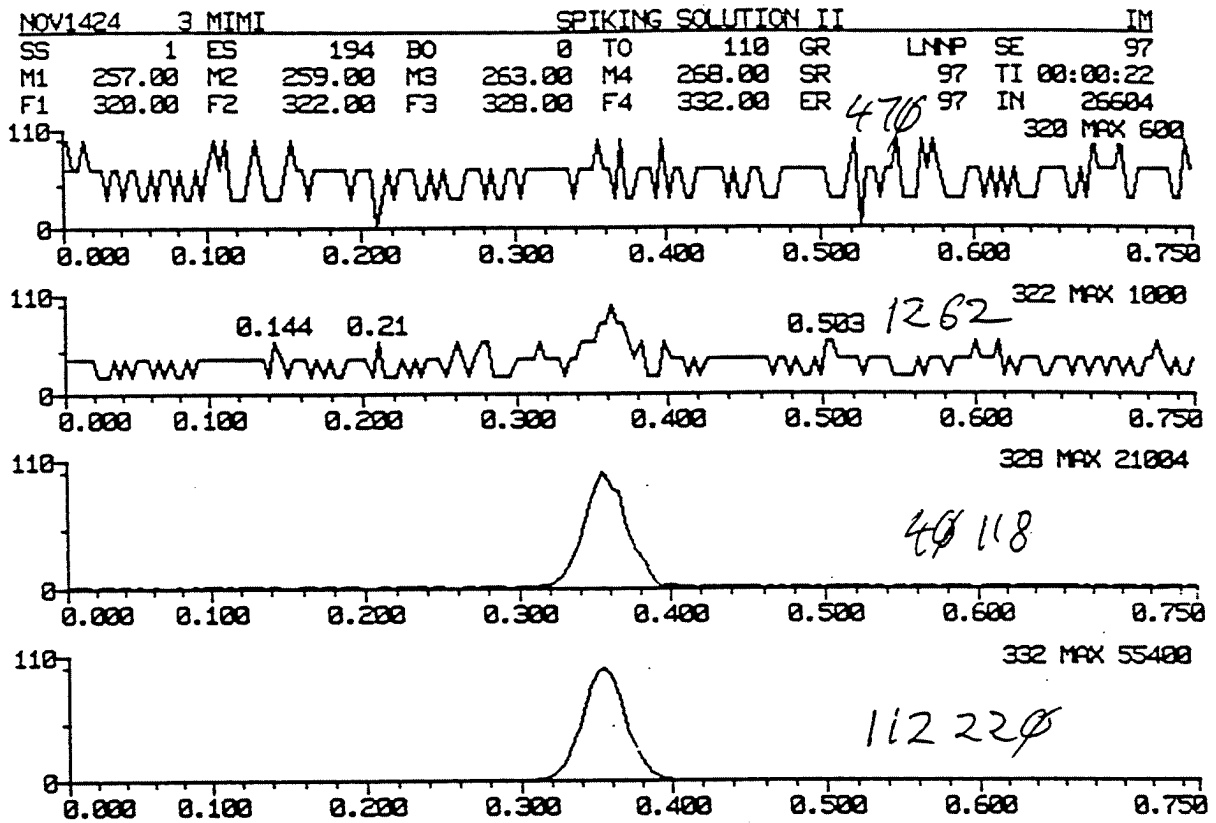
13:50:18

TT=.05

13:50:29

TT=.75;G2=30;DI=-1;CG=SW

3	320	257
	322	259
	328	263
	332	268



14-NOV-88		14:01:42	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00
SY	200	SE	0	C	10	MCL	1260	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.034					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	362.3	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

14:01:42

TT=.05

14:03:21

TT=.05

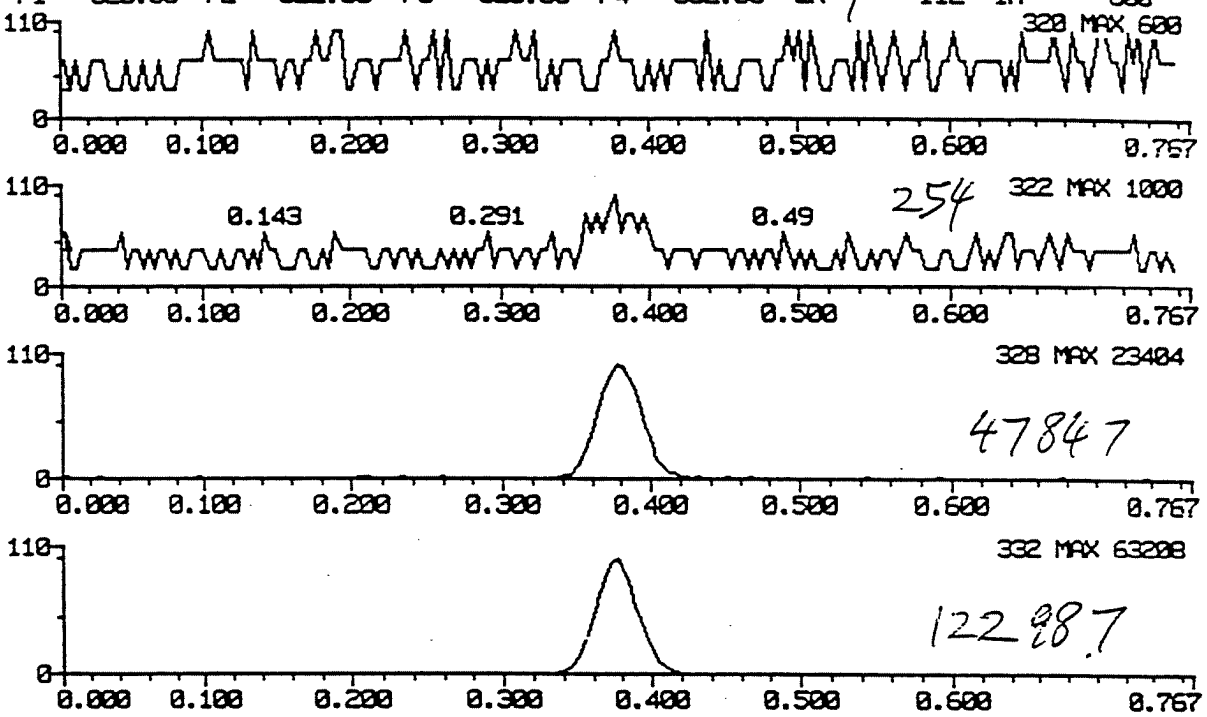
14:03:32

TT=.75;G2=30;DI=-1;CG=SW

3	320	257
	322	259
	328	263
	332	268

NOV1425 3 MIMI SPIKING SOLUTION II IM

SS	1	ES	196	BO	0	TO	110	GR	LNNP	SE	88
M1	257.00	M2	259.00	M3	263.00	M4	268.00	SR	88	TI	00:00:20
F1	320.00	F2	322.00	F3	328.00	F4	332.00	ER	112	IN	666



14-NOV-88		14:08:46	OP	KEM	MTL	0.0500	STEP	0.1000	PE	0.00	
SY	200	SE	0	C	10	MCL	1250	TH	200	TT	0.75
G1	0.000	IT	0.00	DI	0.000			MO	-0.600	FP	60.00
G2	0.000	LT	0.00	DIV	-1.070					MU	-4600.0
G3	0.0000	DT	0.000	IN	0.00	DM1	0.3000	CGT	352.9	DM3	0.4000
SAF	0.0	GR	1.00	OR	0.00	RE1	90.00	CG	OFF	RE3	100.00
DTV	0.000	ST	0.00	R0	-25.00	R1	-20.00	R2	-55.00	R3	-65.00

14:08:46

TT=.05

14:16:57

TT=.05

14:17:08

TT=.75;G2=30;DI=-1;CG=SW

3	320	257
	322	259
	328	263
	332	268

ATTACHMENT 5

CHAIN OF CUSTODY, GC/MS/MS LOG, EXTRACTION RECORD

M.B.A. LABS

CHAIN OF CUSTODY RECORD

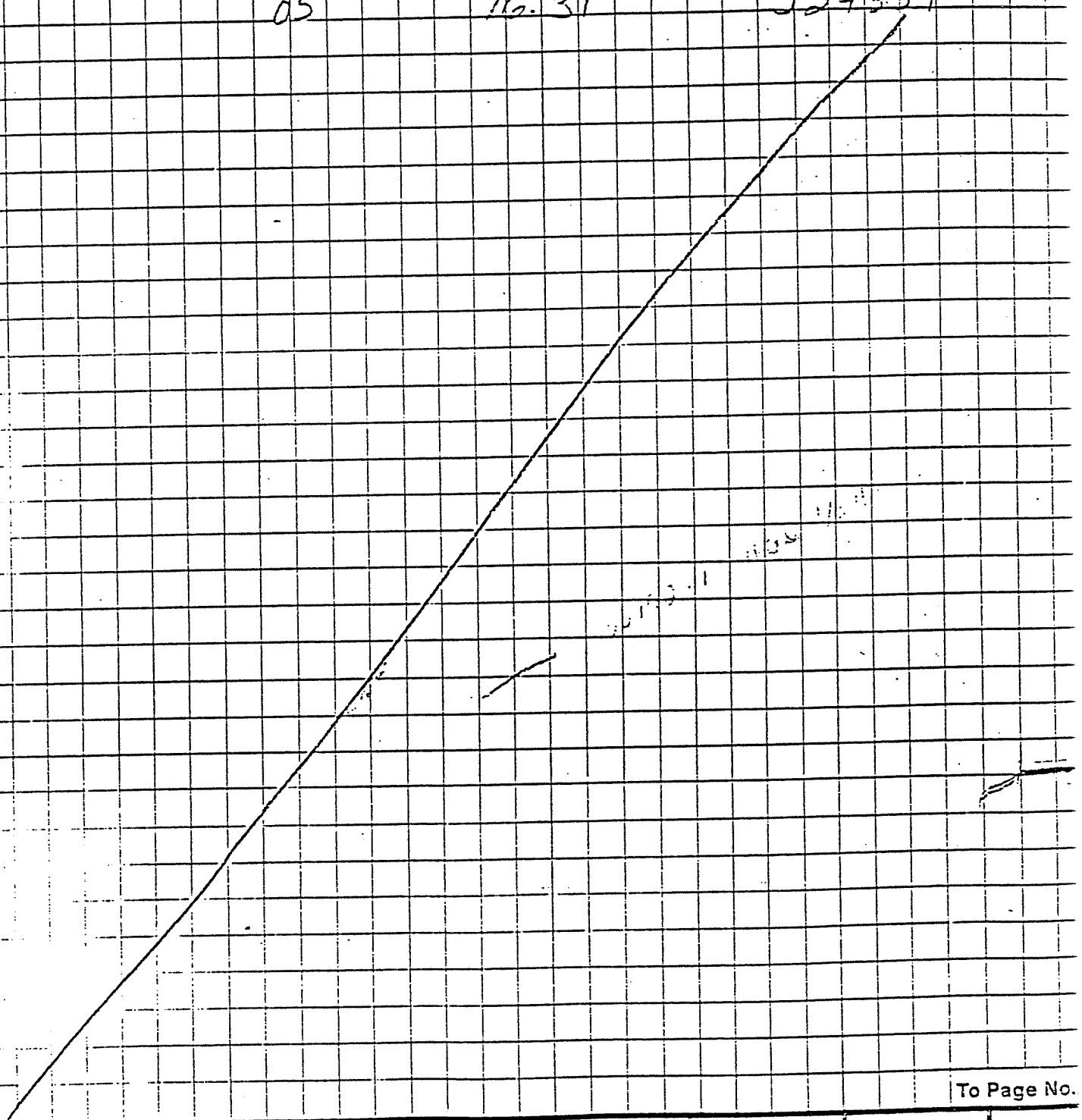
Proj No.	Project Name													
	J-24334 TRICI/#4B													
Samplers (Signature)	Joe Kresse													
Sta. No.	Date	Time	Comp.	Grab	Station Location	No. of Containers	DIOXIN							Remarks
—	—	—	—		TCLP EXTRACT	2								NOTE * This is a TCLP EXTRACT. It is a Sodium Acetate EXTRACT ph = 9.72
														NOTE * These are duplicate samples only run 1, use the other if needed!
														48 HOUR TURNAROUND
														Call Joe Kresse 1-713-928-2702

Relinquished by: (Signature)	Date Time	Received by: (Signature)	Relinquished by: (Signature)	Date Time	Received by: (Signature)
Joe Kresse	4pm 1-23-90		Fed-X	1/24/90 08:40	
Relinquished by: (Signature)	Date Time	Received by: (Signature)	Relinquished by: (Signature)	Date Time	Received by: (Signature)
Relinquished by: (Signature)	Date Time	Received for Laboratory by: (Signature)		Remarks	

TLE GCMSMS LOG Book No. _____ 0011

From Page No. _____

Data Filename	Time	Sample Designation
JAN24 01	15:46	CAL 7
02	16:03	Water Blank
03	Hall	Water Blank
04	1621	900192-1 1/2
05	16:31	J24334



To Page No.

Witnessed & Understood by me,	Date 1/24/90	Invented by NIGL	Date
		Recorded by	

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9330M 5882437002

RECIPIENT'S COPY

Date 1-23-90

From (Your Name) Please Print: Joe Kresse

Your Phone Number (Very Important): (713) 932-1790

Company: KBA LABS

Department/Floor No.:

Street Address: 340 S 66TH ST

City: HOUSTON State: TX ZIP Required: 7 7 0 1

To (Recipient's Name) Please Print: Dan Dolling

Recipient's Phone Number (Very Imp.): ( )

Company:

Department/Floor:

Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.):

City: Indianapolis State: IN ZIP Required:

YOUR INTERNAL BILLING REFERENCE INFORMATION (First 24 characters will appear on invoice.)

IF HOLD FOR PICK-UP, Print FEDEX Address Here

Street Address:

City: State: ZIP Required:

PAYMENT 1 ☐ Bill Sender 2 ☐ Bill Recipient's FedEx Acct. No. 3 ☐ Bill 3rd Party FedEx Acct. No. 4 ☐ Bill Credit Card
5 ☐ Cash

SERVICES (Check only one box)		DELIVERY AND SPECIAL HANDLING	PACKAGES	WEIGHT (In Pounds Only)	YOUR DECLARED VALUE	OVER SIZE
Priority Overnight Service (Delivery by next business morning†)	Standard Overnight Service (Delivery by next business afternoon†)	1 ☐ HOLD FOR PICK-UP (If No in Box 1b)				
11 ☐ YOUR PACKAGING	51 ☐	2 ☑ DELIVER WEEKDAY				
16 ☐ FEDEX LETTER *	56 ☑ FEDEX LETTER *	3 DELIVER SATURDAY (Extra charge) (Not available to all locations) ☐				
12 ☐ FEDEX PAK *	52 ☐ FEDEX PAK *	4 ☐ DANGEROUS GOODS (Extra charge) (DSS not available for Dangerous Goods Shipments)				
13 ☐ FEDEX BOX	53 ☐ FEDEX BOX	5 ☐ CONSTANT SURVEILLANCE SVC. (CSS) (Extra charge) (Release Signature Not Applicable)				
14 ☐ FEDEX TUBE	54 ☐ FEDEX TUBE	6 ☐ DRY ICE ____ Lbs.				
Economy Service (formerly Standard Air) (Delivery by second business day†)	Heavyweight Service (for Extra Large or any package over 150 lbs.)	7 ☑ OTHER SPECIAL SERVICE				
30 ☐ ECONOMY SERVICE	70 ☐ HEAVYWEIGHT **	8 ☐				
	80 ☐ DEFERRED HEAVYWEIGHT **	9 ☐ SATURDAY PICK-UP (Extra charge)				
†Deliver commitment may be later in some areas	*Declared Value Limit $100. **Call for delivery schedule.	10 ☐				
		11 ☐				
		12 ☐ HOLIDAY DELIVERY (Extra charge)				

Total	Total	Total

DIM SHIPMENT (Heavyweight Services Only) ☐ ____ lbs.

Received At: 1 ☐ Regular Stop 2 ☐ On-Call Stop 3 ☐ Drop Box 4 ☐ B.S.C. 5 ☐ Station

FedEx Emp. No.:

Emp. No.: Date:

☐ Cash Received ☐ Return Shipment ☐ Third Party ☐ Chg. To Del. ☐ Chg. To Hold

Street Address:

City: State: Zip:

Received by: X

Date/Time Received: 1/24/90 08:40

FedEx Employee Number:

5 Release Signature:

Date/Time:

Federal Express Base Charges:

Declared Value Charges:

Other 1:

Other 2:

Total Charges:

REVISION DATE 10/89
PART #119501 FXEM 1
FORMAT #014

014

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TMS
TANDEM MASS SPECTROMETRY

TMS Analytical Services Inc.

6376 MORENCI TRAIL • TEL. (317) 291-5697 • INDIANAPOLIS, INDIANA 46268

SAMPLE TRACKING RECORD
2,3,7,8-TCDD ANALYSIS

CASE NUMBER MBA0124A

BALANCE CHECK —
REFRIGERATOR CHECK -1°C

SPIKING SOLUTION I: —
SPIKING SOLUTION II: C-096-02

	CLIENT SAMPLE #	AREA SAMPLE #	SAMPLE WEIGHT	SAMPLE SPIKED	SAMPLE EXTRACTED	COLUMN #1 & #2 CLEANUP	CARBON COLUMN CLEANUP	GC/MS/MS ANALYSIS COMPLETED	ISOMER SPECIFIC ANALYSIS COMPLETED	EXTRACTS RET'D TO STORAGE	COMMENTS
1	WB	WB	1000ml	50ul II	300ml CH_2Cl_2	✓		✓		✓	Waters
2	J-24334	J-24334	↓	↓	↓	↓		↓		↓	↓
3											
4											
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COMPLETED BY	JW	JW	JW	JW	JW	JW	MGD	MGD	JW	
DATE	1/24/90	1/24/90	1/24/90	1/24/90	1/24/90	1/24/90	1/24/90	1/24/90	1/24/90	

PRIVATE SECTOR

TMS
TANDEM MASS SPECTROMETRY

TMS ANALYTICAL SERVICES, INC.

6376 Morenci Trail
Indianapolis, Indiana 46268
317-291-5697 FAX 317-299-7159

GC/MS/MS ANALYSIS REPORT FORM
ANALYSIS FOR 2,3,7,8-TCDD

CLIENT: M.B.A Labs

SHIPMENT:MBA0124A

SAMPLE DESCRIPTION	2,3,7,8-TCDD CONCENTRATION	LOD (ng/l)
Blank	ND	1.000 U
J-24334	ND	1.000 U

ND=NONE DETECTED
ng/l= parts per trillion

TMS
TANDEM MASS SPECTROMETRY

TMS ANALYTICAL SERVICES, INC.

6376 Morenci Trail
Indianapolis, Indiana 46268
317-291-5697 FAX 317-299-7159

January 29, 1990

M.B.A Labs
340 S. 66th St.
Houston, TX 77261
Attn: Joseph Kresse

Dear Mr. Kreese:

Enclosed are the analytical results for the analysis of 1 water sample for 2,3,7,8 TCDD. This sample was analyzed according to the procedures outlined in the 'EPA Contract for Laboratory Program Statement of Work for Rapid Turnaround for Dioxin Analysis Multi-Media', November, 1988. This sample was received as shipment M.B.A for analysis on January 24, 1990 at 08:40. The analytical results of Filename MBA0124A were verbally communicated to you on January 25, 1990 at 10:00.

If you should have any questions regarding this data or this report, please feel free to contact me at (317)291-5697.

Sincerely,

Stephen A. Barnett

Stephen A. Barnett
Vice President of
Operations

ENCLOSURES:

APPENDIX 4

McBride-Ratcliff and Associates, Inc.
Geosciences and Materials Engineering Services

February 5, 1990

Independent Materials Testing Laboratories, Inc.
Neal Court Industrial Park
P.O. Box 745
Plainville, CT 06062

Attention: Mr. David Aiudi

Reference: Submission of Treated Soil Samples
93rd Street School Site
Niagara Falls, New York
MRA File No. 90-0025

Dear Mr. Aiudi:

Enclosed herewith are two (2) 2-inch cube samples for unconfined compressive strength tests and two (2) 2-inch cube samples for a freeze-thaw test. Two (2) samples for permeability tests were prepared in the cylindrical molds that you supplied. The permeability samples are being shipped separately and should arrive at the same time. All of the samples were molded on January 30, 1990, at approximately 3:00 PM, using a bulk sample supplied by Tricil Environmental Responses, Inc. The samples were cured inside plastic bags in a 100% humidity room.

The cube samples had a tendency to stick to the walls of the cube mold even though the mold had a light coat of grease on it. The samples in package B are in better condition than those in package A. We recommend that the unconfined compression tests be run on the samples in package B and that the freeze-thaw test be done on the ones in package A.

If you have any questions, do not hesitate to call.

Yours truly,

Floyd L. Fuqua

Floyd L. Fuqua
Laboratory Manager

cc: Tricil Environmental Responses, Inc.
Mr. Chuck Orwig

7220 Langtry • Houston, Texas 77040 • (713) 460-3766 • Telex 4973853 MRA UI • Fax (713) 939-9604

March 21, 1990

Loureiro Engineering Associates
100 Northweswt Drive
Plainville, CT 06062

Attn: Mr. C. A. Jaworski

RE: Treatability Studies - 93rd St. School, Niagara Falls, NY

Gentlemen:

In response to your letter of 5 March, Tricil has returned treated and untreated soil to the address of Mr. Brian Sadowski.

Regarding other requests for information contained in the referenced letter:

Volume expansion after mixing and recompaction: 25%

The soil mass after treatment will resemble soil before treatment and will be workable with standard construction equipment (bulldozers and compactors). Treated soil will be placed in lifts within the excavation immediately after treatment; all curing will occur in-place after compaction.

With respect to the type and amounts of reagents used for treatment, Tricil has revealed that information in the attached Table 1 only on condition that the treatment chemicals and amounts be kept in strictest confidence. Our costs of conducting treatability studies to arrive at an acceptable reagent blend have been considerably in excess of the amount we were permitted to invoice. It is not our intent that other bidders on this project be provided with the results of our treatability studies.

Four copies of the final report are enclosed. The final report is comprised of:

1. Our preliminary report submitted 23 February,

2. this letter, containing supplemental information requested by you in your letter of 5 March, and

3. a separate letter, enclosed, from McBride-Ratcliff & Associates, identifying results of the freeze-thaw weathering tests. Please recall that "sample 4A" is the ID given to the chosen treatment.

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Very truly yours,

TRICIL ENVIRONMENTAL RESPONSE INC.

C. H. Orwig
Manager, Technical Services

hs

McBride-Ratcliff and Associates, Inc.
Geosciences and Materials Engineering Services

March 14, 1990
MRA Project No: 90-0025

Mr. Charles Orwig
Tricil Environmental Response
1123 Lumpkin
Houston, Texas 77043

LABORATORY TESTING
93RD STREET SCHOOL SITE

Dear Mr. Orwig:

The freeze-thaw tests that you requested are complete. The tests were performed on compacted, cylindrical specimens that you supplied.

The tests were performed in general accordance with ASTM D560, per your request. The specimens were marked 1A, 4A, 5A and 5A. Each specimen was cut into two (2) pieces approximately the same length. This was necessitated by the test method. The results of the tests and deviations from the test method are shown on Figure 1.

Completion of these tests concludes the laboratory testing program that you requested. No further reports will be sent unless requested. If you have any questions, please call.

Yours truly,
McBRIDE-RATCLIFF AND ASSOCIATES, INC.

Floyd L. Fuqua
Laboratory Manager

Charles E. Williams, P.E.
Executive Vice President

FLF:CEW:ka

7220 Langtry • Houston, Texas 77040 • (713) 460-3766 • Telex 4973853 MRA UI • Fax (713) 939-9604

Mr. Charles Orwig
Tricil Environmental Response
MRA Project No: 90-0025

LABORATORY TEST RESULTS
ASTM D560

	Specimen Number			
	1A	4A	5A	6A
Original Conditions:				
Moisture Content %	27.7	27.7	27.8	29.8
Unit Wet Weight, pcf	115.9	115.4	112.2	110.1
Unit Dry Weight, pcf	90.7	90.3	87.8	84.9
Test Data:				
Maximum Moisture Content, %	34.4	33.1	32.4	36.5
Maximum Volume Change, %	18.7	20.5	26.3	7.6
Soil-Cement Loss, %	14.6	4.3	7.6	4.6

Deviations from ASTM D560:

1. Non-standard specimen preparation
2. Non-standard specimen size (length ≈ 2.0", diameter = 2.0")
3. Freezer cabinet set at -18° C, -23° C required

FIGURE 1

APPENDIX N

DOCUMENTATION ON LOST SAMPLE

VENDOR G - ENVIROSAFE

LEA LOUREIRO ENGINEERING ASSOCIATES

a professional corporation

CONSULTING ENGINEERS

100 NORTHWEST DRIVE
PLAINVILLE, CT 06062
203-747-6181
FAX 203-747-8822

February 6, 1990

ENVIROSAFE Technologies, Inc.
P.O. Box 833
Valley Forge, PA 19482-0833

Att: Robert A. West

Re: Lost Treatability Study Samples
Remediation of the 93rd Street School Site
Niagara Falls, NY
LEA Comm. No. 506-02

Gentlemen:

We have received your telephone notification that certain samples of soil were lost in transit in connection with your work on the treatability studies for the Remediation of the 93rd Street school Site. It is essential that you document to us the circumstances related to the loss of the samples and your efforts to trace or recover them. If any sample remains it must be returned to the New York State Department of Environmental Conservation in Niagara Falls, NY.

The schedule for this project does not allow for repeating the treatability studies or conducting further tests on any samples. Therefore, you are hereby notified of cancellation of any contract, implied, written or oral, for the treatability study work, and no compensation can be made for any work done by ENVIROSAFE

Please feel free to call if you have any questions. Please send to us as soon as possible your documentation of the loss of these samples.

Very truly yours,

LOUREIRO ENGINEERING ASSOCIATES

Charles A. Jaworski

Charles A. Jaworski

cc: New York State Department of Environmental Conservation

CAJ:cap

ENVIROSAFE TECHNOLOGIES, INC.

February 22, 1990

Mr. Charles A. Jaworski
Loureino Engineering Associates
100 Northwest Drive
Plainville, CT 06062

Re: Lost Treatability Study
Samples Remediation of the
93rd St. School Site
Niagara Falls, NY
LEA Comm. No. 506-02

Dear Mr. Jaworski:

As we discussed recently, Envirosafe Technologies Group, Inc.'s overnight carrier, Federal Express, has unfortunately lost the above-referenced samples. As a result of this loss, ETG is unable to perform the work required for the treatability study. Therefore we would request that our name be withdrawn from the treatability activity. However, we would like to remain on the list for actual construction phase activities relating to this project.

I have enclosed a copy of the letter of explanation that I received from Federal Express. They have subsequently suggested that this material, since it was in a hazardous materials package, probably was disposed under Federal Express's hazardous waste disposal protocol. If you have any further questions, please call me.

Sincerely,

Robert A. West
Director of Marketing

RAW:apt

P.O. Box 833, Valley Forge, Pennsylvania 19482-0833 • (215) 962-0800
Facsimile Machine (215) 962-0727

Packages:
Federal Express Corporation
3875 Airways Boulevard, 3rd Floor
Memphis, Tennessee 38116

901 922-1616

Mail:
Box 727
Memphis, Tennessee 38194-4634

VIA FEDEX PRIORITY LETTER

February 16, 1990

Mr. Robert West
Envirosafe Technologies Group, Inc.
900 E. Eighth Avenue, Ste. 200
King of Prussia, PA 19406

Dear Mr. West:

I am writing regarding the shipment on package tracking number 3407427590 destined to Knoxville, TN.

According to the information provided to me, this package was tendered to us on January 18. However, unfortunately, while moving through our system, the package became separated from the airbill, which arrived in our Lost and Found Department. I was disturbed to learn that the package has not been located.

Mr. West, it is our goal to handle each package entrusted to us in a professional manner with speed and alacrity incomparable to any other air express service today. Occasionally a package going through the rigors of our sorting process is inadvertently separated from its airbill, however, I assure you that these incidents are few. Because we stand behind our service, arrangements have been made to intercept and cancel the shipping charges incurred, and should we receive any additional information the shipper will be notified immediately.

On behalf of Federal Express, I offer my sincere apologies to you and all concerned for the inconvenience caused by this incident, and hope to have another opportunity to serve you more satisfactorily.

Sincerely,

Sondra Owens
Customer Relations Department

cc K. Birkholz, Vice President, 0311/MEM/TN
W. Henrikson, Managing Director, 1851/MEM/TN