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U.S. ARMY CHEMICAL AND BIOLOGICAL DEFENSE COMMAND

ERDEC-TR-478

ACCELERATED SOLVENT EXTRACTION OF SOIL SAMPLES FOR THE DETERMINATION OF THE PRESENCE OF CHEMICAL WARFARE (CW) BREAKDOWN PRODUCTS

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March 1998

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Aberdeen Proving Ground, MD 21010-5423

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Allegations concerning the use and/or manufacture of chemical warfare (CW) agents in recent years has been of interest to many countries. The presence of CW agents, precursers, and decomposition (breakdown) products in the environment has been studied by various collection and extraction means. This report details the work performed in the extraction of CW breakdown products from three types of standard soils, using the Dionex ASE 200 Accelerated Solvent Extractor and the Zymark TurboVap LV Evaporation System.

14. SUBJECT TERMS

Soils	Thiodiglycol (TDG)
Extraction	Methyl phosphonic acid (MPA)
Concentration	Ethylmethyl phosphonic acid (EMPA)
Chemical agents	Isopropylmethyl phosphonic acid (IMPA)
Breakdown products	Pinacolylmethyl phosphonic acid (PMPA)

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PREFACE

The work described in this report was authorized in support of the Defense Special Weapons Agency (DSWA) under Project No. DSWA96-2106, Investigate Faster and More Accurate Sample Preparation Procedures, Task 3.4, Dionex Accelerated Solvent Extractor (ASE) 200, and Task 3.6.3, Zymark LV Evaporator. This work was started in August 1996 and completed in January 1997.

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ACCELERATED SOLVENT EXTRACTION OF SOIL SAMPLES FOR THE DETERMINATION OF THE PRESENCE OF CHEMICAL WARFARE (CW) BREAKDOWN PRODUCTS

1. Introduction

Allegations concerning the use and/or manufacture of chemical warfare (CW) agents in recent years has been of interest to many countries.[1] The presence of CW agents, precursers and decomposition (breakdown) products in the environment has been studied by various collection and extraction means.[2] Solid adsorbent technology has been used to directly adsorb vaporous chemicals in the atmosphere and as a means of concentrating matrixed volatile organic chemicals (VOC's) and semi-volatile organic chemicals (SVOC's).[3] Monitoring instrumentation also uses solid adsorbents in demilitarization areas.

Methods of extraction used in the past centered around "shake and settle" technology involving the addition of extraction solvent to a soil, etc. matrix and mixing of the solvent/matrix, followed by removal of the solvent, and concentrating before analyses. Various techniques of solvent separation involved filtration (filter paper), other mechanical means such as vacuum filtration or centrifugation, followed by decantation. Samples were then concentrated by blowing a stream of nitrogen gas across the surface of the liquid in its vessel. Soxhlet extraction was also available, but this involved long extraction times and generated large amounts of solvent which have to be disposed of through time consuming means according to strict requirements involving state and federal laws.

A new approach was sought and found in the use of the Dionex Accelerated Solvent Extraction system (ASE 200) [4] (figure 1) followed by solvent reduction by the use of a Zymark TurboVap LV Evaporation system (figure 2). The Dionex ASE 200 achieves rapid extraction with organic solvent (alone or as a mixture) at a high temperature under pressures set by the operator on a computerized menu. Thus, solvents remain in the liquid phase by the pressure applied to the cell. The kinetic process of extraction is accelerated. And the analytes of interest are desorbed from the matrix (in this case soil) faster than when compared to room temperature extractions. Low amounts of solvent were generated (typically, 10-18 mL for an 11 mm extraction cell) for a 5 gram sample. The extraction solvents were then reduced on the Zymark LV system that uses a cycloned stream of nitrogen which creates a greater surface area for evaporation in a heated water bath. Parameters on each instrument can be varied to create optimum extraction and concentration conditions.

The work detailed in this report was performed by the Analytical Chemistry Team, Edgewood Research and Technology Directorate, U.S. Army Chemical and Biological Defense Command (CBDCOM) in support of the Defense Special Weapons Agency (DSWA). The objective was to evaluate the performance of the Dionex Accelerated Solvent Extractor (ASE) in the extraction of Chemical Warfare Agents (CWA's) and CW breakdown products from a series of soil matrices (sandy loam, humic and clay). The

Figure 1

Dionex ASE 200 Accelerated Solvent Extractor

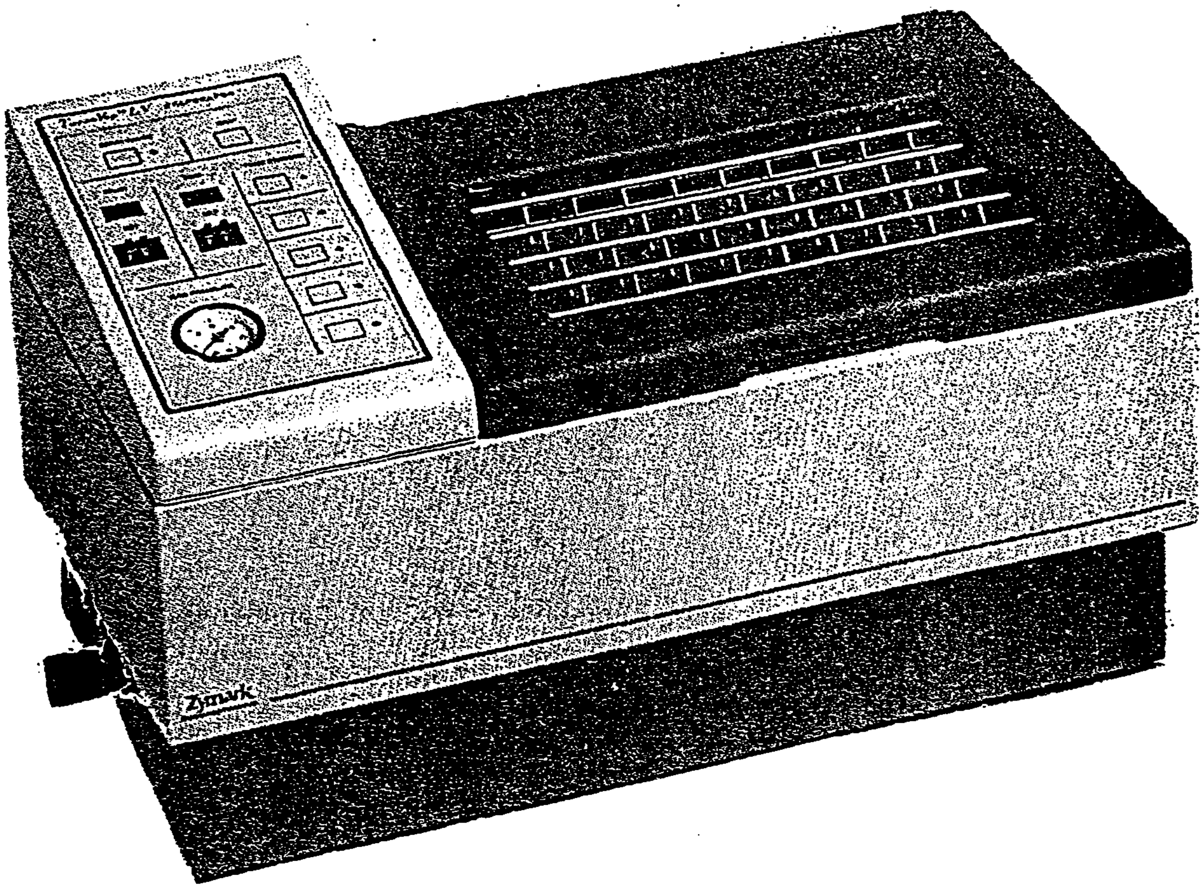

Figure 2

Zymark TurboVap LV Evaporation System

ASE system is seen as a faster, more efficient sample preparation system than that currently used. Different solvent extraction systems were also to be evaluated.

2. Materials and Methods

2.1 Materials

2.1.1 Soils

Soil No. 1 - Sandy Loam - SN 1046, R.T. Corporation - Laramie,WY 82070 (307-7425452)
Soil No. 2 - Sandy Clay-Loam - SN 2002, R.T. Corporation
Soil No. 3 - Loam - SN 3285, R.T. Corporation

(Soils were obtained from R. T. Corporation under contract to Dugway Proving Ground/Defense Special Weapons Agency (DPG/DSWA)).

2.1.2 Sand

Ottawa Sand Standard, 20-30 mesh, Fisher cat no. S23-3 - Fisher Scientific, 585 Alpha Drive, Pittsburgh, PA 15238 (412-963-3300)

2.1.3 Chemicals

MPA (methylphosphonic acid) - ERDEC produced
EMPA (ethylmethylphosphonic acid) - ERDEC produced
IMPA (isopropylmethylphosphonic acid) - ERDEC produced
PMPA (pinacolylmethylphosphonic acid) - ERDEC produced
T-butyl-phosphonic acid (Internal Standard)

TDG (thiodiglycol) - Aldrich (lot # HY 09226CY) - 98% - Aldrich Chemical Co., P.O. Box 355, Milwaukee, WI 53201 (414-273-3850)

Methyl Alcohol GC/MS grade, cat no. 230-4, Baxter (Burdick & Jackson) Muskegon, MI 49442 (616-726-3171)

L-Histidine - Sigma Chemical Company, P.O. Box 14508, St. Louis, MO. (800-325-3010)

2-(N-Morpholino)ethanesulfonic acid (MES) - Sigma Chemical Company, P.O. Box 14508, St. Louis, MO. (800-325-3010)

Tetradecyltrimethylammonium bromide - Sigma Chemical Company, P.O. Box 14508, St. Louis, MO. (800-325-3010)

Triton X-100 - Sigma Chemical Company, P.O. Box 14508, St. Louis, MO. (800-325-3010)

2.2 Instrumentation

Dionex Accelerated Solvent Extractor (ASE 200), (Dionex Corp., 1228 Titan Way, P.O. Box 3603, Sunnyvale CA 94088-3603 (408-737-0700)

Zymark TurboVap LV Concentration Workstation, Zymark Corp., Zymark Center, Hopkinton, MA 01748 (508-435-9500)

THERMO-CE/Crystal Model 300 Capillary Ion Analyzer- Crystal Model 1000 Conductivity Detector, Thermo Capillary Electrophoresis, Inc., Franklin, MA 02038 (508-528-0551)

Waters Millennium 2010 Data Work Station equipped with a Rheodyne Injector, 2 -Model 510 pumps and a Waters Model 490 U.V. Detector, Waters Corporation, Milford, MA 01757-3696 (508-482-3643)

2.3 Extraction Procedure

The Dionex ASE 200 Accelerated Solvent Extractor System in conjunction with the Zymark TurboVap LV Evaporator System were used to prepare previously spiked DPG/DSWA provided soils (Sandy Loam, Sandy Clay-Loam and Loam) for analysis for recoveries of MPA, EMPA, IMPA and PMPA. Samples were processed at 100 degrees C and, in some cases, 150 degrees C to see if enhanced recoveries of the acids from the soil matrices were possible. The operating pressure was maintained at 2000 psig as suggested by the Dionex Corporation. Specifications of each DPG/DSWA standard soil can be viewed as Appendices A, B and C.

Approximately 5 grams of matrix was weighed into a 25 mL bottle with Teflon lined-screw caps for spiking. Aliquots of the dilute standard materials (CW breakdown products in methanol) were added to the matrix. Each soil type was spiked with two levels of chemicals (5 mg and 2.5 mg) and processed in triplicate. Each matrix was allowed to stand for one half hour to evaporate the solvent. The bottles were then each sealed and mixed to distribute the analyte by hand shaking and vortex mixing.

Prior to the addition of the spiked matrix to the Dionex 11 mm extraction cell, a 1.91 cm Whatman filter pad (Whatman cat. no. 10289356) was placed in the bottom of the cell. Two and one half grams of inert Ottawa sand, 20-30 mesh (Fisher cat. no. S23-3) was then added to the cell to provide a barrier to fines from the matrix, which might clog the fine wire mesh screen lining the exit area of the housing of the extraction cell. The spiked sample matrix was then added to the cell, and the cell was tapped to compress the matrix. A second portion of inert sand was added to the cell to within approximately 1 mm of the top edge of the cell. The top (inlet) cap was screwed onto the cell and hand tightened. Each cell was then placed in its appropriate position of the ASE extractor.

After flushing the lines of the ASE 200 four times with solvent (mix), the Method for extraction was entered into the programmer, and the Method was started. Parameters used in the testing of the agent-spiked samples can be seen in Appendix D. After each cell had been processed (approximately 15 minutes), the collection vials were then removed, the extraction volumes measured, and the volume reduced to near dryness using the Zymark TurboVap LV solvent evaporation system. Typical volumes of 20 mLs were reduced. The samples were then reconstituted with one milliliter of methanol each. The reconstituted samples were then analyzed by using a THERMO-CE/Crystal Model 300 Capillary Ion Analyzer - Crystal Model 1000 Conductivity Detector.

The Zymark TurboVap LV system uses a cyclone evaporator system whereby an angular stream of nitrogen against the side of the test tube (in the temperature controlled water bath) causes an increase in the surface area being evaporated per time period. Evaporation times of extracts can be optimized before analyses. Evaporation data charts have been accomplished for individual solvents and solvent mixtures at various temperatures and nitrogen gas flows (pressures). Individual evaporation graphs are included as Appendix E and a table listing the temperatures and pressures for the solvent/solvent mixtures is seen below as Table 3.

TABLE 1

EVAPORATION PARAMETERS
Zymark TurboVap LV

SOLVENT (S)	TEMP oC	PRESSURE N_2 PSI	20--> 2 mL MINUTES
Hexane	40	7	30
Hexane	45	7	25
Chloroform	40	7	40
Chloroform	45	7	35
Methanol	40	7	80
Methanol	45	7	65
Methanol	50	7	55 extrapolated
Water	50	11	300
Methylene chloride	40	7	26
Methylene chloride	45	7	20
Acetone	45	11	20
Methylene chloride/ Acetone	45	11	23 extrapolated

Evaporation curves for Table 1 are provided as Appendix E. An additional chart for methyl alcohol is included as Appendix F ; it shows evaporation times @ 40 degrees C for the three soils.

2.4 Analytical Procedure

The procedure of Rosso and Bossle[5] was used for analyzing MPA, EMPA, IMPA, and PMPA, and is as follows: electrolyte: 30 mM L-histidine, 30 mM MES, 0.7 mM Tetradecyltrimethylammonium hydroxide (TTAOH) (pH 6.5); 0.03 wt percent Triton X-100; potential -25V; Capillary, CONCAP1™ fused silica; and the capillary temperature = 35 °C. The capillary is regenerated before each analysis with electrolyte for 1.5 minutes. TTAOH is prepared from the bromide salt using a styrene-based anion exchange resin (ONGUARD-A sample pretreatment cartridge, Dionex Corp., Sunnydale, CA).

Analytical Chemistry Team Method 030 (25 August 1997) was used to analyze for TDG and is as follows: column = RP-C18 (150 mm x 4.6 mm); eluent = 25 mM potassium phosphate monobasic (95%)/ acetonitrile (5%); flow rate = 1.0 mL/minute; injection volume = 25uL; and UV wavelength = 225 nm.[6]

3. Discussion

It can be seen in the Table 2A that, although the recoveries of the CWA Breakdown Products are low, the trends are consistent. As we proceed from the Sandy Loam to the Sandy Clay Loam to the Loam matrices, the retention of the breakdown products by the matrix appears to become stronger. The figures suggest that the recovery of MPA from soils is the most difficult, especially from Loam type soil.

Additionally, each soil type was spiked with 5 mg of MPA, IMPA and PMPA and processed at a higher temperature to see whether the processing at a higher temperature might cause more of a release of the breakdown products than that performed at 100 degrees C as seen in Table 2A. The results are seen in Table 2B .

TABLE 2A

EXTRACTION OF SOIL SAMPLES FOR RECOVERY OF CHEMICAL WARFARE BREAKDOWN PRODUCTS -Processed @ 100 degrees C.

SAMPLE I.D.	SOIL TYPE	WEIGHT grams	SPIKE (1 PPT) or (0.5 PPT) MPA, EMPA, IMPA, PMPA with Internal Standard (t-butly phosphonic acid)	RECOVERED			
				MPA	EMPA	IMPA	PMPA
RAZ19	SL	5.0860	5 mg	2.46 mg	2.77 mg	3.74 mg	3.88 mg
RAZ20	SL	5.0868	5	2.33	2.86	3.96	4.23
RAZ21	SL	5.0420	5	2.64	2.97	4.00	4.17
RAZ22	SL	5.0912	2.5 mg	1.32	2.77	2.83	2.85
RAZ23	SL	5.0163	2.5	0.903	2.52	2.64	2.66
RAZ24	SL	5.0116	2.5	0.913	2.67	2.75	2.69
RAZ25	SCL	4.9653	5 mg	0.577	4.26	4.00	4.56
RAZ26	SCL	4.9980	5	0.683	4.00	3.92	4.47
RAZ27	SCL	5.1054	5	0.680	4.20	3.91	4.44
RAZ28	SCL	4.9264	2.5 mg	*	3.06	2.84	3.38
RAZ29	SCL	5.0104	2.5	0.253	2.54	2.76	3.31
RAZ30	SCL	5.0600	2.5	*	2.73	2.96	2.88
RAZ31	L	4.9739	5 mg	*	1.27	2.09	3.00
RAZ32	L	4.9594	5	*	1.27	2.14	3.11
RAZ33	L	5.0220	5	*	1.31	2.16	3.08
RAZ34	L	5.0309	2.5 mg	*	0.650	1.04	1.89
RAZ35	L	5.0823	2.5	*	0.534	0.895	1.64
RAZ36	L	5.0771	2.5	*	0.714	1.09	2.06

SL = Sandy Loam
SCL = Sandy Clay Loam
L = Loam
* = below 200 ng per one mL MeOH extract

TABLE 2B

EXTRACTION OF SOIL SAMPLES FOR RECOVERY OF CHEMICAL WARFARE BREAKDOWN PRODUCTS - Processed @ 150 degrees C.

SAMPLE I.D.	SOIL TYPE	WEIGHT grams	SPIKE (1 PPT) or (0.5 PPT) MPA, EMPA, IMPA, PMPA with Internal Standard (t-butly phosphonic acid)	RECOVERED			
				MPA	EMPA	IMPA	PMPA
RAZ37	SL	5.0179	5 mg	1.66 mg	3.75 mg	3.89mg	4.03mg
RAZ38	SL	5.0053	5	1.57	3.84	3.96	4.11
RAZ39	SL	5.0014	5	1.71	3.80	3.87	3.74
RAZ40	SCL	5.0553	5 mg	BDL	3.23	3.35	3.62
RAZ41	SCL	5.1032	5	BDL	3.25	3.38	3.68
RAZ42	SCL	5.0313	5	BDL	2.99	3.33	3.43
RAZ43	L	5.0385	5 mg	*	0.78	1.17	1.98
RAZ44	L	5.0608	5	*	0.67	1.03	1.79
RAZ45	L	5.0070	5	*	0.67	1.02	1.66

SL = Sandy Loam
SCL = Sandy Clay Loam
L = Loam
* = below 200 ng per one mL MeOH extract

In reviewing the data above, it appears that the increase in the processing temperature alone results in lower recoveries of Breakdown products

The next task involved the recovery of thiodiglycol (TDG) which had been spiked into DPG/DSWA soils. These soils were processed according to the procedures delineated for "Chemical warfare Breakdown Products - MPA, EMPA, IMPA and PMPA" found on page ?. Each sample (after spiking) was mixed and allowed to stand for one-half hour at room temperature. The matrixed samples were processed at 100 degrees C and reconstituted with methanol as before noted. These reconstituted samples were analyzed on a Waters Millenium 2010 Data Work Station equipped with a Rheodyne Injector, 2 - Model 510 pumps and a Waters Model 490 U.V. Detector. The results are found in Table 3.

TABLE 3

EXTRACTION OF SOIL SAMPLES FOR RECOVERY OF CHEMICAL WARFARE BREAKDOWN PRODUCTS

SAMPLE I.D.	SOIL TYPE	WEIGHT grams	SPIKE (1 PPT) or (0.5 PPT)	TDG RECOVERED @100 degrees C
RAZ46	SL	5.0080	5mg	3.36 mg
RAZ47	SL	5.0242	5	3.87
RAZ48	SL	5.0173	5	3.62
RAZ55	SL	5.0117	2.5mg	1.69
RAZ56	SL	5.0155	2.5	1.84
RAZ57	SL	5.0027	2.5	1.80
RAZ49	SCL	5.0404	5mg	4.03
RAZ50	SCL	5.0111	5	3.99
RAZ51	SCL	5.0041	5	3.60
RAZ58	SCL	5.0742	2.5mg	2.00
RAZ59	SCL	5.0970	2.5	1.90
RAZ60	SCL	5.0690	2.5	1.83
RAZ52	L	5.0023	5mg	3.45
RAZ53	L	4.9996	5	4.54
RAZ54	L	5.0013	5	3.56
RAZ61	L	5.0507	2.5mg	1.80
RAZ62	L	5.0384	2.5	1.70
RAZ63	L	5.0420	2.5	1.38

SL = Sandy Loam
SCL = Sandy Clay Loam
L = Loam
* = below 200 ng per one mL MeOH extract

The recoveries seem consistent from soil to soil, about 70 %. Further work could include determining th lower limits of extraction from the soils and enhanced recoveries through chemical solvent changes, and long term setting times of the TDG/matrix before analysis.

4. Conclusions

The combination of the Dionex ASE (Accelerated Solvent Extractor) and the Zymark TurboVap LV concentrator system provide a systematic alternative to traditional means of processing soil matrixed samples for CW breakdown products. Rapid completion of processing of samples leads to savings in labor, time, and solvent use minimization.

The low recoveries for the "breakdown" products can partially be attributed to complex and simple interactions between minerals and organics.[7-9] Weak to strong binding between organics and soils has been noted in the references given above on soils These interactions can vary between mineral-organic reactions, dipole-dipole attractions, hydrogen bonding, intercalation and chelation.

The previous work of extracting chemical agents from DPG/DSWA standard soils needs to be repeated using the 1/2 hour setting time and three different temperatures (75/100/150 degrees C) in triplicate for the three soils. At least four different concentration levels need to be addressed; sitting times of 1/2 hr, 2 hrs, 1 day, 3 days, weeks, months, etc. need to be addressed. A separate extraction scheme for 2-(diisopropylamino)ethanol and VX needs to be addressed.

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Literature Cited

1. "Convention on the Prohibition of the Development, Production, Stockpiling, and the Use of Chemical Weapons and their Destruction", 13 Jan 93.

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5. "Capillary Ion Electrophoresis Screening of Nerve Agent Degradation Products in Environmental Samples Using Conductivity Detection; Rosso, Thomas E. and Bossle, Paul C., J Chromatography (submitted for publication) 1997.

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8. "The Nature of Chemical Bonding Between Organic Wastes and Organophilic Binders, Part 2", American Laboratory, July 1989, pp. 70-79

9. Encyclopedia of the Geological Sciences, "Soil Chemistry", McGraw Hill, pp. 784-792.

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APPENDIX A

Specifications of Standard Sandy Loam Soil
Soil No. 1
Inorganics and Physical

METALS ANALYSIS

Element	MDL	Value
Aluminum (Al)	3	1,400
Antimony (Sb)	1	ND
Arsenic (As)	0.5	0.33
Barium (Ba)	0.3	23.1
Beryllium (Be)	0.2	ND
Cadmium (Cd)	0.3	ND
Calcium, soluble (Sat. Paste)	0.01	5.8
Cation Exchange Capacity (CEC)	0.03	2.0
Chromium (Cr)	1	3.3
Cobalt (Co)	1	0.33
Copper (Cu)	1	2.0
Iron (Fe)	1	2,173
Lead (Pb)	2	4.0
Manganese (Mn)	0.5	90.8
Magnesium (Mg)	0.02	0.74
Mercury (Hg)	0.02	ND
Nickel (Ni)	1	2.3
Potassium, soluble (Sat. Paste)	0.008	0.65
Selenium (Se)	0.1	ND
Silver (Ag)	0.5	ND
Sodium, soluble (Sat. Paste)	0.01	0.26
Thallium (Tl)	1	ND
Vanadium (V)	0.5	3.6
Zinc (Zn)	1	10.0

All values given in mg/Kg except Cation Exchange meq/100g, and Calcium, Magnesium, Potassium, and Sodium meq/L

SOIL ANALYSIS

Parameter	MDL	Value
Carbon, total (TC).		5,617 ug/g
Carbonate, total (as $CaCO_3$)	0.01	2.5 %
Conductivity @ 25° C	0.001	0.67mmhos/cm
Exchangeable Acidity	0.2	9.9 meq/100g
Organic Matter	0.01	0.48 %
pH, Saturated Paste	0.1	7.5 units
Solids, Percent	0.1	99.6 %
Sulfate, soluble (Water)	30	130 mg/Kg
Sulfur, total	0.01	ND %
Texture by Hydrometer		
Clay	1	3.3 %
Sand	1	93.3%
Silt	1	3.3 %
Texture Classification		S.

WET CHEMISTRY

Parameter	MDL	Value
Cyanide, reactive	0.03	ND
Nitrate as N, soluble (Water)	0.5	1.2
Nitrogen, ammonia (KCL)	0.3	2.0
Nitrogen, total Kjeldahl	0.01	ND
Phosphorus, extractable (AB-DTPA)	1	6.7
Phosphorus, total	0.01	0.01
Sulfide, reactive	0.1	ND

All values given in mg/Kg except Nitrogen, total Kjeldahl and Phosphorus, total which are given in %.

Methods

Analysis

All Metals analyzed by SW-846 6010 and 7000 series, 3051 digestion.

Cation Exchange	USDA No. 60(19)
TC	ASTM D4129
Carbonate	ASTM D4129
Conductivity	M120.1 - Meter
Exchangeable Acidity	ASA No. 9 9-4.1
Organic Matter	USDA No. 60 Method 24
pH, Saturated Paste	USDA No. 60 (21A)
Solids, %	CLPSW390, Part F, D-98
Sulfate, soluble H2O	M375.3-Gravimetric
Sulfur, total	ASTM D-4239-85C, LECO Furn.
Texture	ASTM D 422 Hydrometer

Soil Preparation

AB-DPTA Extraction	ASA No. 9,3-5.34
Air Dry at 34 C	USDA No. 1, 1972
Digestion	M3051, HNO3
KCL Extraction	ASA No. 9 33-3.22
Sat. Paste Ext.	M2, USDA Handbook 66
Water Ext.	ASA No. 9 10-2.3.2

Wet Chemistry

CN, reactive	Section 8.3 SW-846 & M9012
Nitrate as N	M353.2
KCL	M350.1
N, total Kjeldahl	M351.2-TKN by Block Digester
P, extractable	M365.1 Auto Ascorbic Acid digest
Sulfide, reactive	Section 8.3 SW-846 & M9030

SW-846 Method 8140
Organo-phosphorus pesticides

Parameter	MDL (ug/Kg)	Value
Azinphos methyl	5	ND
Bolstar	5	ND
Chlorpyrifos	5	ND
Coumaphos	5	ND
Demeton	5	ND
Diazinon	5	ND
Dichlorvos	5	ND
Disulfoton	5	ND
Ethoprop	5	ND
Fensulfothion	5	ND
Fenthion	5	ND
Merphos	5	ND
Mevinphos	5	ND
Naled	5	ND
Parathion methyl	5	ND
Phorate	5	ND
Ronnel	5	ND
Stirophos	5	ND
Tokuthion	5	ND
Trichloronate	5	ND

SW-846 Method 8150B
Chlorinated Herbicides

Compound	MDL (ug/Kg)	Value
2,4-D	20	ND
2,4-DB	5	ND
2,4,5-TP	5	ND
2,4,5-T	5	ND
Dalapon	5	ND
Dicamba	20	ND
Dichloroprop	20	ND
Dinoseb	20	ND
MCPA	20	ND
MCPP	5	ND

SW-846 Method 8080A
Chlorinated Pesticides

Compound	MDL (ug/Kg)	Value
Aldrin	8	ND
Alpha-BHC	8	ND
Beta-BHC	8	ND
Delta-BHC	8	ND
Gamma-BHC (Lindane)	8	ND
Chlordane (technical)	80	ND
4,4'-DDD	16	ND
4,4'-DDE	16	ND
4,4'-DDT	16	ND
Dieldrin	16	ND
Endosulfan I	8	ND
Endosulfan II	16	ND
Endosulfan sulfate	16	ND
Endrin	16	ND
Endrin aldehyde	16	ND
Endrin Ketone	16	ND
Heptachlor	8	ND
Heptachlor epoxide	8	ND
4,4' -Methoxychlor	80	ND
Toxaphene	80	ND

SW-846 Method 8270
Semi-Volatile Organics

Compound	MDL (ug/Kg)	Value
Phenol	330	ND
Bis(2-Chloroethyl) Ether	330	ND
2-Chlorophenol	330	ND
1,3-Dichlorobenzene	330	ND
1,4-Dichlorobenzene	330	ND
1,2-Dichlorobenzene	330	ND
2-Methylphenol	330	ND
Bis(2-Chloroisopropyl)ether	330	ND
4-Methylphenol	330	ND
N-Nitroso-Di-N-Propylamine	330	ND
Hexachloroethane	330	ND
Nitrobenzene	330	ND
Isophorone	330	ND
2-Nitrophenol	330	ND
2,4-Dimethylphenol	1650	ND
Bis(2-Chloroethoxy)methane	330	ND
2,4-Dichlorophenol	330	ND
1,2,4-Trichlorobenzene	330	ND
Naphthalene	330	ND
4-Chloroaniline	330	ND
Hexachlorobutadiene	330	ND
4-Chloro-3-Methylphenol	330	ND
2-Methylnaphthalene	330	ND
Hexachlorocyclopentadiene	330	ND
2,4,6-Trichlorophenol	330	ND
2,4,5-Trichlororphenol	1650	ND
2-Chloronaphthalene	330	ND
2-Nitroaniline	1650	ND
Dimethyl Phthalate	330	ND
Acenaphthylene	330	ND
3-Nitroaniline	1650	ND
Acenaphthene	330	ND
2,4-Dinitrophenol	1650	ND
4-Nitrophenol	1650	ND
Dibenzofuran	330	ND
2,4-Dinitrotoluene	330	ND
2,6-Dinitrotoluene	330	ND
Diethyl Phthalate	330	ND
4-Chlorophenyl Phenyl Ether	330	ND
Fluorene	330	ND
4-Nitroaniline	1650	ND
4,6-Dinitro-2-Methylphenol	1650	ND
N-Nitrosodiphenylamine	330	ND
4-Bromophenyl Phenyl Ether	330	ND
Hexachlorobenzene	330	ND
Pentachlorophenol	330	ND
Phenanthrene	330	ND
Anthracene	330	ND
Carbazole	330	ND
Di-N-Butyl Phthalate	330	ND
Fluoranthene	330	ND
Pyrene	330	ND
Butyl Benzyl Phthalate	330	ND
3,3'-Dichlorobenzidine	660	ND
Benzo(a)anthracene	330	ND
Bis(2-Ethylhexyl)phthalate	330	ND
Chrysene	330	ND
Di-N-Octylphthalate	330	ND
Benzo(b)fluoranthene	330	ND
Benzo(k)fluoranthene	330	ND
Benzo(a)pyrene	330	ND
Indeno(1,2,3-c,d)pyrene	330	ND
Dibenz(a,h)anthracene	330	ND
Benzo(g,h,i)perylene	330	ND

SW-846 Method 8260
Volatile Organics

Compound	MDL (ug/Kg)	Value
Chloromethane	10	ND
Bromomethane	10	ND
Vinyl Chloride	10	ND
Chloroethane	10	ND
Methylene Chloride	5	ND
Acrylonitrile	10	ND
Acetone	10	178
Carbon Disulfide	5	ND
1,1-Dichloroethene	5	ND
1,1-Dichloroethane	5	ND
cis-1,2-Dichloroethene	5	ND
trans-1,2-Dichloroethene	5	ND
Chloroform	5	ND
1,2-Dichloroethane	5	ND
2-Butanone	10	8.4
1,1,1-Trichloroethane	5	ND
Carbon Tetrachloride	5	ND
Vinyl Acetate	10	ND
Bromodichloromethane	5	ND
1,2-Dichloropropane	5	ND
cis-1,3-Dichloropropene	5	ND
Trichloroethene	5	ND
Dibromochloromethane	5	ND
1,1,2-Trichloroethane	5	ND
Benzene	5	ND
trans-1,3-dichloropropene	5	ND
Bromoform	5	ND
4-Methyl-2-Pentanone	10	ND
2-Hexanone	10	ND
Tetrachloroethene	5	ND
1,1,2,2-Tetrachloroethane	5	ND
Toluene	5	9.7
Chlorobenzene	5	ND
Ethylbenzene	5	ND
Styrene	5	ND
Xylene (total)	5	ND
1,2-Dichlorobenzene	5	ND
1,4-Dichlorobenzene	5	ND
1,2-Dibromo-3-chloropropane	5	ND
1,2-Dibromoethane	5	ND
Dichlorodifluoromethane	5	ND
Dibromomethane	5	ND
Acrolein	10	ND
1,1,1,2-Tetrachloroethane	5	ND
Trichlorofluromethane	5	ND
1,2,3-Trichloropropane	5	ND
2,2-Dichloropropane	5	ND
1,1-Dichloropropene	5	ND
1,3-Dichloropropane	5	ND
Isopropylbenzene	5	ND
Bromobenzene	5	ND
n-Propylbenzene	5	ND
2-Chlorotoluene	5	ND
4-Chlorotoluene	5	ND
1,3,5-Trimethylbenzene	5	ND
tert-Butylbenzene	5	ND
1,2,4-Trimethylbenzene	5	ND
sec-Butylbenzene	5	ND
4-Isopropyltoluene	5	ND
1,3-Dichlorobenzene	5	ND
n-Butylbenzene	5	ND
1,2,4-Trichlorobenzene	5	ND
Hexachlorobutadiene	5	ND
Naphthalene	5	ND
1,2,3-Trichlorobenzene	5	ND

Blank

APPENDIX B

Specifications of Sandy Clay Loam Soil
Soil No. 2
Inorganics and Physical

METALS ANALYSIS

Element	MDL	Value
Aluminum (Al)	3	3,540
Antimony (Sb)	1	ND
Arsenic (As)	0.5	2.0
Barium (Ba)	0.3	50.0
Beryllium (Be)	0.2	ND
Cadmium (Cd)	0.3	ND
Calcium, soluble (Sat. Paste)	0.01	20.5
Cation Exchange Capacity (CEC)	0.03	13.9
Chromium (Cr)	1	ND
Cobalt (Co)	1	ND
Copper (Cu)	1	ND
Iron (Fe)	1	3,163
Lead (Pb)	2	ND
Manganese (Mn)	0.5	97.3
Magnesium (Mg)	0.02	228.0
Mercury (Hg)	0.02	0.03
Nickel (Ni)	1	ND
Potassium, soluble (Sat. Paste)	0.008	5.72
Selenium (Se)	0.1	0.40
Silver (Ag)	0.5	ND
Sodium, soluble (Sat. Paste)	0.01	38.7
Thallium (Tl)	1	ND
Vanadium (V)	0.5	16.0
Zinc (Zn)	1	21.3

All values given in mg/Kg except Cation Exchange meq/100g, and Calcium, Magnesium, Potassium, and Sodium meq/L

SOIL ANALYSIS

Parameter	MDL	Value
Carbon, total (TC)		1,773 ug/g
Carbonate, total (as $CaCO_3$)	0.01	4.6 %
Conductivity @ 25° C	0.001	14.9mmhos/cm
Exchangeable Acidity	0.2	11.3 meq/100g
Organic Matter	0.01	1.85 %
pH, Saturated Paste	0.1	8.4 units
Solids, Percent	0.1	86.0 %
Sulfate, soluble (Water)	30	16,700 mg/Kg
Sulfur, total	0.01	12.7 %
Texture by Hydrometer		
Clay	1	10.0 %
Sand	1	50.0 %
Silt	1	40.0 %
Texture Classification		L

WET CHEMISTRY

Parameter	MDL	Value
Cyanide, reactive	0.03	ND
Nitrate as N, soluble (Water)	0.5	34.3
Nitrogen, ammonia (KCL)	0.3	4.7
Nitrogen, total Kjeldahl	0.01	0.13
Phosphorus, extractable (AB-DTPA)	1	1.0
Phosphorus, total	0.01	0.02
Sulfide, reactive	0.1	ND

All values given in mg/Kg except Nitrogen, total Kjeldahl and Phosphorus, total which are given in %.

Methods

Analysis

All Metals analyzed by SW-846 6010 and 7000 series, 3051 digestion.

Cation Exchange	USDA No. 60(19)
TC	ASTM D4129
Carbonate	ASTM D4129
Conductivity	M120.1 - Meter
Exchangeable Acidity	ASA No. 9 9-4.1
Organic Matter	USDA No. 60 Method 24
pH, Saturated Paste	USDA No. 60 (21A)
Solids, %	CLPSW390, Part F, D-98
Sulfate, soluble H2O	M375.3-Gravimetric
Sulfur, total	ASTM D-4239-85C, LECO Furn.
Texture	ASTM D 422 Hydrometer

Soil Preparation

AB-DPTA Extraction	ASA No. 9,3-5.34
Air Dry at 34 C	USDA No. 1, 1972
Digestion	M3051, HNO3
KCL Extraction	ASA No. 9 33-3.22
Sat. Paste Ext.	M2, USDA Handbook 66
Water Ext.	ASA No. 9 10-2.3.2

Wet Chemistry

CN, reactive	Section 8.3 SW-846 & M9012
Nitrate as N	M353.2
KCL	M350.1
N, total Kjeldahl	M351.2-TKN by Block Digester
P, extractable	M365.1 Auto Ascorbic Acid digest
Sulfide, reactive	Section 8.3 SW-846 & M9030

SW-846 Method 8140
Organo-phosphorus pesticides

Parameter	MDL (ug/Kg)	Value
Azinphos methyl	5	ND
Bolstar	5	ND
Chlorpyrifos	5	ND
Coumaphos	5	ND
Demeton	5	ND
Diazinon	5	ND
Dichlorvos	5	ND
Disulfoton	5	ND
Ethoprop	5	ND
Fensulfothion	5	ND
Fenthion	5	ND
Merphos	5	ND
Mevinphos	5	ND
Naled	5	ND
Parathion methyl	5	ND
Phorate	5	ND
Ronnel	5	ND
Stirophos	5	ND
Tokuthion	5	ND
Trichloronate	5	ND

SW-846 Method 8150B
Chlorinated Herbicides

Compound	MDL (ug/Kg)	Value
2,4-D	20	ND
2,4-DB	5	ND
2,4,5-TP	5	ND
2,4,5-T	5	ND
Dalapon	5	ND
Dicamba	20	ND
Dichloroprop	20	ND
Dinoseb	20	ND
MCPA	20	ND
MCPP	5	ND

SW-846 Method 8080A
Chlorinated Pesticides

Compound	MDL (ug/Kg)	Value
Aldrin	8	ND
Alpha-BHC	8	ND
Beta-BHC	8	ND
Delta-BHC	8	ND
Gamma-BHC (Lindane)	8	ND
Chlordane (technical)	80	ND
4,4'-DDD	16	ND
4,4'-DDE	16	ND
4,4'-DDT	16	ND
Dieldrin	16	ND
Endosulfan I	8	ND
Endosulfan II	16	ND
Endosulfan sulfate	16	ND
Endrin	16	ND
Endrin aldehyde	16	ND
Endrin Ketone	16	ND
Heptachlor	8	ND
Heptachlor epoxide	8	ND
4,4' -Methoxychlor	80	ND
Toxaphene	80	ND

SW-846 Method 8270
Semi-Volatile Organics

Compound	MDL (ug/Kg)	Value
Phenol	330	ND
Bis(2-Chloroethyl) Ether	330	ND
2-Chlorophenol	330	ND
1,3-Dichlorobenzene	330	ND
1,4-Dichlorobenzene	330	ND
1,2-Dichlorobenzene	330	ND
2-Methylphenol	330	ND
Bis(2-Chloroisopropyl)ether	330	ND
4-Methylphenol	330	ND
N-Nitroso-Di-N-Propylamine	330	ND
Hexachloroethane	330	ND
Nitrobenzene	330	ND
Isophorone	330	ND
2-Nitrophenol	330	ND
2,4-Dimethylphenol	1650	ND
Bis(2-Chloroethoxy)methane	330	ND
2,4-Dichlorophenol	330	ND
1,2,4-Trichlorobenzene	330	ND
Naphthalene	330	ND
4-Chloroaniline	330	ND
Hexachlorobutadiene	330	ND
4-Chloro-3-Methylphenol	330	ND
2-Methylnaphthalene	330	ND
Hexachlorocyclopentadiene	330	ND
2,4,6-Trichlorophenol	330	ND
2,4,5-Trichlororphenol	1650	ND
2-Chloronaphthalene	330	ND
2-Nitroaniline	1650	ND
Dimethyl Phthalate	330	ND
Acenaphthylene	330	ND
3-Nitroaniline	1650	ND
Acenaphthene	330	ND
2,4-Dinitrophenol	1650	ND
4-Nitrophenol	1650	ND
Dibenzofuran	330	ND
2,4-Dinitrotoluene	330	ND
2,6-Dinitrotoluene	330	ND
Diethyl Phthalate	330	ND
4-Chlorophenyl Phenyl Ether	330	ND
Fluorene	330	ND
4-Nitroaniline	1650	ND
4,6-Dinitro-2-Methylphenol	1650	ND
N-Nitrosodiphenylamine	330	ND
4-Bromophenyl Phenyl Ether	330	ND
Hexachlorobenzene	330	ND
Pentachlorophenol	330	ND
Phenanthrene	330	ND
Anthracene	330	ND
Carbazole	330	ND
Di-N-Butyl Phthalate	330	ND
Fluoranthene	330	ND
Pyrene	330	ND
Butyl Benzyl Phthalate	330	ND
3,3'-Dichlorobenzidine	660	ND
Benzo(a)anthracene	330	ND
Bis(2-Ethylhexyl)phthalate	330	ND
Chrysene	330	ND
Di-N-Octylphthalate	330	ND
Benzo(b)fluoranthene	330	ND
Benzo(k)fluoranthene	330	ND
Benzo(a)pyrene	330	ND
Indeno(1,2,3-c,d)pyrene	330	ND
Dibenz(a,h)anthracene	330	ND
Benzo(g,h,i)perylene	330	ND

SW-846 Method 8260
Volatile Organics

Compound	MDL (ug/Kg)	Value
Chloromethane	10	ND
Bromomethane	10	ND
Vinyl Chloride	10	ND
Chloroethane	10	ND
Methylene Chloride	5	ND
Acrylonitrile	10	ND
Acetone	10	39
Carbon Disulfide	5	ND
1,1-Dichloroethene	5	ND
1,1-Dichloroethane	5	ND
cis-1,2-Dichloroethene	5	ND
trans-1,2-Dichloroethene	5	ND
Chloroform	5	ND
1,2-Dichloroethane	5	ND
2-Butanone	10	ND
1,1,1 -Trichloroethane	5	ND
Carbon Tetrachloride	5	ND
Vinyl Acetate	10	ND
Bromodichloromethane	5	ND
1,2-Dichloropropane	5	ND
cis-1,3-Dichloropropene	5	ND
Trichloroethene	5	ND
Dibromochloromethane	5	ND
1,1,2-Trichloroethane	5	ND
Benzene	5	ND
trans-1,3-dichloropropene	5	ND
Bromoform	5	ND
4-Methyl-2-Pentanone	10	ND
2-Hexanone	10	ND
Tetrachloroethene	5	ND
1,1,2,2-Tetrachloroethane	5	ND
Toluene	5	ND
Chlorobenzene	5	ND
Ethylbenzene	5	ND
Styrene	5	ND
Xylene (total)	5	ND
1,2-Dichlorobenzene	5	ND
1,4-Dichlorobenzene	5	ND
1,2-Dibromo-3-chloropropane	5	ND
1,2-Dibromoethane	5	ND
Dichiorodifluoromethane	5	ND
Dibromomethane	5	ND
Acrolein	10	ND
1,1,1,2-Tetrachloroethane	5	ND
Trichlorofluromethane	5	ND
1,2,3-Trichloropropane	5	ND
2,2-Dichloropropane	5	ND
1,1 -Dichloropropene	5	ND
1,3-Dichloropropane	5	ND
Isopropylbenzene	5	ND
Bromobenzene	5	ND
n-Propylbenzene	5	ND
2-Chlorotoluene	5	ND
4-Chlorotoluene	5	ND
1,3,5-Trimethylbenzene	5	ND
tert-Butylbenzene	5	ND
1,2,4-Trimethylbenzene	5	ND
sec-Butylbenzene	5	ND
4-Isopropyltoluene	5	ND
1,3-Dichlorobenzene	5	ND
n-Butylbenzene	5	ND
1,2,4-Trichlorobenzene	5	ND
Hexachlorobutadiene	5	ND
Naphthalene	5	ND
1,2,3-Trichlorobenzene	5	ND

Blank

APPENDIX C

Specifications of Standard Loam Soil
Soil No. 3
Inorganics and Physical

METALS ANALYSIS

Element	MDL	Value
Aluminum (Al)	3	11,033
Antimony (Sb)	1	ND
Arsenic (As)	0.5	2.0
Barium (Ba)	0.3	204.3
Beryllium (Be)	0.2	0.70
Cadmium (Cd)	0.3	0.53
Calcium, soluble (Sat. Paste)	0.01	11.0
Cation Exchange Capacity (CEC)	0.03	14.7
Chromium (Cr)	1	9.0
Cobalt (Co)	1	9.3
Copper (Cu)	1	9.7
Iron (Fe)	1	27,000
Lead (Pb)	2	17.3
Manganese (Mn)	0.5	577.3
Magnesium (Mg)	0.02	3.04
Mercury (Hg)	0.02	0.31
Nickel (Ni)	1	8.0
Potassium, soluble (Sat. Paste)	0.008	0.92
Selenium (Se)	0.1	0.30
Silver (Ag)	0.5	ND
Sodium, soluble (Sat. Paste)	0.01	0.48
Thallium (Tl)	1	ND
Vanadium (V)	0.5	17.4
Zinc (Zn)	1	112.3

All values given in mg/Kg except Cation Exchange meq/100g, and Calcium, Magnesium, Potassium, and Sodium meq/L

SOIL ANALYSIS

Parameter	MDL	Value
Carbon, total (TC)		45,067 ug/g
Carbonate, total (as $CaCO_3$)	0.01	0.04 %
Conductivity @ 25° C	0.001	1.27mmhos/cm
Exchangeable Acidity	0.2	19.1 meq/100g
Organic Matter	0.01	5.96 %
pH, Saturated Paste	0.1	5.8 units
Solids, Percent	0.1	96.4 %
Sulfate, soluble (Water)	30	526.7 mg/Kg
Sulfur, total	0.01	0.02 %

Texture by Hydrometer		
Clay	1	10.0 %
Sand	1	65.0 %
Silt	1	25.0 %
Texture Classification		SL

WET CHEMISTRY

Parameter	MDL	Value
Cyanide, reactive	0.03	ND
Nitrate as N, soluble (Water)	0.5	0.57
Nitrogen, ammonia (KCL)	0.3	5.17
Nitrogen, total Kjeldahl	0.01	0.19
Phosphorus, extractable (AB-DTPA)	1	14.3
Phosphorus, total	0.01	0.09
Sulfide, reactive	0.1	ND

All values given in mg/Kg except Nitrogen, total Kjeldahl and Phosphorus, total which are given in %.

Methods

Analysis

All Metals analyzed by SW-846 6010 and 7000 series, 3051 digestion.

Cation Exchange	USDA No. 60(19)
TC	ASTM D4129
Carbonate	ASTM D4129
Conductivity	M120.1 - Meter
Exchangeable Acidity	ASA No. 9 9-4.1
Organic Matter	USDA No. 60 Method 24
pH, Saturated Paste	USDA No. 60 (21A)
Solids, %	CLPSW390, Part F, D-98
Sulfate, soluble H2O	M375.3-Gravimetric
Sulfur, total	ASTM D-4239-85C, LECO Furn.
Texture	ASTM D 422 Hydrometer

Soil Preparation

AB-DPTA Extraction	ASA No. 9,3-5.34
Air Dry at 34 C	USDA No. 1, 1972
Digestion	M3051, HNO3
KCL Extraction	ASA No. 9 33-3.22
Sat. Paste Ext.	M2, USDA Handbook 66
Water Ext.	ASA No. 9 10-2.3.2

Wet Chemistry

CN, reactive	Section 8.3 SW-846 & M9012
Nitrate as N	M353.2
KCL	M350.1
N, total Kjeldahl	M351.2-TKN by Block Digester
P, extractable	M365.1 Auto Ascorbic Acid digest
Sulfide, reactive	Section 8.3 SW-846 & M9030

SW-846 Method 8140
Organo-phosphorus pesticides

Parameter	MDL (ug/Kg)	Value
Azinphos methyl	5	ND
Bolstar	5	ND
Chlorpyrifos	5	ND
Coumaphos	5	ND
Demeton	5	ND
Diazinon	5	ND
Dichlorvos	5	ND
Disulfoton	5	ND
Ethoprop	5	ND
Fensulfothion	5	ND
Fenthion	5	ND
Merphos	5	ND
Mevinphos	5	ND
Naled	5	ND
Parathion methyl	5	ND
Phorate	5	ND
Ronnel	5	ND
Stirophos	5	ND
Tokuthion	5	ND
Trichloronate	5	ND

SW-846 Method 8150B
Chlorinated Herbicides

Compound	MDL (ug/Kg)	Value
2,4-D	20	ND
2,4-DB	5	ND
2,4,5-TP	5	ND
2,4,5-T	5	ND
Dalapon	5	ND
Dicamba	20	ND
Dichloroprop	20	ND
Dinoseb	20	ND
MCPA	20	ND
MCPP	5	ND

SW-846 Method 8080A
Chlorinated Pesticides

Compound	MDL (ug/Kg)	Value
Aldrin	8	ND
Alpha-BHC	8	ND
Beta-BHC	8	ND
Delta-BHC	8	ND
Gamma-BHC (Lindane)	8	ND
Chlordane (technical)	80	ND
4,4'-DDD	16	ND
4,4'-DDE	16	ND
4,4'-DDT	16	ND
Dieldrin	16	ND
Endosulfan I	8	ND
Endosulfan II	16	ND
Endosulfan sulfate	16	ND
Endrin	16	ND
Endrin aldehyde	16	ND
Endrin Ketone	16	ND
Heptachlor	8	ND
Heptachlor epoxide	8	ND
4,4' -Methoxychlor	80	ND
Toxaphene	80	ND

SW-846 Method 8270
Semi-Volatile Organics

Compound	MDL (ug/Kg)	Value
Phenol	330	ND
Bis(2-Chloroethyl) Ether	330	ND
2-Chlorophenol	330	ND
1,3-Dichlorobenzene	330	ND
1,4-Dichlorobenzene	330	ND
1,2-Dichlorobenzene	330	ND
2-Methylphenol	330	ND
Bis(2-Chloroisopropyl)ether	330	ND
4-Methylphenol	330	ND
N-Nitroso-Di-N-Propylamine	330	ND
Hexachloroethane	330	ND
Nitrobenzene	330	ND
Isophorone	330	ND
2-Nitrophenol	330	ND
2,4-Dimethylphenol	1650	ND
Bis(2-Chloroethoxy)methane	330	ND
2,4-Dichlorophenol	330	ND
1,2,4-Trichlorobenzene	330	ND
Naphthalene	330	ND
4-Chloroaniline	330	ND
Hexachlorobutadiene	330	ND
4-Chloro-3-Methylphenol	330	ND
2-Methylnaphthalene	330	ND
Hexachlorocyclopentadiene	330	ND
2,4,6-Trichlorophenol	330	ND
2,4,5-Trichlororphenol	1650	ND
2-Chloronaphthalene	330	ND
2-Nitroaniline	1650	ND
Dimethyl Phthalate	330	ND
Acenaphthylene	330	ND
3-Nitroaniline	1650	ND
Acenaphthene	330	ND
2,4-Dinitrophenol	1650	ND
4-Nitrophenol	1650	ND
Dibenzofuran	330	ND
2,4-Dinitrotoluene	330	ND
2,6-Dinitrotoluene	330	ND
Diethyl Phthalate	330	ND
4-Chlorophenyl Phenyl Ether	330	ND
Fluorene	330	ND
4-Nitroaniline	1650	ND
4,6-Dinitro-2-Methylphenol	1650	ND
N-Nitrosodiphenylamine	330	ND
4-Bromophenyl Phenyl Ether	330	ND
Hexachlorobenzene	330	ND
Pentachlorophenol	330	ND
Phenanthrene	330	ND
Anthracene	330	ND
Carbazole	330	ND
Di-N-Butyl Phthalate	330	ND
Fluoranthene	330	ND
Pyrene	330	ND
Butyl Benzyl Phthalate	330	ND
3,3'-Dichlorobenzidine	660	ND
Benzo(a)anthracene	330	ND
Bis(2-Ethylhexyl)phthalate	330	ND
Chrysene	330	ND
Di-N-Octylphthalate	330	ND
Benzo(b)fluoranthene	330	ND
Benzo(k)fluoranthene	330	ND
Benzo(a)pyrene	330	ND
Indeno(1,2,3-c,d)pyrene	330	ND
Dibenz(a,h)anthracene	330	ND
Benzo(g,h,i)perylene	330	ND

SW-846 Method 8260
Volatile Organics

Compound	MDL (ug/Kg)	Value
Chloromethane	10	ND
Bromomethane	10	ND
Vinyl Chloride	10	ND
Chloroethane	10	ND
Methylene Chloride	5	ND
Acrylonitrile	10	ND
Acetone	10	38.7
Carbon Disulfide	5	ND
1,1-Dichloroethene	5	ND
1,1-Dichloroethane	5	ND
cis-1,2-Dichloroethene	5	ND
trans-1,2-Dichloroethene	5	ND
Chloroform	5	ND
1,2-Dichloroethane	5	ND
2-Butanone	10	ND
1,1,1 -Trichloroethane	5	ND
Carbon Tetrachloride	5	ND
Vinyl Acetate	10	ND
Bromodichloromethane	5	ND
1,2-Dichloropropane	5	ND
cis-1,3-Dichloropropene	5	ND
Trichloroethene	5	ND
Dibromochloromethane	5	ND
1,1,2-Trichloroethane	5	ND
Benzene	5	ND
trans-1,3-dichloropropene	5	ND
Bromoform	5	ND
4-Methyl-2-Pentanone	10	ND
2-Hexanone	10	ND
Tetrachloroethene	5	ND
1,1,2,2-Tetrachloroethane	5	ND
Toluene	5	13.7
Chlorobenzene	5	ND
Ethylbenzene	5	ND
Styrene	5	ND
Xylene (total)	5	14.3
1,2-Dichlorobenzene	5	ND
1,4-Dichlorobenzene	5	ND
1,2-Dibromo-3-chloropropane	5	ND
1,2-Dibromoethane	5	ND
Dichlorodifluoromethane	5	ND
Dibromomethane	5	ND
Acrolein	10	ND
1,1,1,2-Tetrachloroethane	5	ND
Trichlorofluromethane	5	ND
1,2,3-Trichloropropane	5	ND
2,2-Dichloropropane	5	ND
1,1 -Dichloropropene	5	ND
1,3-Dichloropropane	5	ND
Isopropylbenzene	5	ND
Bromobenzene	5	ND
n-Propylbenzene	5	ND
2-Chlorotoluene	5	ND
4-Chlorotoluene	5	ND
1,3,5-Trimethylbenzene	5	ND
tert-Butylbenzene	5	ND
1,2,4-Trimethylbenzene	5	ND
sec-Butylbenzene	5	ND
4-Isopropyltoluene	5	ND
1,3-Dichlorobenzene	5	ND
n-Butylbenzene	5	ND
1,2,4-Trichlorobenzene	5	ND
Hexachlorobutadiene	5	ND
Naphthalene	5	ND
1,2,3-Trichlorobenzene	5	ND

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APPENDIX D

Dionex ASE 200 Method *"for extraction"*

DIONEX
ACCELERATED SOLVENT EXTRACTOR
ASE 200
PARAMETERS

SOIL TYPE	SANDY LOAM	SANDY CLAY LOAM	LOAM
HEAT minutes	5	5	5
STATIC minutes	5	5	5
FLUSH % Volume	60	60	60
PURGE seconds	60	60	60
CYCLES	1	1	1
PRESSURE psi	2000	2000	2000
TEMPERATURE °C	100/150	100/150	100/150
SOLVENT	Methanol	Methanol	Methanol

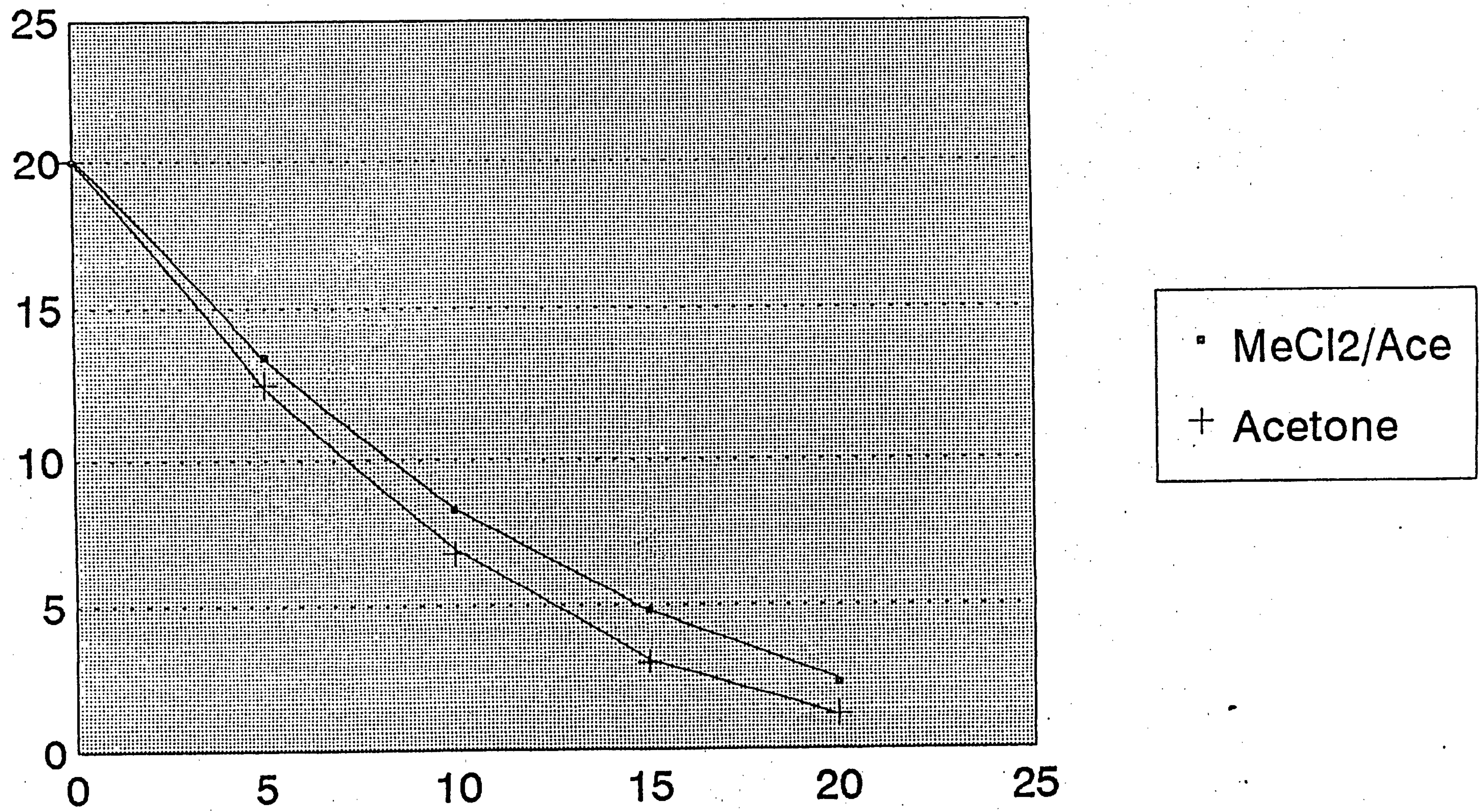
Blank

APPENDIX E

Zymark TurboVap LV Evaporation Graphs - Solvents

EVAPORATION DATA

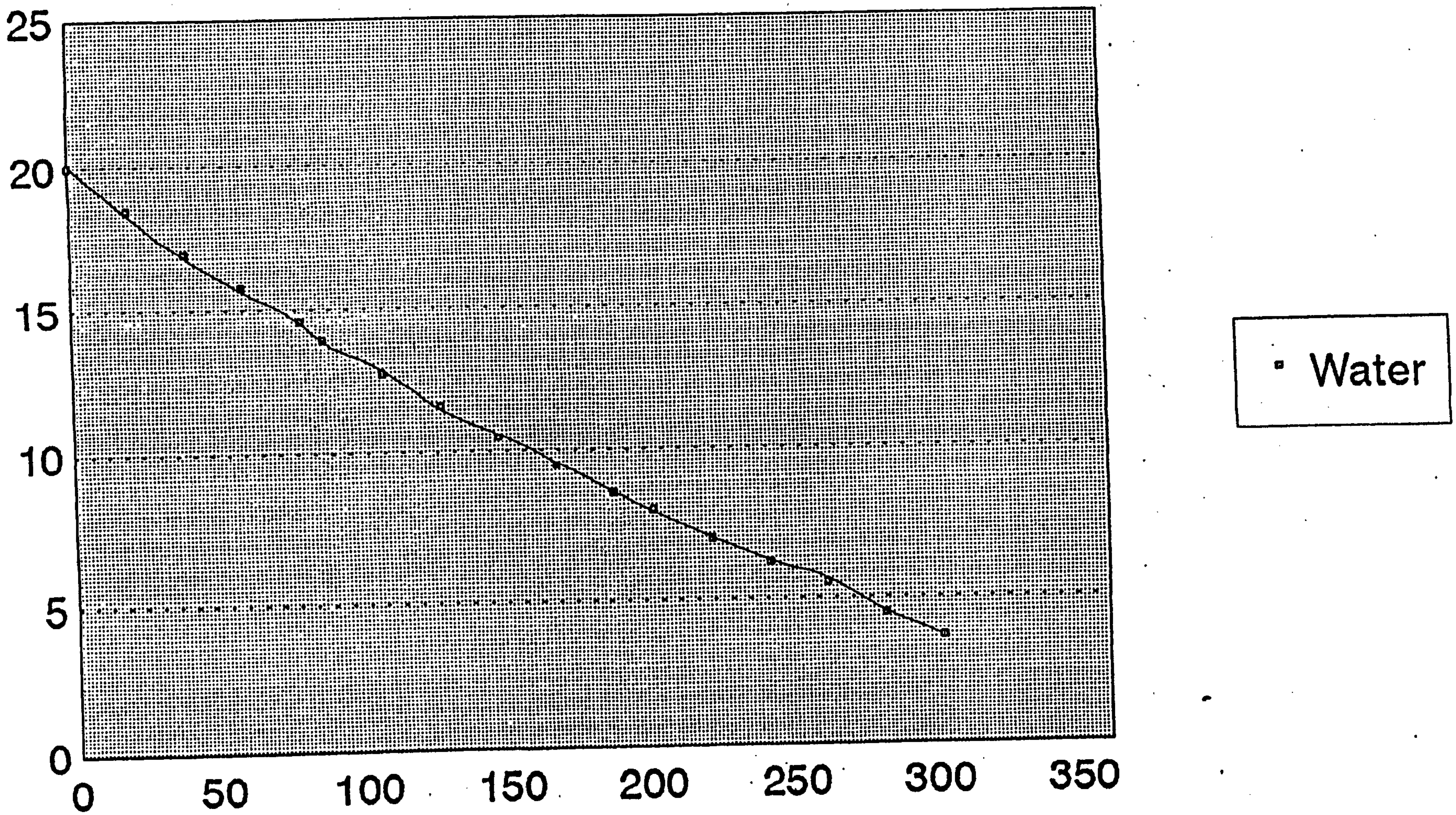
ZYMARK



45 DEGREES @ 11 PSI

EVAPORATION DATA

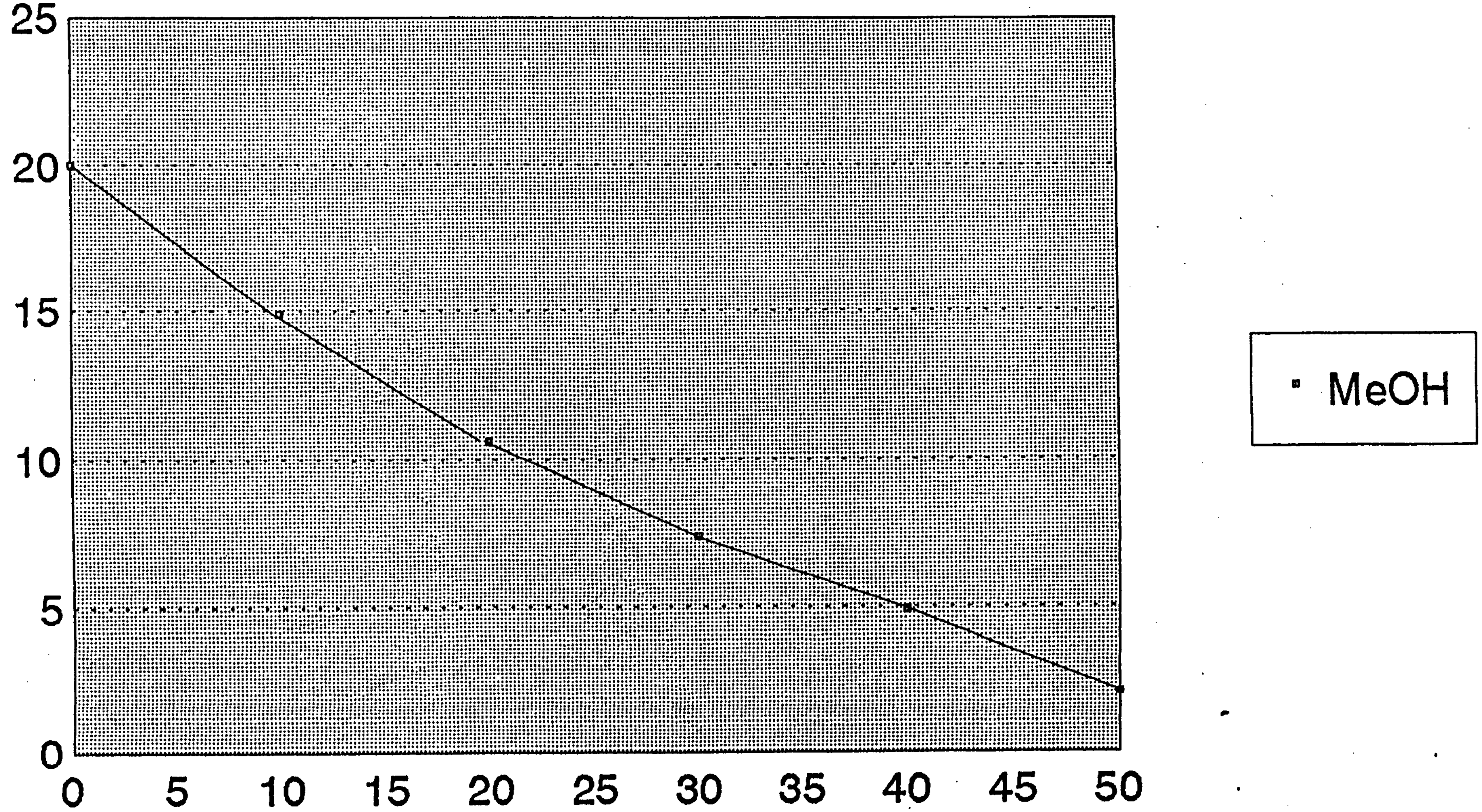
ZYMARK



50 DEGREES @ 11 PSI

EVAPORATION DATA

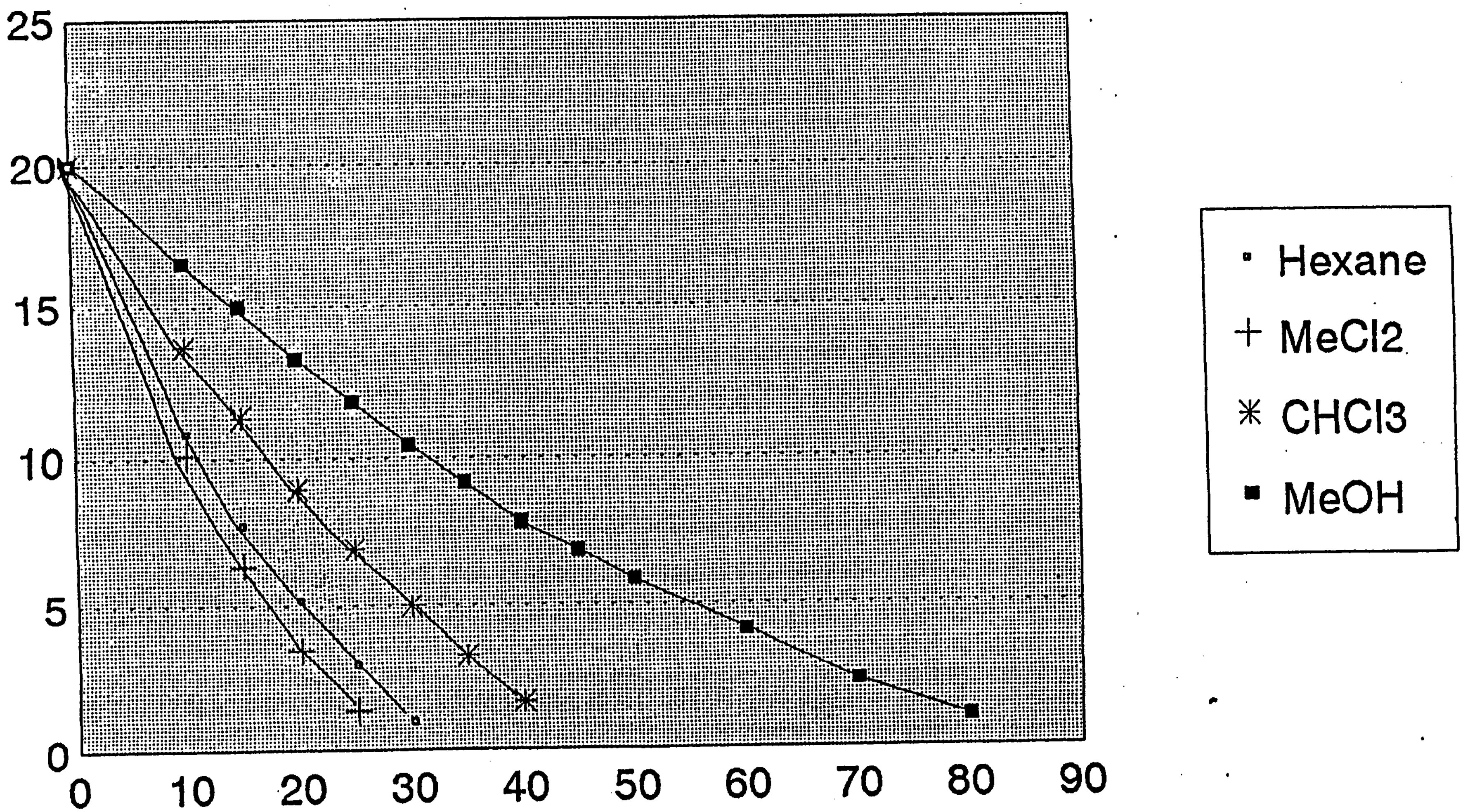
ZYMARK



50 DEGREES @ 7 PSI

EVAPORATION DATA

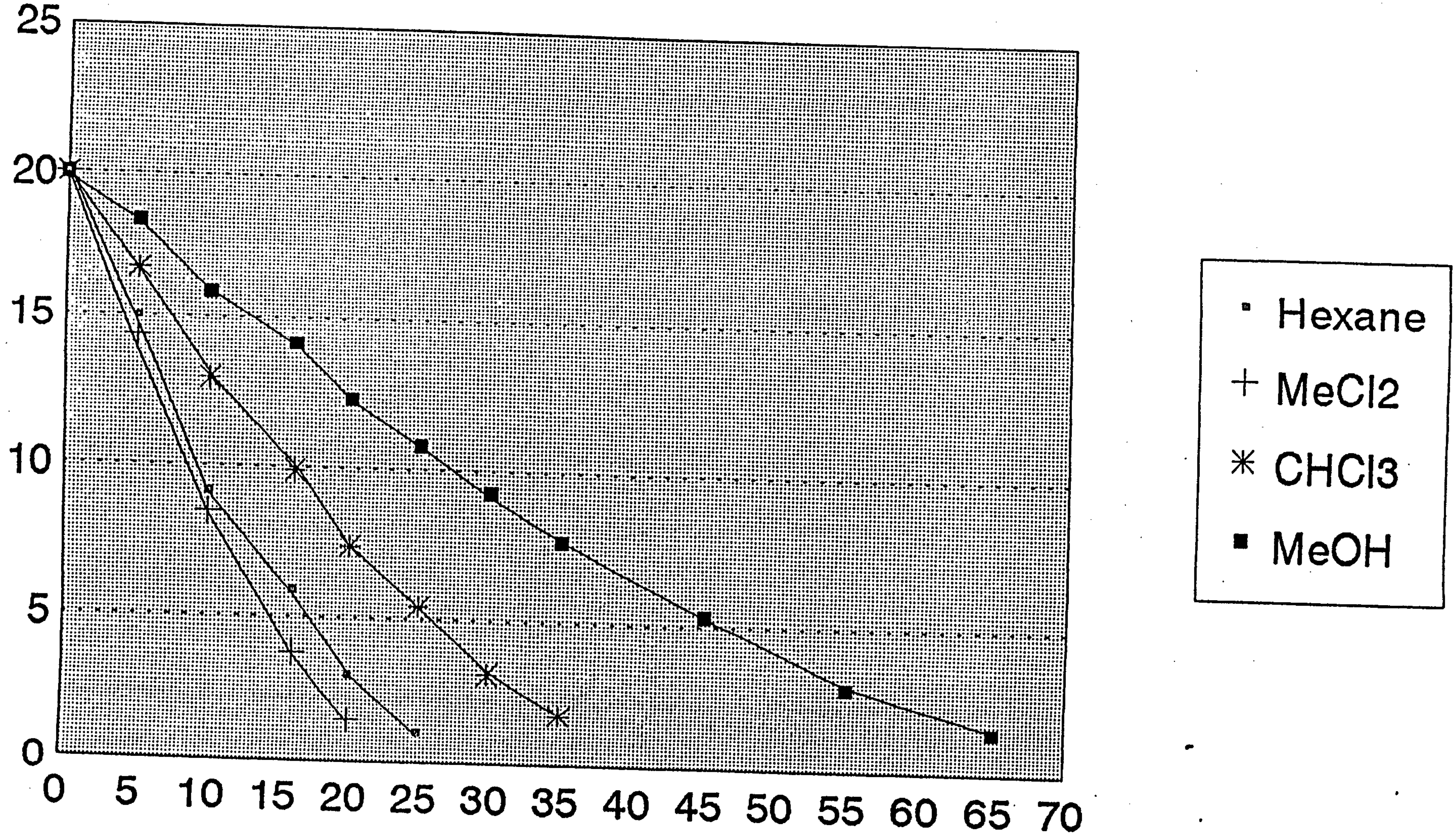
ZYMARK



40 DEGREES @ 7 PSI

EVAPORATION DATA

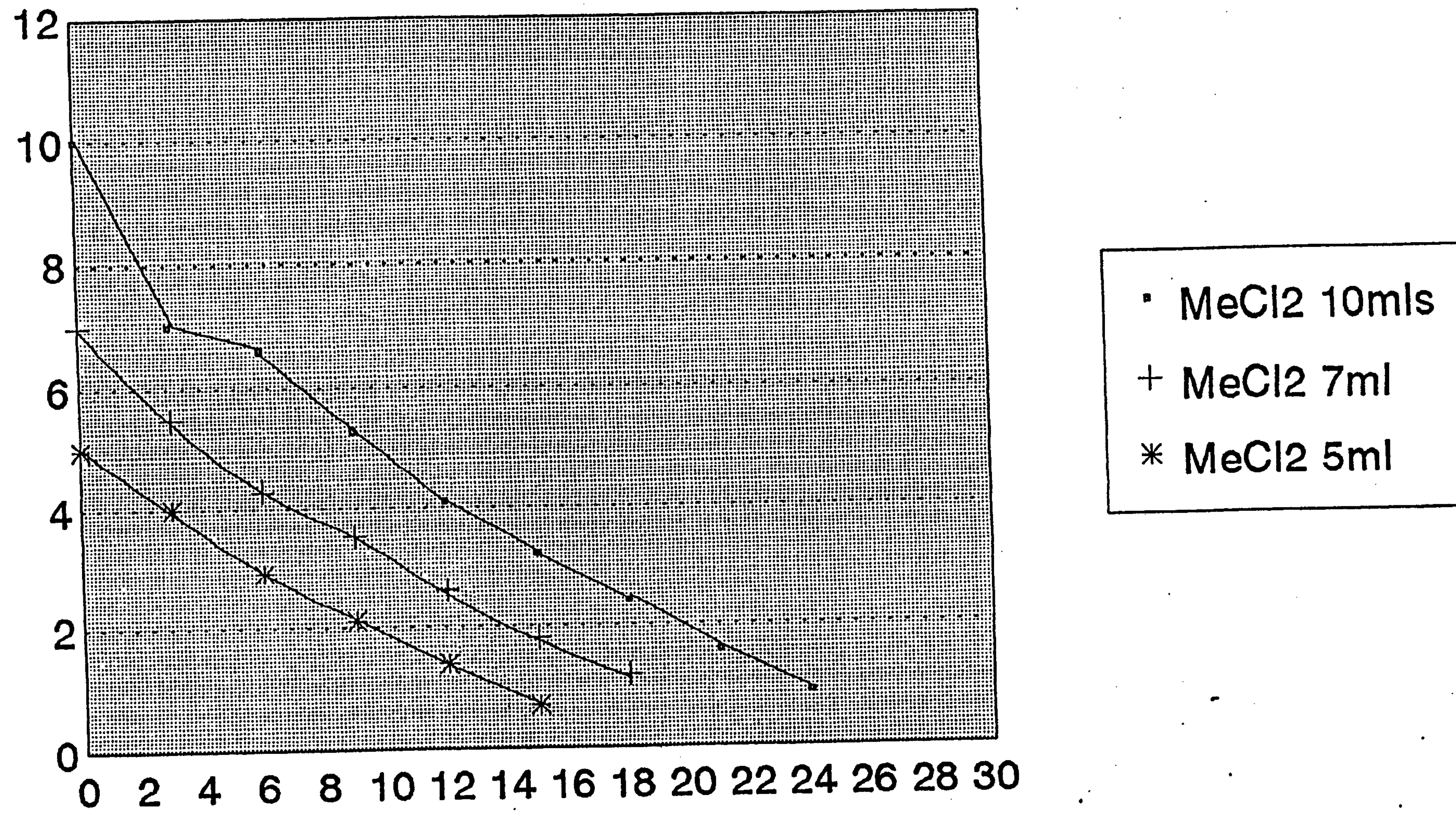
ZYMARK



45 DEGREES @ 7 PSI

EVAPORATION DATA

ZYMARK



23 DEGREES @ 7 PSI

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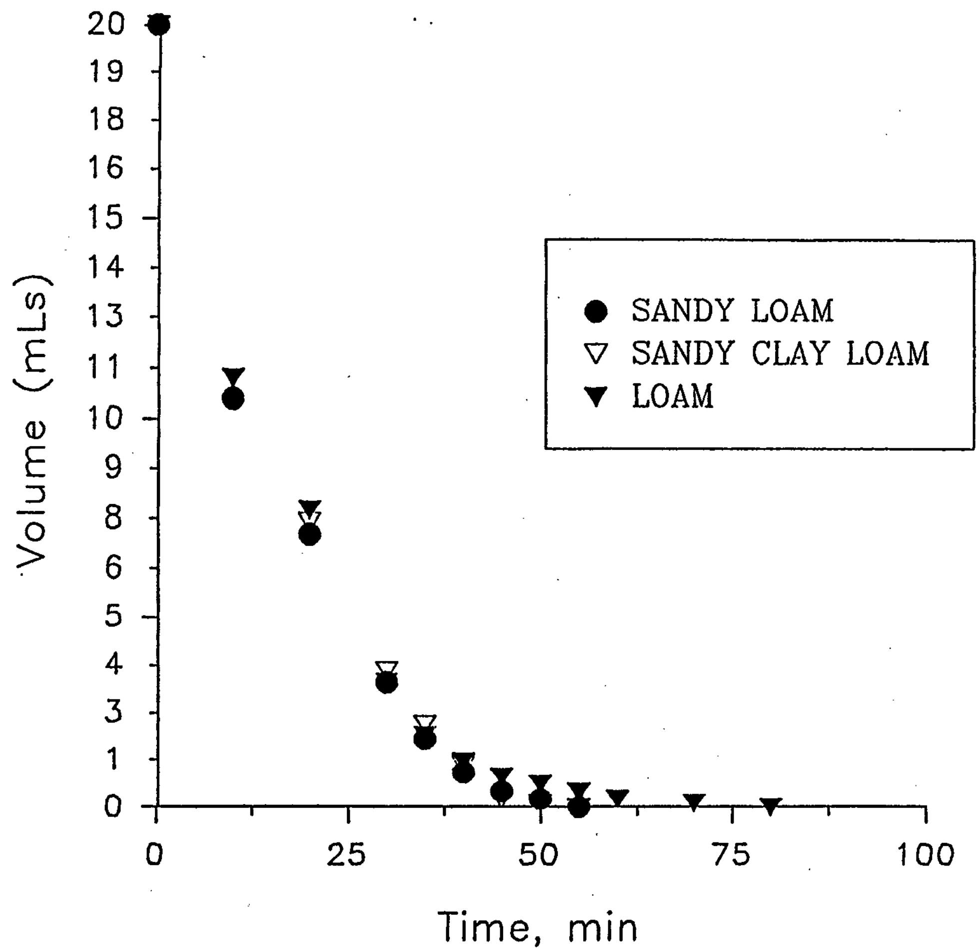
APPENDIX F

Zymark TurboVap Evaporation Chart - Methanol/Matrix

ZYMARK EVAPORATION CURVE FOR MeOH EXTRACTS (T = 40 °C)



APPENDIX F